



Service Manual

Models

TL1055C

TL1255C

S/N KDE00150 & After
S/N DHW00150 & After
S/N MDD00150 & After
S/N SXM00150 & After

31200793

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EFFECTIVITY PAGE

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EFFECTIVITY PAGE

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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 the local Caterpillar dealer.

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 the manufacturer in the form of Service Bulletins, Service Campaigns, Service Training Schools, the service 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 & MAINTENANCE MANUAL

The mechanic must not operate the machine until the Operation & Maintenance 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 & Maintenance Manual is supplied with each machine and must be kept in the manual holder located in the cab. In the event that the Operation & Maintenance Manual is missing, consult the local Caterpillar dealer 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 machine. 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.

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.

RADIATOR 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.

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 & Maintenance Manual supplied with machine for information.



Section 2

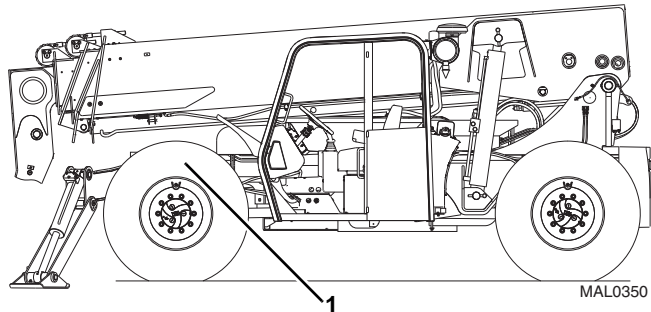
General Information and Specifications

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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 on the left front frame rail behind the left front tire.

Note: *The replacement of any part on this machine with any other than factory 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 local Caterpillar dealer.

Registration activates the warranty period and helps to assure that warranty claims are promptly processed to guarantee full warranty service.



2.2 TORQUE CHARTS

2.2.1 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]
		In	Sq In	LB	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

NO. 5000059 REV. J

- 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

MY3141



General Information and Specifications

2.2.1 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	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	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

NO. 5000059 REV. J

- 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

MY3151



2.2.1 SAE Fastener Torque Chart (Continued)

SOCKET HEAD CAP SCREWS										
Magni Coating (Ref 4150701)*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K = .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	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	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 OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
 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.

NO. 5000059 REV. J

MY3161



General Information and Specifications

2.2.1 SAE Fastener Torque Chart (Continued)

SOCKET HEAD CAP SCREWS										
Zinc Yellow Chromate Fasteners (Ref 4150707)*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K = .20		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140 OR Precoat 85® 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	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							
10	24	0.1900	0.01750							
	32	0.1900	0.02000							
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	775	1055	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

NO. 500059 REV. J

- 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 OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
 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.

MY3400



2.2.2 Metric Fastener Torque Chart

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)							
CLASS 8.8 METRIC BOLTS CLASS 8 METRIC NUTS							
Size	Pitch	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263™)	Torque (Lub)	Torque (Loctite® 262™ OR Vibra-TITE™ 131)	Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140)
		Sq mm	KN	[N.m]	[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

NO. 5000059 REV. J

- 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 OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
 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.

MY3171



General Information and Specifications

2.2.2 Metric Fastener Torque Chart (Continued)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)						
CLASS 10.9 METRIC BOLTS CLASS 10 METRIC NUTS CLASS 12.9 SOCKET HEAD CAP SCREWS M3 - M5*						
Size	Pitch	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263™) K = 0.20	Torque (Lub 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	25.2	22.7	18.9
8	1.25	36.60	22.8	36.5	32.8	27.4
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

NO. 500059 REV. J

- 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 OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
 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.

MY3181



**2.2.2 Metric Fastener Torque Chart
(Continued)**

Magni Coating (Ref 4150701)*						
CLASS 12.9 SOCKET HEAD CAP SCREWS M6 AND ABOVE*						
Size	Pitch	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™) K = .17	Torque (Lub OR Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K = .16	Torque (Loctite® 262™ OR Vibra-TITE™ 131) K = .15
		Sq mm	kN	[N.m]	[N.m]	[N.m]
3	0.5	5.03				
3.5	0.6	6.78				
4	0.7	8.78				
5	0.8	14.20				
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	54
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	220.0	900	845	790
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

NO. 500059 REV. J

- 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 OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
 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.

MY3191



General Information and Specifications

2.2.3 Hydraulic Hose Torque Chart

O-Ring Face Seal & JIC Torque Chart

Size	ORFS	JIC	Flats Method
4	13 lb-ft (18 Nm)	13 lb-ft (18 Nm)	1.5 to 1.75
6	23 lb-ft (31 Nm)	23 lb-ft (31 Nm)	1 to 1.5
8	40 lb-ft (54 Nm)	40 lb-ft (54 Nm)	1.5 to 1.75
10	60 lb-ft (81 Nm)	60 lb-ft (81 Nm)	1.5 to 1.75
12	74 lb-ft (100 Nm)	85 lb-ft (115 Nm)	1.0 to 1.5
16	115 lb-ft (156 Nm)	115 lb-ft (156 Nm)	0.75 to 1.0
20	170 lb-ft (230 Nm)	170 lb-ft (230 Nm)	0.75 to 1.0
24	200 lb-ft (271 Nm)	200 lb-ft (271 Nm)	0.75 to 1.0
32	N/A	270 lb-ft (366 Nm)	0.75 to 1.0

Note: By definition the “Flats Method” will contain some variance. Use the “Flats Method” only when accessibility with a torque wrench is not possible.

Torque Wrench:

1. Identify the appropriate application and refer to the above chart for the correct torque value.
2. If equipped, lubricate o-ring with hydraulic oil. Hand tighten the swivel nut until no lateral movement of the swivel nut can be detected. Average hand torque is 3 lb-ft (4 Nm).
3. Use the double wrench method while tightening to avoid hose twist.
4. Torque wrench must be held at the center of the grip. Apply constant force until it clicks.
5. After the connection has been properly tightened, mark a straight line across the connecting parts indicating that the connection has been properly tightened.

Flats Method:

1. If equipped, lubricate o-ring with hydraulic oil. Hand tighten the swivel nut until no lateral movement of the swivel nut can be detected. Average hand torque is 3 lb-ft (4 Nm).
2. Mark a dot on one of the swivel nut flats and another dot in line on the hex of the adapter it's connecting to.
3. Use the double wrench method while tightening to avoid hose twist.
4. After the connection has been properly tightened, mark a straight line across the connecting parts, not covering the dots indicating that the connection has been properly tightened.



2.3 SPECIFICATIONS

2.3.1 Travel Speeds

	TL1055C	TL1255C
First Gear	3.3 mph (5,31 km/h)	3.3 mph (5,31 km/h)
Second Gear	6.4 mph (10,3 km/h)	6.4 mph (10,3 km/h)
Third Gear	14.6 mph (23,5km/h)	14.6 mph (23,5km/h)
Fourth Gear	20.4 mph (32,8 km/h)	20.4 mph (32,8 km/h)

2.3.2 Hydraulic Cylinder Performance

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

FUNCTION	APPROXIMATE TIMES (seconds)	
	TL1055C	TL1255C
Boom Extend (Boom Level)	16.5 - 18.3	16.3 - 18.0
Boom Retract (Boom Level)	14.0 - 15.6	12.2 - 14.5
Boom Lift	13.1 - 114.6	15.2 - 16.8
Boom Lower	12.9 - 14.4	14.1 - 15.5
Attachment Tilt Forward	5.1 - 5.7	5.8 - 6.5
Attachment Tilt Rearward	4.5 - 5.0	5.0 - 6.0
Frame Level - Full Right to Left	9.4 - 10.4	9.4 - 10.4
Frame Level - Full Left to Right	10.2 - 11.3	10.2 - 11.3

2.3.3 Cylinder Drift

CYLINDER	MAXIMUM ROD TRAVEL (loaded or unloaded)
Lift/Lower Cylinder	0.125 in (3.2 mm) per hour
Extend/Retract Cylinder	0.125 in (3.2 mm) per hour
Attachment Tilt Cylinder	0.125 in (3.2 mm) per hour



General Information and Specifications

2.3.4 Electrical System

Battery	
Type, Rating	12 BCI, Negative (-) Ground, Maintenance Free
Quantity	1
Reserve Capacity	1,000 Cold Cranking Amps @ 0° F (-18° C)
Group/Series	Group 31
Alternator	12V, 100 Amps

2.3.5 Engine Performance Specifications

a. S/N KDE00150 & After, S/N DHW00150 & After

Description	Specifications
Engine Make/Model	CAT 4.4L ACERT
Displacement	269 in ³ (4,4 liters)
Low Idle	910 to 930 rpm
High Idle	2,290 to 2,310 rpm
Horsepower	142 HP (106 kW) @ 2200 rpm
Peak Torque	394 lb-ft (534 Nm) @ 1400 rpm
Fuel Delivery	Electronic Fuel Injection
Air Cleaner	Dry Type, Replaceable Primary and Safety Elements

b. S/N MDD00150 & After, S/N SXM 00150 & After

Description	Specifications
Engine Make/Model	CAT 4.4L
Displacement	269 in ³ (4,4 liters)
Low Idle	910 to 930 rpm
High Idle	2,290 to 2,310 rpm
Horsepower	142 HP (106 kW) @ 2200 rpm
Peak Torque	394 lb-ft (534 Nm) @ 1400 rpm
Fuel Delivery	Electronic Fuel Injection
Air Cleaner	Dry Type, Replaceable Primary and Safety Elements



2.3.6 Tires

Note: Standard wheel lug nut torque is 350-400 lb-ft (475-542 Nm).

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

c. TL1055C

Size	Tire Type	Minimum Ply/Star Rating	Fill Type	Pressure
14.00 x 24	G-2/L-2 Bias Ply Traction	12 Ply	Pneumatic	65 psi (4,5 bar)
			Foam - Approx 720 lb (327 kg)	62 psi (4,3 bar)
17.50 x 25	G-2/L-2 Bias Ply Traction	12 Ply	Pneumatic	65 psi (4,5 bar)
			Foam - Approx 785 lb (356 kg)	51 psi (3,5 bar)
400/75x28	DuraForce	14 Ply	Pneumatic	76 psi (5,2 bar)
			Foam - Approx 570 lb (259 kg)	73 psi (5,0 bar)

d. TL1255C

Size	Tire Type	Minimum Ply/Star Rating	Fill Type	Pressure
17.50 x 25	G-2/L-2 Bias Ply Traction	12 Ply	Pneumatic	65 psi (4,5 bar)
			Foam - Approx 785 lb (356 kg)	51 psi (3,5 bar)
400/75x28	DuraForce	14 Ply	Pneumatic	76 psi (5,2 bar)
			Foam - Approx 570 lb (259 kg)	73 psi (5,0 bar)



2.4 FLUIDS AND LUBRICANT CAPACITIES

a. Fluids

S/N KDE00150 & After
S/N DHW00150 & After

Compartment or System	Type and Classification	Viscosities	Ambient Temperature Range			
			°F		°C	
			Min	Max	Min	Max
Engine Crankcase	CAT DEO-ULS API CJ-4 Multigrade	SAE 0W-20	-40	50	-40	10
		SAE 0W-30	-40	86	-40	30
		SAE 0W-40	-40	104	-40	40
		SAE 5W-30	-22	86	-30	30
		SAE 5W-40	-22	122	-30	50
		SAE 10W-30	0	104	-18	40
		SAE 10W-40	0	122	-18	40
		SAE 15W-40	15	122	-9.5	50
Transmission and Transfer Case	CAT MTO	SAE 0W-20	-40	95	-40	35
		SAE 10W	-4	95	-20	35
		SAE 30	77	122	25	50
		CAT TDTO-TMS	10	50	50	122
Axle Differentials* and Wheel Ends	CAT Synthetic Gear Oil (GO)	SAE 75W-140	-22	113	-30	45
	CAT Gear Oil (GO)	SAE 80W-90	-10	120	-23	49
	CAT Gear Oil (GO)	SAE 85W-140	10	120	-12	59
	CAT TDTO-TMS	CAT TDTO-TMS	-4	122	-20	50
Hydraulic System	CAT TDTO CAT TDTO-TMS CAT Arctic TDTO SYN Commercial TO-4	SAE 0W-20	-40	104	-40	40
		SAE 0W-30	-40	104	-40	40
		SAE 5W-30	-22	104	-30	40
		SAE 5W-40	-22	104	-30	40
		SAE 10W	-4	104	-20	40
		SAE 30	50	122	10	50
		SAE 10W-30	-4	104	-20	40
		SAE 15W-40	5	122	-15	50
		CAT TDTO-TMS	-4	122	-20	50
Boom Wear Pad Grease	CAT Advanced 3Moly	NLGI Grade 2	-4	104	-20	40



Compartment or System	Type and Classification	Viscosities	Ambient Temperature Range			
			°F		°C	
			Min	Max	Min	Max
Cylinder and Axle Grease	CAT Multipurpose	NLGI Grade 2	-22	104	-30	40
Boom Chain Lubricants	Schaffer 200S Silver Streak					
Engine Coolant	CAT DEAC (Glycol and Water)	50/50 Mix	Standard			
		60/40 Mix	Cold Weather			
Fuel	#2 Diesel	Ultra Low Sulfur (S<15 mg/kg)	Standard			
	Blend of #1 diesel and #2 diesel fuels ("winterized" #2)		Cold Weather			
Air Conditioning	Refrigerant R-134a	Tetrafluorethane				

Note: Friction Modifier (CAT Brake Oil Additive P/N 197-0017) required for axle differentials, see Section b, "Capacities."



General Information and Specifications

S/N MDD00150 & After
S/N SXM00150 & After

Compartment or System	Type and Classification	Viscosities	Ambient Temperature Range			
			°F		°C	
			Min	Max	Min	Max
Engine Crankcase	API CI-4 Multigrade	SAE 0W-20	-40	50	-40	10
		SAE 0W-30	-40	86	-40	30
		SAE 0W-40	-40	104	-40	40
		SAE 5W-30	-22	86	-30	30
		SAE 5W-40	-22	122	-30	50
		SAE 10W-30	0	104	-18	40
		SAE 10W-40	0	122	-18	40
		SAE 15W-40	15	122	-9.5	50
Transmission and Transfer Case	CAT TDTO	SAE 10W	0	95	-18	35
		SAE 30	32	95	0	35
		SAE 50	50	122	10	50
		SAE 5W-30	-22	68	-30	20
		SAE 0W-20	-40	68	-40	20
Axle Differentials* and Wheel Ends	CAT Synthetic Gear Oil (GO)	SAE 75W-140	-22	113	-30	45
	CAT Gear Oil (GO)	SAE 80W-90	-10	120	-23	49
	CAT Gear Oil (GO)	SAE 85W-140	10	120	-12	59
	CAT TDTO-TMS	CAT TDTO-TMS	-4	122	-20	50
Hydraulic System	CAT TDTO CAT TDTO-TMS CAT Arctic TDTO SYN Commercial TO-4	SAE 0W-20	-40	104	-40	40
		SAE 0W-30	-40	104	-40	40
		SAE 5W-30	-22	104	-30	40
		SAE 5W-40	-22	104	-30	40
		SAE 10W	-4	104	-20	40
		SAE 30	50	122	10	50
		SAE 10W-30	-4	104	-20	40
		SAE 15W-40	5	122	-15	50
		CAT TDTO-TMS	-4	122	-20	50
Boom Wear Pad Grease	CAT Advanced 3Moly	NLGI Grade 2	-4	104	-20	40
Cylinder and Axle Grease	CAT Multipurpose	NLGI Grade 2	-22	104	-30	40
Boom Chain Lubricants	Schaffer 200S Silver Streak					



Compartment or System	Type and Classification	Viscosities	Ambient Temperature Range			
			°F		°C	
			Min	Max	Min	Max
Engine Coolant	CAT DEAC (Glycol and Water)	50/50 Mix	Standard			
		60/40 Mix	Cold Weather			
Fuel	#2 Diesel	Low Sulfur (S<500mg/kg)	Standard			
	Blend of #1 diesel and #2 diesel fuels ("winterized" #2)		Cold Weather			
Air Conditioning	Refrigerant R-134a	Tetrafluorethane				

Note: Friction Modifier (CAT Brake Oil Additive P/N 197-0017) required for axle differentials, see Section b, "Capacities."



General Information and Specifications

b. Capacities

Engine Crankcase Oil

Capacity with Filter Change	9 quarts (8,5 liters)
-----------------------------	-----------------------

Fuel Tank

Capacity	38 gallons (144 liters)
----------	-------------------------

Cooling System

System Capacity	22.8 quarts (21,6 liters)
-----------------	---------------------------

Overflow Bottle Capacity	5 quarts (4,7 liters)
--------------------------	-----------------------

Hydraulic System

System Capacity	63 gallons (238 liters)
-----------------	-------------------------

Reservoir Capacity	33 gallons (125 liters)
--------------------	-------------------------

Auxiliary Hydraulic Circuit Max Flow	16 gpm (60,5 lpm)
--------------------------------------	-------------------

Transmission

Capacity with Filter Change	19.2 quarts (18,2 liters)
-----------------------------	---------------------------

Transfer Case

Capacity	3.0 quarts (2,8 liters)
----------	-------------------------

Axles

Differential Housing Capacity	
-------------------------------	--

Front Axle	15.0 quarts (14,1 liters)
------------	---------------------------

Rear Axle	15.5 quarts (14,7 liters)
-----------	---------------------------

Friction Modifier (differential only)	
---------------------------------------	--

Front Axle	24 oz (709,7 ml)
------------	------------------

Wheel End Capacity	2 quarts (1,9 liters)
--------------------	-----------------------

Air Conditioning System (if equipped)

System Capacity	2.5 lb (1134 g)
-----------------	-----------------




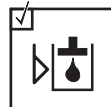




2.5 SERVICE AND MAINTENANCE SCHEDULES

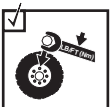
2.5.1 10, 1st 50 & 50 Hour




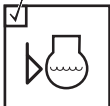
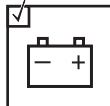


EVERY
10 ⌚

 Check Fuel Level	 Air Filter Restriction Indicator	 Check Engine Oil Level	 Check Hydraulic Oil Level	 Check Tire Condition & Pressure
 Check Transmission Oil Level				

1st
50 ⌚

 Check Wheel Lug Nut Torque				
---	--	--	--	--

EVERY
50 ⌚

 Drain Fuel/Water Separator	 Check Engine Coolant Level	 Check Battery	 Check Washer Fluid Level (if equipped)	 Lubrication Schedule
---	---	--	--	---

MAL1890

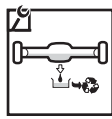


General Information and Specifications

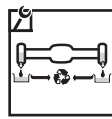
2.5.2 1st 250, 250 & 1st 500 Hour



1st
250 ⌚

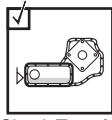


Change Axle Oil

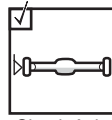


Change Wheel End Oil

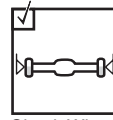
EVERY
250 ⌚



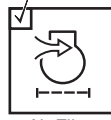
Check Transfer Case Oil Level



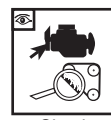
Check Axle Oil Level



Check Wheel End Oil Levels



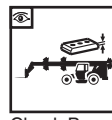
Air Filter Vacuumator Valve



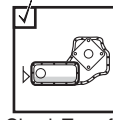
Check Fan Belt



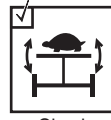
Check Boom Extend Chains



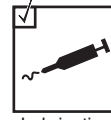
Check Boom Wear Pads



Check Transfer Case Oil Level



Check Rear Axle Stabilization

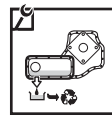


Lubrication Schedule

1st
500 ⌚



Change Transmission Oil & Filter



Change Transfer Case Oil

OAL3070

Note: Engine oil and filter service interval can be extended. See Engine Manual for details.



2.5.3 500, 1000 & 1500 Hour



EVERY
500 ⌚



Change Engine Oil and Filter

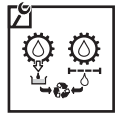


Change Fuel Filters

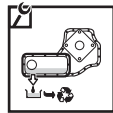


Check Wheel Lug Nut Torque

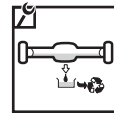
EVERY
1000 ⌚



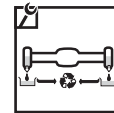
Change Transmission Oil & Filter



Change Transfer Case Oil



Change Axle Oil



Change Wheel End Oil



Change Hydraulic Tank Breather



Check Air Intake System



Check Boom Retract Chains

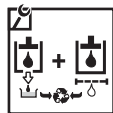


Lubrication Schedule

EVERY
1500 ⌚



Change Engine Coolant



Change Hydraulic Fluid & Filters



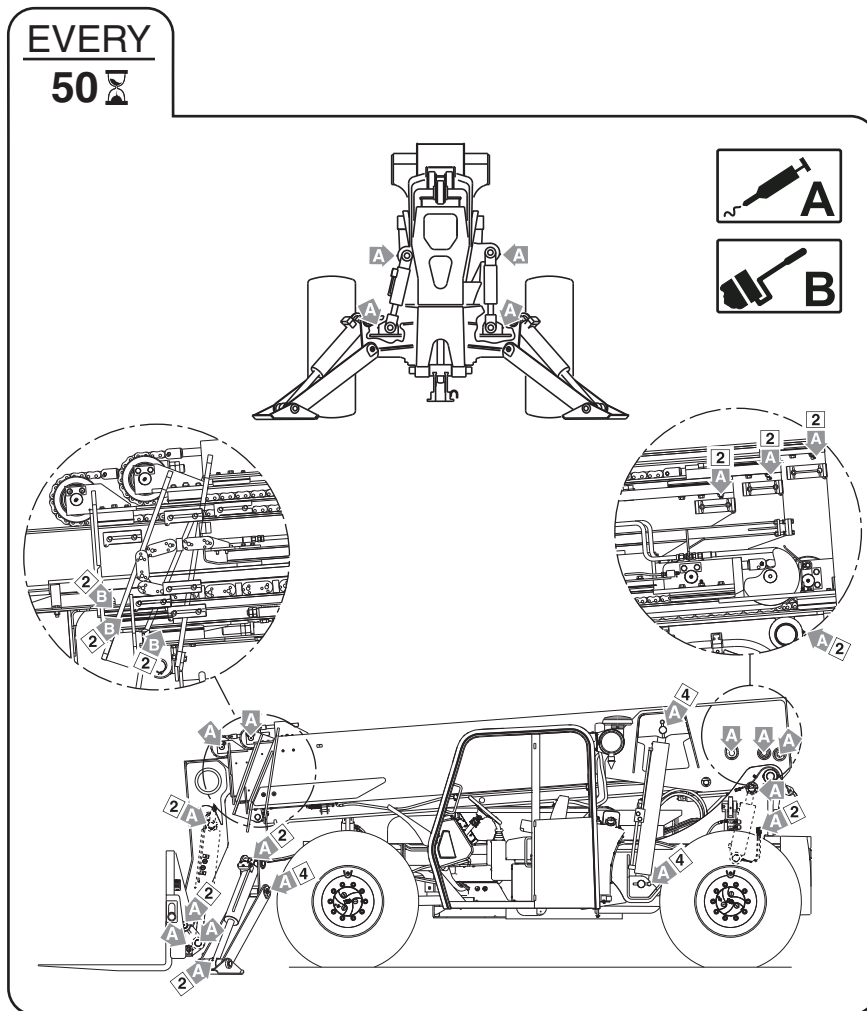
Change Crankcase Vent Filter

OAL3081



2.6 LUBRICATION SCHEDULES

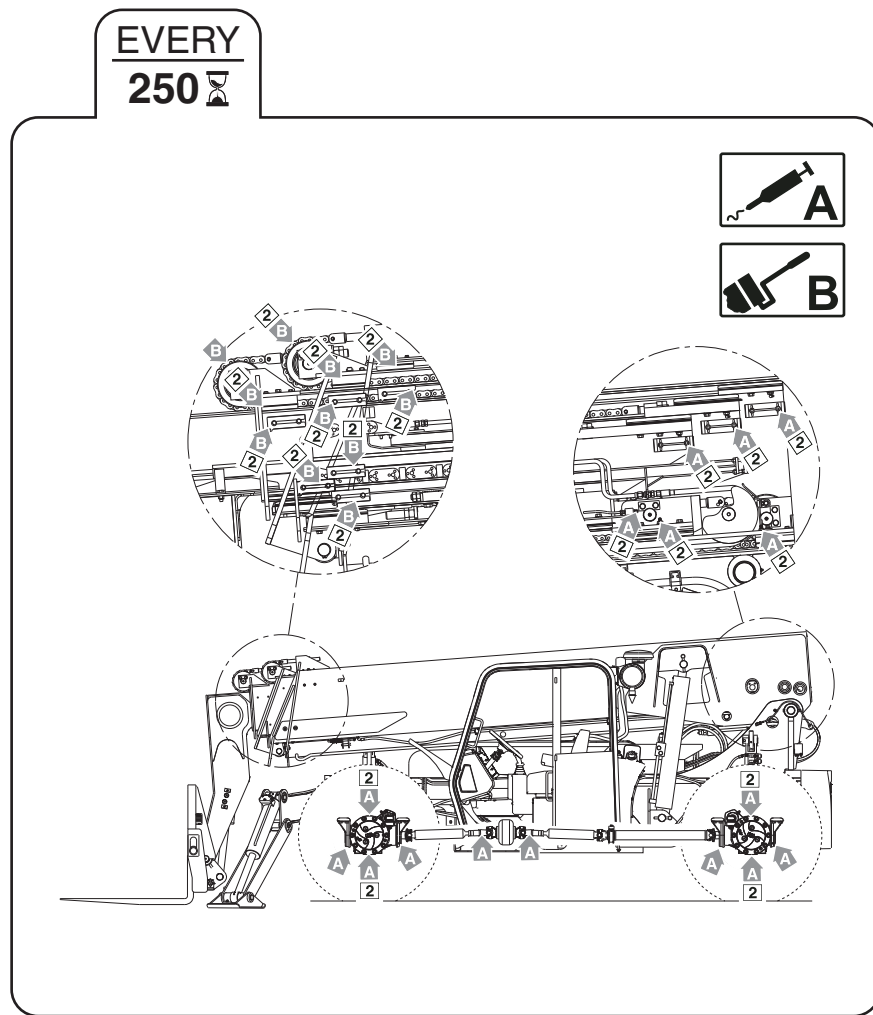
2.6.1 50 Hour



OAL0450



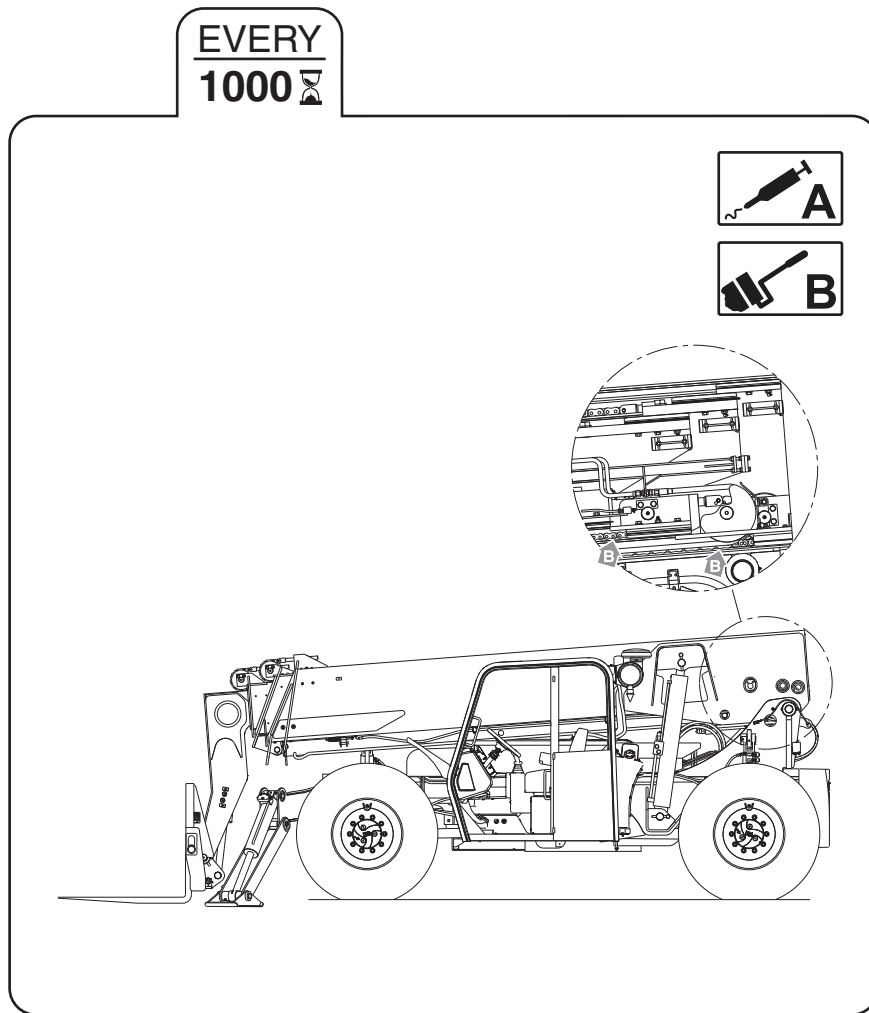
2.6.2 250 Hour



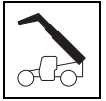


General Information and Specifications

2.6.3 1000 Hour



OY2080



Section 3 Boom

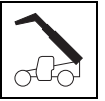
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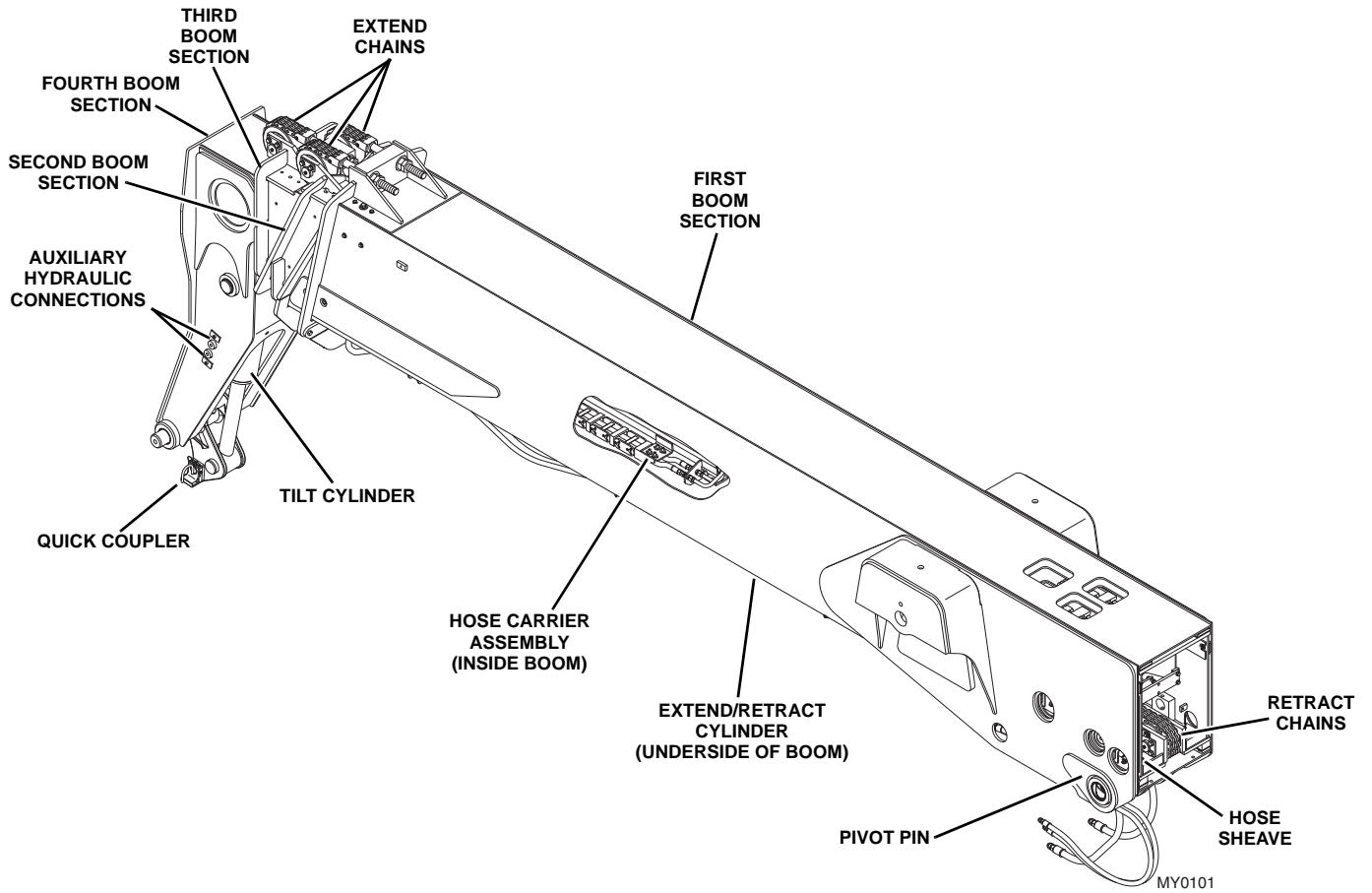
Boom

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3.1 BOOM SYSTEM COMPONENT TERMINOLOGY

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





Boom

3.2 BOOM SYSTEM - FOUR SECTION

3.2.1 Boom System Operation

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

As the extend/retract 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 boom sections are connected by extend and retract chains. These chains are routed around sheaves on the second and third boom sections. As the second section is forced out hydraulically, the third and fourth boom sections are pulled out by the extend chains.

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 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 third and fourth boom sections at the same rate.

The boom section lifts and lowers via action of the lift/lower cylinder.

3.3 BOOM ASSEMBLY MAINTENANCE

These instructions provide the complete boom assembly removal and installation or the second, third and fourth boom sections removal and installation.

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. The boom assembly consists of the first, second and third section booms and supporting hardware.

Note: Before removing the boom or boom section, the carriage or any other attachment must be removed from the quick coupler.

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.

During service of the boom, perform the following:

1. Check wear pads. (Refer to Section 3.10, "Boom Wear Pads.")
2. Check hose sheaves and chain rollers.
3. Apply grease at all lubrication points (grease fittings). (Refer to Section 2.6, "Lubrication Schedule.")
4. Check for proper operation by operating all boom functions through their full ranges of motion several times.

Depending on your particular circumstance, the following procedures explain the removal/installation of individual boom sections or removal/installation of the complete boom.

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 COMPLETE BOOM REMOVAL/ INSTALLATION

3.4.1 Complete Boom Removal

1. Remove any attachment from the quick coupler assembly. Refer to Operation & Maintenance Manual.
2. Remove the quick coupler assembly. Refer to Section 3.8.1, "Quick Coupler Removal."
3. If equipped, remove the Boom Head Mounted Winch. Refer to Section 3.9.1, "Boom Head-Mounted Winch Removal."
4. Park the machine on a hard, level surface, level the machine, fully retract the boom, raise the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
5. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
6. Open the engine cover. Allow the system fluids to cool.
7. Properly disconnect the battery.
8. Support the front of the boom by placing a sling behind the boom head.
9. Label, disconnect and cap all hydraulic hoses for the extend/retract and tilt circuits. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
10. Support the lift/lower cylinder on the left side of the machine. Remove the lock bolt and rod end pin. Lower the lift/lower cylinder onto the frame rails. Repeat this step for the right side lift/lower cylinder.
11. Support the compensation cylinder. Remove the lock bolt and rod end pin. Lower the compensation cylinder onto the frame rails.
12. Lower the boom to a level position and place a suitable support under the boom head. Reposition the slings to each end of the boom.
13. Remove the bolt securing the boom pivot pin. Pull out the boom pivot pin.
14. Lift the complete boom off machine and set on level ground or supports.

3.4.2 Complete Boom Installation

1. Park the machine on a hard, level surface, place the transmission control lever in (N) NEUTRAL, engage the park brake, chock the wheels and shut the engine OFF.

2. Using suitable slings, balance the boom assembly, lift and carefully guide the boom into place. Align the frame pivot bore with the boom assembly pivot bore.
3. Install the boom pivot pin.
4. With the sling still in place, install the compensation cylinder, pins and bolts.
5. With the sling still in place, install the rod end of the left lift/lower cylinder, pin and lock bolt. Repeat for the right side lift/lower cylinder.

Note: Raising the boom up or down with the sling may be necessary so the boom, compensation and lift/lower cylinder bores can be aligned for easier pin installation.

Note: Grease the boom pivot bore, compensation cylinder rod ends, lift/lower cylinder rod end and pins before installing.

6. Uncap and reconnect the previously labeled hydraulic hoses to the extend/retract cylinder.
7. Uncap and connect any remaining hydraulic fittings to their appropriate locations.
8. Recheck the wear pad gaps to ensure they meet the minimum gap requirement. Shim if necessary.
9. Ensure that the boom chains are properly adjusted. Refer to Section 3.6, "Boom Section Separation Adjustment."
10. Properly connect the battery.
11. Start the engine and operate all boom functions several times. Check for leaks, and check the hydraulic fluid level in the reservoir; add fluid if required.
12. Install the quick coupler assembly. Refer to Section 3.8.2, "Quick Coupler Installation."
13. If equipped, install the Boom Head Mounted Winch. Refer to Section 3.9.2, "Boom Head-Mounted Winch Installation."
14. Clean up all debris, hydraulic fluid, etc., in, on, near and around the machine.
15. Close and secure the engine cover.
16. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.
17. Install the previously remove attachment to the quick coupler assembly. Refer to Operation & Maintenance Manual.

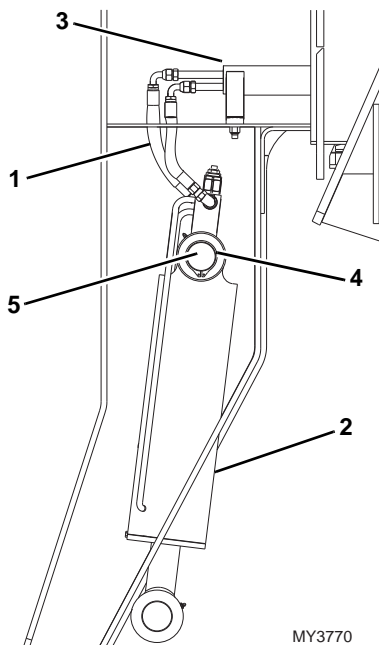


Boom

3.5 BOOM SECTION REMOVAL/ INSTALLATION

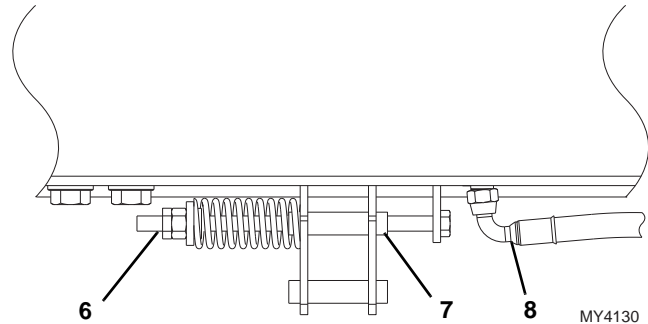
3.5.1 Second, Third & Fourth Boom Section Removal

1. Remove any attachment from the quick coupler assembly. Refer to Operation & Maintenance Manual.
2. Remove the quick coupler assembly. Refer to Section 3.8.1, "Quick Coupler Removal."
3. If equipped, remove the Boom Head Mounted Winch. Refer to Section 3.9.1, "Boom Head-Mounted Winch Removal."
4. Park the machine on a hard, level surface, level the machine, fully retract the boom, level the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
5. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
6. Open the engine cover. Allow the system fluids to cool.

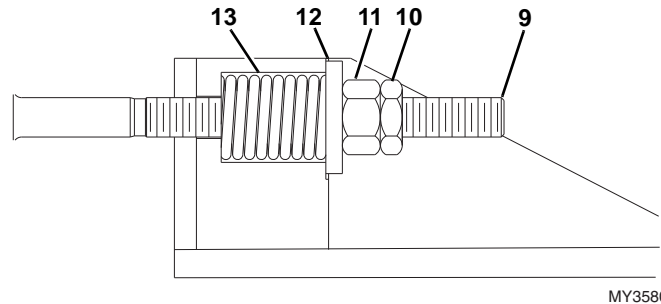


7. Label and remove both tilt cylinder hoses (1) between the tilt cylinder (2) and the hose carrier (3). Label, cap and plug the hose carrier tube ends and cylinder ports to prevent dirt and debris from entering the hydraulic system.
8. Using a suitable lifting device, secure the tilt cylinder barrel with a nylon strap.

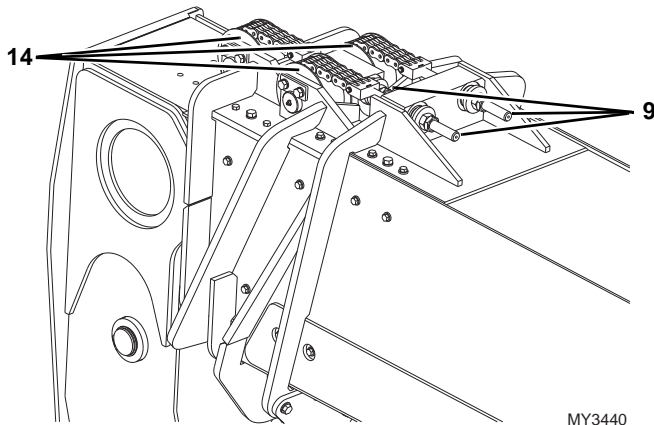
9. Remove both retaining clips (4) from each side of the tilt cylinder mounting pin (5).
10. Remove the tilt cylinder mounting pin (5).
11. Lower tilt cylinder from the boom head.
12. Support the front of the boom by placing a sling behind the boom head.



13. Loosen the jam nut and lock nut (6) to release tension from the hoses on the hose take-up weldment (7).
14. Loosen the hydraulic hoses (8) and electrical cables if equipped on the hose take-up weldment (7). Plug the hose ends and tube ends to prevent dirt and debris from entering the hydraulic system.



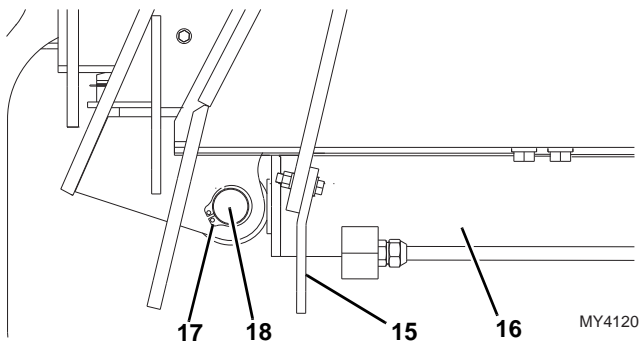
15. At the top front of the boom, measure and note the distance from the end of the three extend chain clevises (9) to the face of the lock nut (10).
16. Loosen and remove the lock nuts (10), adjusting nuts (11), washers (12) and springs (13) from the three extend chain clevises (9).



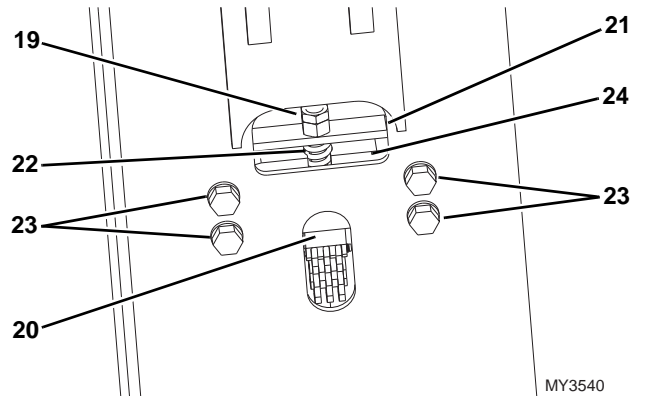
17. Pull the three extend chain clevises (9) off of each chain roller (14) and lay each assembly on the third and fourth boom sections respectively.

Note: It may be necessary to remove the extend chain rollers to help in the removal of the top wear pads.

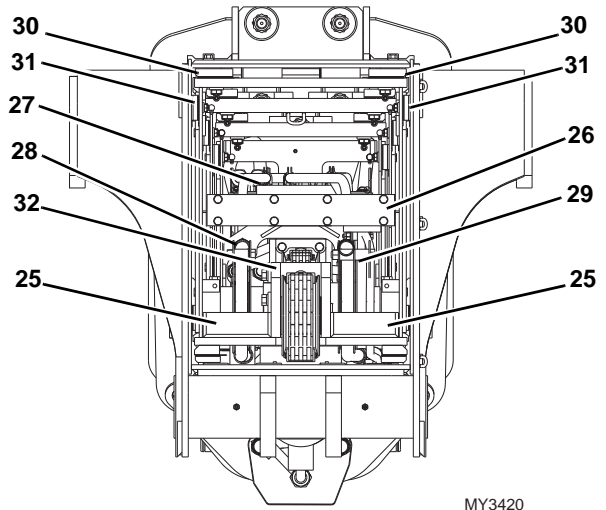
18. Verify all fittings, tubes and hoses are properly capped and /or plugged.
19. Extend the second boom section to access the retract chain adjusting block.



20. Remove the extend/retract cylinder support (15) from the front of the first boom section.
21. Support the extend/retract cylinder (16) with a suitable sling.
22. Remove the retaining clips (17) from each side of the extend/retract cylinder rod.
23. Remove the extend/retract cylinder rod mounting pin (18).
24. Lower the front of the extend/retract cylinder to a secured block on top of the frame. Do Not use the engine hood for support.



25. Remove the adjusting nut and lock nut (19), retract chain and clevis (20), spring stop (21) and spring (22). Loosen bolts (23) and adjusting block (24).
26. Properly disconnect the battery.



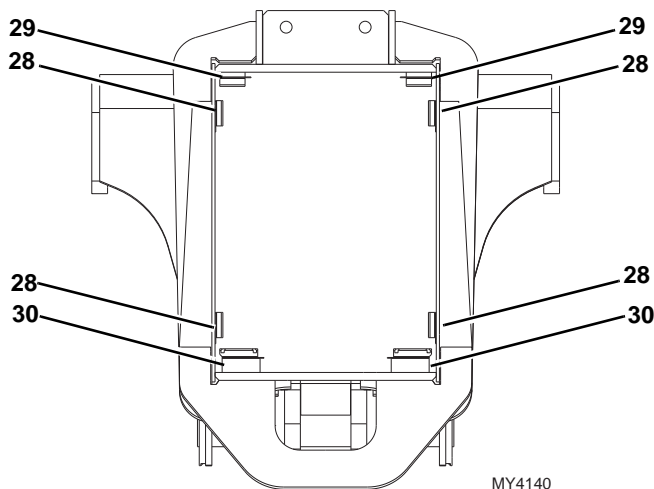
27. At the rear of the boom, remove both hose sheave covers (25).
28. Unbolt the hose carrier bracket (26) from the rear of the second boom section and the hose carrier.
29. Pull the hose carrier (27) back to gain access to the tilt hose (28) and the auxiliary hose (29) connections.
30. Disconnect the tilt hoses, auxiliary hoses and if equipped, the electrical connector at the rear of the hose carrier. Label, plug and cap all hydraulic connections to prevent dirt and debris from entering the hydraulic system.
31. Push hose carrier (27) as far forward as possible.

Note: Tag each wear pad, spacer, shim and hardware from each location. Note the location of any grease fitting (if equipped) on each wear pad.



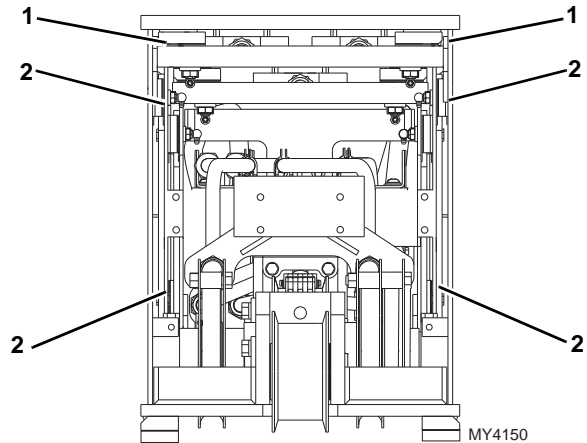
Boom

32. Remove the top rear wear pads, spacers, shims and hardware (30) from the rear of the second boom section.
33. Remove the left (or right) side rear wear pad, spacer, shims and hardware (31) from the rear of the second boom section.
34. Pull each boom section slightly forward to relieve the tension in retract chain (32).
35. Remove the snap rings and pin connecting the rear retract chain (32) from the chain clevis at the rear of the boom. Allow chain to hang out over the rear of the boom.
36. Place a sling around the second boom section. With a suitable lifting device, slowly pull the second, third and fourth boom sections approximately 25% out of the first boom section.



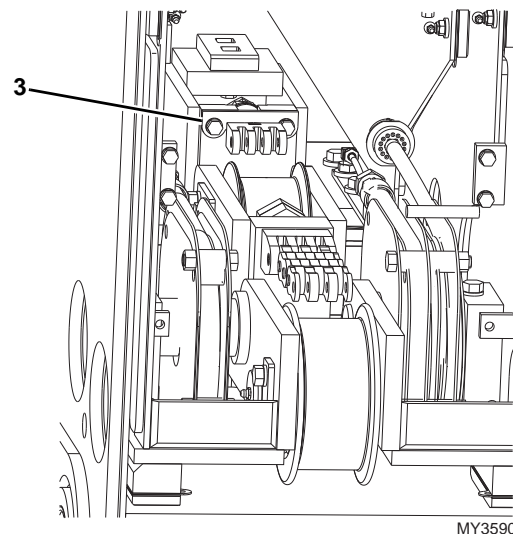
37. With the second, third and fourth boom section still connected to a suitable lifting device, remove all wear pads, spacers, shims, and hardware (28) from the front sides of the first boom section.
38. Remove both wear pads, spacers, shims, blocks and hardware (29) from the front top of the first boom section.
39. Remove both wear pads, spacers, shims and hardware (30) from the front bottom of the first boom section.
40. Adjust sling(s) around the second boom section to help balance the second, third and fourth boom sections.
41. Remove the remainder of the second, third and fourth boom sections from the first boom section and set on suitable supports.

3.5.2 Third & Fourth Boom Section Removal



Note: Tag each wear pad, spacer, shim and hardware from each location. Note the location of any grease fitting (if equipped) on each wear pad.

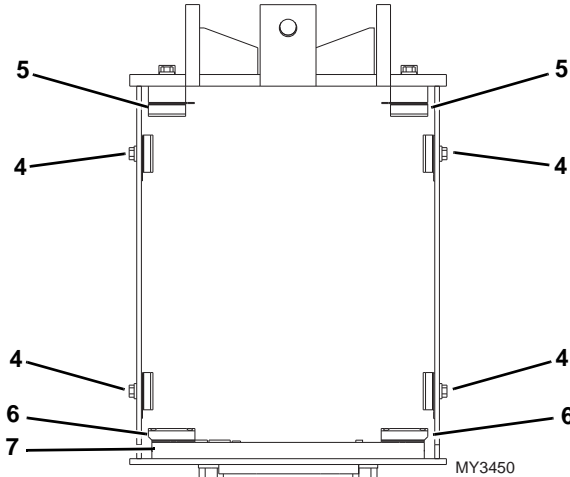
1. Remove the top rear wear pads, spacers, shims and hardware (1) from the rear of the third boom section.
2. Remove the left (or right) side rear wear pad, spacer, shims and hardware (2) from the rear of the third boom section.
3. Verify all disconnected hoses, tubes and fittings are capped and/or plugged.



4. Pull each boom section slightly forward to relieve the tension on the retract chain (3).
5. Remove the snap rings and pin connecting the rear retract chain (3) from the chain clevis at the rear of the boom. Allow chain to hang out over the rear of the boom.



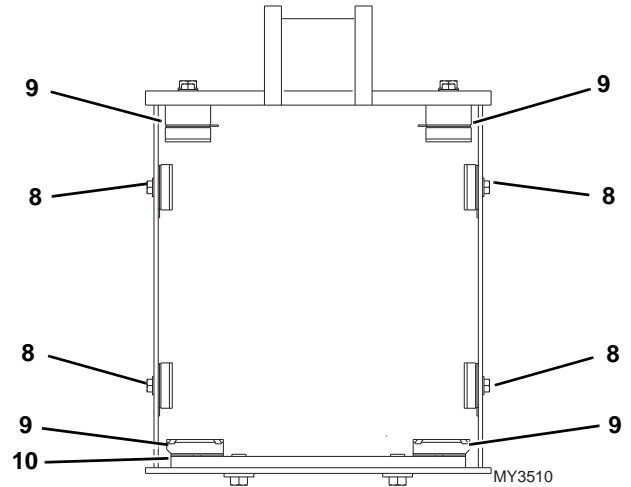
- Place a sling around the third boom section. With a suitable lifting device, slowly pull the third and fourth boom sections approximately 25% out of the second boom section.



- With the third and fourth boom section still connected to a suitable lifting device, remove all wear pads, spacers, shims, and hardware (4) from the front sides of the second boom section.
- Remove both wear pads, spacers, shims, blocks and hardware (5) from the front top of the second boom section.
- Remove both wear pads, spacers, shims and hardware (6) from the front bottom of the second boom section.
- Loosen and remove the wear pad support plate (7) from the bottom front of the second boom section.
- Adjust sling(s) around the third boom section to help balance the third and fourth boom sections.
- Remove the remainder of the third and fourth boom sections from the second boom section and set on suitable supports.

3.5.3 Fourth Boom Section Removal

- Place a sling around the fourth boom section and slowly pull the fourth boom section approximately 25% out of the third boom section. Lower the fourth section boom head onto a suitable support.

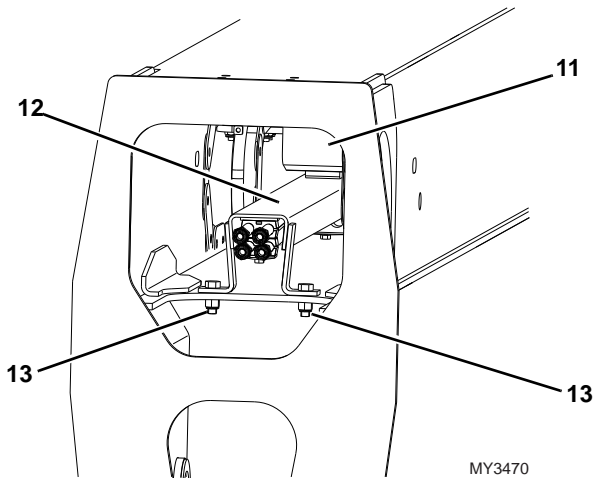


- With the fourth boom section still connected to a suitable lifting device, remove all wear pads, spacers, shims, and hardware (8) from the front sides of the third boom section.
- Remove top and bottom front wear pads, shims and blocks (9) from the third boom section.
- Loosen and remove the wear pad support plate (10) from the bottom front of the third boom section.
- Adjust the sling(s) around the fourth boom section for stability. Balance the fourth boom section and slowly pull the fourth boom section out of the third boom section being careful not to damage any surrounding components.
- Lower the fourth boom section onto a suitable support.

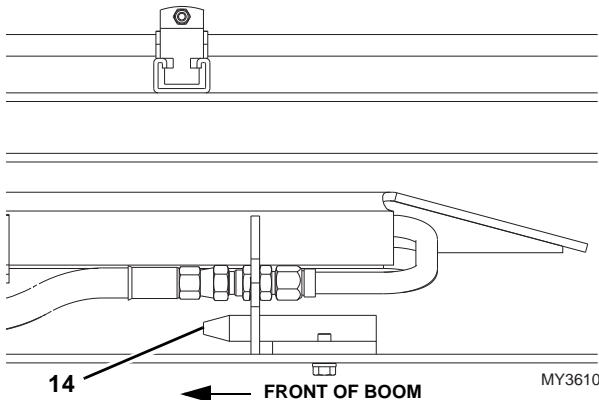


Boom

3.5.4 Hose Carrier Removal



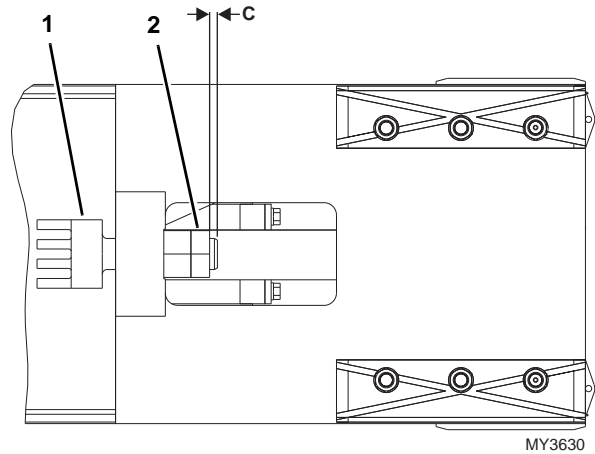
1. Remove the guide bracket (11) at the front of the hose carrier (12). Reuse the existing hardware.
2. Loosen and remove the front two mounting bolts (13) holding the hose carrier in place. Tag all hardware.
3. Remove the hose carrier through the front of the fourth boom section.
4. When the hose carrier is approximately 25% free of the fourth boom section, fasten the two hose carriers together (using nylon tie-wraps or nylon straps) to prevent separation.
5. Continue to remove the hose carrier, fastening the hose carriers together as they are being removed.
6. When the hose carrier is approximately 75% tied together, pull the assembly free of the boom section.
7. Lower the hose carrier onto a suitable support.



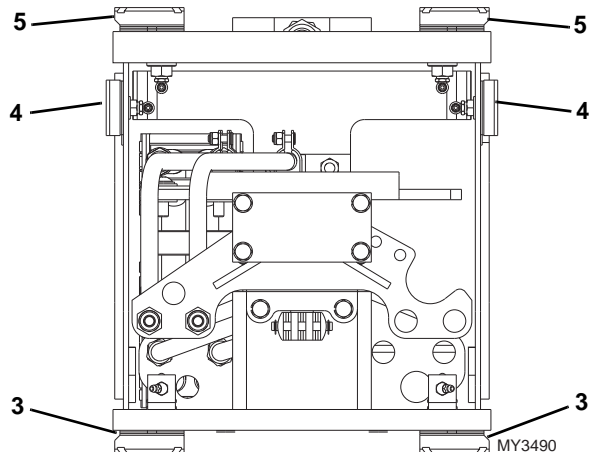
8. Remove the hose carrier guide bracket from the inside of the fourth boom section (14).

3.5.5 Fourth Boom Section Assembly

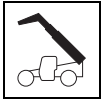
1. Place the fourth boom section onto suitable supports.



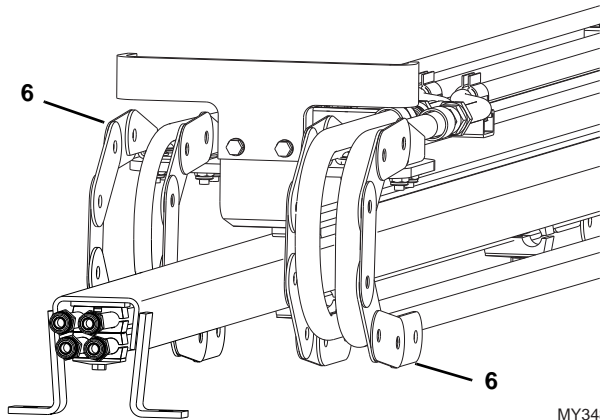
2. Install the previously removed extend chain assembly and clevis (1) at the top rear of the fourth boom section. Allow 0.250 in (6,35 mm) (C) between the end of the clevis (1) and the face of the lock nut (2). Torque lock nut to 100 lb-ft (135 Nm).



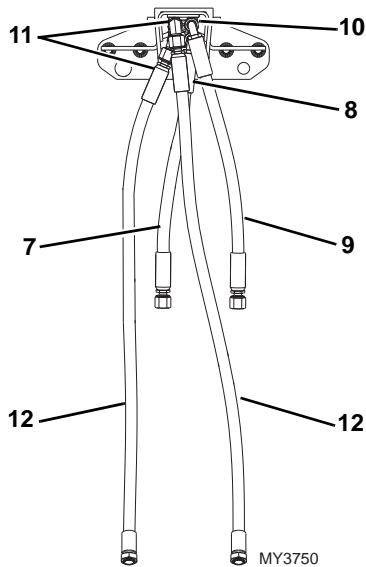
3. Install all wear pads, spacers and shims (3, 4 & 5) at the rear of the fourth boom section. Snug mounting bolts. Shim as needed AFTER boom section is installed. Refer to Section 3.10.2, "Wear Pad Installation and Lubrication," for detailed information.



3.5.6 Hose Carrier Installation

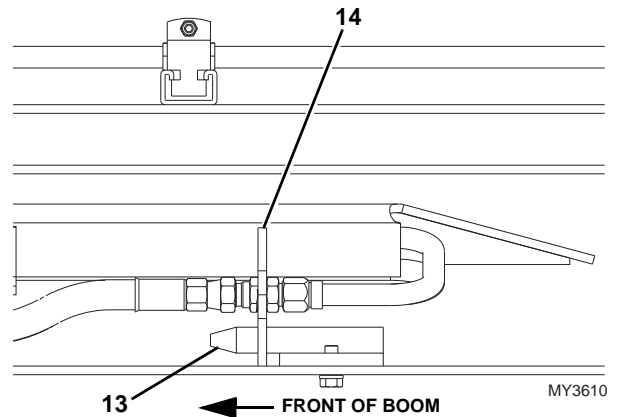


1. Inspect the hose carrier track (6) for any broken or missing clips. Repair or replace as needed.
2. Remove the caps from the tubes on the hose carrier.

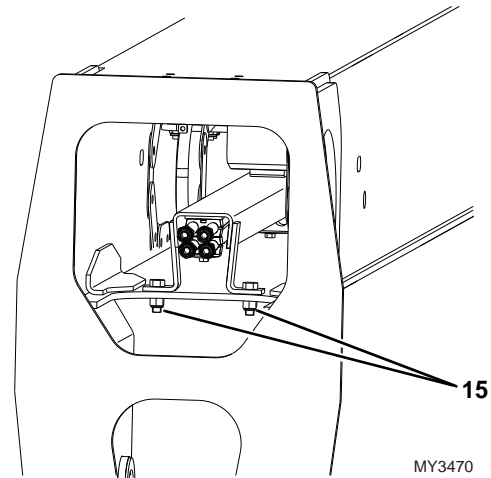


Note: Connect the tilt cylinder hoses and the auxiliary hoses to the hose carrier bulkhead before installing the hose carrier in the fourth boom section.

3. Install tilt cylinder hose (7) to the bottom left fitting on the hose carrier tube (8).
4. Install tilt cylinder hose (9) to the top left fitting on the hose carrier tube (10).
5. Install adaptors (11) to each auxiliary tube at the front right of the hose carrier.
6. Install auxiliary hoses (12) to each adaptor (11) on the auxiliary tubes at the front right of the hose carrier.
7. Orient each auxiliary hose (12) as shown above.
8. Torque each fitting and hose as required.



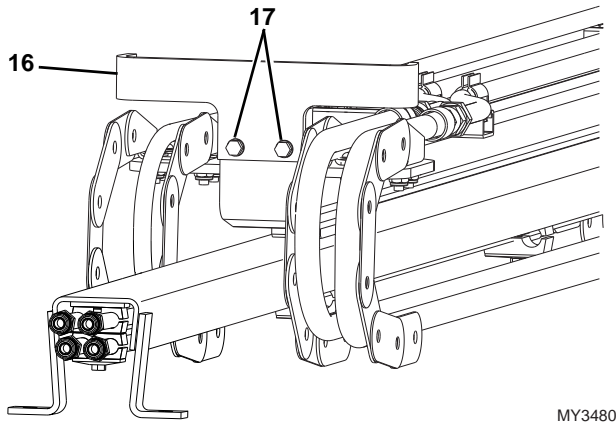
9. Install the previously removed hose carrier guide bracket (13). Torque as required.
10. Install the hose carrier (14) into the front of the fourth boom section. Remove each nylon tie or nylon strap as the hose carrier is installed.
11. Align the hose carrier (14) to the hose carrier guide bracket (13).



12. Align the hose carrier mounting bracket and install the previously removed hardware to mounting bracket at the front of the fourth boom section (15). Torque as required.



Boom



MY3480

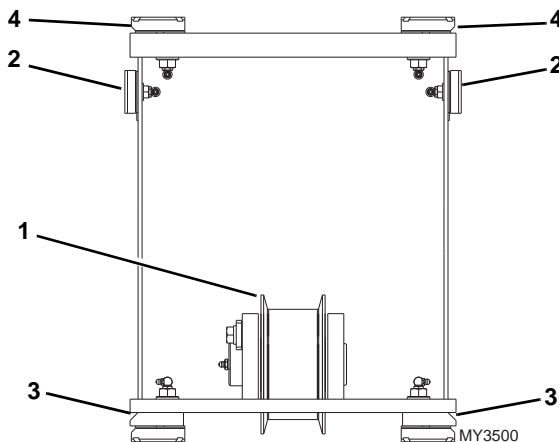
13. Install guide bracket (16) P/N using the previously removed hardware (17). Torque as required.

3.5.7 Third Boom Section Assembly

Note: Inspect and lubricate all extend and retract chains before re-assembly. Refer to Section 3.12.1, “Boom Chain Inspection,” for detailed information.

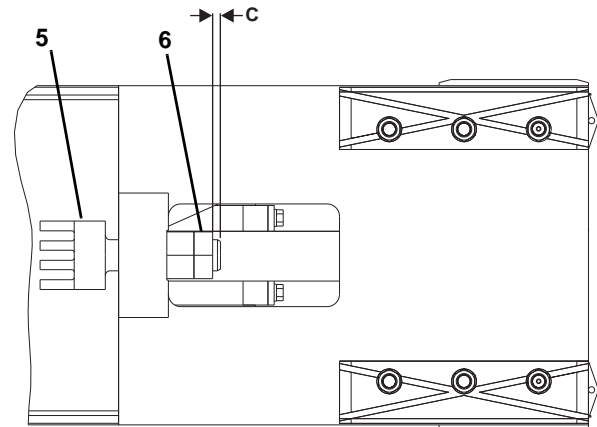
Note: Using a straight bar approximately 40 in (1041 mm) long will aid in the installation of the wear pads located on the inside front of each boom section.

1. Place the third boom section onto suitable supports.



MY3500

2. Install the previously removed chain roller (1) at the rear of the third boom section. Insert the mounting pin, retainer plate and hardware. Torque as required.
3. Install all wear pads, spacers and shims (2, 3 & 4) at the rear of the third boom section. Snug mounting bolts. Shim as needed AFTER boom section is installed. Refer to Section 3.10.2, “Wear Pad Installation and Lubrication,” for detailed information.



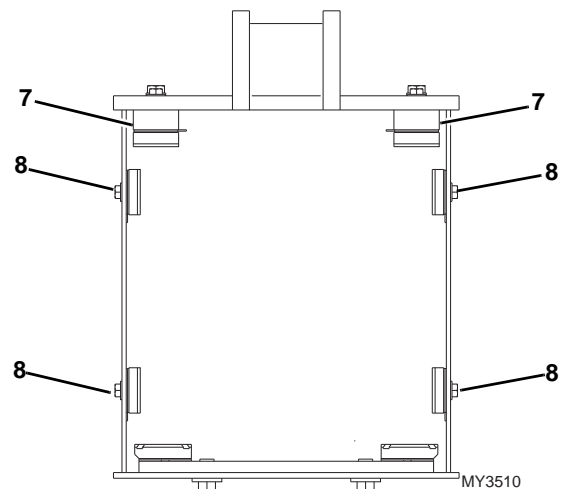
MY3630

4. Install the previously removed extend chain assemblies and clevises (5) at the top rear of the third boom section. Allow 0.250 in (6,35 mm) between the end of the clevis (5) and the face of the lock nut (6). Torque lock nut to 100 lb-ft (135 Nm).

3.5.8 Fourth Boom Section Installation

Note: Using a straight bar approximately 40 in (1041 mm) long will aid in the installation of the wear pads located on the inside front of each boom section.

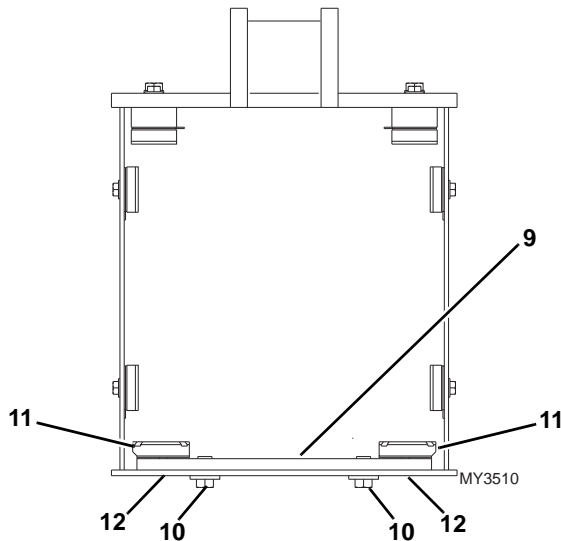
1. Clean and lubricate the bottom of the fourth boom section where the wear pads of the third boom section contact the fourth boom section.
2. Place the sling, or two slings for better stability, around the fourth boom section and slowly insert the fourth boom section into the third boom section being careful not to damage any surrounding components.



MY3510



3. Install the wear pad, support plates and spacers (7) with existing hardware at the inside top front of the third boom section. Snug mounting bolts. Shim as needed AFTER boom section is installed. Refer to Section 3.10.2, "Wear Pad Installation and Lubrication," for detailed information.

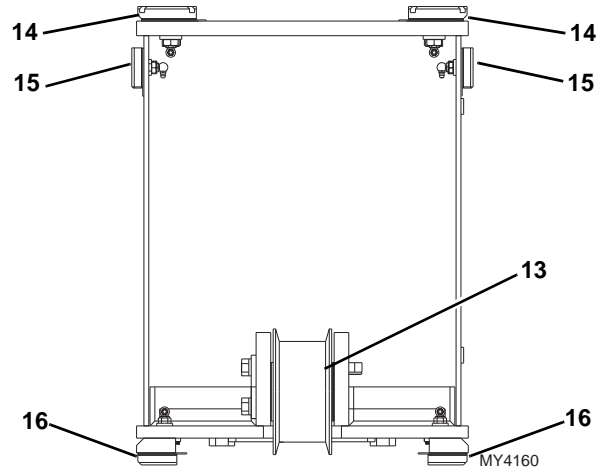


4. Install the previously removed wear pad support (9) at the front inside of the third boom section. Use the previously removed hardened washers and bolts (10). Torque as required.
5. Install the wear pads, spacers and shims on each side and bottom (8 & 11) at the front of the third boom section. Snug mounting bolts. Shim as needed AFTER boom section is installed. Refer to Section 3.10.2, "Wear Pad Installation and Lubrication," for detailed information.

Note: Longer bolts (12) may be required to fully engage the threaded inserts in the wear pads without allowing bolts to protrude past the chamfer on the wear pads. Refer to page 6, Wear Pad Installation and Lubrication for detailed information.

3.5.9 Second Boom Section Assembly

1. Place the second boom section onto suitable supports.



2. Install the previously removed chain roller (13) at the rear of the second boom section. Insert the mounting pin, retainer plate and hardware. Torque as required.
3. Install the wear pads and spacers (14, 15 & 16) at the rear of the second boom section. Snug mounting bolts. Shim as needed AFTER boom section is installed. Refer to Section 3.10.2, "Wear Pad Installation and Lubrication," for detailed information.

3.5.10 Third & Fourth Boom Section Installation

Note: Refer to Section 2.2, "Torque Charts," for standard bolt torque information.

Note: Refer to Section 2.2.3, "Hydraulic Hose Torque Chart," for standard hose torque information.

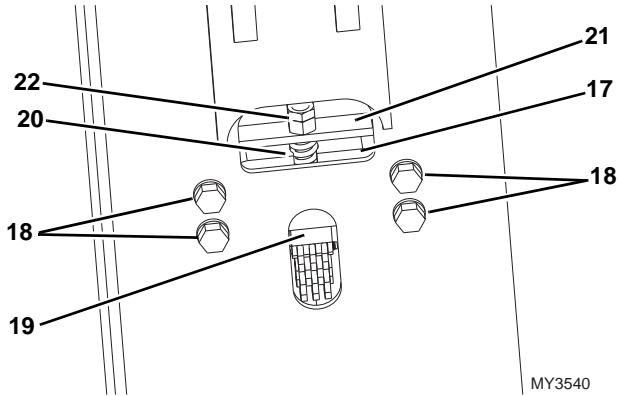
Note: Apply Loctite® 242™ to all boom assembly bolts.

Note: Using a straight bar approximately 40 in (1041 mm) long will aid in the installation of the wear pads located on the inside front of each boom section.

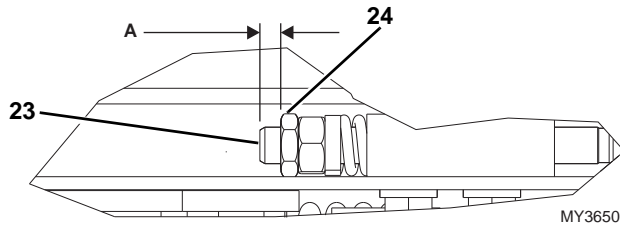
1. Place the sling or using two slings for better stability, around the third boom section and slowly insert the third and fourth boom sections into the second boom section being careful not to damage any surrounding components.



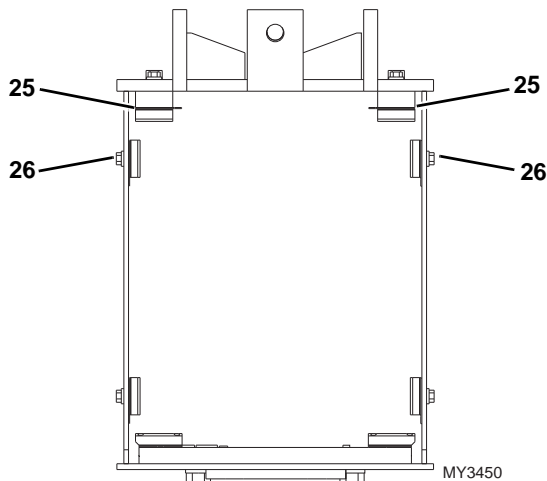
Boom



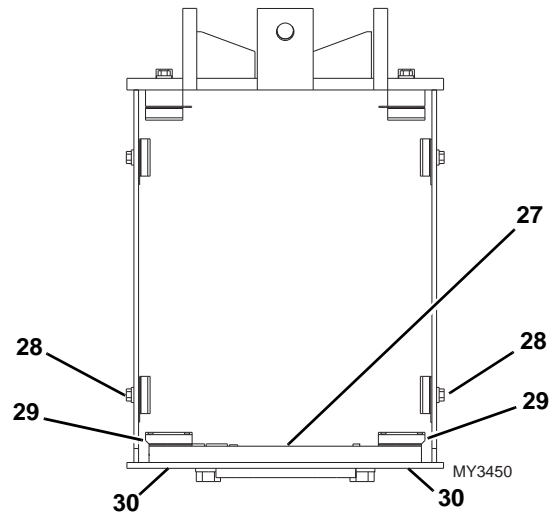
2. Install adjusting block (17) using existing hardware (18). Torque as required.
3. Install chain and clevis (19), spring (20), spring stop (21), adjusting nut and lock nut (22).



4. Allow 0.50 in (1,27 mm) (A) between the end of the clevis (23) and the face of the lock nut (24). Torque lock nut to 100 lb-ft (135 Nm).
5. Properly connect the battery.
6. Retract the second boom section pulling both retract chains at the same time.



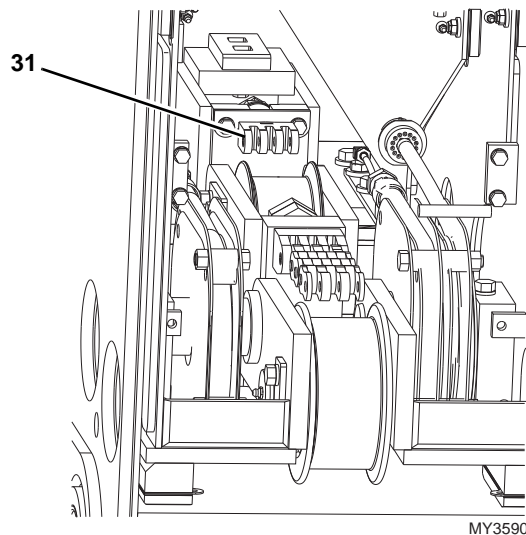
7. Install the wear pad, support plates and spacers (25) with existing hardware at the inside top front of the second boom section. Snug mounting bolts. Shim as needed AFTER boom section is installed. Refer to Section 3.10.2, "Wear Pad Installation and Lubrication," for detailed information.

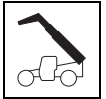


8. Install the wear pad support plate (27) with existing hardware at the inside front of the second boom section.

Note: Longer bolts (30) may be required to fully engage the threaded inserts in the wear pads without allowing bolts to protrude past the chamfer on the wear pads. Refer to Section 3.10.2, "Wear Pad Installation and Lubrication."

9. Install the wear pads, spacers and shims on each side and bottom (26, 28 & 29) at the front of the second boom section. Snug mounting bolts. Shim as needed AFTER boom section is installed. Refer to Section 3.10.2, "Wear Pad Installation and Lubrication," for detailed information.
10. Manually retract the boom sections as required to connect the retract chains.



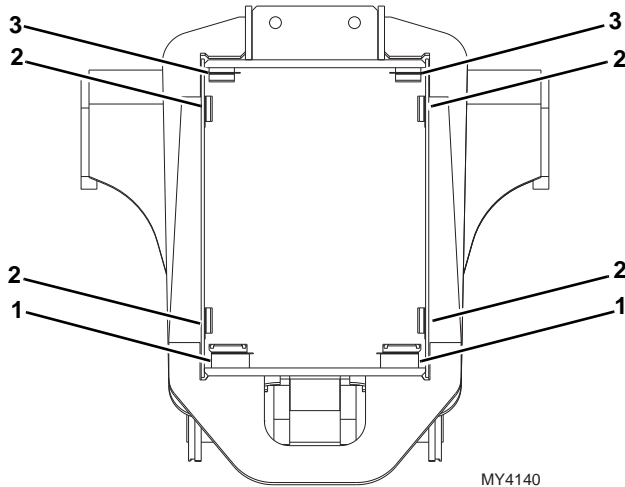


11. Install the bracket and clevis assembly (31) at the rear of the fourth boom section. Torque mounting bolts.

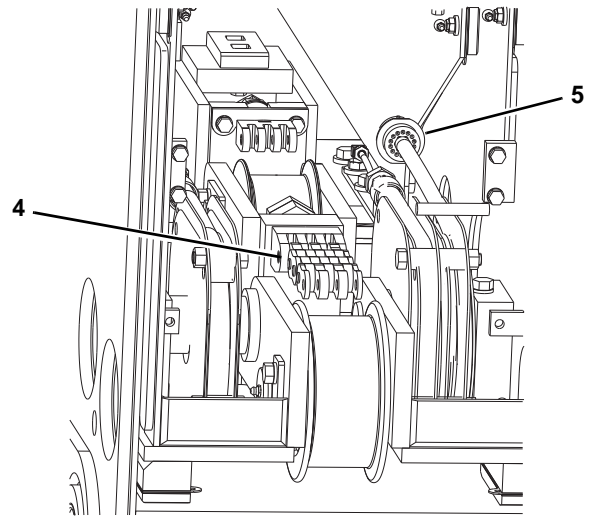
3.5.11 Second, Third and Fourth Boom Section Installation

Note: Using a straight bar approximately 40 in (1041 mm) long will aid in the installation of the wear pads located on the inside front of each boom section.

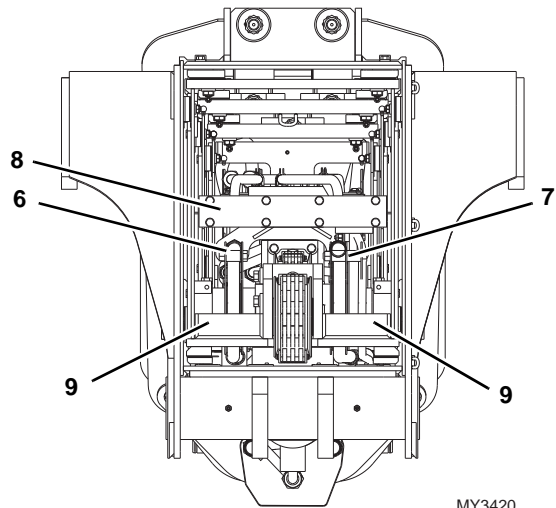
1. Place the sling or using two slings for better stability, around the second boom section and slowly insert the second, third and fourth boom sections into the first boom section being careful not to damage any surrounding components and allowing sufficient room to install the wear pads at the front of the first boom section.



2. Install all wear pads, spacers and shims (1, 2 & 3) at the front of the first boom section. Snug mounting bolts. Shim as needed AFTER boom section is installed. Refer to Section 3.10.2, "Wear Pad Installation and Lubrication," for detailed information.
3. Re-adjust the sling(s) and push the second, third and fourth boom assembly the remainder of the way into the first boom section.



4. Connect the rear retract chain (4) to the chain clevis with the previously removed pin at the rear of the third boom section. Secure the pin with the previously removed snap rings.
5. Pull hose carrier from the rear as far as possible to access the hydraulic and if equipped, the electrical connections.
6. If equipped, connect the electrical cable (5) to the fitting on the hose carrier.

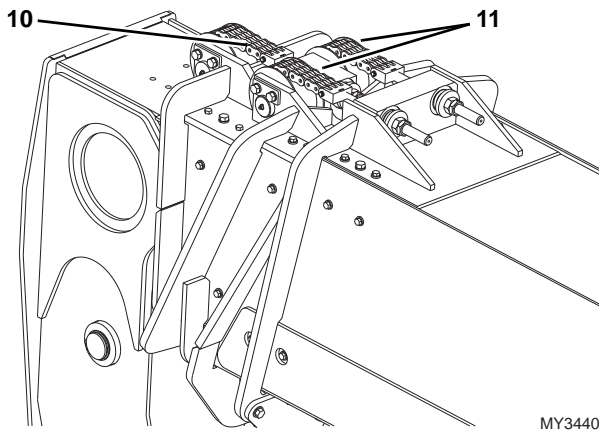


7. Remove any caps and plugs from the tilt and auxiliary hoses at the rear of the boom assembly. Connect and tighten the tilt (6) and auxiliary hoses (7) to their proper fitting locations on the hose carrier. Torque as required.
8. Install the hose carrier bracket (8) at the rear of the third boom section and the hose carrier. Torque mounting bolts as required.



Boom

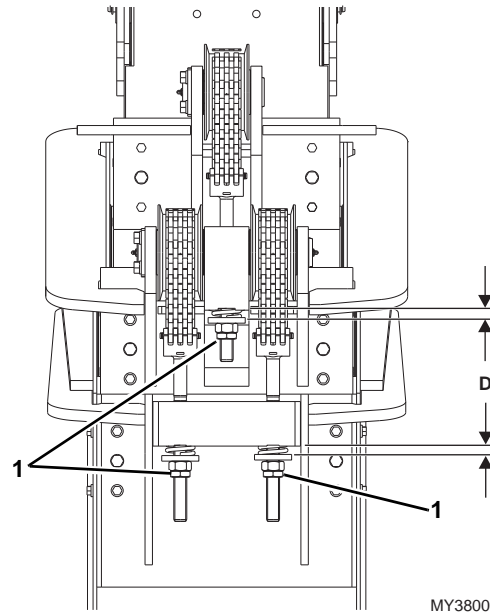
- Install both hose sheave covers (9). Torque mounting bolts as required.



- Connect the fourth boom section extend chain (10) to the clevis at the top front of the third boom section and adjust to the previously measured setting. Do Not tighten the lock nut at this time.
- Connect the third boom section extend chains (11) to the clevises at the top front of the second boom section and adjust to the previously measured setting. Do Not tighten the lock nut at this time.
- Grease all wear pad at the rear of the boom using the grease fittings.
- Refer to Section 3.6, "Boom Section Separation Adjustment," for proper boom section adjustments.

3.6 BOOM SECTION SEPARATION ADJUSTMENT

- Start the machine and verify the boom is in a horizontal (level) position.
- Extend the boom 4-5 ft (1,2-1,5 m), then fully retract the boom.
- Shut machine OFF.



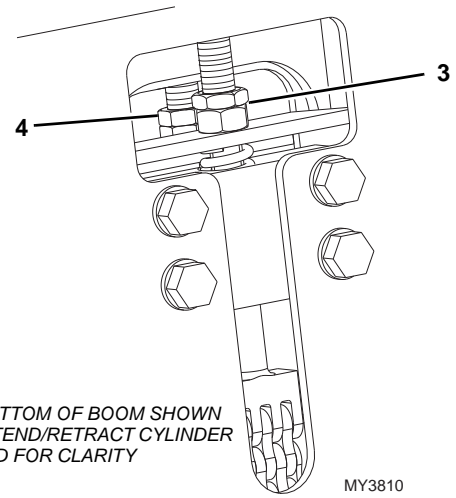
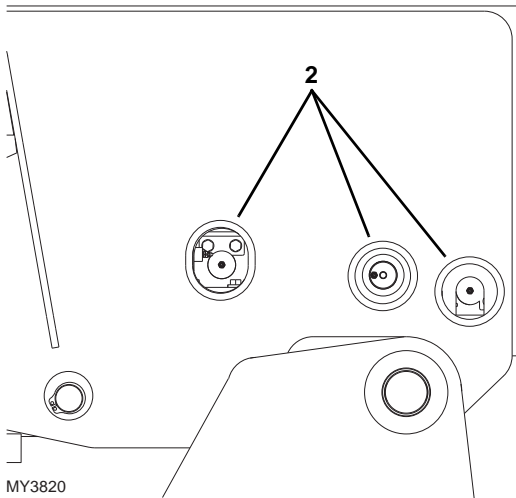
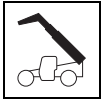
- Measure the gap (D) between the flat washer at the extend chain anchor on the top front of the first boom section and the second boom section. If the gap is greater than 0.375 in (9.52 mm), the boom chains will need to be adjusted.

Adjust the extend chain as follows:

- Loosen the lock nut (1) on each of the extend chains.
- Tighten the adjusting nuts on the first boom section until the gap (D) between the flat washers and boom is 0.375 in (9,52 mm) maximum. The gap must be equal on both chains. Torque the lock nut to 100 lb-ft (135 Nm).

Note: Verify the exposed threads on both extend chain clevises are kept equal.

- Tighten the adjusting nut on the second boom section until the gap (D) between the washer and boom is 0.375 in (9,52 mm) maximum. Torque the lock nut to 100 lb-ft (135 Nm).

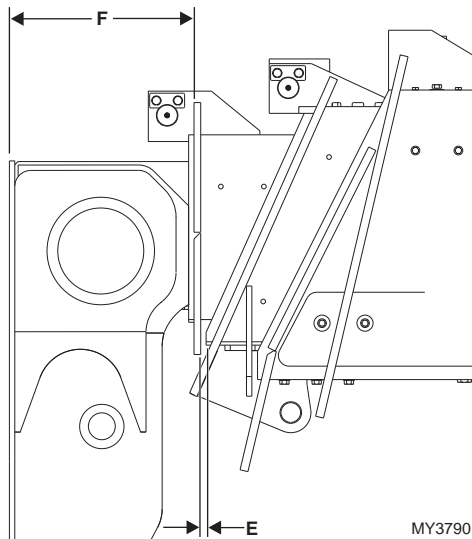


Note: BOTTOM OF BOOM SHOWN WITH EXTEND/RETRACT CYLINDER REMOVED FOR CLARITY

4. After adjusting, check to see that the boom sections and access holes (2) are aligned. If they are not, the retract chain will need to be adjusted as well.

Adjust the retract chain as follows:

1. Fully retract the boom.



2. Measure the distance between the second boom section and the third boom section (E). The dimension should be 0.50-0.75 in (12,7-19,5 mm).

3. Loosen the second to third boom section retract chain lock nut and adjusting nut (3) as far as possible.
4. Loosen the third to fourth boom section retract chain lock nut and adjusting nut (4) as far as possible.
5. Tighten the retract chain adjusting nut (3) until the proper distance (E) is obtained and proper access hole alignment (2) is obtained.
6. Torque the lock nut to 100 lb-ft (135 Nm).
7. Recheck the extend chain adjustments and readjust if necessary.
8. Measure the distance between the third boom section and fourth boom section (F). The dimension should be:
TL1055 - 17.5-17.75 in (444,5-451,3 mm)
TL1255 - 18.5-18.75 in (469,9-476,7 mm)
9. Tighten the retract chain adjusting nut (4) until the proper distance (F) is obtained and proper access hole alignment (2) is obtained.
10. Torque the lock nuts to 100 lb-ft (135 Nm).
11. Re-adjust the extend chains as needed.



Boom

3.7 HOSE CARRIER ASSEMBLY REMOVAL/INSTALLATION

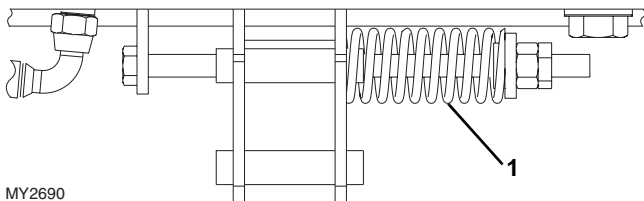
The hose carrier assembly locates primarily in the fourth boom section. It is fastened at the bottom front of the fourth boom section and at the rear of the third boom section.

3.7.1 Hose Carrier Assembly Removal

1. Remove any attachment from the quick coupler assembly. Refer to Operation & Maintenance Manual.

Note: Allow adequate room in front of the machine when removing and installing the hose carrier assembly.

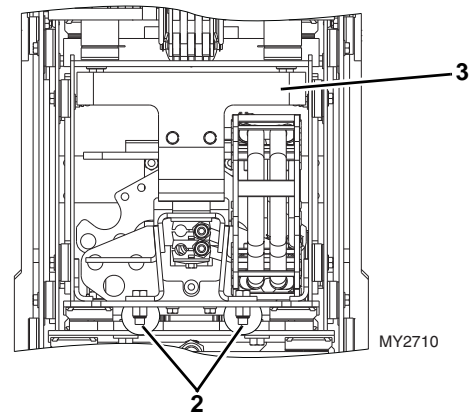
2. Park the machine on a hard, level surface, level the machine, fully retract the boom, level the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
3. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
4. Open the engine cover. Allow the system fluids to cool.
5. Properly disconnect the battery.



MY2690

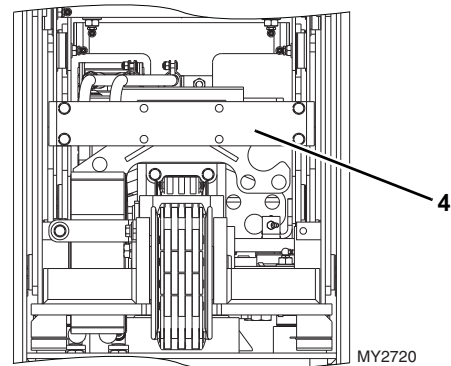
6. Loosen and remove both compression springs (1) from the hose take-up weldment at the bottom of the first boom section.
7. Label and disconnect the tilt and auxiliary hydraulic hoses attached to the hose carrier at the rear of the boom and at the front of the boom head. Plug and cap the hose ends to prevent dirt and debris from entering the hydraulic system.
8. If equipped, label and disconnect any electrical connections at the front and rear of the boom assembly.

Note: Tag or identify each hose to the corresponding fitting it was removed from.



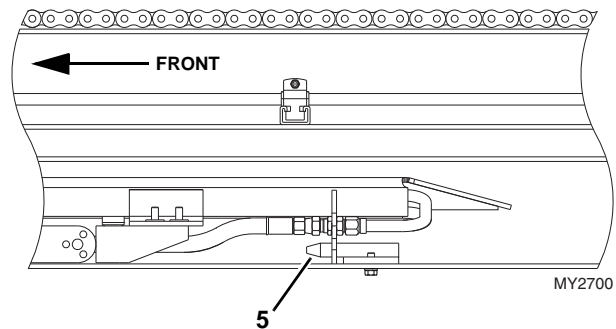
MY2710

9. Loosen and remove both cap screws and locknuts (2) from the hose carrier bracket at the front of the fourth boom section.
10. Loosen and remove the guide bracket (3) from the front of the fourth boom section.



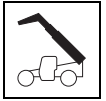
MY2720

11. Loosen and remove the hose carrier bracket (4) at the rear of the third boom section.



MY2700

12. Install a sling around the hose carrier at the front of the boom. With a suitable lifting device, slowly pull the hose carrier loose from the bottom bracket (5) located approximately halfway in the fourth boom section.



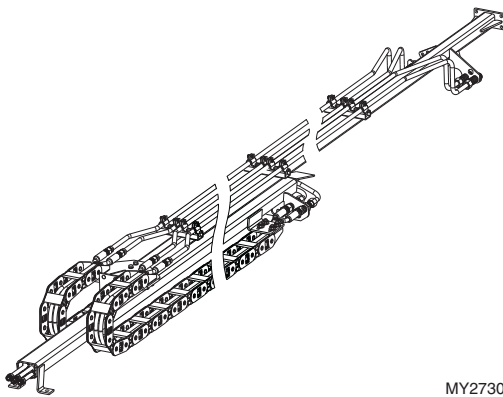
13. When the hose carrier is pulled approximately 25% out of the boom, fasten the two hydraulic carriers together using plastic tie wraps or nylon straps to keep them from separating.

Note: Do Not wrap the hose carrier since it will not prevent the two hydraulic carriers from moving apart sideways.

14. Continue withdrawing the hose carrier, fastening the two hydraulic carriers together.
15. With the two hose assemblies tied together, remove the hose carrier and set on the ground or proper supports.

3.7.2 Assembling the Hose Carrier Assembly

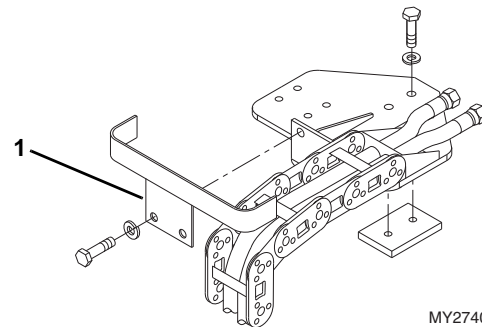
The following procedure is described with the assumption that all components have been removed and assembly proceeding from the beginning.



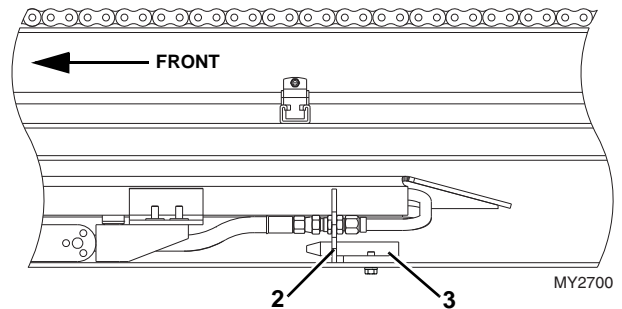
1. Place both sections on a suitable stand or support.
2. Install the wear pad to the bottom of the upper hydraulic carrier.
3. Install the bulkhead fittings to the each hydraulic carrier.
4. Install the tube assemblies to the bulkhead fittings on each hydraulic carrier.
5. Install the cushion clamps to the tube assemblies and secure to each hydraulic carrier.
6. Install the hose carrier to each hydraulic carrier and install each tilt hose and auxiliary hose to the proper fitting or tube connection.
7. Tie wrap the hydraulic hoses together where they extend from each end of the hose carrier.
8. Fasten the two hydraulic carriers together using plastic tie wraps or nylon straps for stability.

3.7.3 Hose Carrier-Assembly Installation

1. Clean and lubricate the side surfaces where the hose carrier rides.
2. Fully collapse the hose carriers and secure together using plastic tie wraps or nylon straps to keep them from separating.
3. Install a sling around the balance point of the hose carrier. With a suitable lifting device, slowly insert the hose carrier into the front of the fourth boom section.
4. Remove the first plastic tie wrap or nylon strap as the hose carrier is being inserted into the front of the fourth boom section.
5. Continue inserting the hose carrier and removing the plastic tie wraps or nylon straps until the hose carrier is fully inserted into the boom.



6. Install the guide bracket (1) on the front of the hose carrier.

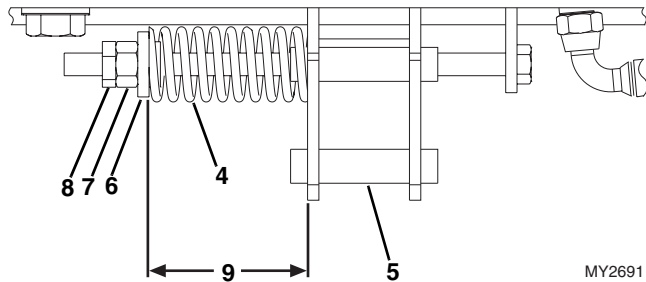


7. Verify that the bottom bracket (2) on the hose carrier is in place on the bottom plate (3) of the fourth boom section.
8. Install the cap screws, washers and nuts to the hose carrier bracket at the rear of the third boom section.
9. Install both cap screws and locknuts to the hose carrier bracket at the front of the fourth boom section.
10. Uncap and reconnect the previously labeled tilt and auxiliary hydraulic hoses to the proper fittings at the rear of the hose carrier.



Boom

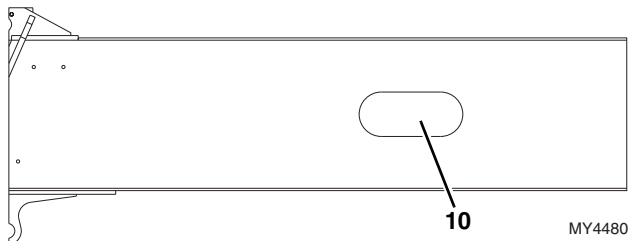
11. Uncap and reconnect the previously labeled tilt and auxiliary hydraulic hoses to the proper fittings at the front of the fourth boom section.
12. If equipped, reconnect any electrical connections at the front and rear of the boom assembly.



13. Install the hose take-up compression spring (4) on each hose take-up bracket (5) at the bottom of the first boom section. Install the washer (6), adjusting nut (7) and jam nut (8). Tighten the adjusting nut (7) to compress the hose take-up compression spring to measure 2.875-3.187 in (73-81 mm)(9). Refer to Section 3.7.4, "Boom Hose Adjustment," if required.
14. Torque the jam nut (8) against the adjusting nut (7) to 100 ft-lb (135,5 Nm).
15. Properly connect the battery.
16. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

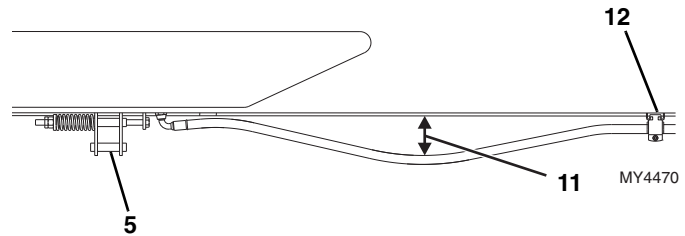
3.7.4 Boom Hose Adjustment

1. Park the machine on a hard, level surface, level the machine, fully extend the boom, lower the boom head to the ground, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Verify any trapped hydraulic pressure in the auxiliary circuit and the tilt circuit is relieved.
4. Open the engine cover. Allow the system fluids to cool.



5. Verify the auxiliary hoses and/or tilt hoses are NOT touching the bottom of the second boom section by

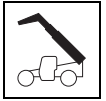
viewing the auxiliary hoses and/or tilt hoses through the access hole (10) in each side of the second boom section.



6. Verify that 4 in (101,6 mm) of slack (11) is present between the hose take-up bracket (5) and the first hose clamp (12).
7. Verify the hose take-up bracket (5) is not bent and is at an 85° angle to the hose.

Note: Replace both auxiliary hoses and/or tilt hoses if the hoses are touching the bottom of the second boom section AND 4 in (101,6 mm) of slack is present between the hose take-up bracket and the first hose clamp.

8. Refer to Section 3.7.3, "Hose Carrier-Assembly Installation," step 13 and 14 for hose take-up bracket adjustment.
9. Measure the slack (11) at the lowest point between the hose take-up bracket (5) and the first hose clamp (12). The 4 in (101,6 mm) measurement is from the bottom of the first boom section to the top of the hose.
10. If necessary, loosen the hose clamp (12), pull the auxiliary hoses and/or the tilt hoses, tighten the hose clamp for additional clearance.
11. Replace the auxiliary hoses and/or the tilt hoses if the proper slack, 4 in (101,6 mm)(11) cannot be achieved.
12. Start the machine, raise the boom to level, cycle the extend/retract cylinder, fully extend the boom.
13. Cycle the auxiliary circuit and/or the tilt circuit, verifying the auxiliary hoses and the tilt hoses are NOT touching the bottom of the second boom section and the proper slack, 4 in (101,6 mm) is maintained.
14. Retract the boom and shut engine OFF.
15. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.



3.8 QUICK COUPLER ASSEMBLY

3.8.1 Quick Coupler Removal

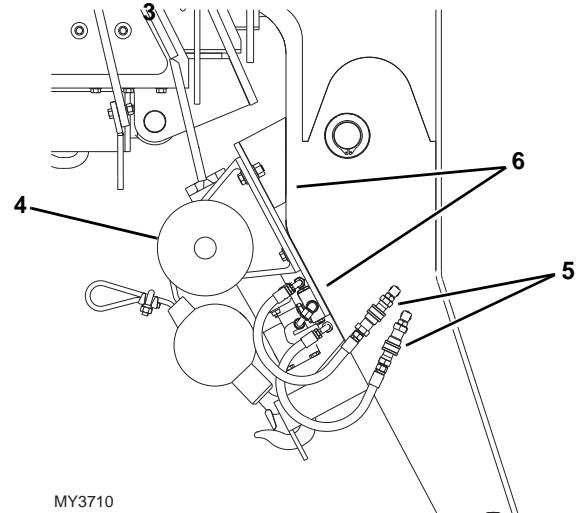
1. Remove the lock bolt holding the tilt cylinder rod end pin to the quick coupler assembly. Remove the Tilt Cylinder pin.
2. Support the quick coupler assembly. Remove the capscrew and locknut securing the head pin to the boom head.
3. Inspect the above pins for nicks or surface corrosion. Use fine emery cloth to fix minor nicks or corrosion. If damaged or if it cannot be repaired the pin must be replaced.

3.8.2 Quick Coupler Installation

1. 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.
2. Coat the quick coupler head pin with an anti-seize compound. Insert the quick coupler head pin through the quick coupler and boom head. Secure with the previous capscrew and locknut.
3. Align the quick coupler with the tilt cylinder rod end and insert the tilt cylinder pin. Align the tilt cylinder pin and screw in the locking bolt. Torque as required.

3.9 BOOM HEAD - MOUNTED WINCH

3.9.1 Boom Head-Mounted Winch Removal



1. Using a suitable lifting device, secure the winch assembly (4) with a nylon strap.
2. Disconnect the hydraulic hoses (5).
3. Loosen and remove the mounting bolts, washers and nuts (6)(not shown).
4. Lower the winch assembly (4) onto a suitable skid or table.

3.9.2 Boom Head-Mounted Winch Installation

1. Using a suitable lifting device, secure the winch assembly (4) with a nylon strap.
2. Raise the winch assembly (4) into position behind the boom head.
3. Apply Loctite® 242™ to the previously removed mounting bolts.
4. Install the mounting bolts, washers and nuts (6)(not shown). Torque to 200 lb-ft (271Nm).
5. Connect the hydraulic hoses (5).



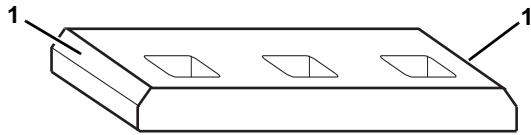
Boom

3.10 BOOM WEAR PADS

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

A total of 42 wear pads are installed on the boom sections of the TL1055 and the TL1255 machines.

3.10.1 Wear Pad Inspection



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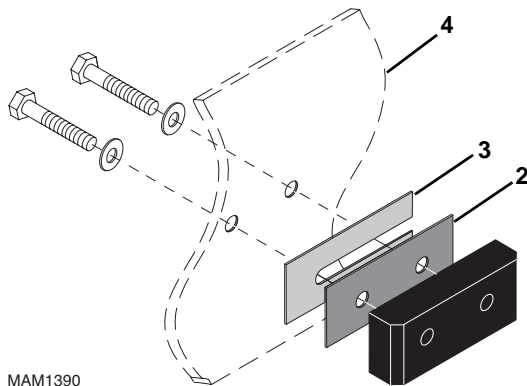
Inspect all wear pads for wear. If the angle indicators (1) on the ends of the wear pads are visible, the wear pads can be reused. If the pads show uneven wear (front to back), they should be replaced. Replace pads as a set if worn or damaged.

3.10.2 Wear Pad Installation and Lubrication

Note: Inspect all wear pads. Replace as necessary.

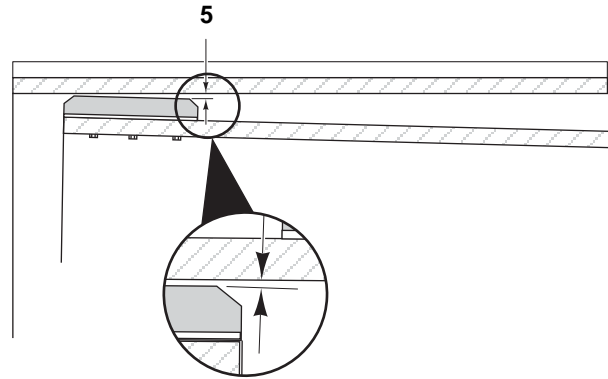
The following wear pad procedure must be followed to insure the proper wear pad installation:

- The wear pad inserts and mounting bolts MUST be clean from any grease, oil or other contaminants before applying Loctite® 242™ and installing mounting bolts.
- Apply Loctite® 242™ to all wear pad mounting bolts.

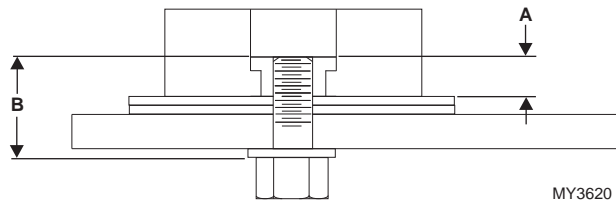


MAM1390

- A spacer (2) with holes must be used before any shim (3) is used.
- A shim (3) must be inserted between the spacer (2) and wear pad support plate, block or boom section (4).
- The number of shims can vary at each shim point.
- The bottom wear pads must be shimmed equally on each side.



- Maintain a total boom section clearance (5) of 0.070 - 0.130 in (1,78 - 3,30 mm) both the horizontal and vertical directions.

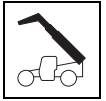


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- The length of the wear pad bolt depends on the number of shims, spacers and washers being used.
- The thickness of each threaded wear pad insert is 0.312 in (7,92 mm) (A).
- The bolt length should be determined by measuring the distance from the face of the insert to the face of the boom (B) including any spacer, shim(s) and washer(s).
- Bolt thread engagement in the wear pad insert should be 0.275 ± 0.040 in (6,98 ± 1,0 mm).
- 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.
- Wear Pad Bolt Torque:
 - 3/8 - 24 Bolt, 32 - 37 lb-ft (43 - 50 Nm)
 - 3/8 - 24 Hollow Bolt, 15 - 17 lb-ft (20 - 23 Nm)
 - 1/2 - 20 Bolt, 76 - 86 lb-ft (103 - 116 Nm)
 - 1/2 - 20 Hollow Bolt, 45 - 50 lb-ft (61 - 68 Nm)
- Torque wear pad bolts after shimming is completed.
- 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 CAT ADVANCED 3MOLY - NLGI Grade 2 grease.
- Clean and lightly grease the hose carrier guide bar pathways with CAT ADVANCED 3MOLY - NLGI Grade 2 grease.



3.11 BOOM CHAIN REMOVAL/ INSTALLATION

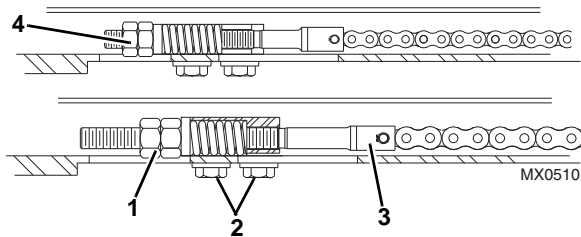
3.11.1 Retract Chain Removal

The following section explains the removal of the retract chains without removing the boom assemblies.

Note: *The retract chain on the bottom of the boom must be removed to gain access to the inner retract chain.*

To remove the retract chain from the third to first boom sections:

1. Park the machine on level ground. Place the transmission control lever 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 the ignition key switch and the steering wheel.
3. Properly disconnect the battery.
4. Attach a suitable sling to the extend/retract cylinder. Remove the extend/retract cylinder support.
5. Remove the rod end pin and lower the cylinder onto the frame rails. Lowering the extend/retract cylinder will allow access to the chains.



6. Remove tension from the chain by backing off the jam nut and adjusting nut (1).
7. Remove the four bolts (2) from the chain adjustment block.
8. Remove the chain from the clevis (3) at the block.
9. Install a nylon tie wrap through the holes of the removed chain, making a loop with a tie wrap and tie a rope to the loop.
10. At the rear of the boom, pull the chain to the rear to allow slack for removal.
11. Remove the chain from the clevis and drop it free from the boom.
12. Holding a rope at the front adjustment block, carefully pull the chain out through the back of the boom.
13. Untie the rope and leave it in place for reinstallation of the chain.

To remove the retract chain from the fourth to second boom sections:

1. Remove the jam nut (4) from the chain clevis installed in the chain adjustment block.
2. Back off the adjusting nut fully on the chain clevis. Do not remove the nut from the clevis.
3. Remove the chain from the clevis, install a nylon tie-wrap through the holes in the chain, making a loop with the tie-wrap and tie a rope to the loop.
4. Move to the back of the boom and pull the chain to the rear to allow slack for removal.
5. Remove the chain from the clevis and drop it free from the boom.
6. Holding the rope at the front, carefully pull the chain out through the back of the boom until it's free.
7. Untie the rope and leave it in place for reinstallation of the chain.

3.11.2 Retract Chain Installation

Inspect and lubricate chains thoroughly before installation. Articulate the chains to make sure all working surfaces are thoroughly lubricated.

Note: *If the inner retract chain was removed, it must be installed first.*

1. Fasten a rope to the end of the 3/4 in. chain in order to pull it back into the boom.
2. Attach the chain to the chain clevis at the rear of the boom.
3. Carefully pull the chain into the boom until it can be fastened to the chain clevis.
4. Remove the rope.
5. Fasten the chain into the clevis by installing the pin and retaining ring.
6. Torque the jam nuts to 100 lb-ft (135 Nm).

To install the outer retract chain:

1. Fasten a rope to the end of the chain in order to pull it back into the boom.
2. Attach the chain to the chain clevis at the rear of the boom.
3. Carefully pull the chain into the boom until it can be fastened to the chain clevis.
4. Remove the rope.
5. Fastened the chain into the clevis by installing the pin and cotter pin.



Boom

6. Install the chain adjustment block and mounting bolts. Torque the chain adjustment block mounting bolts to 360-390 lb-ft (475-530 Nm).
7. Install the extend/retract cylinder and cylinder support.
8. Adjust the retract chains as needed. Refer to Section 3.6, "Boom Section Separation Adjustment."
9. Properly connect the battery.
10. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

3.11.3 Extend Chain Removal

The following section explains the removal of the extend chains without removing the boom assemblies.

1. Park the machine on level ground. Place the transmission control lever in (N) NEUTRAL, engage the parking brake switch, level the boom, extend the boom far enough to access the chain anchor and the clevis through the top rear access hole, shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Properly disconnect the battery.
4. Secure the boom sections together to prevent uncontrolled boom run out when the extend chains are removed.
5. On the chain being removed, loosen and remove the jam nut from the rear chain clevis and back off the adjusting nut on the chain clevis to the end of the threads. Do not completely remove the nut.
6. Remove the chain clevis pin and retaining ring to free the chain.
7. Install the nylon tie wrap through the holes in the chain, making a loop with the tie wrap and tie a rope to the loop.
8. Pull the slack to the chain clevis at the front of the boom.
9. Remove the clevis pin and the retaining ring from the chain and chain clevis.
10. Install a nylon tie wrap through the chain holes, forming a loop and tie a rope to the loop.
11. Carefully pull the chain out of the boom.
12. Untie the rope and leave it in place for reinstallation of the chain.

3.11.4 Extend Chain Installation

The following section explains the installation of the retract chains without removing the boom assemblies.

Inspect and lubricate chains thoroughly before installation.

1. Fasten the previously used rope to the end of the extend chain.
2. Carefully pull the chain into the boom to the chain clevis anchor.
3. Fasten the chain to clevis with a pin and cotter pin.
4. At the other end of the chain, connect the chain to the clevis fastening the chain to the clevis with a pin and retaining ring.
5. Install the chain clevis fastening and adjusting hardware on both ends.
6. Remove any clamping devices being used to keep the boom sections from moving.
7. Properly connect the battery.
8. Adjust the extend chains as needed. Refer to Section 3.6, "Boom Section Separation Adjustment."
9. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.



3.12 BOOM CHAIN INSPECTION AND LUBRICATION

3.12.1 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 extend chains will need to be inspected and lubricated every 250 hours of operation. The retract chains need to be exposed, inspected and lubricated 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 vehicles 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 vehicle.

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.

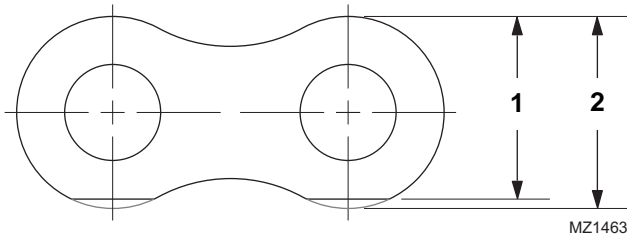
3.12.2 Inspection Guidelines

1. Park the machine on a firm, level surface, raise the boom to a horizontal (level) position, place the transmission control lever 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 vehicle 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

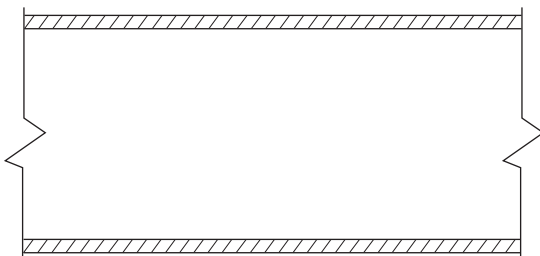
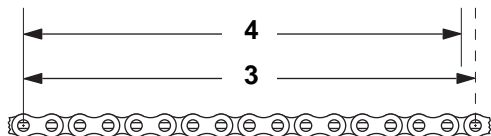


Check the chain for wear on the link plate edges caused by running back and forth over the sheave. The maximum reduction of material should not exceed 5%. Measure and compare to a normal link plate height by measuring a portion of chain that does not run over the sheave. If the measured plate height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

Elongation

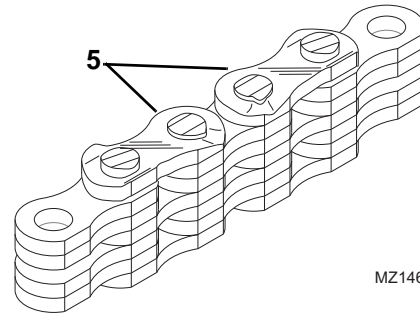
It is important to measure the chain in the section that moves over the sheaves because it receives the most frequent articulation. Measuring the chain near its clevis terminals could give an inaccurate reading. The ends of the chains, near the clevis terminal, will not have flexed as frequently, if 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 apart, the distance after 12 pins should be 9 in.



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

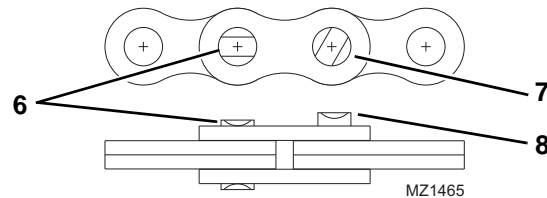
Distorted or Battered Link Plates



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

Turning or Protruding Pins

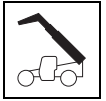
Highly loaded chain, operating with inadequate lubrication can generate abnormal frictional forces between pin and link plates. When chain is allowed to operate in this condition, a pin or series of pins, can begin to twist out of a chain, resulting in failure.



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.



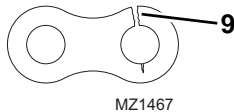
Cracked Plates

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.

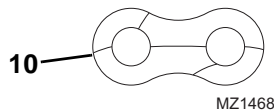
It is important, however to determine the cause of the crack before installing a new chain so the condition does not repeat itself.

The types of cracks are:

- **Fatigue Cracking** - Fatigue cracks (9) are a result of repeated cyclic loading beyond the chain's endurance limit.



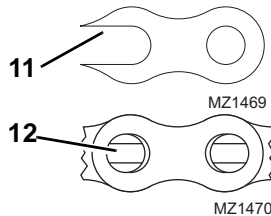
- **Stress Corrosion Cracking** - The outside link plates are particularly susceptible to stress corrosion cracking (10).



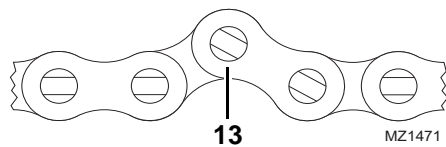
- **Corrosion Fatigue Cracking** - Corrosion fatigue cracks are very similar to fatigue cracks in appearance. Corrosion fatigue is the combined action of an aggressive environment and cyclic stress.

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.



- **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.

3.12.3 Expose Chains for Inspection

c. Extend Chains

1. Park the machine on a firm, level surface. Place the transmission control lever in (N) NEUTRAL, engage the park brake switch and raise the boom to a horizontal (level) position.
2. Fully extend the boom until both extend chains are taut. 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 three 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 chains should be removed and inspected. Refer to Section 3.11, "Boom Chain Removal/Installation" for detailed information. Replace chains 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.



3.12.4 Chain Lubrication

After inspection and before being returned to service, chains must be lubricated. Refer to Section 2.4, "Fluids and 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.

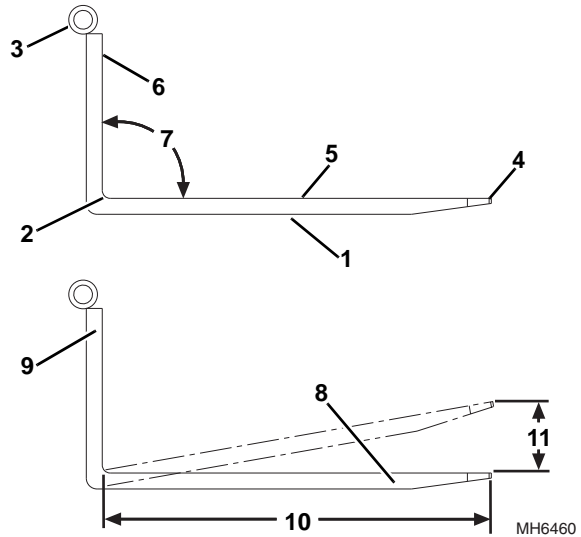
Regular application of lubricant is necessary to make sure that all working surfaces are adequately lubricated. In extremely dusty conditions, it may be necessary to lubricate the chains more often. Refer to Section 2.5, "Service and Maintenance Schedules," and Section 2.6, "Lubrication Schedules," for detailed information.

Lubrication of chains on vehicles working consistently in extreme hot or cold conditions requires special consideration. Contact the Caterpillar dealer for guidance.

3.13 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



1. Inspect forks (1) for cracks, paying special attention to heel (2) and mounting tubes (3).
2. 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 (8) and shank (9) should not be reduced to 90 percent of original thickness.

Note: Contact the local Caterpillar dealer with the fork part number to find the manufactured dimensions of the fork blade.

4. Ensure fork length (10) is adequate for intended loads.
5. Fork markings should be legible, re-stamp if required.
6. Compare fork tips (11) when mounted on a carriage. Maximum difference in height of fork tips is 3 percent of the length of the blade (10).



3.14 EMERGENCY BOOM LOWERING PROCEDURE

WARNING

To avoid instability of the machine, the extend/retract cylinder **MUST BE** fully retracted prior to retracting the lift cylinders. If circumstances prevent retraction of the extend/retract cylinder first, lower the lift cylinders the minimum amount necessary and resume retraction of the extend/retract cylinder as soon as possible in accordance with the machines load chart.

WARNING

Properly support the boom before attempting to proceed with the emergency boom lowering procedure.

WARNING

If possible, safely remove and/or secure the load on the machine before starting the boom lowering procedure. If load cannot be removed, the machine load chart **MUST** be followed.

3.14.1 Equipment and Supplies Required

Auxiliary Hydraulic Power Supply:

- Portable hydraulic unit or another machine with an auxiliary hydraulic power supply with a capacity to hold up to 22 gal (83 L) of hydraulic oil from the machine during lowering process.

Note: *If another machine is being used, the hydraulic reservoir must be drained to accept a minimum of 22 gal (83 L) of hydraulic oil before attempting this procedure.*

- Standard Mechanic Tools.

NOTICE

EQUIPMENT DAMAGE. Auxiliary Hydraulic Power Supply hydraulic oil must be compatible with hydraulic oil shown in Section 2.4, "Fluids and Lubricant Capacities."

Hoses:

- Two Hydraulic Hoses - Approximately 10 ft (3,0 m) each, with a minimum I.D. of 0.375 in (9,5 mm) and a minimum rating of 4000 psi (275,8 bar).

TL1055C or TL1255C - Fittings:

- Two -12 ORFS Caps
- Two -12 ORFS Plugs

Adaptors:

- Two -12 ORFS 90° Adaptors

Note: *The adaptor size may vary depending on the hose ends of the auxiliary hydraulic power supply.*

3.14.2 Lowering Procedure

a. Retract the boom as follows:

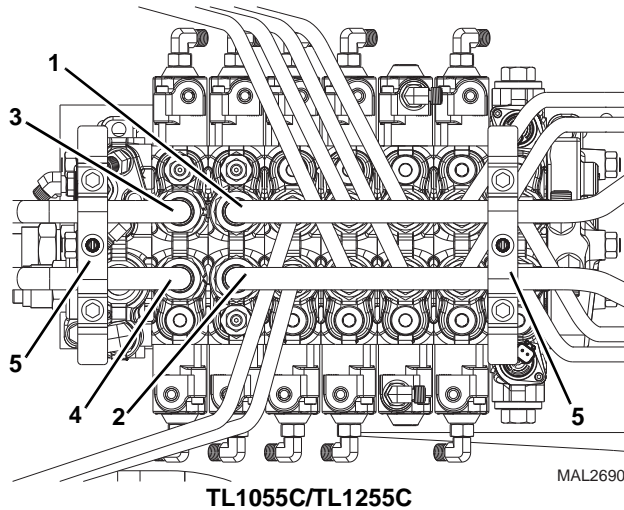
1. If equipped with Personal Work Platform, rescue occupants prior to performing procedure.
2. Properly support the boom before attempting to proceed with the emergency boom lowering procedure.
3. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
4. Properly support the boom as required.
5. Place a suitable receptacle under the main control valve.
6. Remove the plastic cover from the top of the main control valve.

WARNING

Loss of hydraulic oil is limited to the amount trapped within each tube/hose. Slowly loosen each hydraulic tube fitting to release any possible hydraulic oil pressure that may be trapped between the main control valve and the counterbalance valve of the extend/retract cylinder or the lift/lower cylinder.



Boom



7. Remove the brackets (5) that is attached to the steel tubes supporting the plastic cover.
 8. Loosen and remove any clamps securing the extend/retract cylinder (1 & 2) and lift/lower cylinder tubes (3 & 4) together and to the frame.
 9. Disconnect the extend/retract cylinder tubes (1 & 2) from the main control valve. Install plugs in tubes to prevent fluid loss. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
 10. Using the hoses and fittings specified, connect the hoses between the auxiliary hydraulic power supply and the tubes removed from the main control valve extend/retract section of the affected machine. Retract tube (1) is the supply and extend tube (2) is the return. Connect the hoses in the proper order to ensure that the cylinder is retracted, not extended.
 11. Remove the previously installed the boom support.
 12. Use the auxiliary power supply to slowly retract the extend/retract cylinder.
 13. Properly support the boom as required.
 14. Loosen and remove the jumper hoses, caps, plugs and reconnect the extend/retract cylinder tubes. Torque as required.
- b. Lower the boom as follows:**
1. Place a suitable receptacle under the main control valve.
 2. Disconnect the lift/lower cylinder tubes (3 & 4) from the main control valve. Install plugs in tubes to prevent fluid loss. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
 3. Using the hoses and fittings specified, connect the hoses between the auxiliary hydraulic power supply and the tubes removed from the main control valve lift/lower section of the affected machine. Lift tube (3) is the return and lower tube (4) is the supply. Connect the hoses in the proper order to ensure that the boom is lowered, not raised.
 4. Remove the previously installed boom support.
 5. Use the auxiliary power supply to slowly lower the boom.
 6. Loosen and remove the jumper hoses, caps, plugs and reconnect the lift/lower cylinder tubes. Torque as required.
 7. Install the previously remove clamps securing the extend/retract and lift/lower cylinder tubes.
 8. Install the plastic cover over the top of the main control valve.
 9. Transfer any hydraulic oil into a suitable, covered container, and label the container as "Used Oil." Dispose of used oil at an approved recycling facility.
 10. Clean up all debris, hydraulic oil, etc., in, on, near and around the machine.
 11. Remove the Do Not Operate Tag on both the ignition key switch and steering wheel.



3.15 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. 	<ol style="list-style-type: none"> 1. Locate break, replace hose(s) or tube(s), tighten connections. 2. Refer to Section 8.4, "Hydraulic Circuits." 3. Repair cylinder, Refer to Section 8.8.1, "General Cylinder Removal Instructions."
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 3.10, "Boom Wear Pads."
3. Excessive boom 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 2.6, "Lubrication Schedules." Replace worn pins as needed. 2. Replace bearing(s) and lubricate at regular intervals. Refer to Section 2.6, "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 2.6, "Lubrication Schedules." Replace worn pins as needed. 2. Replace bushing(s) and lubricate at regular intervals.



Boom

Problem	Cause	Remedy
5. 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 3.6, "Boom Section Separation Adjustment." 3. Replace wear pad. Refer to Section 3.10, "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 8.4, "Hydraulic Circuits." 6. Replace the damaged boom section. Refer to Section 3.3, "Boom Assembly Maintenance."
6. 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 8.4, "Hydraulic Circuits." 3. Repair cylinder. Refer to Section 8.8.1, "General Cylinder Removal Instructions." 4. Replace bearing.
7. 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 2.5, "Service and Maintenance Schedules." Replace worn pins as needed. Refer to Section 8.8.1, "General Cylinder Removal Instructions." 2. Replace bushing(s) and lubricate at regular intervals. Refer to Section 2.6, "Lubrication Schedules."



Problem	Cause	Remedy
<p>8. Rapid boom pad wear.</p>	<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 3.10, "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.
<p>9. Auxiliary hydraulics will not operate.</p>	<ol style="list-style-type: none"> 1. Auxiliary hydraulic system not operating properly. 	<ol style="list-style-type: none"> 1. Refer to Section 8, "Hydraulic System."
<p>10. Excessive chain wear.</p>	<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 3.6, "Boom Section Separation Adjustment."- Replace chains as needed. 2. Lubricate chain sheave. (Refer to Section 2.5, "Service and Maintenance Schedules.") 3. Lubricate chain sheave. Refer to Section 2.5, "Service and Maintenance Schedules." Repair or replace chain sheave(s) as needed. 4. Lubricate at regular intervals. Refer to Section 2.5, "Service and Maintenance Schedules." Replace chains as needed.



Boom

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Section 4

Cab and Covers

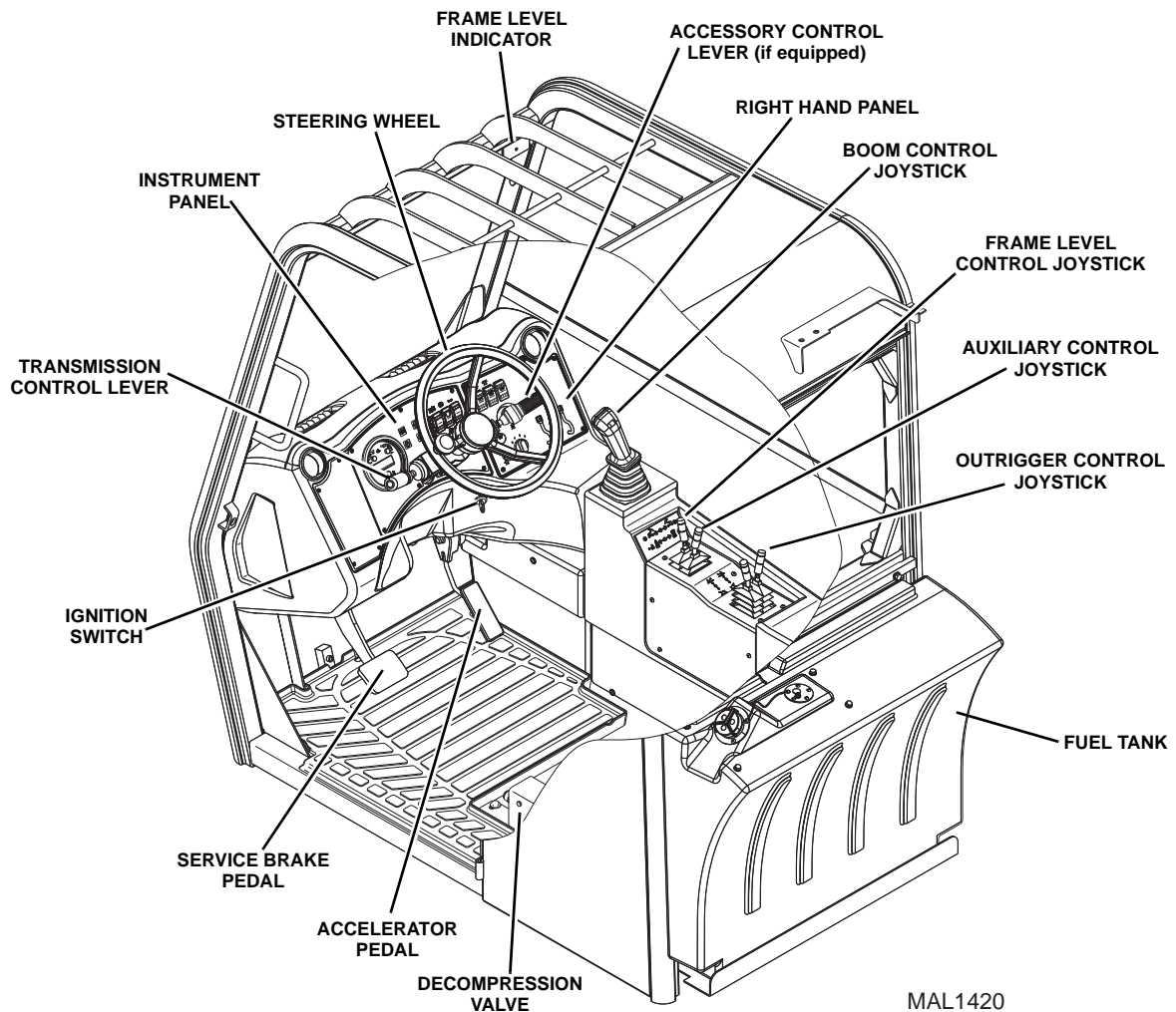
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4.1 OPERATOR CAB AND COVERS COMPONENT TERMINOLOGY

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 and covers. The following illustration identifies the components that are referred to throughout this section.





4.2 OPERATOR CAB

! WARNING

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

4.2.1 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.

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

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

4.2.2 Serial Number Decal

The cab serial number decal 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.

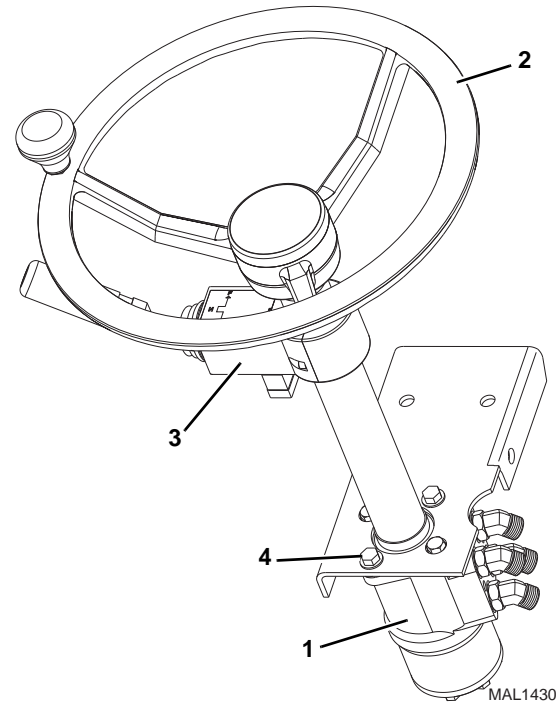
4.3 CAB COMPONENTS

4.3.1 Steering Column and Orbitrol Valve

a. Orbitrol Valve Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in the (N) NEUTRAL position, engage the parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.

Note: It may be necessary to remove the main dash panel to gain access to the appropriate hydraulic hoses. Refer to Section 9.12.1, "Gauges."



5. Label, disconnect and cap the four hoses from the side of the steering valve (1). 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.
6. Remove the steering wheel (2).
7. Disconnect and remove the travel select lever (3).
8. Remove the steering assembly through the dash panel opening.
9. Support the steering valve, and remove the four hex-head capscrews and four lockwashers (4).

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



b. Orbitrol Valve Installation

1. Secure the steering valve to the steering column with four hex-flange capscrews and four lockwashers.
2. Install the steering column through the dash panel opening. Position steering valve to its original orientation in the cab.
3. Install the travel select lever and connect the lever
4. Install the steering wheel assembly. Torque the steering wheel nut to 29-34 lb-ft (39-46 Nm).
5. Install new o-rings into the steering valve fittings. Lubricate the o-rings with clean hydraulic oil.
6. Uncap and connect the previously labeled load sense hose to the steering valve.
7. Uncap and connect the remaining previously labeled four hoses to the steering valve.

Note: If necessary, install the main dash panel. Refer to Section 9.12.1, "Gauges."

8. Properly connect the battery.
9. 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.
10. Close and secure the engine cover.
11. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

c. Steering Test

Conduct a pressure check of the steering hydraulic circuits at the main control valve. Refer to Section 8.3.1, "Pressure Checks and Adjustments."

4.3.2 Service Brake Pedal

a. Brake Valve Removal

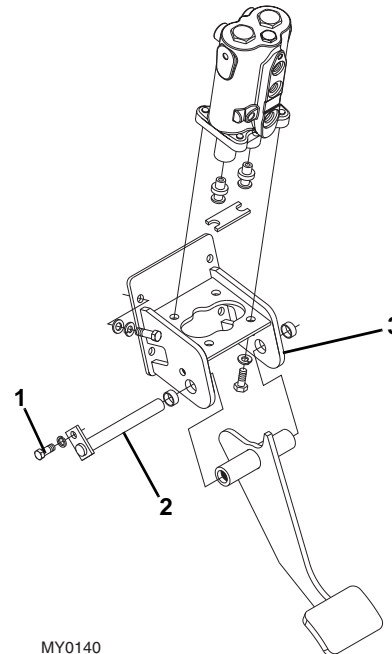
Refer to Section 8.7.3, "Service Brake Valve," for removal information.

b. Brake Valve Installation

Refer to Section 8.7.3, "Service Brake Valve," for installation information.

c. Service Brake Pedal Removal

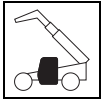
1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in the (N) NEUTRAL position, engage the parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.



5. Remove the bolt and lockwasher (1) securing the service brake pedal pivot pin (2).
6. Pull the pivot pin from the service brake pedal bracket (3).
7. Remove the service brake pedal from the cab.

d. Service Brake Pedal Installation

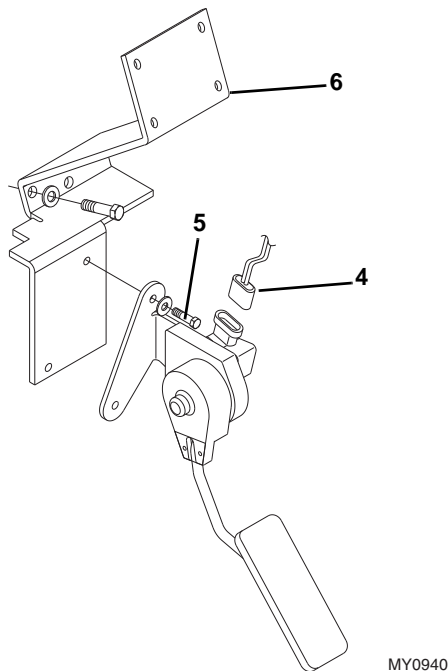
1. Position the service brake pedal in its mounting location within the cab.
2. Secure the brake pedal into position with the pivot pin.
3. Be sure the brake pedal has the correct range of motion. Secure pivot pin with bolt and lockwasher.
4. Properly connect the battery.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.



4.3.3 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 control lever in the (N) NEUTRAL position, engage the parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Properly disconnect the battery.



4. Disconnect the electrical harness connector (4).
5. Remove the bolts (5) securing the throttle pedal to the throttle pedal bracket (6).
6. Remove the throttle pedal assembly from the cab.

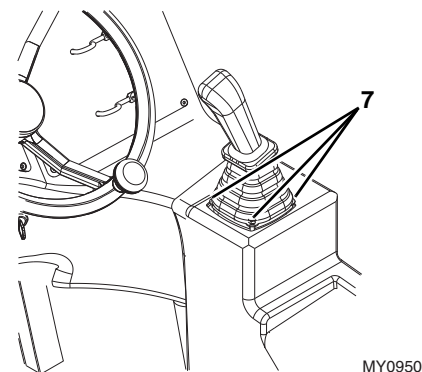
b. Throttle Pedal Installation

1. Position the throttle pedal in its mounting location within the cab.
2. Secure the throttle pedal into position with the pivot pin.
3. Install the throttle pedal ball joint to the throttle pedal.
4. Properly connect the battery.
5. Verify proper throttle pedal operation.
6. Close and secure the engine cover.
7. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

4.3.4 Boom and Tilt Joystick Assembly

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 control lever in the (N) NEUTRAL position, engage the parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Properly disconnect the battery.



4. Lift the joystick's rubber sleeve, remove the bolts securing the boom joystick to the cab (7).
5. Lift the joystick from its mounting position.
6. Label, disconnect and cap the hydraulic hoses attached to the boom joystick.
7. Disconnect the tilt function electronic connector.
8. Remove the joystick assembly.



Cab and Covers

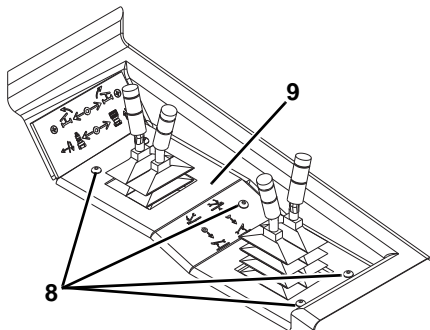
b. Joystick Assembly Installation

1. Uncap and connect the previously labeled hydraulic hoses to their appropriate locations.
2. Connect the tilt function electronic connector.
3. Install the bolts securing the joystick to the cab.
4. Properly connect the battery.
5. Test the complete range of the joystick functions per the control decal in the cab or operators manual.
6. Close and secure the engine cover.
7. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

4.3.5 Frame Level, Auxiliary and Outrigger Control Joysticks

a. Joystick Removal

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



4. Remove the screws (8) securing the dash panel (9) to the cab. Remove the dash panel.
5. Remove any hardware securing the joystick to the cab.
6. Label, disconnect and cap the hydraulic hoses attached to the joystick.
7. Remove the joystick from the cab.

b. Joystick Installation

1. Uncap and connect the previously labeled hydraulic hoses to their appropriate locations.
2. Install the bolts securing the joystick to the cab.
3. Install the dash panel to its original position with the previously used hardware.
4. Properly connect the battery.
5. Test the complete range of the joystick functions per the control decal in the cab or operators manual.
6. Close and secure the engine cover.
7. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

4.3.6 Windshield Wiper Assembly

Refer to Section 9.9, "Window Wiper/Washer Windshield Wiper Motor," for removal and installation information.

4.3.7 Heater/Air Conditioning System (if equipped)

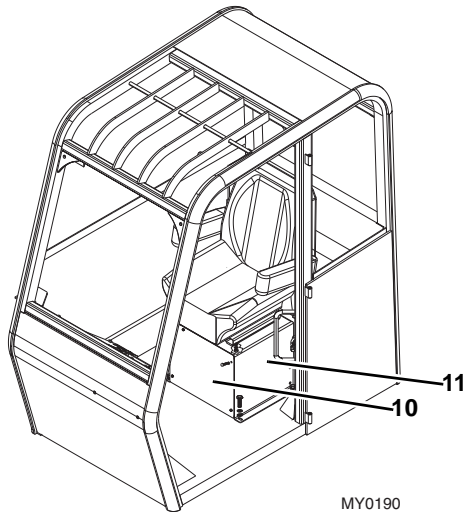
Note: If machine is equipped with air conditioning, DO NOT loosen or disconnect any air conditioning hoses until the air conditioning system has been properly drained by the local Caterpillar dealer or certified air conditioning service center.

a. Heater Assembly Removal

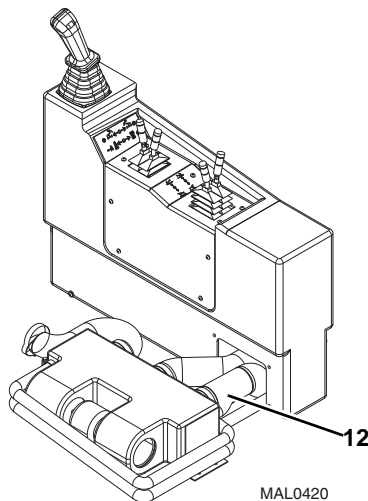
1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in the (N) NEUTRAL position, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Place a suitable container beneath the radiator. Slowly turn the radiator cap to the first stop, 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 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. Tighten the radiator drain petcock.



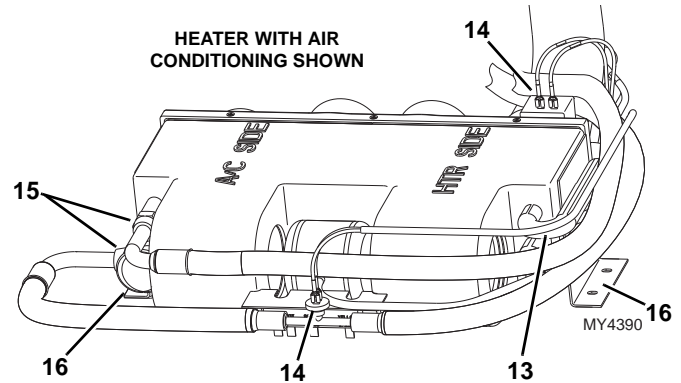
9. Remove the bolts that secure the seat to the cab.
Remove the seat.



10. Remove the bolts securing the front plate (10) to the seat riser weldment (11).
11. Remove the bolts securing the seat riser weldment to the cab. Remove the riser weldment.



12. Loosen the hose and disconnect the heater air duct hoses (12).



13. Loosen the hose clamps securing the heater hoses (13).
14. Label and remove both heater hoses.
15. Label and disconnect any electrical connections (14).
16. Label and disconnect both air conditioning hoses (15).
17. Remove the bolts (16) securing the heater assembly to the cab. Remove the heater assembly.

b. Heater Assembly Installation

Note: If machine is equipped with air conditioning, the air conditioning system must be charged by the local Caterpillar dealer or certified air conditioning service center.

1. Position the heater assembly to its original orientation in the cab. Secure with the previous hardware.
2. Connect the previously labeled electrical connections.
3. Connect the previously labeled heater hoses to their appropriate locations.
4. Connect the previously labeled air conditioning hoses to their appropriate locations.
5. Install the seat riser weldment.
6. Install the front plate to the seat riser weldment.
7. Install the cab seat.
8. 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 2.4, "Fluids and Lubricant Capacities."
9. Properly connect the battery.



Cab and Covers

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.

10. Wait for the engine to cool and check the coolant level. Add coolant as required to bring the coolant to the proper level.
11. Remove the Do Not Operate Tags from both the ignition key switch and the 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.

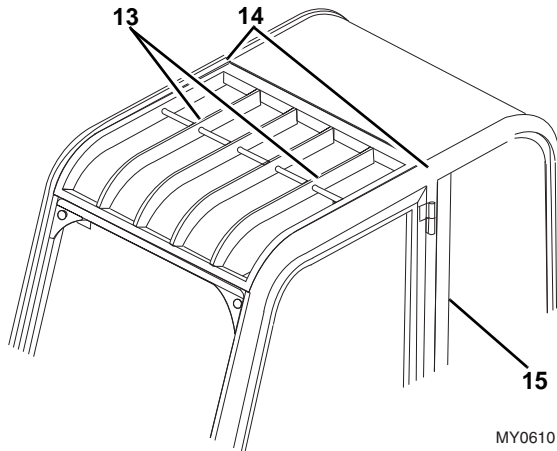
Inspect the cab, its welds and mounts. If modification, damage, a cracked weld and/or fatigued metal is discovered, replace the cab. Contact the local Caterpillar dealer with any questions about the suitability or condition of a cab.

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.

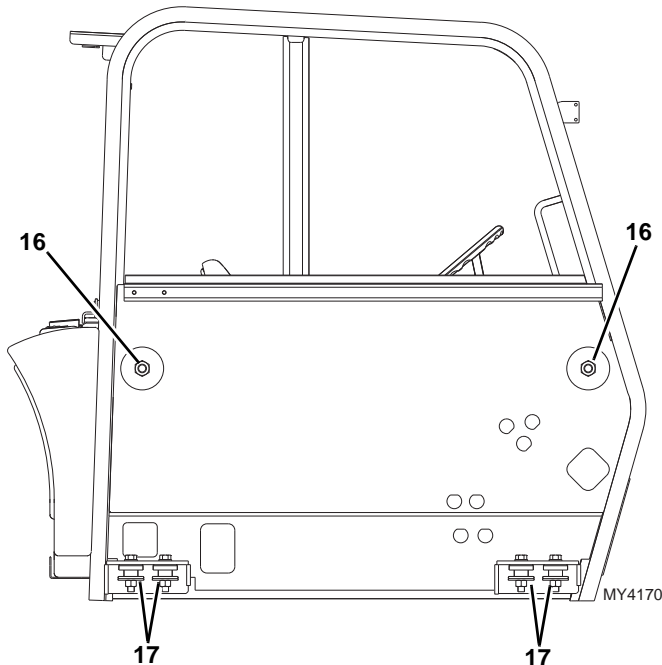
1. Park the machine on a firm, level surface. Allow sufficient overhead and side clearance for cab removal. Level the machine, fully retract the boom, lower the boom, place the transmission control lever in the (N) NEUTRAL position, engage the park brake and shut the engine OFF.
2. Block all four wheels to help prevent the machine from moving. Assure that there is sufficient overhead and side clearance for cab removal.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Place a funnel at the base of the radiator to channel the drained coolant into the container. Loosen the drain petcock and allow the coolant to drain.
6. Transfer the coolant to a container with a cover, and label as "Used Antifreeze." Dispose of the used coolant at an approved recycling facility.
7. Tighten the radiator drain petcock.
8. Disconnect the cab heater hoses. Refer to Section 4.3.7, "Heater/Air Conditioning System (if equipped)."
9. Remove the necessary dash panels to gain access to the electrical wiring connections. Label and disconnect the harnesses. Push the harness connectors through the opening in the cab.
10. Remove the boom joystick from its mounting position. Refer to Section 4.3.4, "Boom and Tilt Joystick Assembly." Label, disconnect and cap all hydraulic hoses attached to the boom joystick. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
11. Remove the frame level and attachment tilt and auxiliary control joystick. Refer to Section 4.3.5, "Frame Level, Auxiliary and Outrigger Control Joysticks." Label, disconnect and cap all hydraulic hoses attached to the joystick. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
12. Label, disconnect and cap all hydraulic hoses attached to the steering orbitrol valve. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
13. Label, disconnect and cap all hydraulic hoses attached to the steering orbitrol valve. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
14. Label, disconnect and cap all hydraulic hoses attached to the service brake valve. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
15. Push all the hydraulic hoses through the opening in the cab.
16. Disconnect the throttle cable from the throttle assembly. Refer to Section 4.3.3, "Throttle Pedal."
17. Disconnect the engine air filter and hydraulic oil reservoir breather from their brackets at the top of the cab. Move the air filter and breather clear from the cab so they do not become damaged during cab removal.



18. Remove the fuel tank from the cab. Refer to Section 7.6.2, "Fuel Tank."



19. Open Cab: Route a sling with a minimum lifting capacity of 1000 lb (453 kg) under the inner four braces (13) and behind the center cross support above the wind shield or install two lifting eye bolts (14) in the threaded holes on the roof of the cab above the B pillars (15).
20. Enclosed Cab: Install two lifting eye bolts (14) in the threaded holes on the roof of the cab above the B pillars (15).

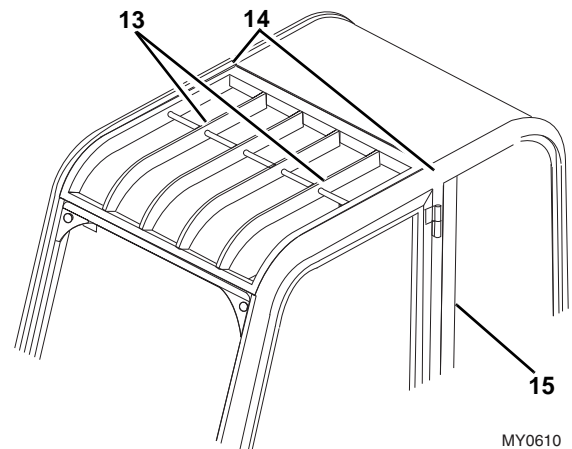


21. Remove the two cab side-mount bolts in the cab (16).
22. Remove the four cab-to-frame bolts, flat washers and nuts (17).

23. Remove the mirrors and all other cab components as needed, if not previously removed.
24. Carefully begin to lift the cab. Stop and check that all wiring, hydraulic hoses and fasteners are disconnected or removed.
25. 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.
26. 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.
27. Inspect the condition of the fittings, clamps, hydraulic hoses, etc. Replace parts as indicated by their condition.
28. 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.

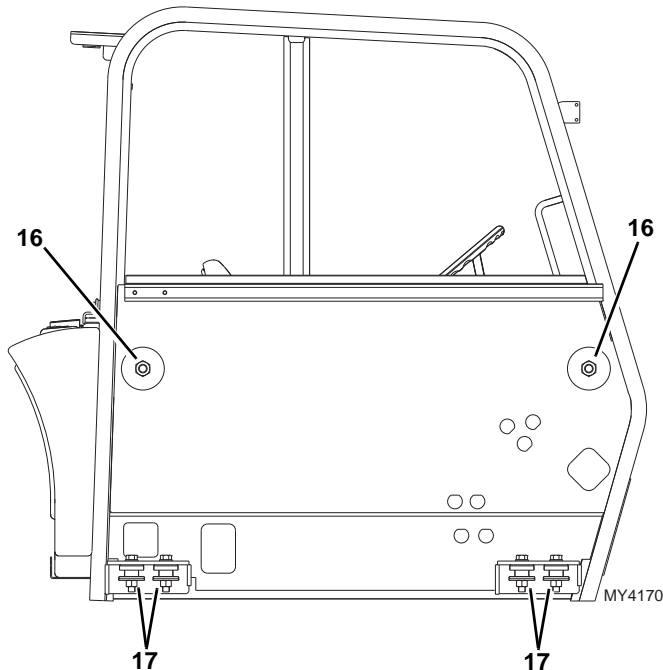


2. Open Cab: Route a sling with a minimum lifting capacity of 1000 lb (453 kg) under the inner four braces (13) and behind the center cross support above the wind shield or install two lifting eye bolts (14) in the threaded holes on the roof of the cab above the B pillars (15).
3. Enclosed Cab: Install two lifting eye bolts (14) in the threaded holes on the roof of the cab above the B pillars (15).



Cab and Covers

- Use a hoist or overhead crane and sling attached to the cab. 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.

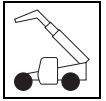


- Install the four cab-to-frame mount bolts, washers and nuts (17). Torque to 280-305 lb-ft (379-414 Nm).
- Install the two cab side mount bolts washers and nuts (16). Torque to 680-720 lb-ft (922-976 Nm).
- Install the engine air filter and hydraulic oil reservoir breather to their brackets at the top of the cab.
- Install the throttle cable to the throttle pedal assembly. Refer to Section 4.3.3, "Throttle Pedal."
- Pull all the hydraulic hoses and electrical wires through the cab.
- Uncap and reconnect the previously labeled hydraulic hoses to their appropriate locations.
- Reconnect the previously labeled electrical connections to their appropriate locations.
- For machines equipped with the heater option, reconnect the heater hoses to the cab heater. Refer to Section 4.3.7, "Heater/Air Conditioning System (if equipped)."
- Install the fuel tank to the cab. Refer to Section 7.6.2, "Fuel Tank."

- 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 2.4, "Fluids and Lubricant Capacities."
- Properly connect the battery.
- 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.

- 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.
- Install the mirrors and all other cab components as needed, if removed.
- Close and secure the engine cover.
- Unblock the wheels.
- Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

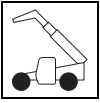


Section 5

Axles, Drive Shafts, Wheels and Tires

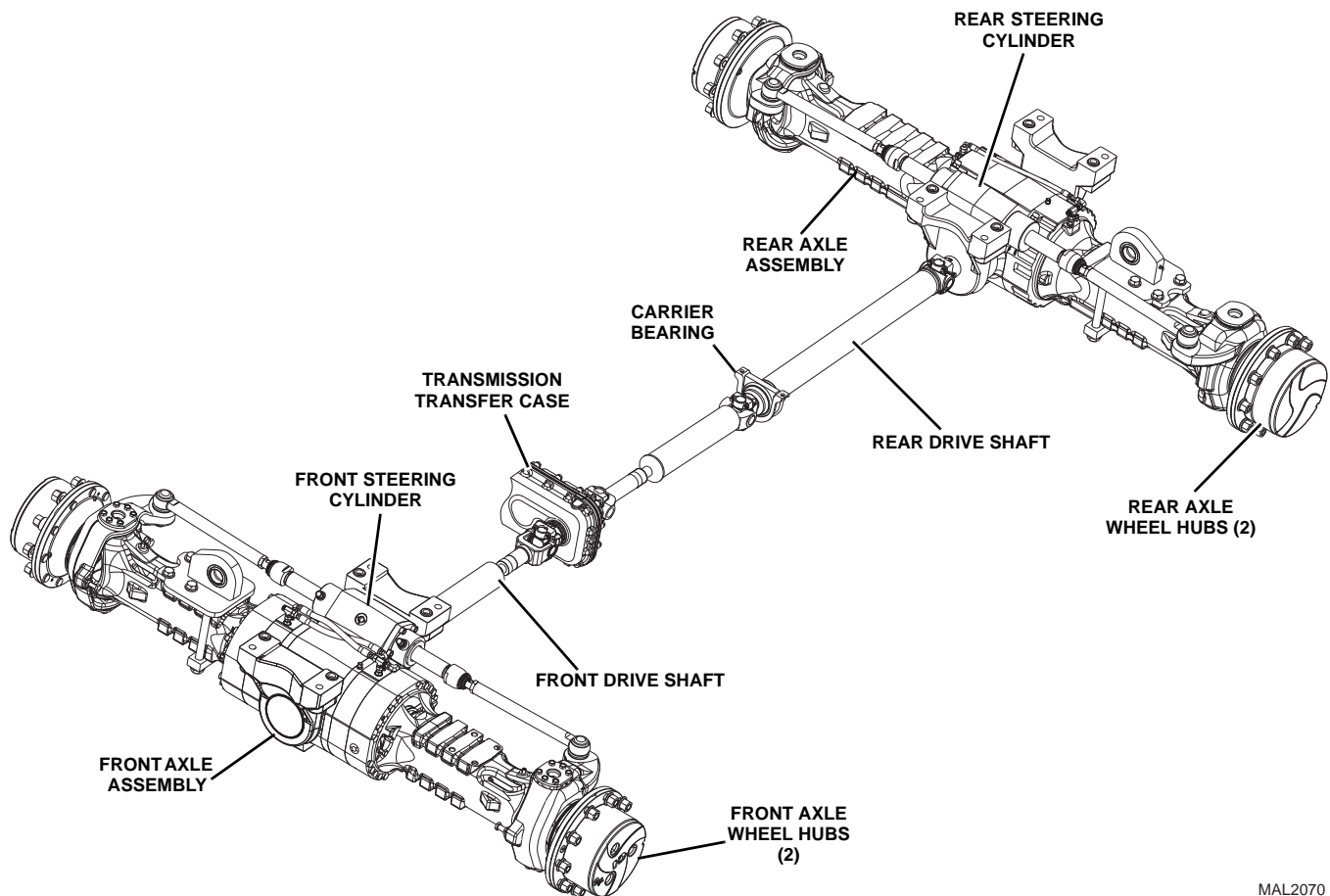
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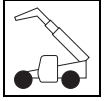


5.1 AXLE, DRIVE SHAFT AND WHEEL COMPONENT TERMINOLOGY

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.



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! WARNING

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

5.2 AXLE SERIAL NUMBER

The front and rear axle serial number plate is located on a mounting pad on the front side of the center section of each axle. 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 AXLE SPECIFICATIONS AND MAINTENANCE INFORMATION

For axle, oil specifications and maintenance information, refer to Section 2, "General Information and Specifications."

Detailed axle service instructions are provided in the following publications:

- Service Manual (P/N 31200240)
- Parts Manual (P/N 31200724)

5.4 AXLE REPLACEMENT

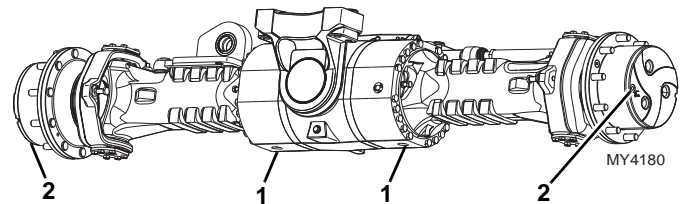
5.4.1 Axle Removal

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.

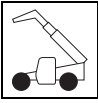
Cleanliness is extremely important. Before attempting to remove the axle, thoroughly clean the machine. Avoid spraying water or cleaning solution on electrical components. If using a steam cleaner, seal all openings before steam cleaning.

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 control lever in the (N) NEUTRAL position, engage the parking brake, straighten all wheels and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Remove the optional fender assembly.



6. If the axle will be disassembled after removal, place a suitable receptacle under the axle (1) and wheel hubs drain plugs (2). Remove the drain plugs 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.
7. Label, disconnect and cap the steering and brake lines at the axle. 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.



Axles, Drive Shafts, Wheels and Tires

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.")

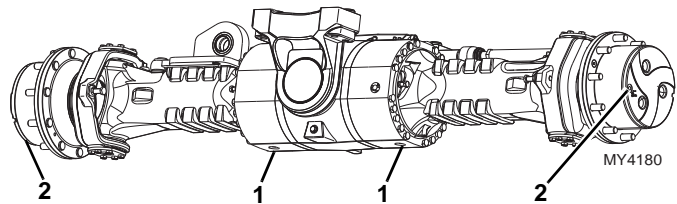
Note: The wheel and tire assemblies must be re-installed later with the directional tread pattern "arrows" facing in the direction of forward travel.

12. Remove the drive shaft assembly. Refer to Section 5.5.3, "Drive Shaft Removal."
13. On the front axle remove the capscrew and locknuts securing the lower position cylinder-mount pin to the front cylinder. Tap the cylinder mount pin out, and move the cylinder to prevent it from interfering with axle removal.
14. Remove the bolts and locknuts securing the axle to the 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.

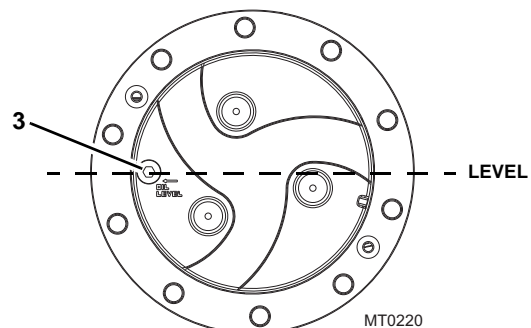
5.4.2 Axle Installation

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 axle housings with the holes in the frame.
5. Install the four axle bolts and nuts. Tighten and torque to 530-565 lb-ft (718-766 Nm).
6. 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 a new locknut.
7. Apply multi-purpose grease through the self-tapping lube fitting to lubricate the self-align bearing and the cylinder-mount pin.
8. Install the drive shaft assemblies. (Refer to Section 5.5.5, "Drive Shaft Installation.")
9. 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.



10. Tighten the axle oil drain plug, loosen and remove the axle oil fill plug (1). (Refer to Section 2.4, "Fluids and Lubricant Capacities," for proper oil and capacities.)



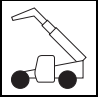


11. Rotate wheel hubs 90 degrees so the drain plug (2) becomes the fill plug (3). Refer to Section 2.4, "Fluids and Lubricant Capacities," for proper oil and capacities.
12. Install the wheel and tire assemblies. Refer to Section 5.6.2, "Installing Wheel and Tire Assembly onto Machine."
13. Carefully remove the jack, hoist or overhead crane and sling supporting the axle.
14. Carefully raise the machine using a suitable jack or hoist. Remove the supports from beneath the frame and lower the machine to the ground.
15. 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.*

16. Install new o-rings into the fittings. Lubricate the o-rings with clean hydraulic oil.
17. Uncap and connect the steering and brake lines at their axle fittings.
18. Check the hydraulic reservoir oil level.
19. 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.
20. Install the optional fender assembly.
21. Close and secure the engine cover.
22. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

Note: *The service brake and parking brake circuits will need to be bled after axle installation. Refer to Section 8.7.4, "Service Brake Bleeding."*



Axles, Drive Shafts, Wheels and Tires

5.4.3 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 2.4, "Fluids and 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 with hydraulic oil. Refer to Section 2.4, "Fluids and 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 with hydraulic oil. Refer to Section 2.4, "Fluids and 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.

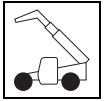


Problem	Cause	Remedy
<p>4. Oil leaking from axle (differential housing and/or axle housings).</p>	<ol style="list-style-type: none"> 1. Drain and/or inspection plugs loose and/or o-rings damaged or missing. 2. Hose fittings loose. 3. Axle shaft seal damaged or missing and/or worn or damaged shaft sealing 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 130 Nm (96 lb-ft). 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 Engine Repair Manual. 5. Replace o-rings and seals. 6. Tighten housing nuts and capscrews to 390 Nm (288 lb-ft). 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 130 Nm (96 lb-ft). 2. Replace o-ring. 3. Replace seal and/or fork joint shaft. 4. Tighten housing capscrews to 55 Nm (41 lb-ft). 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 with hydraulic oil. Refer to Section 2.4, "Fluids and Lubricant Capacities." 2. Drain axle and fill to correct level with hydraulic oil. Refer to Section 2.4, "Fluids and 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 8.4, "Hydraulic Circuits." 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 8.4, "Hydraulic Circuits." 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, "Brakes." 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 8.4, "Hydraulic Circuits." 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 2.4, "Fluids and Lubricant Capacities." 2. Refer to Section 8.4, "Hydraulic Circuits." 3. Replace o-rings and seals.



5.5 DRIVE SHAFTS

5.5.1 Drive Shaft Inspection and Service

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

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.

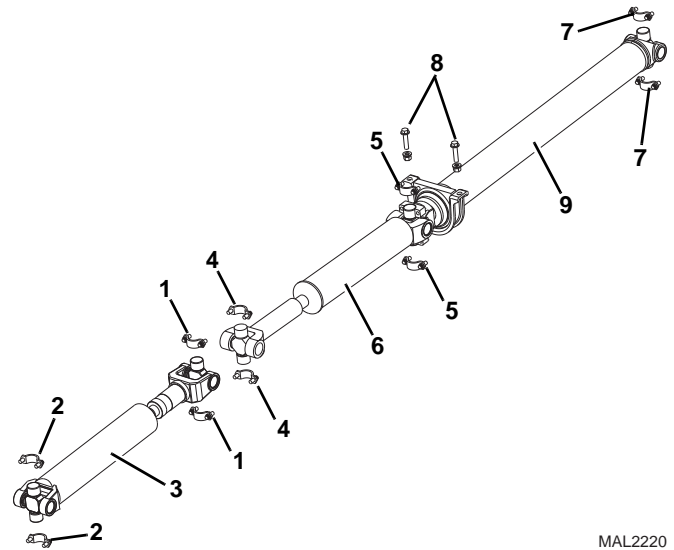
Note: Any bolt removed from the drive shaft assembly **MUST** be replaced. Do Not re-torque.

5.5.2 Drive Shaft Maintenance

Refer to Section 2.4, “Fluids and Lubricant Capacities,” for information regarding the lubrication of the drive shafts.

5.5.3 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 control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Block the wheels.
6. The drive shaft assembly is 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.



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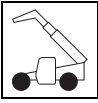
7. Remove the four bolts and two straps (1) securing the bearing cross to the transmission output shaft flange. Discard bolts.
8. Remove the four bolts and two straps (2) securing the bearing crosses to the axle. Discard bolts.
9. Remove the front drive shaft assembly (3).
10. Remove the four bolts and two straps (4) securing the bearing cross to the transmission output shaft flange. Discard bolts.
11. Remove the four bolts and two straps (5) securing the bearing crosses to rear axle (6) at the carrier bearing. Discard bolts.
12. Remove the rear drive shaft assembly (6).
13. Remove the four bolts and two straps (7) securing the bearing cross to the rear axle. Discard bolts.
14. Remove the two bolts, nuts and washers (8) securing the carrier bearing to the frame.
15. Remove the rear drive shaft assembly (9).

5.5.4 Drive Shaft Cleaning and Drying

1. Disassemble and clean all parts using an approved cleaning fluid. Allow to dry.
2. Remove and burrs or rough spots from all machined surfaces. Re-clean and dry as required.

5.5.5 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.



Axles, Drive Shafts, Wheels and Tires

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

2. Apply Loctite® 243™ to all mounting bolts.
3. Install the two straps and four new bolts (1) securing the front axle (3) bearing crosses to the transmission. Torque bolts to 55-60 lb-ft (75-81 Nm).
4. Install the two straps and four new bolts (2) securing the front axle (3) bearing crosses to the axle. Torque bolts to 55-60 lb-ft (75-81 Nm).
5. Install the two straps and four new bolts (7) securing the rear axle (9) bearing crosses to the axle. Torque bolts to 55-60 lb-ft (75-81 Nm).
6. Install the previously removed bolts, nuts and washers (8) and secure the carrier bearing to the frame. Torque to 55 lb-ft (75 Nm).
7. Install the two straps and four new bolts (4) securing the rear axle (6) bearing crosses to the transmission. Torque bolts to 55-60 lb-ft (75-81 Nm).
8. Install the two straps and four new bolts (4) securing the rear axle (6) bearing crosses to the rear axle (9) at the carrier bearing. Torque bolts to 55-60 lb-ft (75-81 Nm).
9. Properly connect the battery.
10. Close and secure the engine cover.
11. Unblock the wheels.
12. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

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).

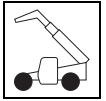
The rims installed have been designed for stability requirements which consist of track width, tire pressure and load capacity. Size changes such as rim width, center piece location, larger or smaller diameter, etc., without written factory recommendations, may result in unsafe condition regarding stability.

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.

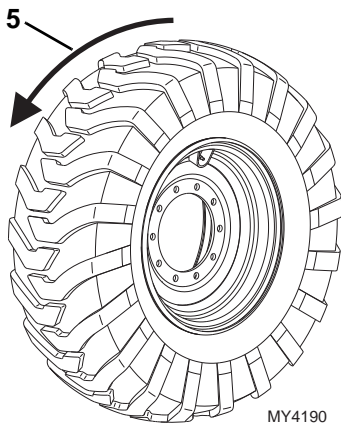
5.6.1 Removing Wheel and Tire Assembly from Machine

1. Park the machine on a firm, level surface, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place an Do Not Operate Tag on both the 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.

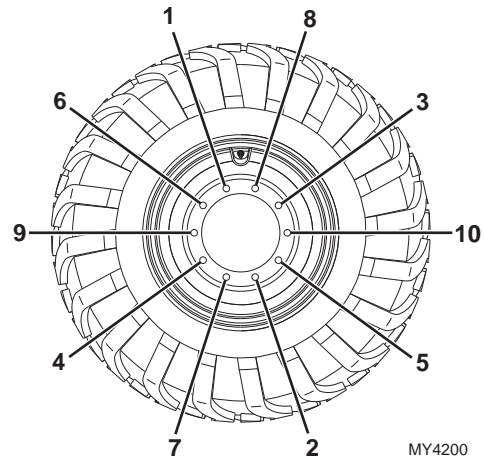
5.6.2 Installing Wheel and Tire Assembly onto Machine



Note: If the machine is equipped with directional tire assemblies, the wheel and tire assemblies must be installed with the directional tread pattern “arrows” facing in the direction of forward travel (5).

Note: Verify valve stems face outward on all wheel and tire assemblies.

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

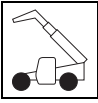


4. Tighten lug nuts in an alternating pattern as indicated in figure. Torque to 350-400 lb-ft (475-542 Nm).
5. Remove machine from supports.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

5.7 BRAKES

Check the brake disks for wear every 1,000 hours of operation or yearly.

For more information on brake disk inspection, refer to the Axle Repair Manual (P/N 31200240).

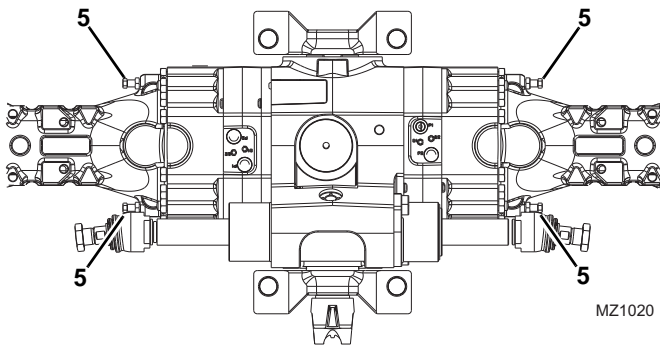


5.8 TOWING A DISABLED MACHINE

Towing a disabled machine should only be attempted as a last resort, after exhausting all other options. Make every effort to repair the machine, and move it under its own power, before using the emergency towing procedures outlined below.

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.

5.8.1 Manually Releasing the Park Brake

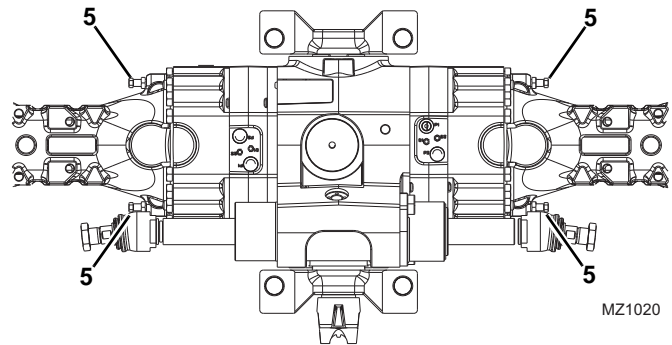


1. Loosen the nuts of the screws (5) for the manual release of the braking units. Draw the nuts back approximately 6 mm.
2. Tighten the screws until they are gently seated on the driving plate
3. Carefully tighten each release screw a 1/4 turn at a time in sequence until all have been turned on full turn 360°.
4. Repeat steps 1 thru 3 for the other side of the differential.

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

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 (5), only 1/4 turn at a time, in sequence, until each screw has lost contact with the guide pin.
2. Remove the screws along with the nuts and seals. Replace the seals, lubricate the screws with a silicone-based grease and re-install the screws along with the 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 the other side of the differential.
5. After repairs to the machine have been made, start the machine and check the park brake and service brakes for proper function. Refer to Section 8.7.4, "Service Brake Bleeding," Section 8.7.5, "Service Brake Test," and Section 8.7.6, "Steering Orbitrol Valve."



Section 6

Transmission

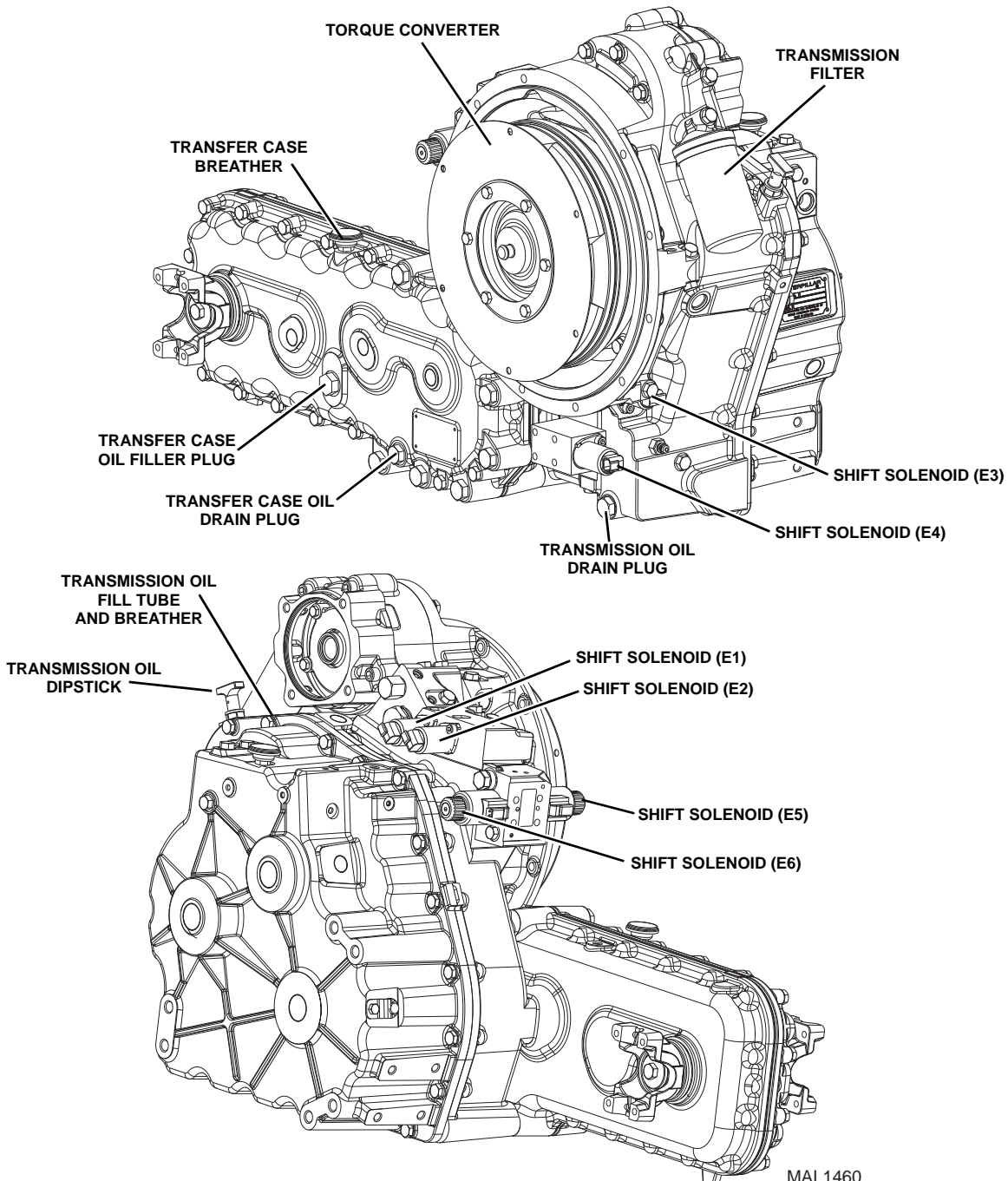
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6.1 TRANSMISSION ASSEMBLY COMPONENT TERMINOLOGY

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.



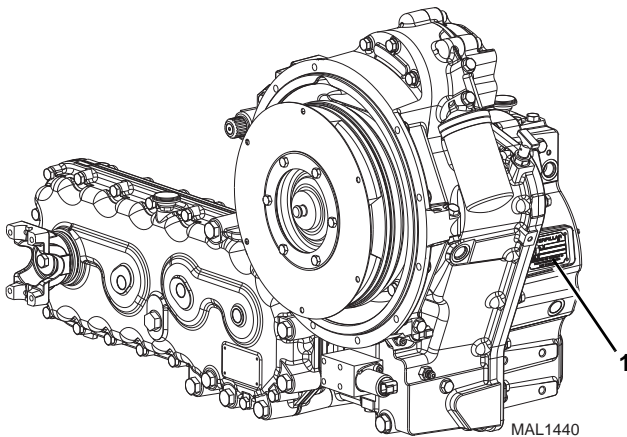


! WARNING

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

Note: These instructions cover only the routine maintenance, removal, installation and troubleshooting of the transmission. Refer to the local Caterpillar dealer and the applicable Transmission Service Manual for assistance with comprehensive transmission diagnosis, repair and component replacement.

6.2 TRANSMISSION SERIAL NUMBER



The transmission serial number plate (1) is located on the side of the transmission case near the transmission oil filter. Information on the serial number plate is required in correspondence regarding the transmission.

6.3 TRANSMISSION SPECIFICATIONS AND MAINTENANCE INFORMATION

For transmission, oil specifications and maintenance information, refer to Section 2, "General Information and Specifications."

Detailed transmission service instructions are provided in the following publications:

- Service Manual (Not Available at Publication)
- Parts Manual (P/N 31200724)

6.4 TRANSMISSION REPLACEMENT

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

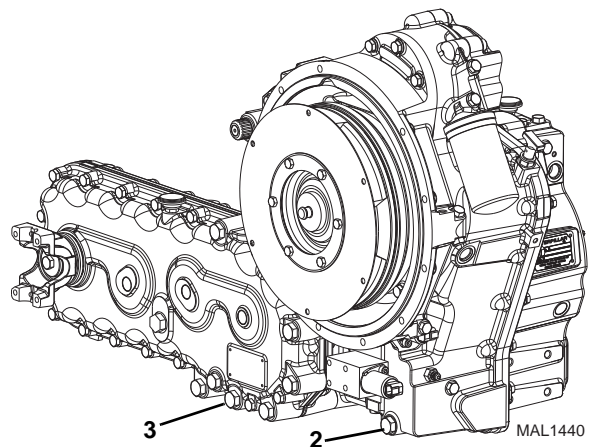
6.4.1 Transmission Removal

! 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 a minimum lifting capacity of 1000 lb (454 kg).

Note: The engine/transmission must be removed from the machine before being able to separate the transmission from the engine.

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Refer to Section 7.9.1, "Engine/Transmission Removal," for detailed removal instructions.
5. If not previously removed, remove the implement pump. Refer to Section 8.6.1, "Implement Pump Replacement."





Transmission

6. Place a suitable receptacle under the transmission drain plug (2). Remove the transmission drain plug and allow the transmission oil to drain into the receptacle. Repeat the drain procedure with the transfer case (3).
 7. Transfer the used oil into a suitable container. Label the container "Used Oil." Dispose of used oil at an approved recycling facility. Clean and reinstall the drain plugs.
 8. Remove the access cover from the bottom of the engine bell housing. This will allow access to remove the six bolts holding the torque converter diaphragm to the engine flywheel.
 9. Turn the engine over slowly by hand and align each of the six torque converter diaphragm bolts to be accessed. Remove them one at a time.
 10. Connect a lifting strap or chain to the lifting eye at the top of the transmission, and to a suitable hoist or overhead crane.
 11. Carefully separate the transmission from the engine. Avoid causing damage to the transmission or surrounding parts.
 12. Lift the transmission clear of the machine, and lower it onto suitable supports or secure it to a stand built especially for transmission or engine service. Secure the transmission so that it will not move or fall.
3. Align the torque converter, align the transmission bolt holes with the two studs in the bell housing. Install the twelve bolts and washers and torque to 53 lb-ft (72 Nm). Remove the two alignment studs and install and torque the last two transmission mounting bolts.
 4. Turn the engine over slowly by hand and align each of the four torque converter diaphragm bolts through the access cover in the bell housing. Install them one at a time. DO NOT fully tighten until all of the capscrews and locknuts are in place. Torque to 26-39 lb-ft (35-59 Nm). Replace access cover.
 5. If previously removed, install the implement pump. Refer to Section 8.6.1, "Implement Pump Replacement."
 6. Refer to Section 7.9.2, "Engine/Transmission Installation," for detailed installation instructions.
 7. Fill the transmission. Refer to Section 2.4, "Fluids and Lubricant Capacities," for proper capacity.
 8. Properly connect the battery.

Note: Check transmission oil level with engine at idle and transmission oil cold.

9. Apply park brake, shift transmission control lever to the (N) NEUTRAL position and lower the forks or attachment to the ground.
10. Open engine cover.
11. Remove the transmission dipstick (5) and check the oil level. The oil level should be at the MAX line.
12. Replace the transmission dipstick.
13. If oil is low, Remove fill plug (4) and add oil as required.
14. Replace fill plug.
15. Close and secure engine cover.
16. Recheck all drain plugs, lines, connections, etc., for leaks, and tighten where necessary. Close and secure the engine cover.
17. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

6.4.2 Transmission Inspection and Internal Repair

Refer to Section 6.3, "Transmission Specifications And Maintenance Information."

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.

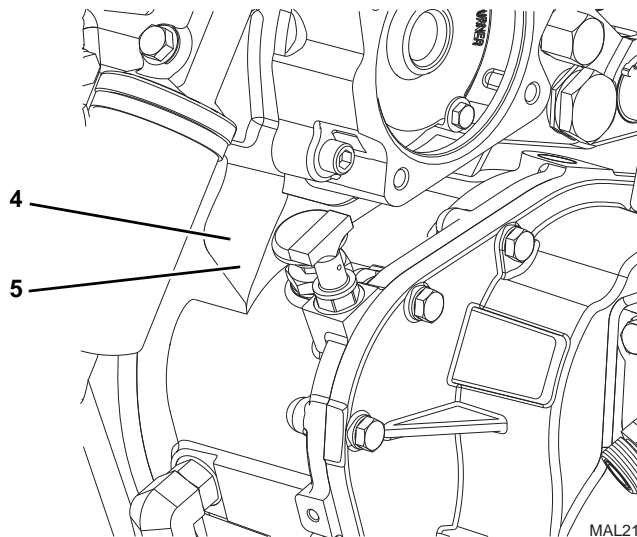
1. Install two guide studs near the top of the engine bell housing.
2. Use a hoist or overhead crane and sling attached to the lifting eye at the top of the transmission. Raise and position the transmission behind the engine.



6.4.4 After Transmission Service or Replacement

In general:

1. Check the transmission oil level and add oil as required.
2. Disconnect and clean all transmission cooler hoses. When possible, remove transmission lines from the machine for cleaning.
3. Drain and flush the entire transmission cooling system.
4. Thoroughly clean transmission filter screens and cases, and replace transmission filter elements.



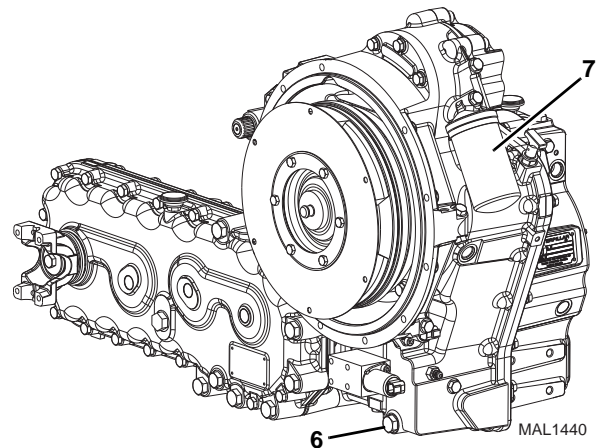
Note: Check transmission oil level with engine at idle and transmission oil cold.

5. Apply park brake, shift transmission control lever to the (N) NEUTRAL position and lower the forks or attachment to the ground.
6. Open engine cover.
7. Remove the transmission dipstick (5) and check the oil level. The oil level should be at the MAX line.
8. Replace the transmission dipstick.
9. If oil is low, Remove fill plug (4) and add oil as required.
10. Replace fill plug.
11. Close and secure engine cover.
12. Recheck all drain plugs, lines, connections, etc., for leaks, and tighten where necessary.

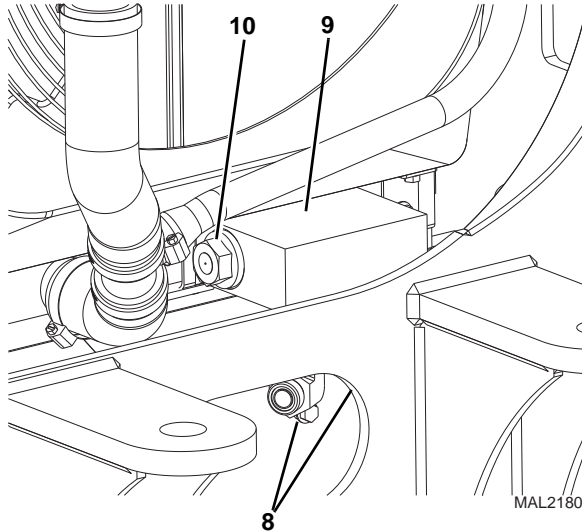
6.5 TRANSMISSION COOLER THERMAL BY-PASS VALVE

6.5.1 Thermal Bypass Valve Cartridge Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.



5. Place a suitable container under the transmission drain plug (6). Remove the transmission drain plug, and allow the transmission oil to drain into the receptacle.
6. Remove the transmission oil filter (7) and dispose of properly. Clean the filter mounting surface. Cover or cap the oil filter mount.
7. 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 and drop box drain plugs.
8. Place a suitable container beneath the transmission cooler fittings on the hydraulic cooler. Transfer any transmission oil into a properly labeled container. Dispose of properly.



9. Label, disconnect and cap the transmission oil cooler hoses (8) at the thermal bypass valve (9). Cap all fittings and openings to prevent dirt and debris from entering.
10. Loosen and remove the cartridge (10) from the side of the thermal bypass valve. Plug the opening to prevent dirt and debris from entering the system.

6.5.2 Thermal Bypass Valve Cartridge Installation

1. Remove the plug and install the new cartridge (10) in the thermal by-pass valve (9).
2. Uncap and connect the previously labeled transmission oil cooler hoses (8) to the thermal bypass valve.
3. Clean the transmission oil filter mounting surface.
4. Apply a thin film of clean hydraulic oil to the new transmission filter gasket. Install the new filter and torque to 20-25 lb-ft (27-34 Nm).
5. Fill the transmission. Refer to Section 2.4, "Fluids and Lubricant Capacities," for proper capacity.
6. Properly connect the battery.

Note: Check transmission oil level with engine at idle and transmission oil cold.

7. Apply park brake, shift transmission control lever to the (N) NEUTRAL position and lower the forks or attachment to the ground.
8. Open engine cover.
9. Remove the transmission dipstick (5) and check the oil level. The oil level should be at the MAX line.
10. Replace the transmission dipstick.
11. If oil is low, Remove fill plug (4) and add oil as required.
12. Replace fill plug.
13. Close and secure engine cover.
14. Recheck all drain plugs, lines, connections, etc., for leaks, and tighten where necessary.



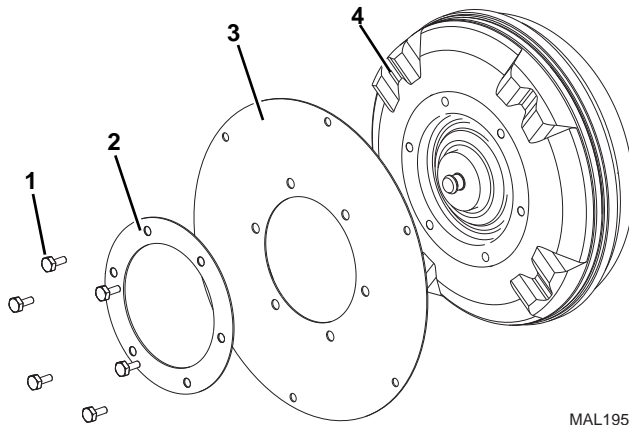
6.6 TORQUE CONVERTOR DIAPHRAGM

6.6.1 Torque Converter Diaphragm Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.

Note: In order to remove the engine drive plate, the engine and transmission must be separated.

2. Refer to Section 6.4.1, "Transmission Removal," or Section 7.9.1, "Engine Removal."



3. Remove the six bolts holding the diaphragm to the flywheel.
4. With the drive plate and torque converter removed, loosen and remove the six bolts (1) holding the support ring (2) and diaphragm (3) to the torque converter (4).
5. Replace both diaphragms if damaged.

6.6.2 Torque Converter Diaphragm Installation

1. Install the new diaphragm on the torque converter and install the six bolts. Torque as required.
2. Mount the diaphragm/converter assembly to the transmission. Torque as required.
3. Refer to Section 6.4.3, "Transmission Installation," or Section 7.9.2, "Engine Installation," for the remainder of the installation.



6.7 TROUBLESHOOTING

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

Note: Contact the local Caterpillar dealer 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
<p>1. Transmission will not engage or will not shift properly.</p>	<ol style="list-style-type: none"> 1. Oil level too high or low. 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. 3. Transmission valve body solenoids not functioning properly. 4. Pilot-operated shift valves not operating properly. 5. Pump output pressure low. 6. Clutch piston o-rings damaged. 7. Clutch discs worn or damaged. 8. Coupling shafts or gear teeth damaged. 	<ol style="list-style-type: none"> 1. Fill transmission to correct level with hydraulic oil. Refer to Section 2.4, "Fluids and Lubricant Capacities." 2. Refer to Section 9.5, "Electrical System Schematics." 3. Refer to Section 9.5, "Electrical System Schematics." 4. Clean the valve spool and housing. Replace return spring as needed. 5. Refer to Problem 2. "Low or no pump flow or pressure." 6. Replace o-rings. 7. Replace clutch discs. 8. Replace couplings.



Problem	Cause	Remedy
2. Low or no pump flow or pressure.	<ol style="list-style-type: none"> 1. Low oil level. 2. Transmission filled with incorrect oil, or oil contaminated. 3. Pump suction pipe screen clogged. 4. Central shaft damaged. 5. Pump worn or damaged. 	<ol style="list-style-type: none"> 1. Fill transmission to correct level with hydraulic oil. Refer to Section 2.4, "Fluids and Lubricant Capacities." 2. Drain transmission and fill to correct level with hydraulic oil. Refer to Section 2.4, "Fluids and Lubricant Capacities." 3. Clean, repair and/or replace suction pipe. 4. Replace central shaft. 5. Repair or replace pump assembly.
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 with hydraulic oil. Refer to Section 2.4, "Fluids and 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 8.4, "Hydraulic Circuits." 2. Adjust the engine rpm to specifications. Refer to Engine Service Manual. 3. Refer to Problem 2. "Low or no pump flow or pressure." 4. Replace clutch discs. 5. Refer to Problem 5. "Transmission overheating (oil above 248° F (120° C))."



Transmission

Problem	Cause	Remedy
5. Transmission overheating (oil above 248° F (120° C)).	<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. Thermal by-pass valve damaged or flow restricted.	<ol style="list-style-type: none">1. Fill transmission to correct level with hydraulic oil. Refer to Section 2.4, "Fluids and Lubricant Capacities."2. Remove debris from the radiator.3. Drain transmission and fill to correct level with hydraulic oil. Refer to Section 2.4, "Fluids and Lubricant Capacities."4. Stop and idle the engine.5. Replace cooler hoses.6. Repair or replace pump assembly.7. Replace thermal by-pass valve cartridge. Refer to Section 6.5, "Transmission Cooler Thermal By- Pass Valve."
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 (torque convertor).6. Loose diaphragm (torque convertor) mounting capscrews.	<ol style="list-style-type: none">1. Fill oil to correct level. Refer to Section 2.4, "Fluids and Lubricant Capacities."2. Drain transmission and fill to correct level with hydraulic oil. Refer to Section 2.4, "Fluids and Lubricant Capacities."3. Refer to Section 9.11.2, "Transmission Solenoid Valves."4. Repair or replace parts as needed.5. Replace diaphragm (torque convertor). Refer to Section 6.4.1, "Transmission Removal."6. Tighten capscrews.



Problem	Cause	Remedy
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. Oil escaping from breather at shut down. 10. 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 2.4, "Fluids and 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. Transmission may be under full. Ensure transmission is at operating temperature, 185° F (85° C) and fill to upper mark on transmission dip stick. 10. Replace housing as needed.



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Section 7

Engine

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Engine

7.1 ENGINE INTRODUCTION AND COMPONENT TERMINOLOGY

7.1.1 Disclaimer and Scope

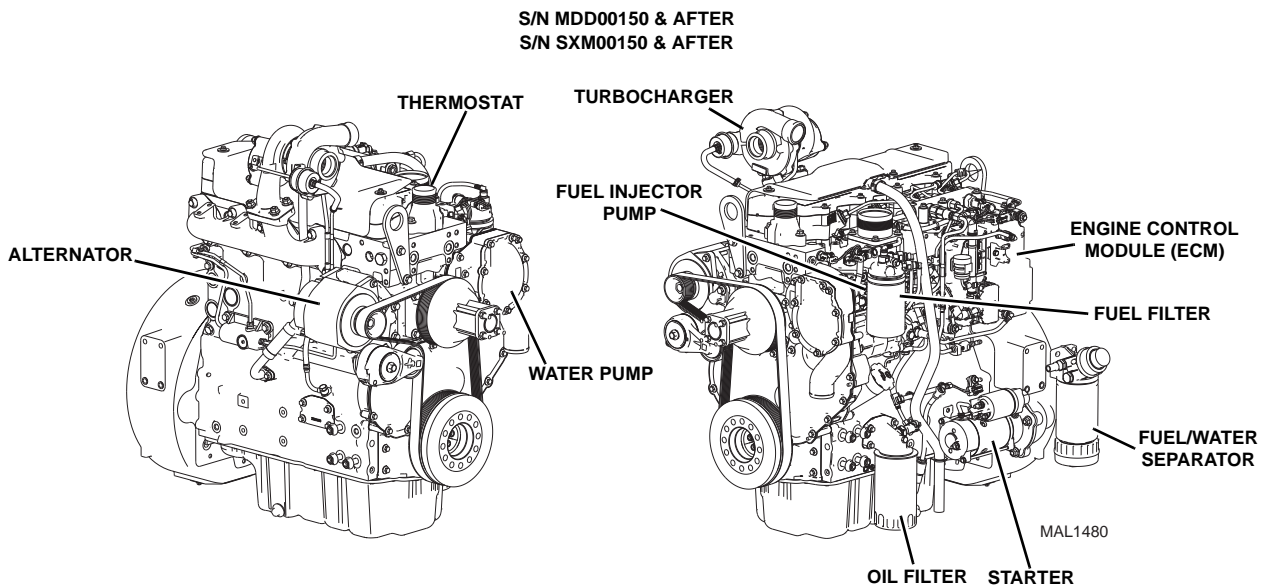
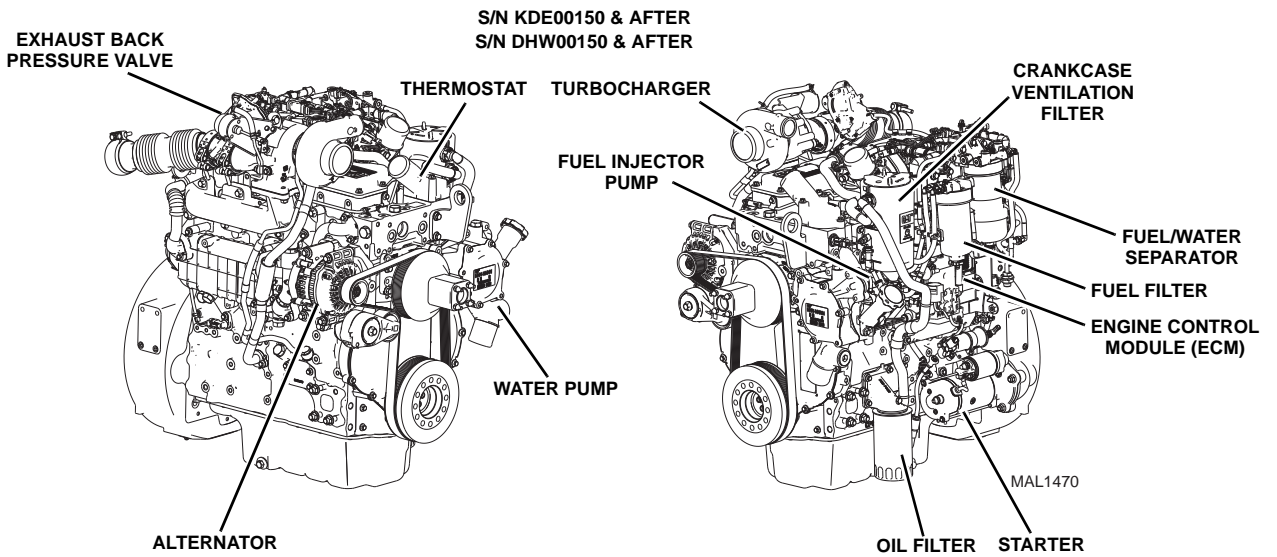
These instructions are written for worldwide use. In territories where legal requirements govern engine smoke emission, noise, safety factors, etc., apply all instructions, data and dimensions provided herein in such a way that after maintenance, service and repair of the engine, engine operation does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

Note: *These instructions cover only the routine maintenance, removal, installation and troubleshooting of the engine. Refer to the local Caterpillar dealer and the applicable 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 the engine is put into service and the coolant temperature is at least 140° F (60° C). Extended light-load operation during the 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.*



7.1.2 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.





Engine

7.2 ENGINE SERIAL NUMBER

The serial number is stamped on top of the engine. Information contained in the serial number is required in correspondence with the engine manufacturer.

7.3 ENGINE SPECIFICATIONS AND MAINTENANCE INFORMATION

For engine, coolant and oil specifications, and maintenance information, refer to Section 2, "General Information and Specifications."

Refer to Section 9.14, "Engine Diagnostic," for diagnostic codes and descriptions.

Detailed engine service instructions are provided in the following publications:

S/N KDE00150 & After **S/N DHW00150 & After**

- Operation and Maintenance Manual (P/N SEBU8606-01)
- Specifications (P/N KENR9118-01)
- System Operation Testing and Adjusting (P/N KENR9119-01)
- Disassembly and Assembly (P/N KENR9120-01)
- Troubleshooting (P/N KENR9111-01)
- Electrical Schematic (P/N KENR9122-01)
- Parts Manual (SEBP6149)
- Service Manual (P/N KENR9133)

S/N MDD00150 & After **S/N SXM00150 & After**

- Operation and Maintenance Manual (P/N SEBU8180-01)
- Specifications (P/N RENR9961-01)
- System Operation Testing and Adjusting (P/N RENR9965)
- Disassembly and Assembly (P/N KENR6216-01)
- Troubleshooting (P/N KENR9969-05)
- Electrical Schematic (P/N RENR9964-02)
- Parts Manual (SEBP4124)
- Service Manual (P/N KENR6217)

7.4 ENGINE COOLING SYSTEM

7.4.1 Surge Tank Cap

A 14 psi (1 Bar) cap is used on the surge tank. An incorrect or malfunctioning cap can result in the loss of coolant and a hot-running engine.

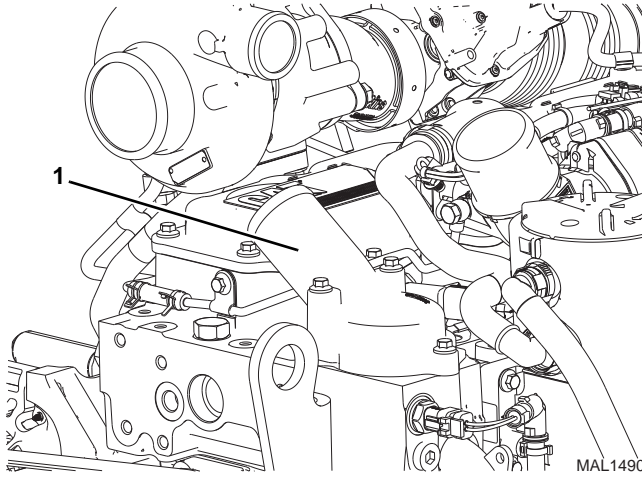
7.4.2 Thermostat Replacement

Before considering thermostat replacement, check the coolant level, fan belt tension and instrument cluster temperature indicator.

- If the engine seems to take a long time to warm up, the thermostat may be stuck in the open position and requires replacement.
- If the engine runs hot, check the temperature of the upper radiator hose.
- If the hose is not hot, the thermostat may be stuck in the closed position.
- If the 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 the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Slowly turn the surge tank cap to the first stop and allow any pressure to escape. Remove the surge tank cap.
6. Place a funnel at the base of the radiator to channel the drained coolant into the container. Loosen the drain cock and slowly remove to allow the coolant to drain. Transfer the coolant into a properly labeled container. Dispose of properly if coolant needs to be replaced. Replace the radiator drain cock.
7. Loosen and remove the top radiator hose from the thermostat housing.



TYPICAL THERMOSTAT

8. Remove the capscrews securing the thermostat housing (1) to the engine.
9. Remove the thermostat housing, old gasket and thermostat. Clean all gasket surfaces. **DO NOT** let any debris into the thermostat opening.

Note: ALWAYS use the correct thermostat and install a new gasket. **NEVER** operate the engine without a thermostat, or engine damage will result.

b. Thermostat Installation

1. Install the engine thermostat, thermostat gasket and thermostat housing. Secure with the two capscrews.
2. Connect the Engine Water Temperature sender.
3. Properly connect the battery.
4. Open the surge tank cap, fill system complete to the "Full Cold" level with coolant. Replace and tighten the surge tank cap.
5. Run the engine to operating temperature. Visually check for leaks with the engine running. Check the coolant level in the surge tank and fill, or drain, as necessary.

7.4.3 Radiator Assembly Replacement

Before considering radiator or transmission cooler replacement for other than obvious damage, conduct a cooling system pressure test check the coolant specific gravity, coolant level, fan belt tension and dash panel temperature indicator.

- If the engine runs hot, check the temperature of the upper radiator hose.
- If the hose is not hot, the thermostat may be stuck in the closed position.
- If the 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 Assembly Removal

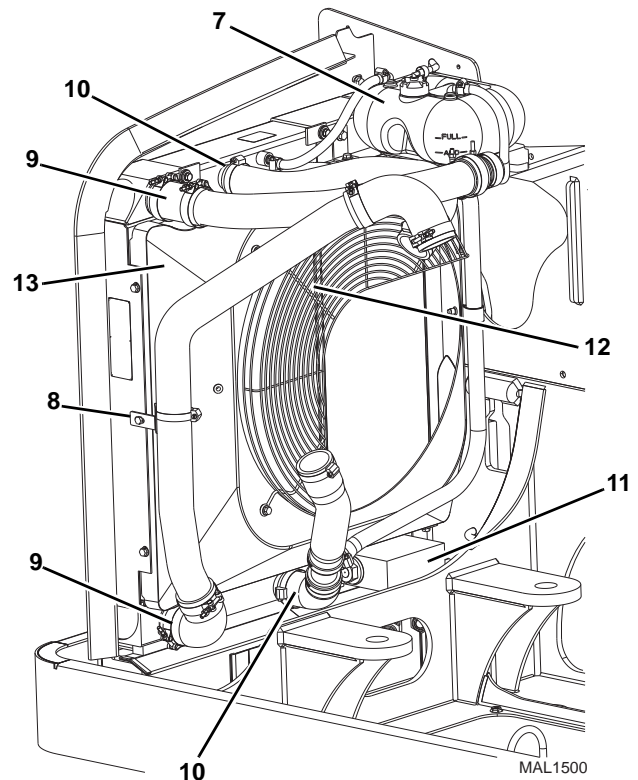
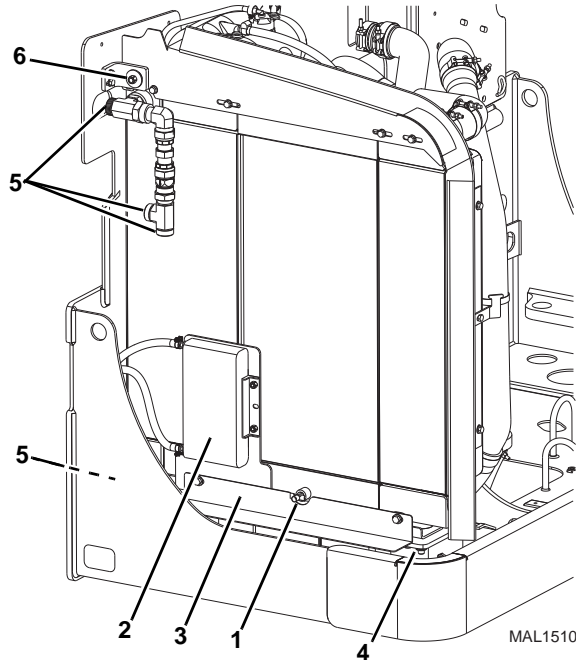
S/N KDE00150 & After

S/N DHW00150 & After

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Remove the engine cover.
6. Slowly turn the surge tank cap to the first stop and allow any pressure to escape. Remove the surge tank cap.
7. Place a suitable container beneath the radiator drain.



Engine



8. Place a funnel at the base of the radiator to channel the drained coolant into a container. Loosen the drain cock (1) to allow the coolant to drain. Transfer the coolant into a properly labeled container. Dispose of properly if coolant needs to be replaced. Tighten the radiator drain cock.
9. Label, remove and cap the fuel cooler (2) fuel lines.
10. Remove drip shield plate (3).
11. Loosen and remove the nuts and washers from two isolator mounts at the bottom of the radiator (4).
12. Place a suitable container beneath the hydraulic oil cooler fittings. Transfer any hydraulic oil into a properly labeled container. Dispose of properly.
13. Label, disconnect and cap the four hydraulic cooler hoses (5). Cap all fittings and openings to prevent dirt and debris from entering the hydraulic system.
14. Loosen and remove the nut and washer (6) from the top of the radiator.

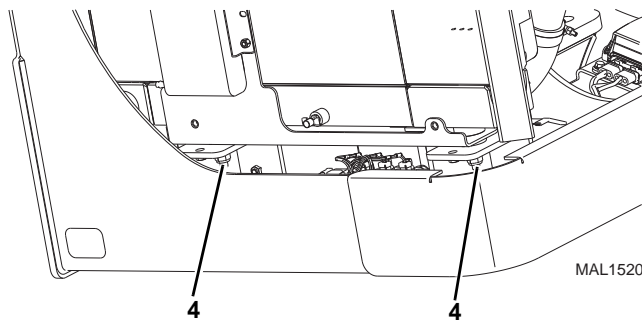
15. Label, disconnect and cap the hose attached to the coolant recovery tank (7). Remove the coolant recovery tank and mounting plate.
16. Loosen the clamp (8) on the charge air cooler inlet hose attached to the radiator.
17. Loosen the clamps on both hoses attached to the charge air cooler (9). Work the hoses and tubes off the charge air cooler. Position the hoses and tubes out of the way to allow radiator removal, or remove the hoses and tubes from the engine. Plug and/or cap the openings on the charge air cooler and tubes to prevent dirt and debris from entering system.
18. Loosen the clamps on both hoses attached to the radiator (10). Work the hoses off the radiator. Position the hoses out of the way to allow radiator removal, or remove the hoses from the engine. Inspect the hoses, and replace if necessary. Plug and/or cap the openings on the radiator and hoses to prevent dirt and debris from entering system.
19. Place a suitable container beneath the transmission cooler fittings. Transfer any transmission oil into a properly labeled container. Dispose of properly.
20. Label, disconnect and cap both transmission cooler hoses at the radiator (11). Cap all fittings and openings to prevent dirt and debris from entering the transmission.



21. Remove the fan guard (12).
22. Loosen and remove the three bolts from the radiator fan shroud (13). Pull the fan shroud back and over the fan assembly.
23. Carefully lift the radiator assembly out of the engine compartment.

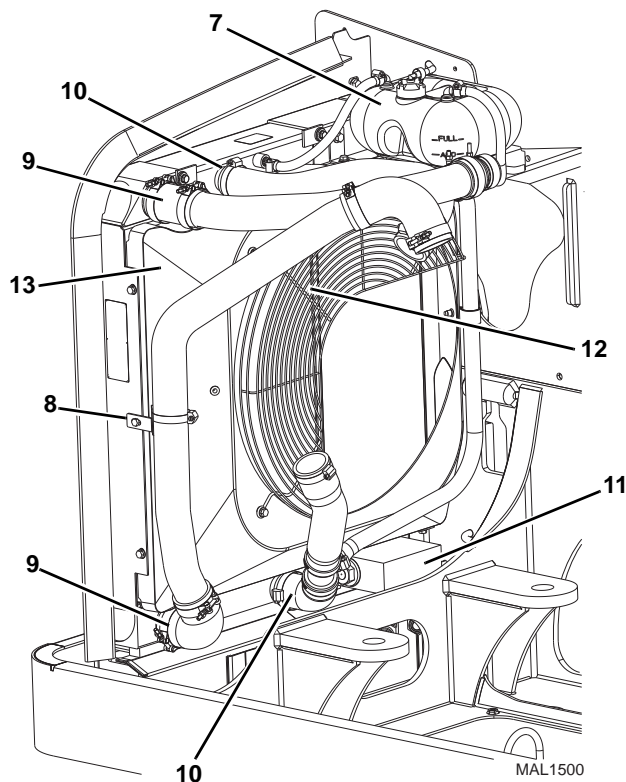
Note: If more clearance is needed to remove the radiator, the engine fan may be removed for easier access.

b. Radiator Assembly Installation



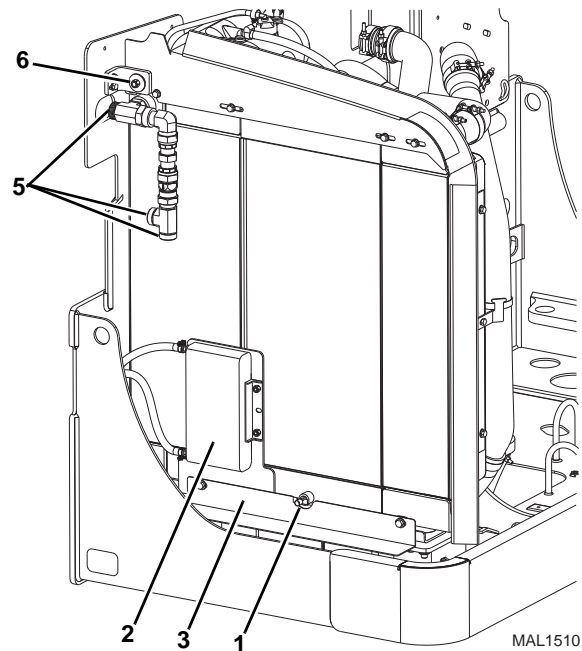
MAL1520

1. Place the radiator assembly in the engine compartment and secure using the previously used hardware (4).
2. Install the engine fan if previously removed.



MAL1500

3. Install the radiator fan shroud (13) with the previously removed hardware.
4. Install the previously removed fan guard (12).
5. Uncap and connect both transmission cooler hoses at the radiator (11).
6. Uncap and install both radiator hoses (10) to the radiator and tighten clamps.
7. Uncap and install both charge air cooler tubes (9) to the radiator and tighten clamps.
8. Tighten the clamp (8) on the charge air cooler inlet hose attached to the radiator.
9. Install the coolant recovery tank (7) and mounting plate. Uncap and connect the previously removed coolant recovery tank hoses.



MAL1510

10. Install the previously removed nut and washer (6) to the isolator mount at the top of the radiator.

Note: Verify proper clearance between the fan and the fan shroud (13).

11. Uncap and connect the previously labeled hydraulic oil cooler hoses to the hydraulic oil cooler fittings (5).
12. Uncap and connect the previously labeled fuel cooler hoses to the fuel cooler fittings (2).
13. Install the previously removed drip shield plate (3).
14. Open the surge tank cap, fill system complete to the "Full Cold" level with coolant. Replace and tighten the surge tank cap. Refer to Section 2.4, "Fluids and Lubricant Capacities," for proper capacities.
15. Properly connect the battery.



Engine

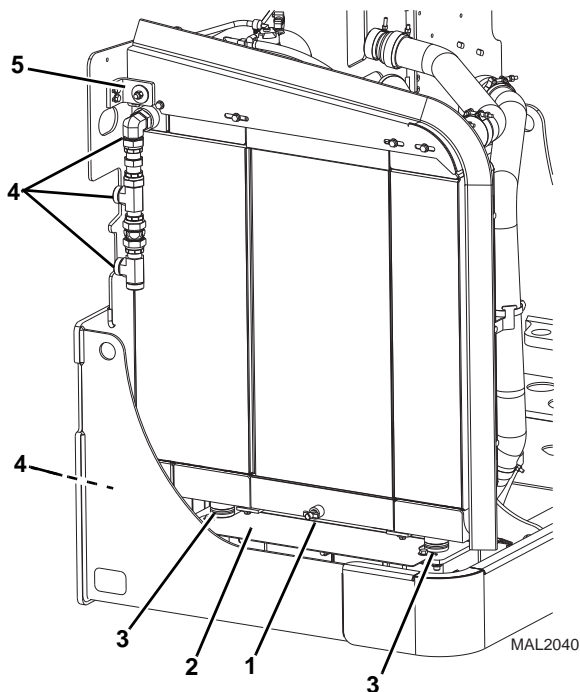
16. Run the engine to operating temperature. Visually check for leaks with the engine running. Check the coolant level in the surge tank and fill, or drain, as necessary.
17. Close and secure the engine cover.
18. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

a. Radiator Assembly Removal

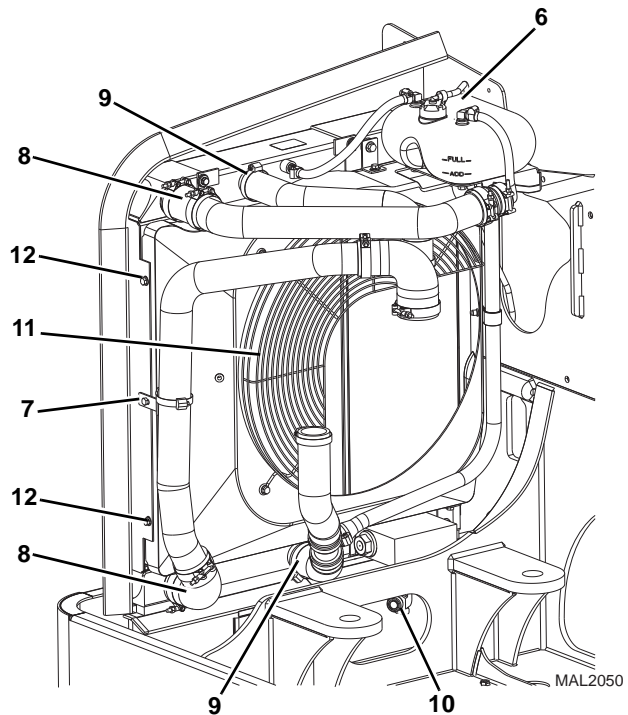
S/N MDD00150 & After

S/N SXM00150 & After

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Remove the engine cover.
6. Slowly turn the surge tank cap to the first stop and allow any pressure to escape. Remove the surge tank cap.
7. Place a suitable container beneath the radiator drain.



8. Place a funnel at the base of the radiator to channel the drained coolant into a container. Loosen the drain cock (1) to allow the coolant to drain. Transfer the coolant into a properly labeled container. Dispose of properly if coolant needs to be replaced. Tighten the radiator drain cock.
9. Remove drip shield plate (2).
10. Loosen and remove the nuts and washers from two isolator mounts at the bottom of the radiator (3).
11. Place a suitable container beneath the hydraulic oil cooler fittings. Transfer any hydraulic oil into a properly labeled container. Dispose of properly.
12. Label, disconnect and cap the four hydraulic cooler hoses (4). Cap all fittings and openings to prevent dirt and debris from entering the hydraulic system.
13. Loosen and remove the nut and washer (5) from the top of the radiator.



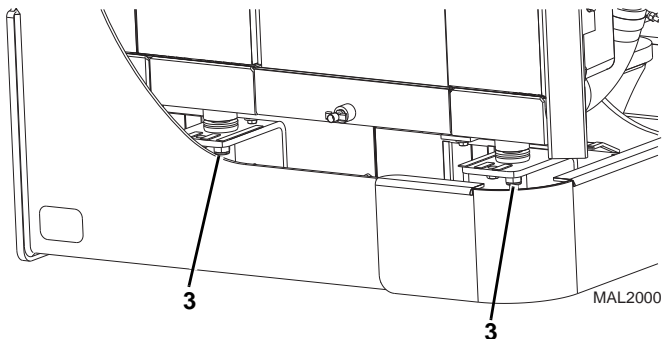
14. Label, disconnect and cap the hose attached to the coolant recovery tank (6). Remove the coolant recovery tank and mounting plate.
15. Loosen the clamp (7) on the charge air cooler inlet hose attached to the radiator.



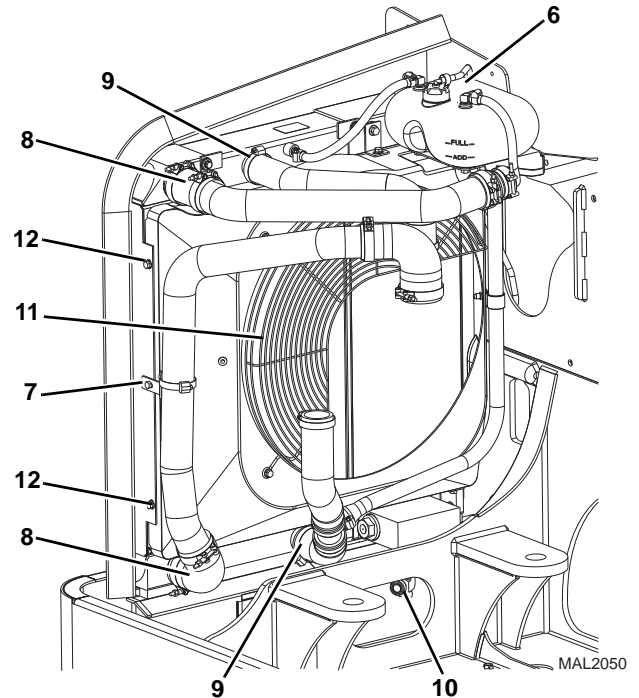
16. Loosen the clamps on both hoses attached to the charge air cooler (8). Work the hoses and tubes off the charge air cooler. Position the hoses and tubes out of the way to allow radiator removal, or remove the hoses and tubes from the engine. Plug and/or cap the openings on the charge air cooler and tubes to prevent dirt and debris from entering system.
17. Loosen the clamps on both hoses attached to the radiator (9). Work the hoses off the radiator. Position the hoses out of the way to allow radiator removal, or remove the hoses from the engine. Inspect the hoses, and replace if necessary. Plug and/or cap the openings on the radiator and hoses to prevent dirt and debris from entering system.
18. Place a suitable container beneath the transmission cooler fittings. Transfer any transmission oil into a properly labeled container. Dispose of properly.
19. Label, disconnect and cap both transmission cooler hoses at the radiator (10). Cap all fittings and openings to prevent dirt and debris from entering the transmission.
20. Remove the fan guard (11).
21. Loosen and remove the two remaining bolts from the radiator fan shroud (12). Pull the fan shroud back and over the fan assembly.
22. Carefully lift the radiator assembly out of the engine compartment.

Note: If more clearance is needed to remove the radiator, the engine fan may be removed for easier access.

b. Radiator Assembly Installation



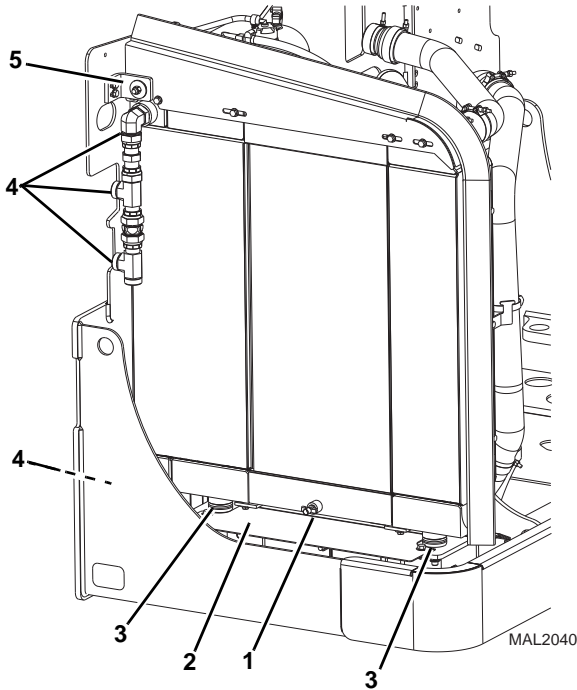
1. Place the radiator assembly in the engine compartment and secure using the previously used hardware (3).
2. Install the engine fan if previously removed.



3. Install the radiator fan shroud (12) with the previously removed hardware.
4. Install the previously removed fan guard (11).
5. Uncap and connect both transmission cooler hoses at the radiator (10).
6. Uncap and install both radiator hoses (9) to the radiator and tighten clamps.
7. Uncap and install both charge air cooler tubes (8) to the radiator and tighten clamps.
8. Tighten the clamp (7) on the charge air cooler inlet hose attached to the engine.
9. Install the coolant recovery tank (6) and mounting plate. Uncap and connect the previously removed coolant recovery tank hoses.



Engine



10. Install the previously removed nut and washer (5) to the isolator mount at the top of the radiator.

Note: Verify proper clearance between the fan and the fan shroud (12).

11. Uncap and connect the previously labeled hydraulic oil cooler hoses to the hydraulic oil cooler fittings (4).
12. Install the previously removed drip shield plate (2).
13. Open the surge tank cap, fill system complete to the "Full Cold" level with coolant. Replace and tighten the surge tank cap. Refer to Section 2.4, "Fluids and Lubricant Capacities," for proper capacities.
14. Properly connect the battery.
15. Run the engine to operating temperature. Visually check for leaks with the engine running. Check the coolant level in the surge tank and fill, or drain, as necessary.
16. Close and secure the engine cover.
17. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

7.5 ENGINE ELECTRICAL SYSTEM

The engine electrical system, including the starter, alternator and primary wiring, is described in Section 9.5, "Electrical System Schematics."

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.

Note: Due to the precise tolerances of diesel injection systems, keep the fuel clean, and free of dirt and water. Dirt and water in the fuel system can cause severe damage to both the injection pump and the injection nozzles. Use ASTM #2 diesel fuel with a minimum Cetane rating of 40. #2 diesel fuel gives the best economy and performance under most operating conditions. Fuels with Cetane numbers higher than 40 may be needed in high altitudes or extremely low ambient temperatures to help prevent misfiring and excessive smoking.

Inform the owner/operator of the machine to use #2 diesel fuel, unless ambient temperatures are below 32° F (0° C). When temperatures are below 32° F (0° C), a blend of #1 diesel and #2 diesel fuels (known as "winterized" #2 diesel) may be used.

Note: #1 diesel fuel may be used, however, fuel economy will be reduced.

S/N KDE00150 & After

S/N DHW00150 & After

Use a ultra low-sulfur content fuel with a cloud point (the temperature at which wax crystals form in diesel fuel) at least 10° below the lowest expected fuel temperature. The viscosity of the fuel must be kept above 1.3 centistokes to provide adequate fuel system lubrication.

S/N MDD00150 & After

S/N SXM00150 & After

Use a low-sulfur content fuel with a cloud point (the temperature at which wax crystals form in diesel fuel) at least 10° below the lowest expected fuel temperature. The viscosity of the fuel must be kept above 1.3 centistokes to provide adequate fuel system lubrication.

7.6.2 Fuel Tank

Note: The fuel tank is a one piece unit. It is located on the rear of the cab. If it is determined that the fuel tank must be removed, the fuel must be drained before tank removal. Always dispose of fuel properly.

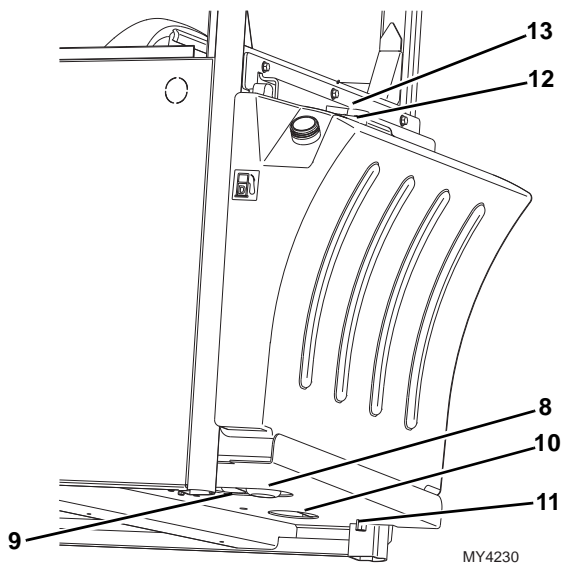


a. Fuel Tank Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.

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.



5. Remove fuel tank drain plug (8), and drain fuel into an approved, clean and suitable container. Dispose of fuel properly if contaminated.
6. Label, disconnect and cap the supply fuel line (9) from the bottom of the fuel tank.
7. Label, disconnect and cap the return fuel line (10) from the bottom of the fuel tank.
8. Disconnect the fuel gauge harness (11).
9. Remove screws securing fuel sender (12) to the tank. Remove fuel sender from tank.
10. Remove the bolts on the fuel tank hold down bar (13).
11. Lift the empty fuel tank from the rear of the cab.

b. Disassembly

The fuel tank is a one-piece unit and cannot be disassembled. The fuel level indicator 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 the local Caterpillar dealer.

To clean the fuel tank:

1. Have a dry chemical (Class B) fire extinguisher near the work area.
2. Remove the fuel or oil tank drain plug, and safely drain any fuel into a suitable container. Dispose of fuel properly.
3. Clean the fuel 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. Add a diesel fuel emulsifying agent to the tank. Refer to the manufacturer's instructions for the correct emulsifying agent-to-water mixture ratio. Refill the tank with water, and agitate the 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 level indicator 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 the local Caterpillar dealer.

1. Inspect the fuel tank thoroughly for any cracks, slices, leaks or other damage.
2. With the fuel tank removed from the machine, plug all openings except one elbow fitting. Install the elbow fitting, and apply approximately 1-1.5 psi (7-10 kPa) of air pressure through the elbow. Check the reservoir for leaks by applying a soap solution to



Engine

the exterior and look for bubbles to appear at the cracked or damaged area.

f. Fuel Tank Installation

1. Set fuel tank in its original orientation at the rear of the cab.
2. Install the fuel tank hold down bar.
3. Install the fuel sender with new gasket into the fuel tank and secure with screws. **DO NOT** overtighten.
4. Connect the previously labeled fuel hoses to their appropriate locations. Secure with clamps.
5. Connect the fuel gauge harness.
6. Fill the fuel tank according to specifications. Refer to Section 2.4, "Fluids and Lubricant Capacities."
7. Check fuel tank for leaks.
8. Properly connect the battery.
9. Close and secure the engine cover.
10. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

7.6.3 After Fuel System Service

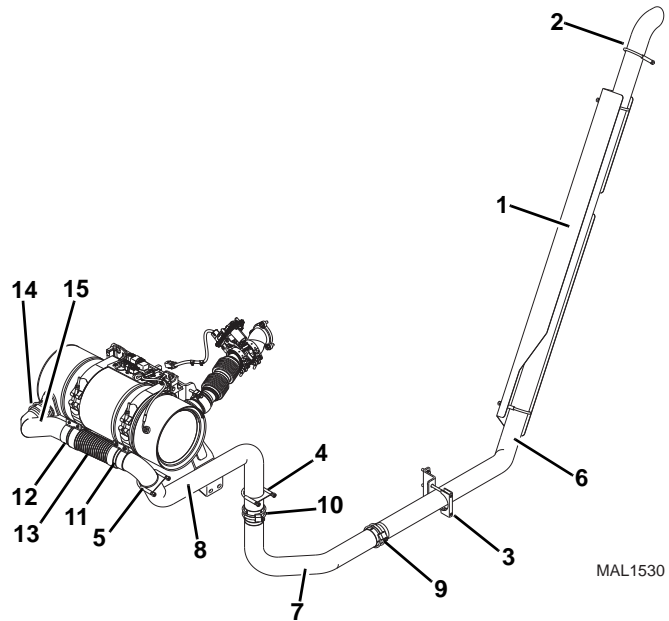
1. Drain and flush the fuel tank if it was contaminated.
2. Vent air from the fuel system in accordance with the instructions found in the appropriate Operation & Maintenance Manual.
3. Fill the fuel tank with fresh, clean diesel fuel as required.

7.7 ENGINE EXHAUST SYSTEM

7.7.1 Exhaust System Removal

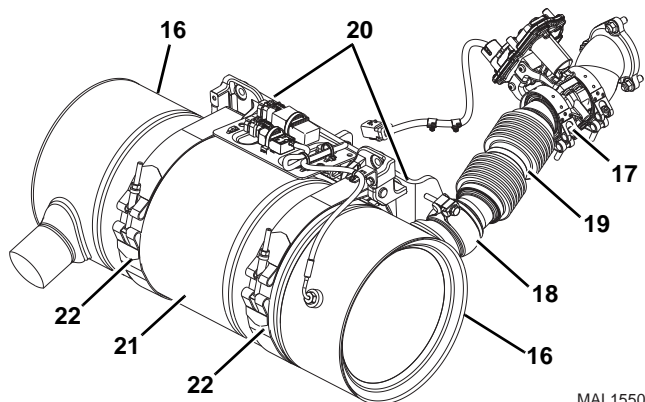
S/N KDE00150 & After
S/N DHW00150 & After

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids and the exhaust system to cool.
4. Properly disconnect the battery.



MAL1530

5. Remove the exhaust heat shield (1).
6. Loosen and remove clamps (2, 3, 4 & 5) securing the exhaust pipe sections (6, 7 & 8) to the frame mounted brackets.
7. Loosen clamp (9) and remove exhaust pipe (6).
8. Loosen clamp (10) and remove exhaust pipe (7).
9. Loosen clamp (11) and remove exhaust pipe (8).
10. Loosen clamp (12), remove and discard flex pipe (13).
11. Loosen clamp (14) and remove exhaust pipe (15).



MAL1550

12. Disconnect two DPF muffler sensor connections (16).
13. Loosen, remove and clamps (17 & 18) securing the bellows assembly (19). Discard the bellows assembly (19) and clamps (17 & 18).



- Loosen and remove the four bolts (20) securing the DPF muffler assembly (21) to the support bracket.

Note: Do Not loosen or remove clamps (22) from the DPF muffler.

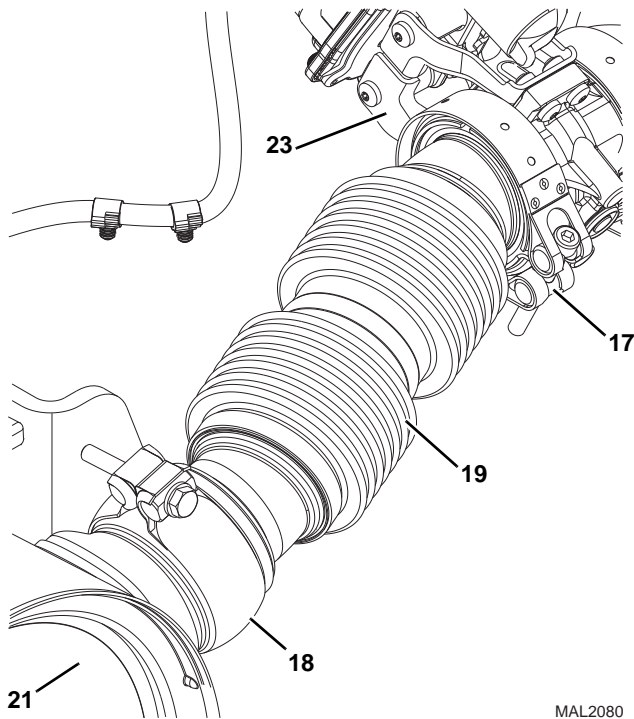
- Remove the DPF muffler assembly (21).

7.7.2 Exhaust System Installation

Note: Keep all clamps AFTER the DPF muffler assembly loose until entire exhaust system is in place.

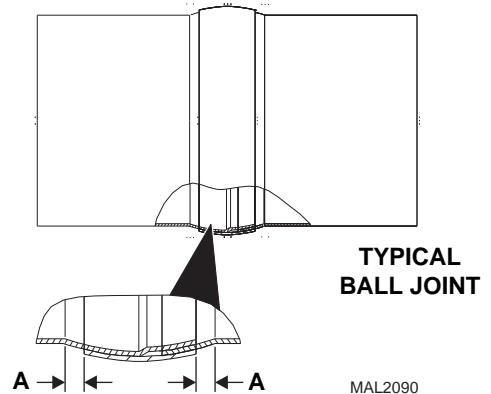
Note: The following exhaust parts MUST be replaced if the DPF muffler assembly is removed from the machine. Flex Pipe (13), Clamps (17 & 18) and Bellows Assembly (19).

- Install the DPF muffler assembly (21) and secure with the four previously removed bolts (20).

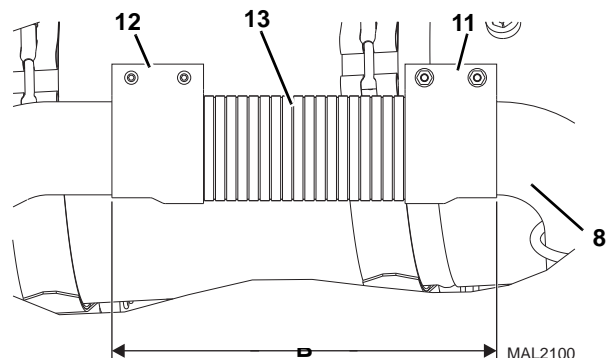


MAL2080

- Install the new bellows assembly (19) between the DPF muffler assembly (21) and the exhaust back pressure valve (23).
- Install new clamp as shown (17) securing the bellows assembly (19) to the exhaust back pressure valve (23). Torque clamp to 9 lb-ft (12,2 Nm).
- Install new ball clamp as shown (18) securing the bellows assembly (19) to the DPF muffler (21). Do Not Tighten.



- Center the ball clamp (18) on the joint between the bellows assembly (19) to the DPF muffler (21) with dimension "A" being within ± 0.08 in (2,03 mm) around the circumference of the bellows assembly. Torque to 23.5-26.5 lb-ft (31,8-49,5 Nm).
- Connect the DPF muffler sensor connections (16).
- Install exhaust pipe (15) and install clamp (14).



- Install new flex pipe (13) and install new clamp (12).
- Install exhaust pipe (8) and new install clamp (11).
- Verify that the flex pipe (13) has not been compressed or stretched and dimension "B" is 12.40 in (315,0 mm).
- Install exhaust pipe (7) and install clamp (10).
- Install exhaust pipe (6) and install clamp (9).
- Install clamps (2, 3, 4 & 5) securing the exhaust pipe sections (6, 7 & 8) to the frame mounted brackets.
- Adjust the muffler and exhaust pipes for proper clearance then tighten all clamps.
- Install the exhaust heat shield (1).
- Properly connect the battery.
- Start engine and check for exhaust leaks at all exhaust connections. Adjust as needed.
- Close and secure the engine cover.



Engine

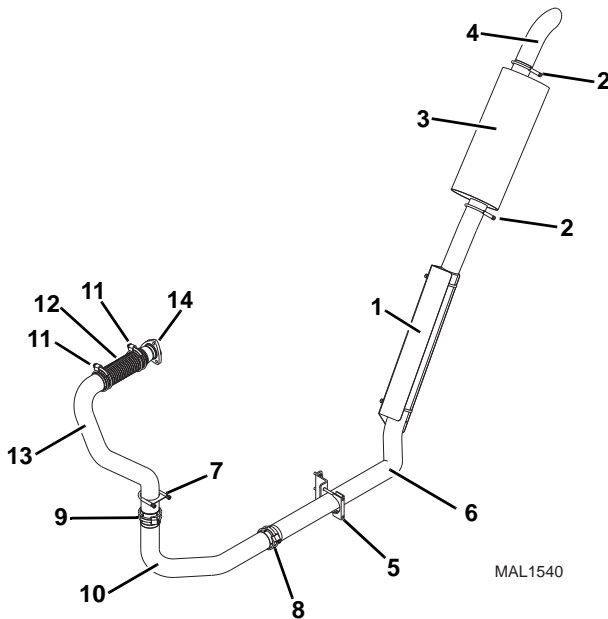
- Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

7.7.3 Exhaust System Removal

S/N MDD00150 & After

S/N SXM00150 & After

- Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
- Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
- Open the engine cover. Allow the system fluids and the exhaust system to cool.
- Properly disconnect the battery.



- Remove the exhaust heat shield (1).
- Loosen and remove both clamps (2) securing the muffler (3) to the frame mounted brackets.
- Remove the tail pipe (4) from the muffler.
- Remove the muffler (3).
- Loosen and remove clamp (5) securing the exhaust pipe (6) to the frame at the bottom rear corner of the engine pod.
- Loosen and remove clamp (7) securing the exhaust pipe (6) to the frame at the side of the engine pod.
- Loosen and remove clamps (8 & 9) from the exhaust pipe (10).

- Loosen and remove clamps (11) from the exhaust flex pipe (12).
- Remove the exhaust pipe (13) and flex pipe (12). Discard the flex pipe.

Note: Removal of the turbo charger heat shields may be required to access exhaust pipe bolts.

- Disconnect and remove the three bolts securing the flange pipe (14) to the turbo charger. Remove the flange pipe from the turbo charger.

7.7.4 Exhaust System Installation

Note: Keep all clamps loosened until entire exhaust system is in place.

Note: The following exhaust part **MUST** be replaced if removed from the machine. Flex Pipe (12).

Note:

- Install the flange pipe (14) with a new seal to the turbo charger.
- Install the new flex pipe (12) and clamps (11) to the flange pipe (14) at the turbo charger.
- Install the exhaust pipe (13) to the flex pipe (12).
- Install clamp (7) securing the exhaust pipe (13) to the frame at the side of the engine pod.
- Install exhaust pipe (10) and secure with clamp (9).
- Install exhaust pipe (6) and secure with clamp (8).
- Install clamp (5) securing the exhaust pipe (6) to the frame at the bottom rear corner of the engine pod.
- Install the muffler (3) to the exhaust pipe (6).
- Install the tail pipe (4) to the muffler (3).
- Install the clamps (2) securing the tail pipe (4), muffler (3) and exhaust pipe (6) to the frame mounted brackets.
- Adjust the muffler, exhaust and tail pipes for proper clearance then tighten all clamps.
- Install the exhaust heat shield (1).
- Properly connect the battery.
- Start engine and check for exhaust leaks at all exhaust connections. Adjust as needed.
- Close and secure the engine cover.
- Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.



7.8 AIR CLEANER ASSEMBLY

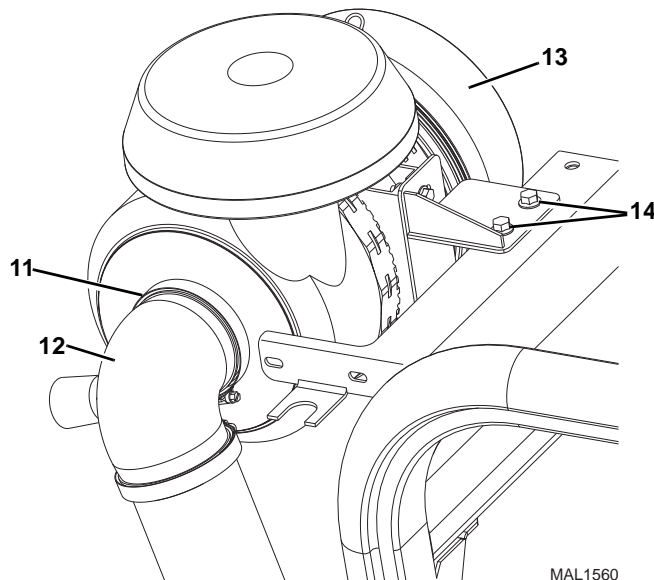
WARNING

NEVER run the engine with only the inner safety element installed.

Note: Refer to the appropriate Operation & Maintenance Manual for your machine for the correct element change procedure.

7.8.1 Air Cleaner Assembly Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.



5. Remove the clamp (11) securing the air intake elbow (12) to the air cleaner assembly (13). Pull the air intake elbow off the air cleaner.
6. Remove the capscrews and nuts securing the air cleaner mounting bracket (14) to the air cleaner mounting plate. Remove the air cleaner assembly.

7.8.2 Air Cleaner Assembly Installation

Note: Apply Loctite® 242™ to the capscrew threads before installation.

1. Install the air cleaner assembly (13) to the cab mounting plate with the previously removed hardware (14).
2. Place the loosened clamp (11) over the air outlet elbow (12) and install elbow on the air cleaner assembly.
3. Adjust and tighten the clamp.
4. Properly connect the battery.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.



Engine

7.9 ENGINE REPLACEMENT

7.9.1 Engine/Transmission Removal

WARNING

NEVER lift the engine/transmission alone; enlist the help of at least one assistant or use a suitable hoist or overhead crane and sling with a minimum lifting capacity of 2000 lb (454 kg).

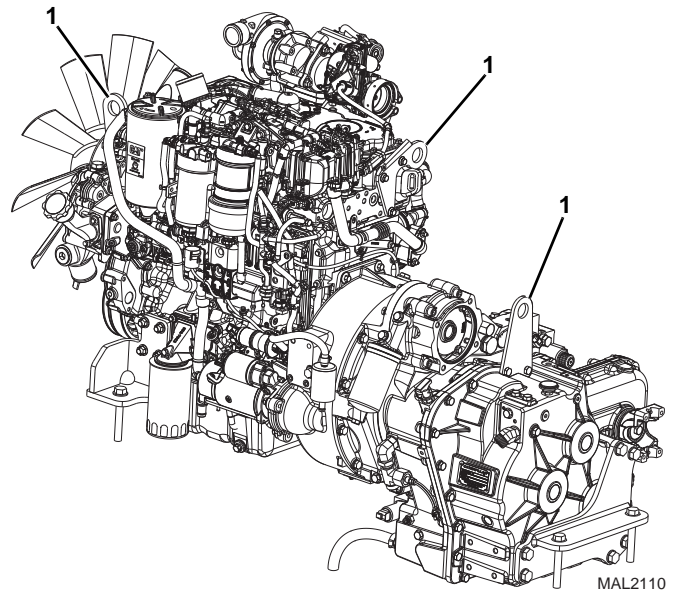
Note: The radiator assembly must be removed from the machine before engine removal. Refer to Section 7.4, “Engine Cooling System.” Several additional components must be removed before engine removal. They will be addressed in the following procedures.

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Thoroughly clean the transmission and surrounding area, including all hoses and fittings, before proceeding.
5. Properly disconnect and remove the battery. Properly disconnect and remove the second battery if equipped.
6. Remove the engine cover. Mark the position of the cover to help with cover adjustment when being reinstalled.
7. Remove the oil pan cover underneath the engine compartment.
8. Remove the transmission-to-axle drive shafts. Refer to Section 5.5.3, “Drive Shaft Removal.”
9. Drain the hydraulic oil reservoir. Refer to Section 8.5.1, “Hydraulic Oil Reservoir Draining.”
10. Drain and remove the radiator assembly. Refer to Section 7.4.3, “Radiator Assembly Replacement.”
11. Remove 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 the engine/transmission, 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/transmission clears the harness during removal.

12. Label and disconnect all electrical wire connections on the engine/transmission.
13. Label and disconnect all hoses on the engine and transmission. Plug and/or cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
14. Label, disconnect and cap the fuel inlet line at the in-line fuel filter.
15. Label, disconnect and cap the two remaining fuel hoses on the engine.
16. **S/N KDE00150 & After**
S/N DHW00150 & After
Remove the DPF muffler assembly. Refer to Section 7.7.1, “Exhaust System Removal.”
17. **S/N MDD00150 & After**
S/N SXM00150 & After
Remove exhaust assembly. Refer to Section 7.7.3, “Exhaust System Removal.”
18. Loosen the clamp on the air suction pipe at the engine turbocharger and pull the air suction tube away from the turbocharger.



19. Use a suitable hoist or overhead crane, secure the engine/transmission with a lifting strap or chain from the front and rear engine lift brackets (1) and to the transmission lift bracket (1).

Note: The transmission lifting bracket is NOT included with the transmission.



20. Remove the four bolts and washers securing the engine/transmission mounts.
21. Slowly lift and pull the engine/transmission out of the machine. Have an assistant ensure that the engine/transmission clears all frame components during removal.
22. Place engine/transmission on a flat, level surface.

7.9.2 Engine/Transmission Installation

1. Secure the engine/transmission with a lifting strap or chain from the front and rear engine lift brackets (1) and to the transmission lift bracket (1). Lift the engine/transmission clear of the ground.

Note: Apply Loctite® 242™ to the engine/transmission mount brackets bolts before installation.

2. Lift the engine/transmission and slowly push and lower into the engine bay. Have an assistant ensure that the engine/transmission clears the frame, hose and harness components during engine installation. Position engine/transmission brackets over the frame mounts.
3. Align the engine/transmission mount holes, install the bolts and lower into place. Torque to 125-140 lb-ft (169-190 Nm).
4. Remove the transmission lift bracket.
5. **S/N KDE00150 & After**
S/N DHW00150 & After
Install the DPF muffler assembly and exhaust. Refer to Section 7.7.2, "Exhaust System Installation."
6. **S/N MDD00150 & After**
S/N SXM00150 & After
Install the exhaust assembly. Refer to Section 7.7.4, "Exhaust System Installation."
7. Install the air suction pipe to the turbocharger and tighten clamp.
8. Uncap and connect the fuel inlet line at the in-line fuel filter.
9. Uncap and connect the two remaining fuel hoses on the engine.
10. Connect all the previously labeled electrical wire connections on the engine/transmission.
11. Uncap and connect all the previously labeled hoses to the engine/transmission. Torque as required.
12. Install both heater hoses to the engine and tighten clamps (if equipped).
13. Install the complete radiator assembly. Refer to Section 7.4.3, "Radiator Assembly Replacement."

14. Fill the hydraulic oil reservoir. Refer to Section 8.5.2, "Hydraulic Oil Reservoir Filling."
15. Install the transmission-to-axle drive shafts. Refer to Section 5.5.5, "Drive Shaft Installation."
16. Install the engine cover and adjust.
17. Install and properly connect the battery.
18. 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.

19. Start the engine and run to normal operating temperature then shut off the engine. While the engine is cooling, check for leaks.
20. Allow the engine to cool. Check the surge tank coolant level, and top off with a mixture of ethylene glycol and water. Replace the surge tank cap.
21. 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.
 - Keep the transmission in (N) NEUTRAL.
22. Obtain and connect an appropriate engine analyzer or tachometer. Check the engine rpm at full throttle.
 23. Purge the hydraulic system of air by operating all boom functions through their entire range of motion several times. Check the hydraulic oil level.
 24. Check for proper operation of all components.
 25. Turn the engine OFF.
 26. Install the oil pan cover underneath the engine compartment.
 27. Close and secure the engine cover.
 28. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.



Engine

7.10 ENGINE INDICATORS

Engine Warning (orange)	Check Engine (red)	Indication Description	Engine Status	Operator Action
ON	ON	When the ignition is turned to the ON position, the indicators will illuminate for 2 seconds and then go OFF. During the indicator check, the after treatment indicators will also be checked.	Key on but engine has yet to be cranked.	If any of the indicators will not illuminate during indicator check, the fault must be investigated immediately.
OFF	OFF	With the engine running, there are no active warnings, diagnostics or events.	Engine is running with no detected faults.	None
Level 1				
ON SOLID	OFF	Should the warning indicator illuminate during engine running, this indicates that an Active diagnostic (Electrical fault) is present.	Engine is running normally but has one or more faults with engine management system.	The fault should be investigated as soon as possible.
Level 2				
FLASH	OFF	Should the warning indicator illuminate and the check engine indicator flash during engine running, this indicates that an active diagnostic is present.	Engine is running but there are active diagnostic or event codes. Derate to engine power may be applied.	Stop the engine and investigate the code.
Level 3				
FLASH	ON SOLID	Level 3 warning if both the warning indicator and the check engine indicator are illuminated, this issue indicates one of the following conditions: <ol style="list-style-type: none"> 1. One or more of the shutdown values for the engine protection strategy has been exceeded. 2. A serious active diagnostic code has been detected. 3. After a short time period, the engine may shut down. 	Engine continues to operate, but the level of importance of the warning has increased. The engine will automatically shut down. If shut down is not enabled, the engine could be damaged if continued to be operated.	Stop the engine immediately. Investigate the fault.



Section 8

Hydraulic System

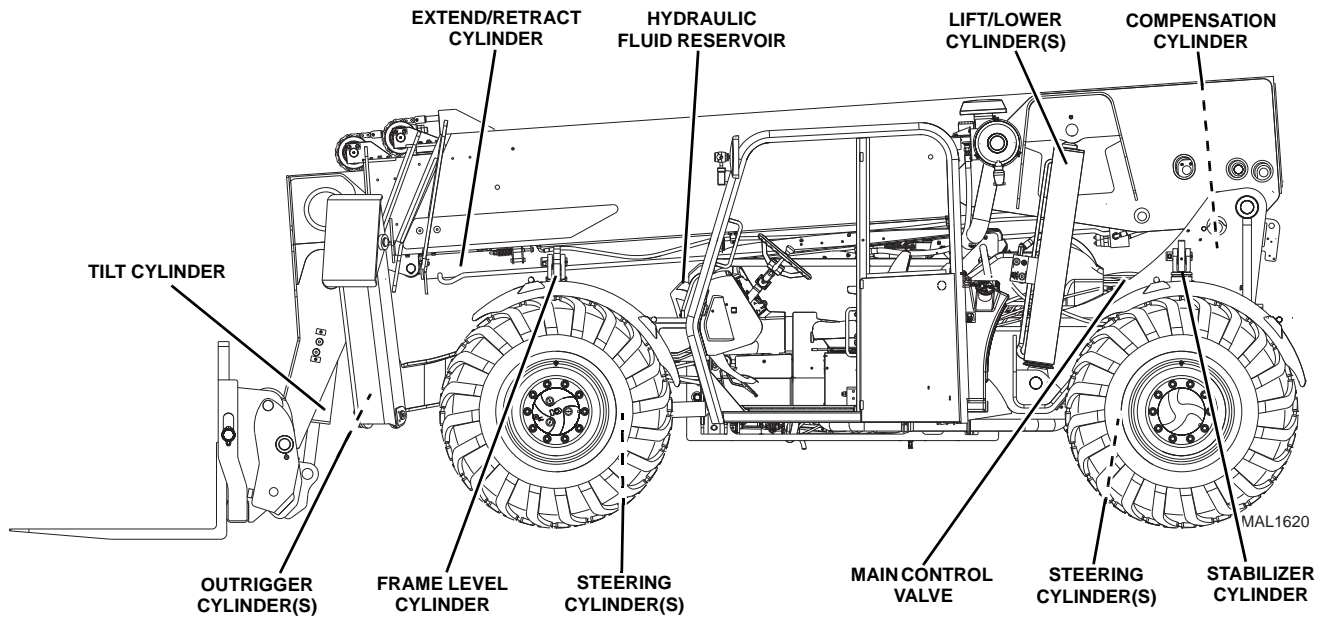
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8.1 HYDRAULIC COMPONENT TERMINOLOGY

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.





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. The temperature of hydraulic fluid increases during the 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.

Note: *Residual pressure may remain in hydraulic cylinders, hoses, valve bodies, components, etc. If the hydraulic lines going to or coming from a component are taut, slowly and cautiously relieve ("bleed off") 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. Sand, grit and other contaminants can damage the finely machined surfaces within hydraulic components. If operating in an exceptionally dirty environment, change filters and inspect the fluid more often. 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.

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," in this manual.

8.3 HYDRAULIC PRESSURE DIAGNOSIS

8.3.1 Pressure Checks and Adjustments

When diagnosing trouble in the hydraulic system, use the hydraulic testing information in Section 8.4.1, "Hydraulic Pressures."

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 control lever in (N) NEUTRAL, level the boom and turn the engine OFF.
2. Locate the proper test port. Install a pressure gauge capable of measuring at least 10% more pressure than that which the circuit being checked operates under.
3. Start the engine. Operate machine functions several times to allow hydraulic oil to reach operating temperature. The hydraulic oil temperature should be a minimum of 130°F (54° C). If a temperature gauge or thermometer is unavailable, the hydraulic oil reservoir should be warm to the touch.
4. Refer to Section 8.4.1, "Hydraulic Pressures," for testing procedures.
5. Fully depress the accelerator pedal if required. Place and hold the joystick in the position needed to operate the particular machine function being checked. Continue holding the joystick in position until pressure readings are taken.
6. Check the pressure gauge reading. It should read as specified in the Pressure Readings column of the charts found in Section 8.4.1, "Hydraulic Pressures." 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.
7. Adjust the relief valve by turning the adjustment screw. Turning clockwise will increase the pressure; turning the screw counterclockwise will decrease the pressure.



Hydraulic System

8. Start the engine and check the pressure again. Turn the engine OFF. If there is pressure reading in the gauge, bleed it off then disconnect or remove the pressure gauge from the machine.

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 the 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 the hydraulic oil level in the reservoir. Oil level should be to the middle of the 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.

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.

8.4.1 Hydraulic Pressures

a. Checking Pressure

1. Start the machine and warm the hydraulic system to operating temperature.
2. Shut off the machine and install a digital or a 5000 psi (345 bar) gauge to the appropriate test port on the hydraulic manifold.
3. Start the machine, run the engine at high idle and bottom the appropriate hydraulic function. Refer to Section 8.4.1, "Hydraulic Pressures," for the correct pressure rating.

b. Adjusting Hydraulic Pressure

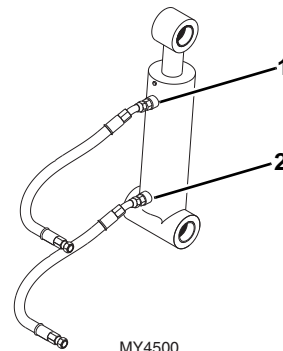
1. Shut the machine off. Remove the cap on the relief (if necessary).

2. Start the machine and loosen the jam nut on the relief. Turn the relief clockwise to increase pressure or counter-clockwise to decrease pressure. Set to the correct pressure.
3. Tighten the jam nut and recheck the pressure at full throttle. If the reading is within specification, shut the machine off, install the safety cap and remove the gauge from the test port.
4. If the proper pressure cannot be set, use the accompanying hydraulic schematic and/or the electrical schematic to help troubleshoot and correct the problem.

8.4.2 Tilt Circuit Port Relief Adjustment

The following procedure is specific to the tilt circuit only and should be performed and verified if the main and/or load sense circuits pressures are in question.

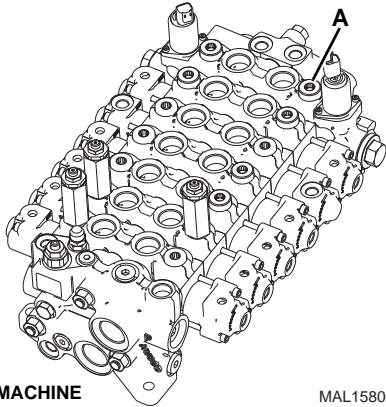
1. Remove any attachment from the quick coupler assembly. Refer to the Operation & Maintenance Manual for attachment removal information.
2. Raise the boom for access to the compensation cylinder.



3. Slowly loosen and remove the retract (1) hose from the compensation cylinder.
4. Install a tee fitting to the retract (1) port of the compensation cylinder. Reconnect the previously removed retract (1) hose to the tee fitting.
5. Slowly loosen and remove the extend (2) hose from the compensation cylinder.
6. Install a tee fitting to the extend (2) port of the compensation cylinder. Reconnect the previously removed extend (2) hose to the tee fitting and cap the open port.
7. Install a digital or a 5000 psi (345 bar) gauge to the retract (1) port tee fitting on the compensation cylinder.
8. Start the machine and warm the hydraulic system to operating temperature.



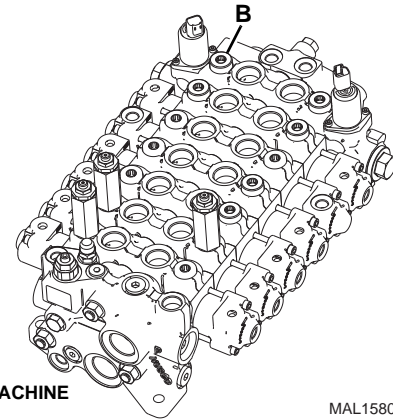
9. Tilt the forks down to allow the tilt cylinder to fully retract.
10. Monitor the gauge and slowly raise the boom. The gauge should read 4100 psi (282 bar).
11. If pressure is correct, proceed to step 14.



FRONT OF MACHINE

MAL1580

12. The relief on the **(A)** port of the main control valve is non-adjustable and must be replaced. Replace and repeat steps 9 and 10.
13. Verify pressure is correct.
14. Shut engine OFF.
15. Remove the digital or the 5000 psi (345 bar) gauge from the retract **(1)** port tee fitting on the compensation cylinder and cap the open port.
16. Remove the cap and install a digital or a 5000 psi (345 bar) gauge to the extend **(2)** port tee fitting on the compensation cylinder.
17. Start the machine and if needed, warm the hydraulic system to operating temperature.
18. Tilt the forks up to allow the tilt cylinder to fully extend.
19. Monitor the gauge and slowly lower the boom. The gauge should read 4100 psi (282 bar).
20. If pressure is correct, proceed to step 23.



FRONT OF MACHINE

MAL1580

21. The relief on the **(B)** port of the main control valve is non-adjustable and must be replaced. Replace and repeat steps 17 and 18.
22. Verify pressure is correct.
23. Shut engine OFF.
24. Slowly remove the gauge, line and tee fitting from the compensation cylinder **(1 & 2)**. Reinstall each hose and torque as required.
25. Install any previously removed attachment.



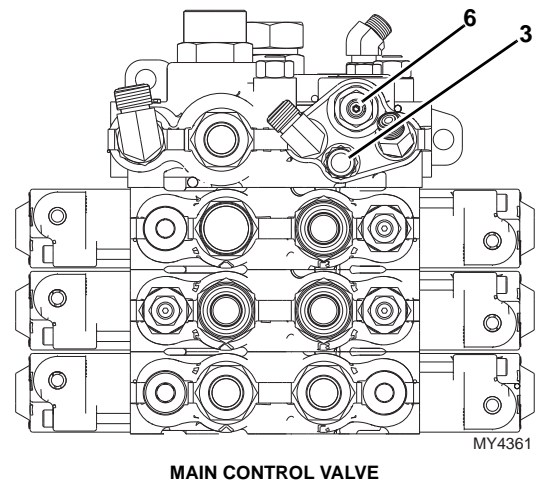
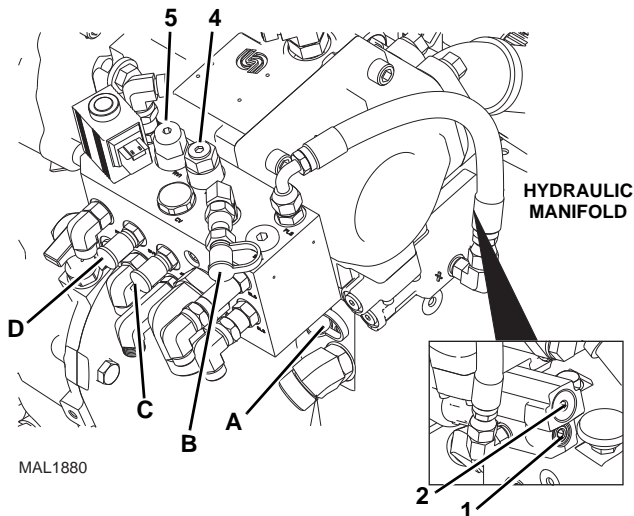
Hydraulic System

c. Pressure Specifications

Note: 1. All pressures must be checked in numerical order.

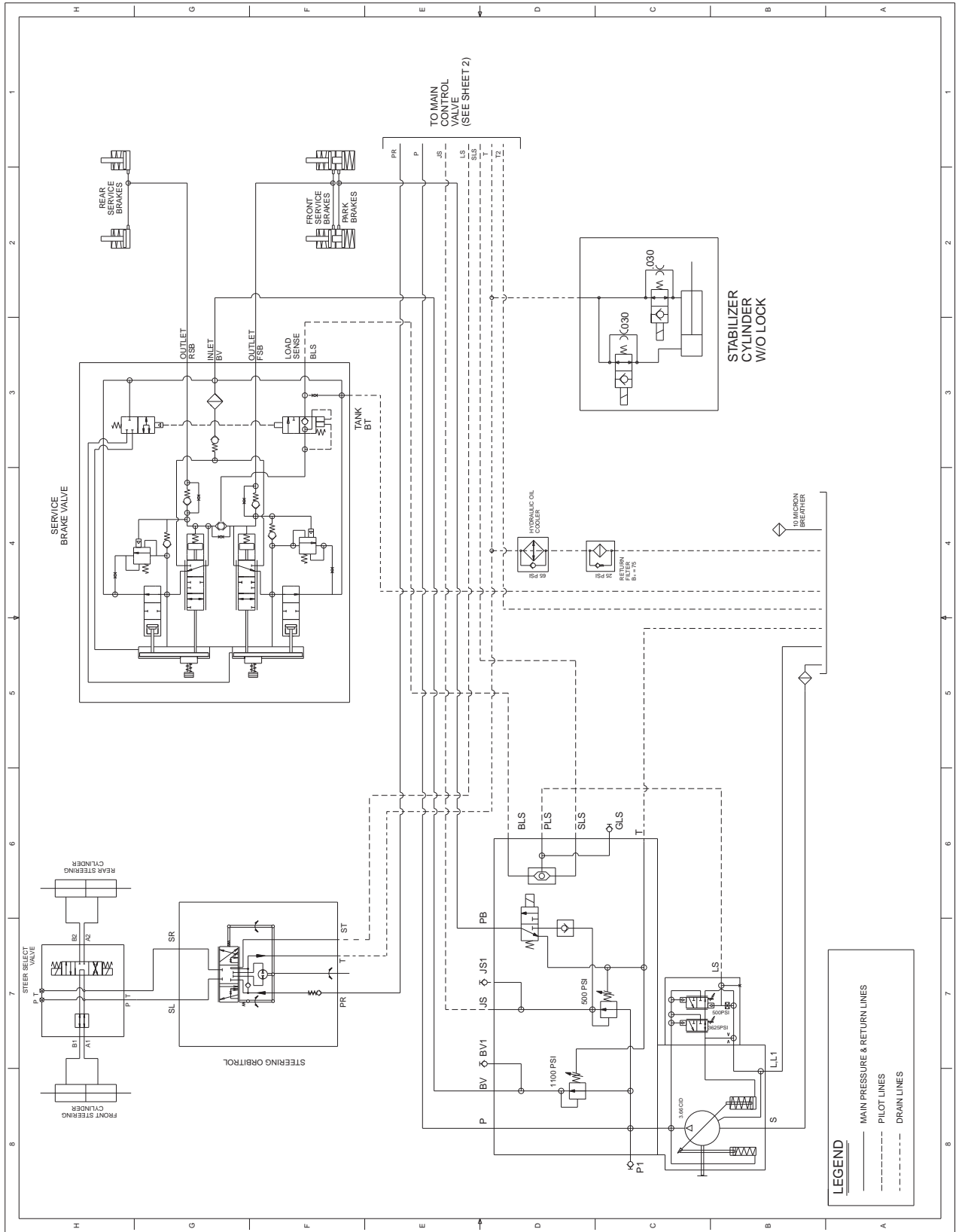
Note: 2. Connect gauge to P1 port, adjust Standby Pressure down to 300 psi (step 2). Adjust Main Compensator Pressure to 3800 psi (step 3). Connect additional gauge to GLS (A) port, stall lift down, adjust Load Sense relief to the setting noted below.

	Hydraulic Circuit	Test Port	Function Used to Test	Adjustment Location	Pressure Range
1	Load Sense Relief	GLS (A)	Bottom Lift Down (See Note 2)	6	3250-3350 psi (224-231 Bar)
2	Standby	P1 (B)	High Idle - No Function	1	500-515 psi (34-35 Bar)
3	Main	P1 (B)	High Idle - Bottom Lift Down	2	3575-3675 psi (246-253 Bar)
4	Pilot	JS1 (C)	High Idle - Bottom Steering, Any Mode	4	500-550 psi (34-38 Bar)
5	Service Brake	BV1 (D)	High Idle - Bottom Steering, Any Mode	5	1050-1150 psi (72-79 Bar)
6	Priority Load Sense	GLS (A)	High Idle - Bottom Steering, Any Mode	3	2375-2475 psi (164-171 Bar)
7	Boom Extend	GLS (A)	High Idle - Bottom Boom Extend	No Adjustment	3250-3350 psi (224-231 Bar)
8	Boom Retract	GLS (A)	High Idle - Bottom Boom Retract	No Adjustment	3250-3350 psi (224-231 Bar)
9	Boom Lift	GLS (A)	High Idle - Bottom Lift Up	No Adjustment	3250-3350 psi (224-231 Bar)
10	Auxiliary Hydraulic	GLS (A)	High Idle - Bottom Auxiliary Function	No Adjustment	3100-3300 psi (214-227 Bar)





8.4.3 Hydraulic Schematic

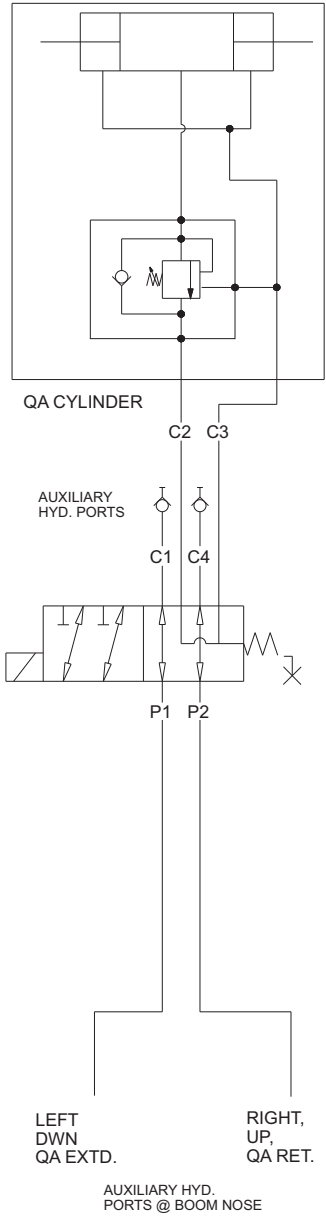


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8.4.3 Hydraulic Schematic (Continued)

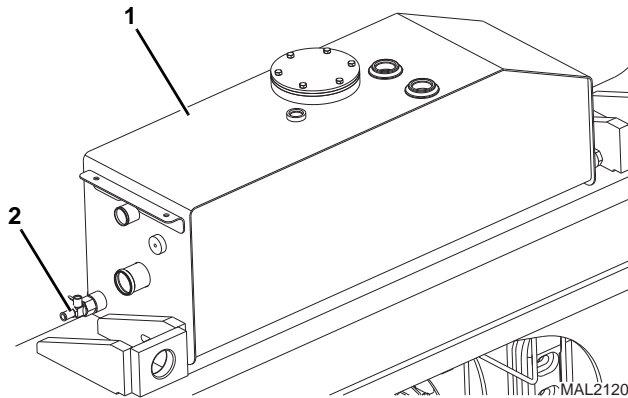
OPTIONAL REMOTE
HYDRAULIC QUICK ATTACH



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8.5 HYDRAULIC RESERVOIR



The hydraulic reservoir (1) is located on the frame between the engine compartment and the cab.

8.5.1 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 control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Attach a drain hose to the hydraulic oil reservoir drain valve (2).

Note: If equipped with extreme cold weather components, the hydraulic oil heating element must be removed to drain the hydraulic tank. Proper precautions must be used to ensure any hydraulic oil being drained is contained and disposed.

6. Open the drain valve on the hydraulic oil reservoir and drain the hydraulic oil into a suitable container.
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. Close the drain valve and remove the drain hose.
8. Wipe up any hydraulic fluid spillage in, on, near and around the machine and the work area.

8.5.2 Hydraulic Oil Reservoir Filling

1. Be sure the reservoir is clean and free of all debris.
2. Install a new hydraulic oil filter.

3. Fill the reservoir with hydraulic oil. Refer to Section 2.4, "Fluids and Lubricant Capacities."
4. Properly connect the battery.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

8.5.3 Hydraulic Oil Reservoir Removal/Installation

If it is determined that the hydraulic oil reservoir must be removed, the hydraulic oil must be drained before the reservoir is removed. Always dispose of hydraulic oil properly.

a. Reservoir Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Drain the hydraulic oil reservoir. Refer to Section 8.5.1, "Hydraulic Oil Reservoir Draining."
6. Label, disconnect and cap all hydraulic hoses attached to the hydraulic oil reservoir. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
7. Remove the bolts securing the hydraulic oil reservoir to the frame.
8. Remove the hydraulic oil reservoir.

b. Disassembly

The hydraulic oil reservoir is a one-piece unit and cannot be disassembled. The hydraulic oil level sight-glass and hydraulic oil filler cap can be removed and reused on the new replacement reservoir. Dispose of the old reservoir according to local regulations concerning hazardous materials disposal.

c. Cleaning and Drying

If contaminated hydraulic oil or foreign material is in the tank, the tank can usually be cleaned.

Note: If a leak is suspected in the hydraulic oil reservoir, contact your local Caterpillar dealer.



To clean the hydraulic oil reservoir:

1. Have a dry chemical (Class B) fire extinguisher near the work area.
2. Remove the hydraulic oil reservoir drain plug, and safely drain any hydraulic oil into a suitable container. Dispose of hydraulic oil properly.
3. Clean the hydraulic oil reservoir with a high-pressure washer, or flush the tank with hot water for five minutes and drain the water. Dispose of contaminated water properly.

d. Inspection

1. Inspect the hydraulic oil reservoir thoroughly for any cracks, slices, leaks or other damage.
2. With the hydraulic oil reservoir removed from the machine, plug all openings except one elbow fitting. Install the elbow fitting, and apply approximately 1-1.5 psi (7-10 kPa) of air pressure through the elbow. Check the reservoir for leaks by applying a soap solution to the exterior and look for bubbles to appear at the cracked or damaged area.

e. Reservoir Installation

1. Place the hydraulic oil reservoir into its original orientation.
2. Secure the hydraulic oil reservoir to the frame with the previous mounting hardware.
3. Uncap and connect the previously labeled hydraulic hoses to their appropriate locations.
4. Install the hydraulic fluid level sight-glass using special designed and drilled capscrews and gaskets.
5. Install hydraulic filter bracket and hydraulic filter.
6. Fill the hydraulic oil reservoir according to specifications. Refer to Section 2.4, "Fluids and Lubricant Capacities."
7. Check the hydraulic oil reservoir for leaks.
8. Properly connect the battery.
9. Close and secure the engine cover.
10. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

8.6 IMPLEMENT PUMP

For internal service instructions contact your local Caterpillar dealer.

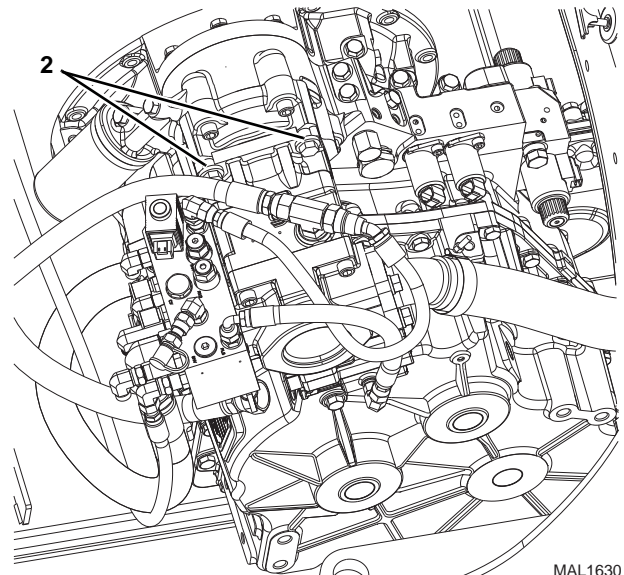
8.6.1 Implement Pump Replacement

a. Pump Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Drain the hydraulic reservoir. Refer to Section 8.5.1, "Hydraulic Oil Reservoir Draining."
6. Thoroughly clean the pump and surrounding area, including all hoses and fittings before proceeding.

Note: Cap all hoses as you remove them to prevent unnecessary fluid spillage.

7. Label, disconnect and cap the hydraulic hoses attached to the pump.



MAL1630

8. Remove the four bolts and lockwashers (2) securing the pump to the transmission (top bolts shown only). Remove the o-ring located between the transmission and the pump. Wipe up any hydraulic oil spillage.

Note: DO NOT disassemble the operating pump. The pump is pre-set from the manufacturer. Any adjustments



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or repairs performed by anyone other than your local Caterpillar dealer could void the warranty.

b. Pump Installation

1. 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.
2. Align the bolt holes with the pump mount holes.
3. Apply Loctite® 242™ to the previously removed bolts.
4. Secure the pump to the transmission with the four bolts and washers. Torque as required.
5. Uncap and connect the previously labeled hydraulic hoses to their appropriate locations.
6. Fill the hydraulic reservoir. Refer to Section 8.5.2, "Hydraulic Oil Reservoir Filling."
7. 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.
8. Check all routing of hoses and tubing for sharp bends or interference with any rotating members. All tube and hose clamps must be tight.
9. Properly connect the battery.
10. 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

Refer to Section 8.3.1, "Pressure Checks and Adjustments."

8.7 CONTROL VALVE

8.7.1 Main Control Valve

The main control valve is mounted at the top of the chassis in front of the mast supports.

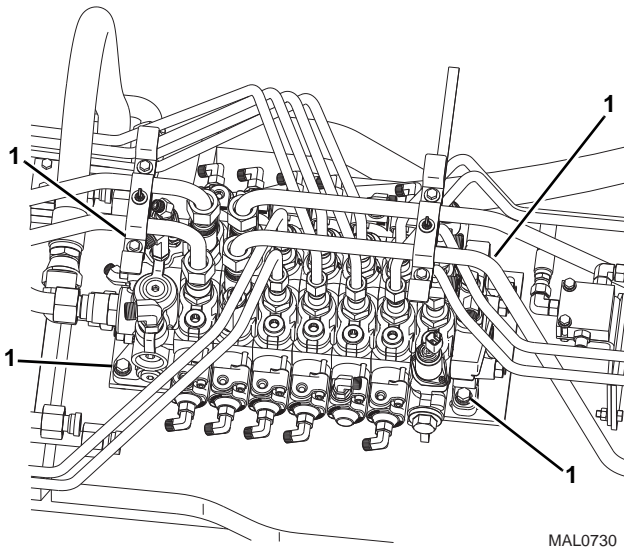
The main control valve assembly consists of individual working sections with their own valve assemblies, each providing a specific hydraulic function.

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 control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Close the engine cover.
6. Remove the main valve cover.
7. Thoroughly clean the main control valve and surrounding area, including all hoses and fittings, before proceeding.
8. Drain the hydraulic fluid reservoir. Refer to Section 8.5.1, "Hydraulic Oil Reservoir Draining."
9. Place a suitable container to catch hydraulic fluid drainage beneath the frame.

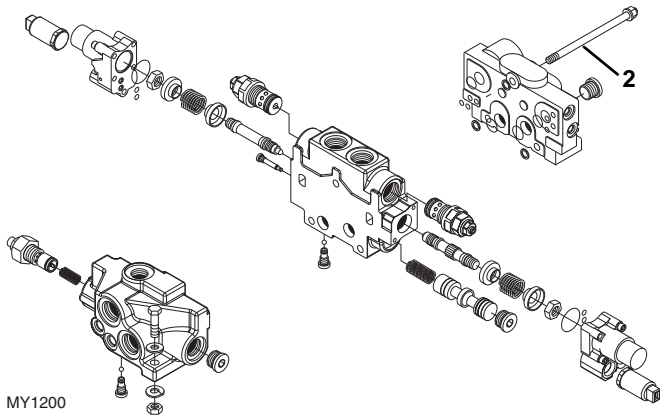
Note: Slowly remove the hydraulic hoses attached to the main control valve to relieve any possible trapped pressure in the hydraulic line.

10. Label, disconnect and cap all the hydraulic hoses, tubes and wires at the main control valve.
11. Wipe up any hydraulic fluid spillage in, on, near and around the machine and the work area.



- Remove the four bolts, washers and nuts (1) securing the main control valve to the frame.

b. Main Control Valve Disassembly



- To disassemble the individual sections of the main control valve, remove the nuts from one end of the tie rods (2). Pull the tie rods out through the sections.
 - 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 recalibration or a new relief valve.

Disassemble each Valve Section

- Carefully separate the load sense outlet section from the lift/lower section.
- Remove the o-rings from between the two sections.

- Carefully separate each remaining sections, being careful not to lose the load sense shuttle ball.
- Remove both end caps from each end of the valve sections then remove each control spool.
- Remove any check valves, compensator valves, anti-cavitation valves or shock valves from individual valve section if equipped.
- 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 trichlorethylene, 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.

8.7.2 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.

- Reassemble any check valves, compensator valves, anti-cavitation valves or shock valves from each individual valve sections if equipped.
- Install the control spool being careful not to nick or scratch the valve section bore or the control spool.
- Install the end caps on each end of the valve section.

Assemble the Main Control Valve.

- Place all three tie rods (2) with the washers and nuts through the end main control valve section.
- Stand the end main control valve section on end.
- Install the proper o-rings and load sense shuttle on the inner face of the end main control valve section. Align the tilt control valve section over the three tie rods and slide onto the end main control valve section.
- Using the proper o-rings and load sense shuttle, repeat step three for the remaining valve sections and lastly the inlet end valve section.



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5. Install the three washers and nuts on the tie rods.
Torque to 30 lb-ft (41 Nm).

e. 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.
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.
4. 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 tube and hose clamps.
5. Fill the hydraulic fluid reservoir. Refer to Section 8.5.2, "Hydraulic Oil Reservoir Filling."
6. Properly connect the battery.
7. Start the 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 main control valve cover.
11. Close and secure the engine cover.
12. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

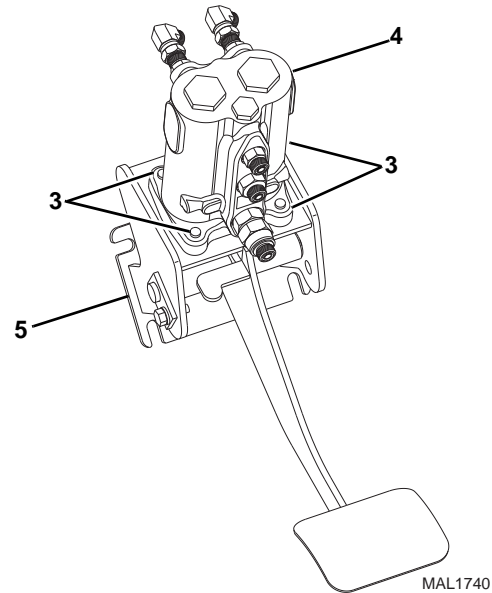
f. Main Control Valve Test

Conduct a pressure check of the hydraulic system in its entirety. Adjust pressure(s) as required. Refer to Section 8.3.1, "Pressure Checks and Adjustments."

8.7.3 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 control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Label, disconnect and cap all hose attached to the service brake valve.
6. Remove the service brake pedal. Refer to Section 4.3.2, "Service Brake Pedal."



7. Remove the four capscrews, four nuts and four lockwashers (3) mounting the service brake valve (4) to the service brake bracket (5).

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



b. Service Brake Valve Installation

1. Install the service brake valve (4) with the four capscrews, four lockwashers and four nuts (3) onto the service brake bracket (5).
2. Install the service brake pedal. Refer to Section 4.3.2, "Service Brake Pedal."

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.

3. Use new oiled o-rings as required. Uncap and connect the previously labeled hoses to the service brake valve.
4. 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.
5. Properly connect the battery.
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 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.

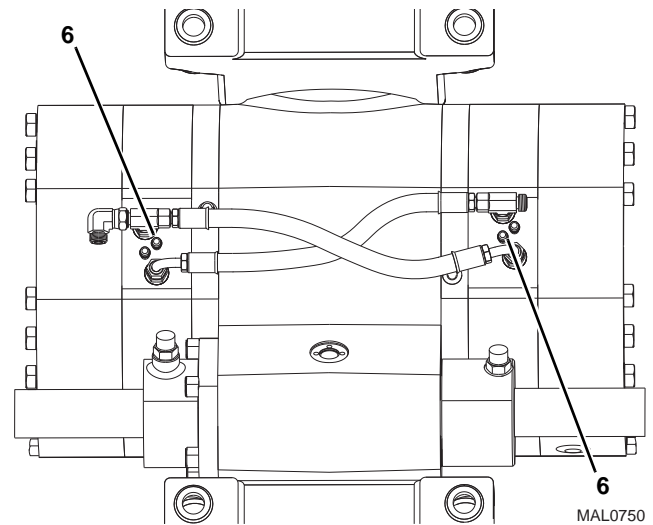
Note: Check for leaks, and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.

8. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
9. Close and secure the engine cover.
10. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

8.7.4 Service 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 located on the front axle (two inner service brake bleeders and two outer park brake bleeders) and two service brake bleeders on the rear axle). Work with an assistant to perform this procedure.

1. Place the travel select lever in (N) NEUTRAL, engage the park brake, and start the engine.



2. Remove the plastic cap from one service brake bleeder (6). Attach one end of a length of transparent tubing over the brake bleeder. Place the other end of this tubing in a suitable transparent container that is partially filled with hydraulic oil. The end of the tubing must be below the oil level in the container.
3. Have the assistant depress the brake pedal. **DO NOT** open the service brake bleeder without holding the tubing firmly on the bleeder. There is pressure at the brakes. Carefully open the bleeder with a 12 mm wrench. Close the service brake bleeder when air bubbles no longer appear in the oil. Release the brake pedal. Remove the tubing from the service brake bleeder.
4. Repeat Steps 2 and 3 for the remaining service brake bleeders.
5. Check hydraulic oil level and add if necessary.
6. Conduct a pressure and function check of the service brake. Refer to Section 8.4.1, "Hydraulic Pressures."



8.7.5 Service Brake Test

This procedure is used in order to determine if the service brake is functional. This procedure is not intended to measure the maximum brake performance. The brake holding torque that is required to sustain an engine torque at a specific engine rpm varies depending on the machine configuration. The variations are the differences in the engine settings, power train efficiency and in the brake holding ability, etc.

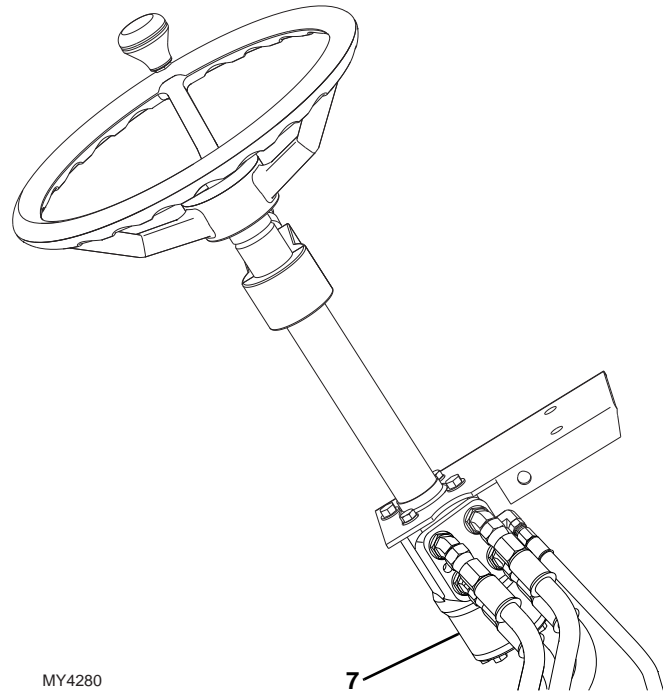
Conduct the following service brake test on a dry level surface, clear of any personnel and/or obstacles.

1. Place the travel select lever in (N) NEUTRAL, engage the park brake, and start the engine.
2. Raise the boom to a travel position.
3. Depress the service brake, disengage the parking brake and place the travel select lever in third gear forward.
4. Smoothly and controllably depress the throttle pedal.

Note: Do Not hold the accelerator pedal in the fully depressed position for more than ten seconds. Damage to the power train could occur.

5. Smoothly and controllably fully release the throttle pedal.
6. The machine should remain stationary during the test.
7. If the machine does not remain stationary during this test, contact the local Caterpillar dealer for proper service.
8. Engage the park brake, place the travel select lever in (N) NEUTRAL, lower the boom and shut engine OFF.

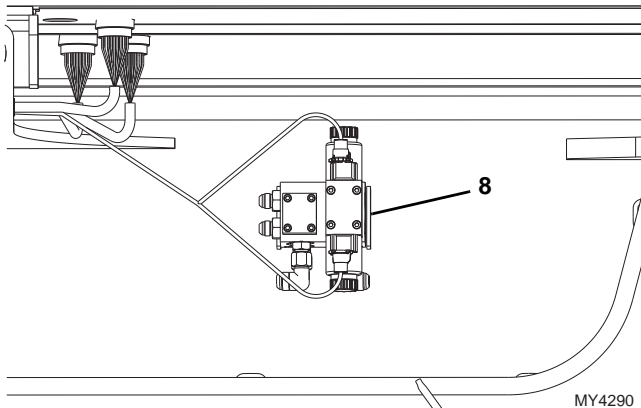
8.7.6 Steering Orbitrol Valve



The steering orbitrol valve (7) 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 4.3.1, "Steering Column and Orbitrol Valve."



8.7.7 Steer Select Valve



The machine can be used in the front-wheel, four-wheel or crab steering mode. The steer select valve (8) controls the direction of hydraulic fluid flow to the steering cylinder mounted on each axle. The steer select valve is attached to a mounting plate under the frame near the left front corner of the cab.

Verify the correct operation of the steer select valve solenoids before considering replacement of the valve. Refer to Section 9.5, "Electrical System Schematics," and Section 9.12, "Display Monitor/Gauge." The housing of the steer select valve is not serviceable and must be replaced if defective.

a. Steer Select Manifold and Valve Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Label, disconnect and cap the hydraulic hoses and the electrical plugs connected to the steering select valve.
6. Remove the bolts holding the steer select valve to the mounting plate on the frame.
7. Remove the steer select manifold with the attached steer select valve from the machine. Wipe up any hydraulic fluid spillage in, on, near and around the machine.

b. Steer Select Manifold and 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 cartridges from the steer select housing.
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 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 secondary function manifold.

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 and cartridges in the steer select housing.
8. Attach the steer select valve to the manifold using four new, oiled o-rings and the four socket head capscrews.

c. Steer Select Valve and Manifold Installation

1. Install the steer select valve to the mounting plate under the left front side of the frame using the two bolts.
2. Connect all the 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.
5. 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.



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6. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.
7. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

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. Close and secure the engine cover.
10. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

d. Steering Test

Refer to Section 8.4.1, “Hydraulic Pressures.”

1. Conduct a pressure check of the steering hydraulic circuit.
2. Check each steering mode for proper function.

8.8 HYDRAULIC CYLINDERS

8.8.1 General Cylinder Removal Instructions

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 control lever in (N) NEUTRAL, engage the park brake, shut the engine OFF and chock wheels.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Label, disconnect and cap or plug hydraulic hoses in relation to the cylinder.
6. Attach a suitable sling to an appropriate lifting device and to the cylinder. Make sure the device used can actually support the cylinder.
7. Remove the lock bolt and/or any retaining clips securing the cylinder pins. Remove the cylinder pins.
8. Remove the cylinder.
9. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.

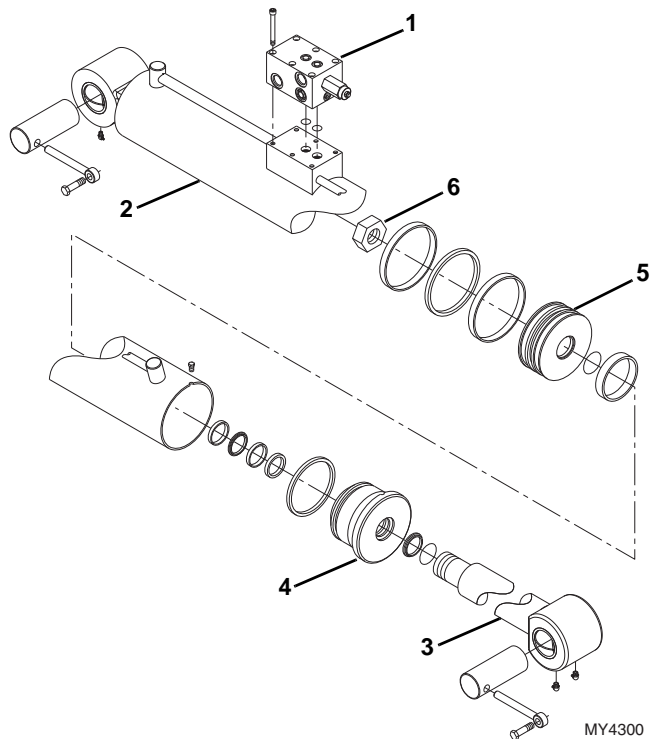
a. General Cylinder Disassembly

1. Clean the cylinder with a suitable cleaner before disassembly. Remove all dirt, debris and grease from the cylinder.
2. 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.



3. If applicable, remove the counterbalance valve (1) from the side of the cylinder barrel (2).

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.

4. Extend the rod (3) 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.

5. Using a pin spanner wrench, unscrew the head gland (4) from the tube (2). 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, 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.

6. Carefully pull the rod assembly (3) along with the head gland (4) out of the cylinder barrel.
7. 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.
8. Remove the set screw from the piston head (5).
9. If equipped, remove the piston head (5) mounting nut (6).

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 the area of the bonded parts. Wipe off any hydraulic oil, then heat the part(s) uniformly to break the bond. A temperature of 300-400° F (149-204° C) will destroy the bond. Avoid overheating, or the parts may become distorted or damaged. Apply sufficient torque for removal while the 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.

10. Remove the piston head (5) from the rod (3) and carefully slide the head gland (4) off the end of the rod.
11. Remove all seals, back-up rings and o-rings from the piston head and all seals, back-up 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.

b. Cylinder Cleaning Instructions

1. Discard all seals, back-up rings and o-rings. Replace with new items from seal kit to ensure proper cylinder function.
2. 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 Loctite® Cleaner prior to reassembly.

8.8.2 Cylinder Inspection

1. 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.
2. Remove light scratches on the piston, head gland, rod or inner surface of the cylinder barrel 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.
3. Check the piston rod assembly for run-out. If the rod is bent, it must be replaced.

c. General Cylinder Assembly Instructions

1. Use the proper tools for specific installation tasks. Clean tools are required for installation.
2. Install new seals, back-up rings and o-rings on the piston and new seals, back-up 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.

3. 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.

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. Loctite® 243™ and install the set screw in the piston head. Refer to Section 8.8.5, "Cylinder Torque Specifications" for torque specifications for the piston head and the set screw.



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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 8.8.5, "Cylinder Torque Specifications" for torque specifications for the head gland.
8. If applicable, install new counter balance valve into block on the cylinder barrel.

d. General Cylinder Installation

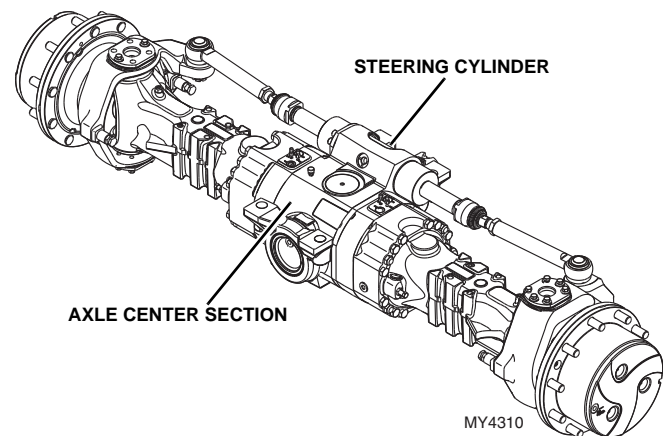
1. Grease the bushings at the ends of the hydraulic cylinder. Using an appropriate sling, lift the cylinder into its mounting position.
2. Align cylinder bushing and install pin, lock bolt or retaining clip.
3. Connect the hydraulic hoses in relation to the labels or markings made during removal.
4. Before starting the machine, check fluid level of the hydraulic fluid reservoir and if necessary fill to full mark with hydraulic oil.
5. Properly connect the battery.
6. Start the machine and run at low idle for about one minute. Slowly activate hydraulic cylinder function in both directions allowing cylinder to fill with hydraulic oil.
7. Inspect for leaks and check level of hydraulic fluid in reservoir. Add hydraulic fluid if needed. Shut the engine OFF.
8. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
9. Close and secure the engine cover.
10. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

8.8.3 Cylinder Pressure Checking

Attach a 5000 psi (345 bar) gauge to the test port on the P1 port on the hydraulic manifold to check the system pressure. For more information, refer to Section 8.4.1, "Hydraulic Pressures."

Note: If a hydraulic cylinder pressure is greater than the main control valve pressure, increase the main control valve pressure by adjusting the main relief. Generally, one half turn clockwise will be adequate to check an individual circuit. Activate the circuit and if pressure is obtained turn the main relief counter clockwise one half turn. Re-check the main relief setting and adjust if necessary.

8.8.4 Steering Cylinders



The steer cylinder is attached to each axle center housing. Steer cylinder service instructions are provided in the following publications:

- Service Manual (31200240)
- Parts Manual (P/N 31200724)



8.8.5 Cylinder Torque Specifications

a. Lift/Lower Cylinder

	Head	Nut	CB Valve	CB Cap Screw
TL1055C, TL1255C	120 lb-ft (163 Nm)	2682 lb-ft (3636 Nm)	45-50 lb-ft (61-67 Nm)	35 lb-ft (47 Nm)

b. Extend/Retract Cylinder

	Head	Nut	CB Valve (Large)	CB Valve (Small)
TL1055C, TL1255C	100 lb-ft (135 Nm)	1376 lb-ft (1866 Nm)	110 lb-ft (149 Nm)	33 lb-ft (45 Nm)

c. Tilt Cylinder

	Head	Nut	CB Valve
TL1055C, TL1255C	550-600 lb-ft (746-814 Nm)	2200-2500 lb-ft (2982-3389 Nm)	40-45 lb-ft (54-61 Nm)

d. Compensation Cylinder

	Head	Nut
TL1055C	400-500 lb-ft (542-678 Nm)	2900-3100 lb-ft (3932-4203 Nm)
TL1255C	500-600 lb-ft (678-814 Nm)	

e. Frame Level Cylinder

	Head	Nut	Check Valve
TL1055C, TL1255C	300-400 lb-ft (407-542 Nm)	750-800 lb-ft (1017-1085 Nm)	20-22 lb-ft (27-30 Nm)

f. Stabilizer Cylinder

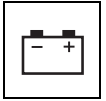
	Head	Nut	Solenoid	Solenoid Nut
TL1055C, TL1255C	300-400 lb-ft (407-542 Nm)	750-800 lb-ft (1017-1085 Nm)	20-22 lb-ft (27-30 Nm)	2.5 lb-ft (3,3 Nm)

g. Outrigger Cylinder

	Head	Nut	Check Valve
TL1055C, TL1255C	300-400 lb-ft (407-542 Nm)	2350-2600 lb-ft (3186-3525 Nm)	30-35 lb-ft (41-47 Nm)



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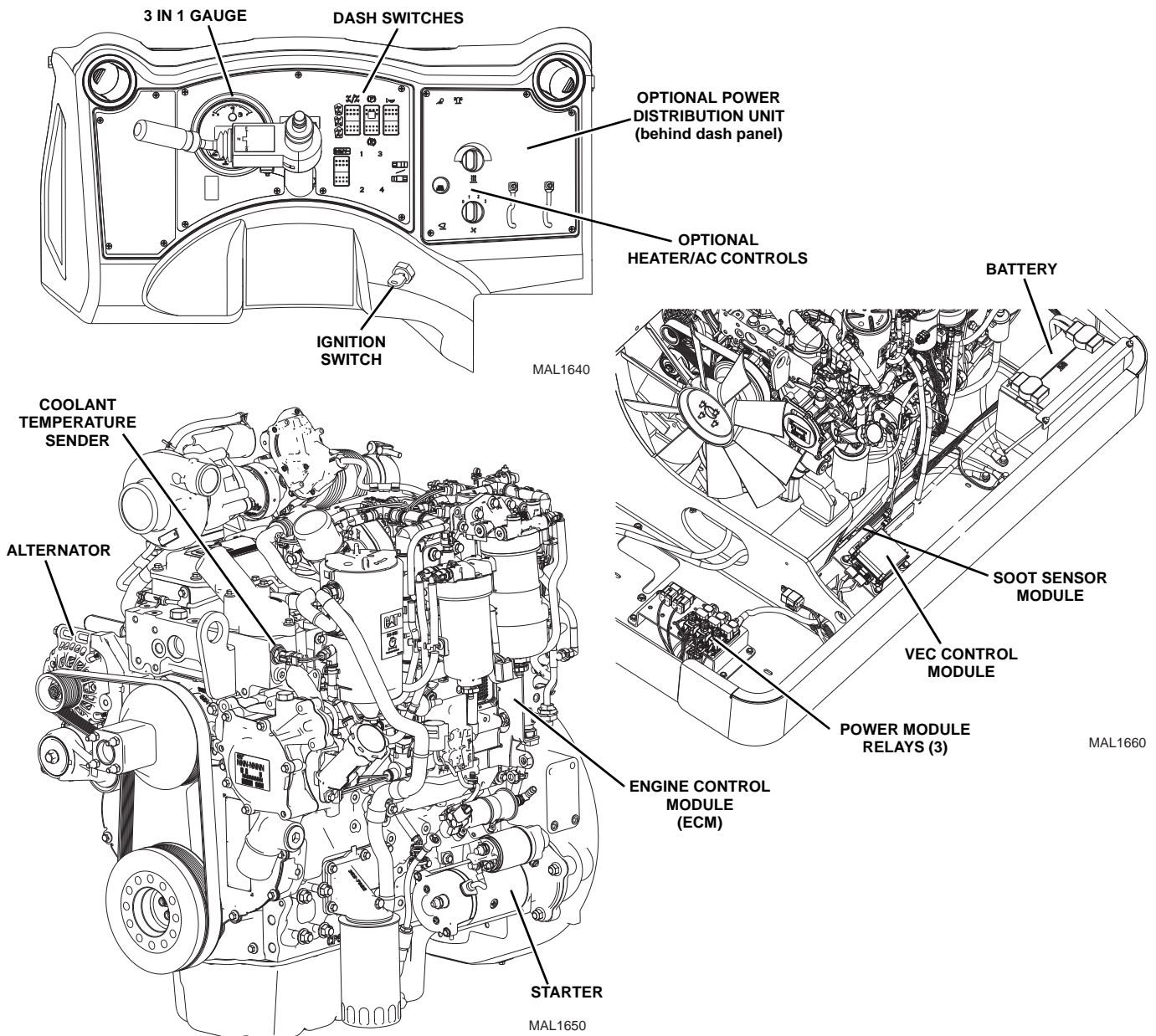
Electrical System

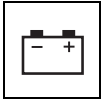
9.1 ELECTRICAL COMPONENT TERMINOLOGY

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

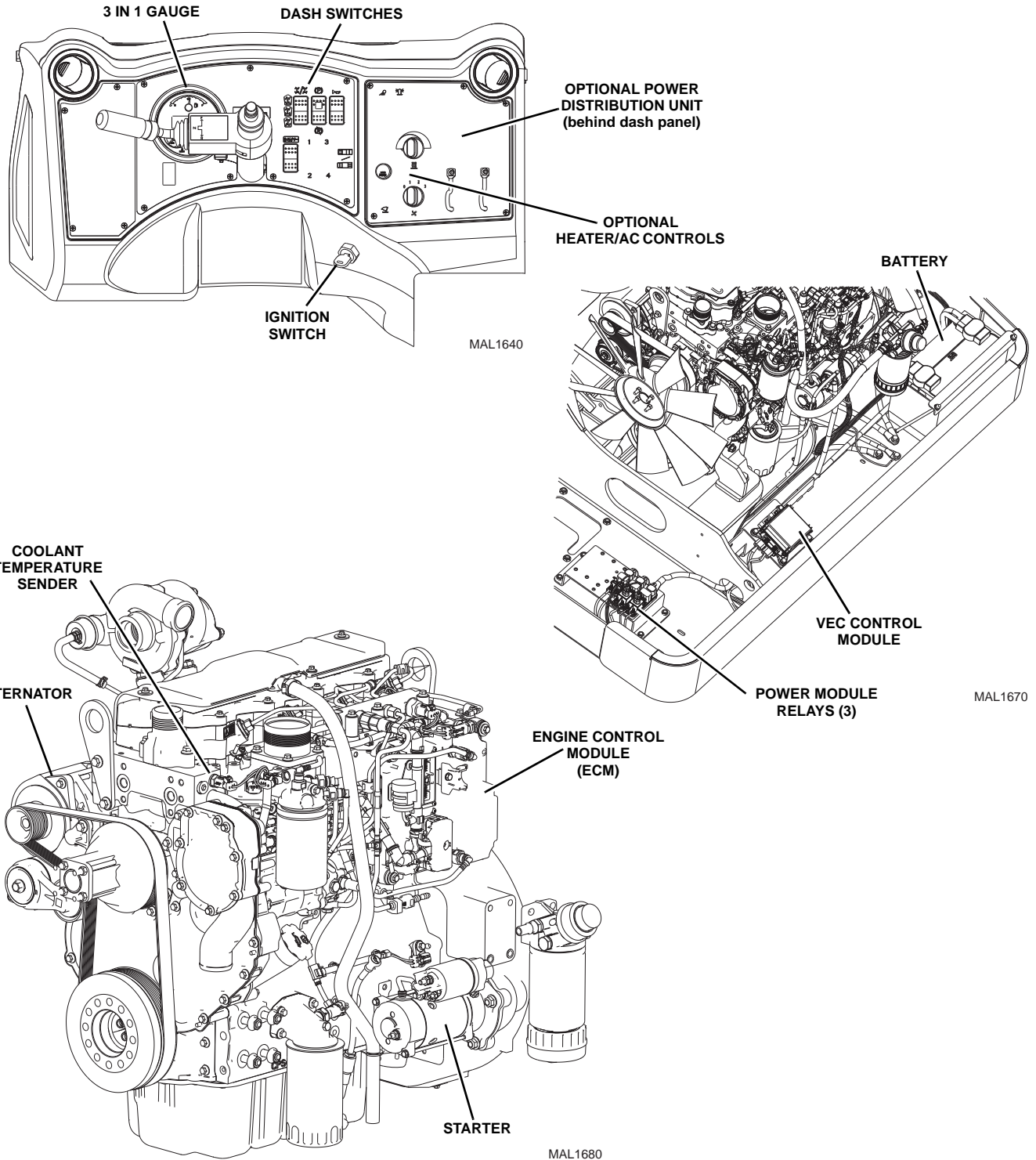
S/N KDE00150 & After
S/N DHW00150 & After





9.1.2 General Overview

S/N MDD00150 & After
S/N SXM00150 & After





Electrical System

9.2 SPECIFICATIONS

Electrical system specifications are listed in Section 2, "General Information and Specifications."

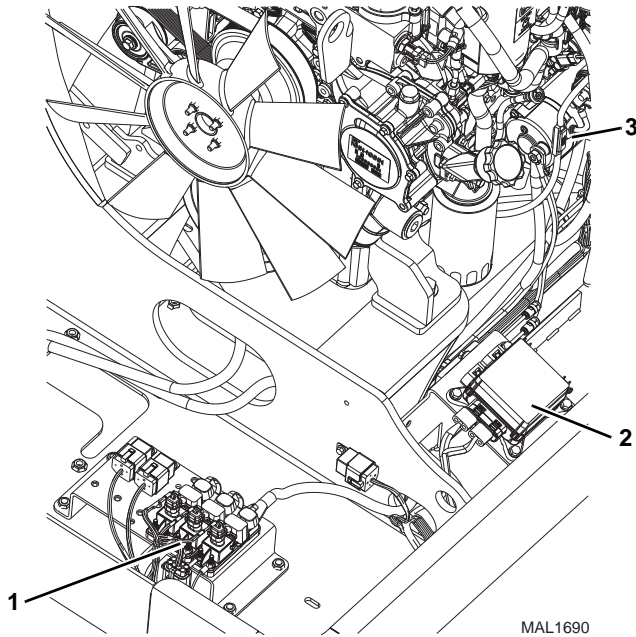
9.3 SAFETY INFORMATION

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

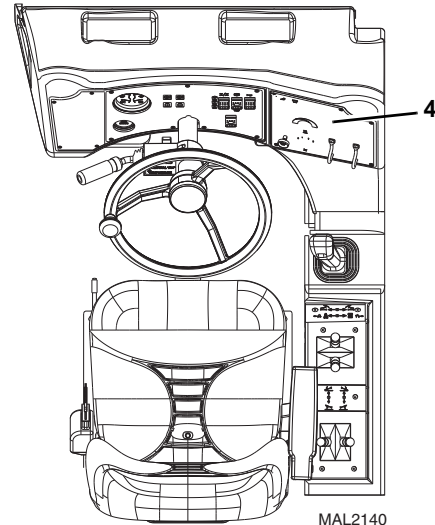
9.4.1 Engine Compartment



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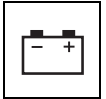
The starter relays (1), VEC control module (2) and 150 amp in-line fuse (3) are located in the engine compartment.

9.4.2 Cab

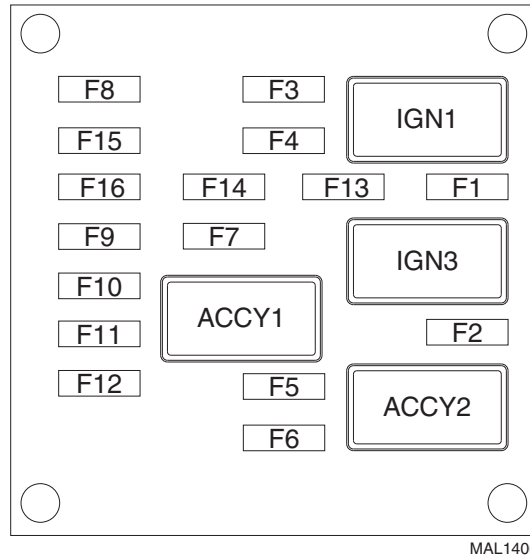


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The optional power distribution unit is located in the cab. For access, remove the screws securing the load chart panel (4) to the dash.



9.4.3 Power Distribution Unit (VEC)



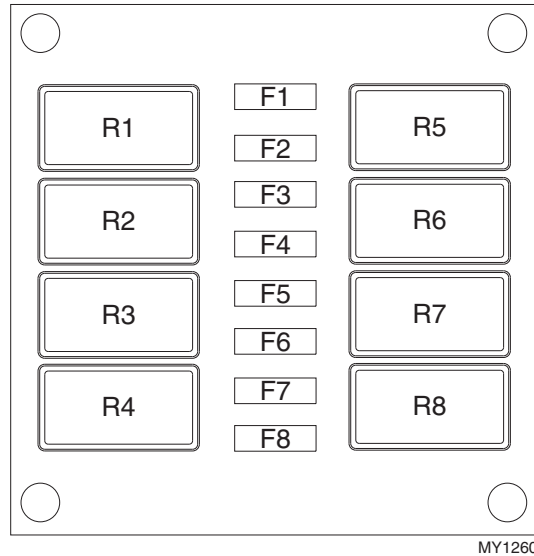
Connector Legend

No.	Function	Amp Rating
F1	Trans/Park Brake Power	15
F2	Alternator Excite	5
F3	Engine ECU Ignition Power	10
F4	Gauge Power	10
F5	Spare Accessory Power	15
F6	Auxiliary Electric Power	10
F7	Horn Power	15
F8	Spare Battery Power	25
F9	Engine ECU Battery Power	25
F10	Steer/Frame Level Power	10
F11	Rear Axle Stabilizer/Tilt Power	10
F12	Key Battery Power	15
F13	Options Power 3	20
F14	Options Power 4	20
F15	Options Power 1	20
F16	Options Power 2	20
IGN1	Ignition 1	
IGN 2	Ignition 2	
ACCY1	Accessory 1	
ACCY2	Accessory 2	



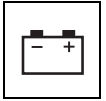
Electrical System

9.4.4 Optional Power Distribution Unit (VEC)



Connector Legend

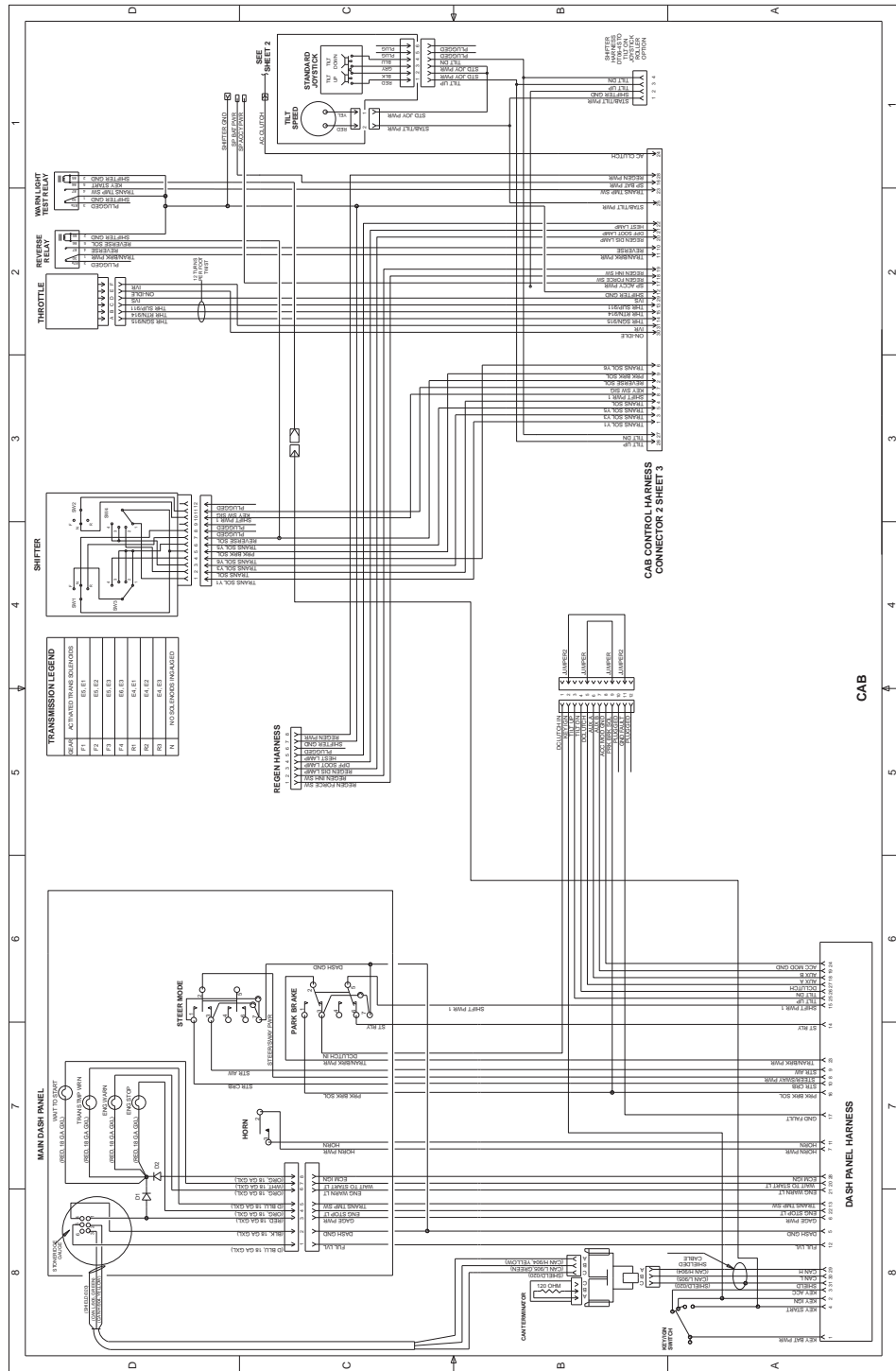
No.	Function	Amp Rating
F1	Wiper	20
F2	Option	15
F3	Option	15
F4	Option	15
F5	Heater	20
F6	Lights	30
F7	Beacon	10
F8	Dash Fan	10
R1	Wiper	
R2	Heater Blower	
R3	Auxiliary Electric 1	
R4	Auxiliary Electric 2	
R5	Option	15
R6	Option	25
R7	Lights	
R8	Beacon/Fan	



9.5 ELECTRICAL SYSTEM SCHEMATICS

9.5.1 S/N KDE00150 & After S/N DHW00150 & After

a. Cab Schematic

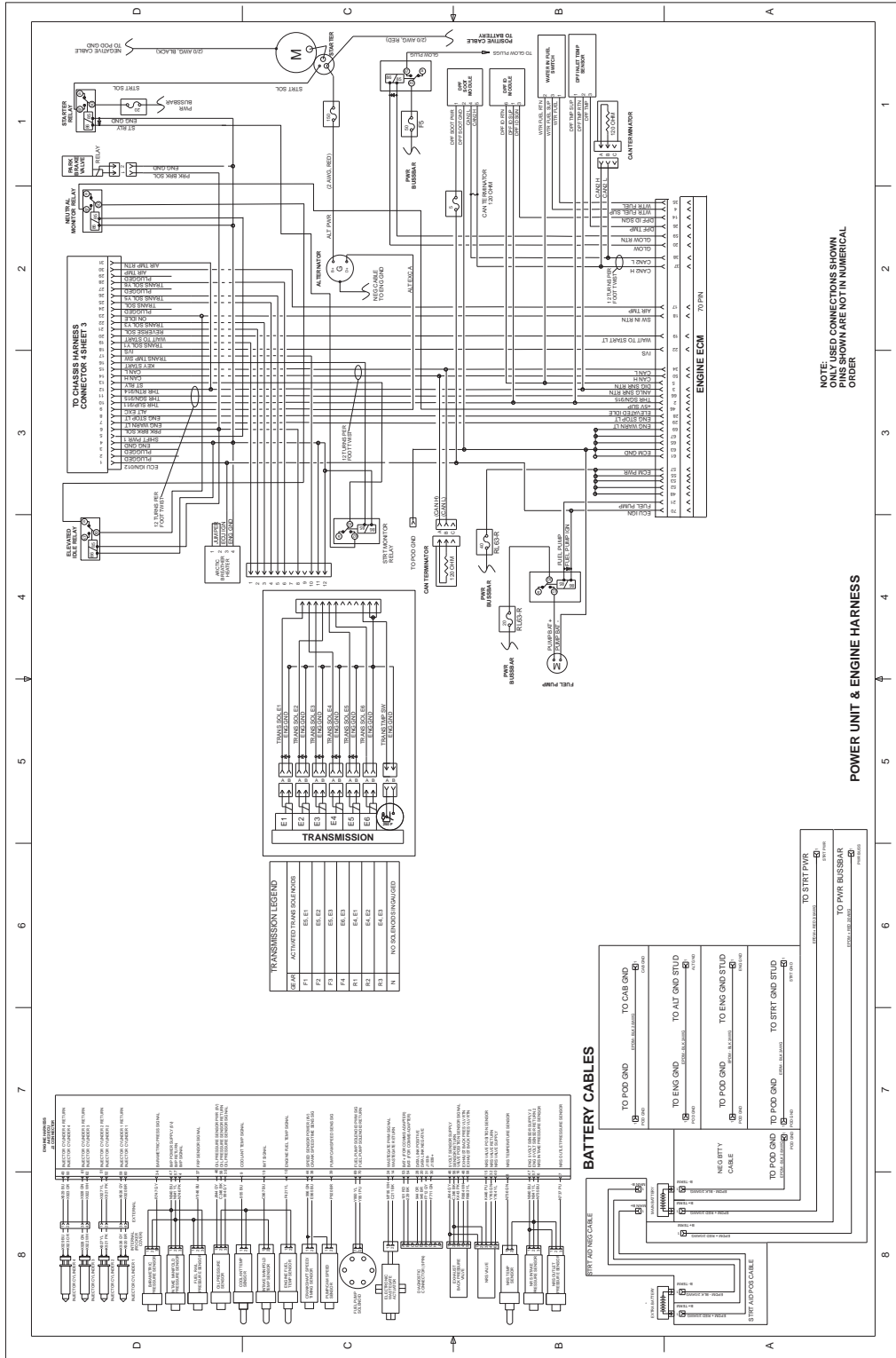


MAL1701G

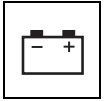


Electrical System

d. Power Unit & Engine Schematic

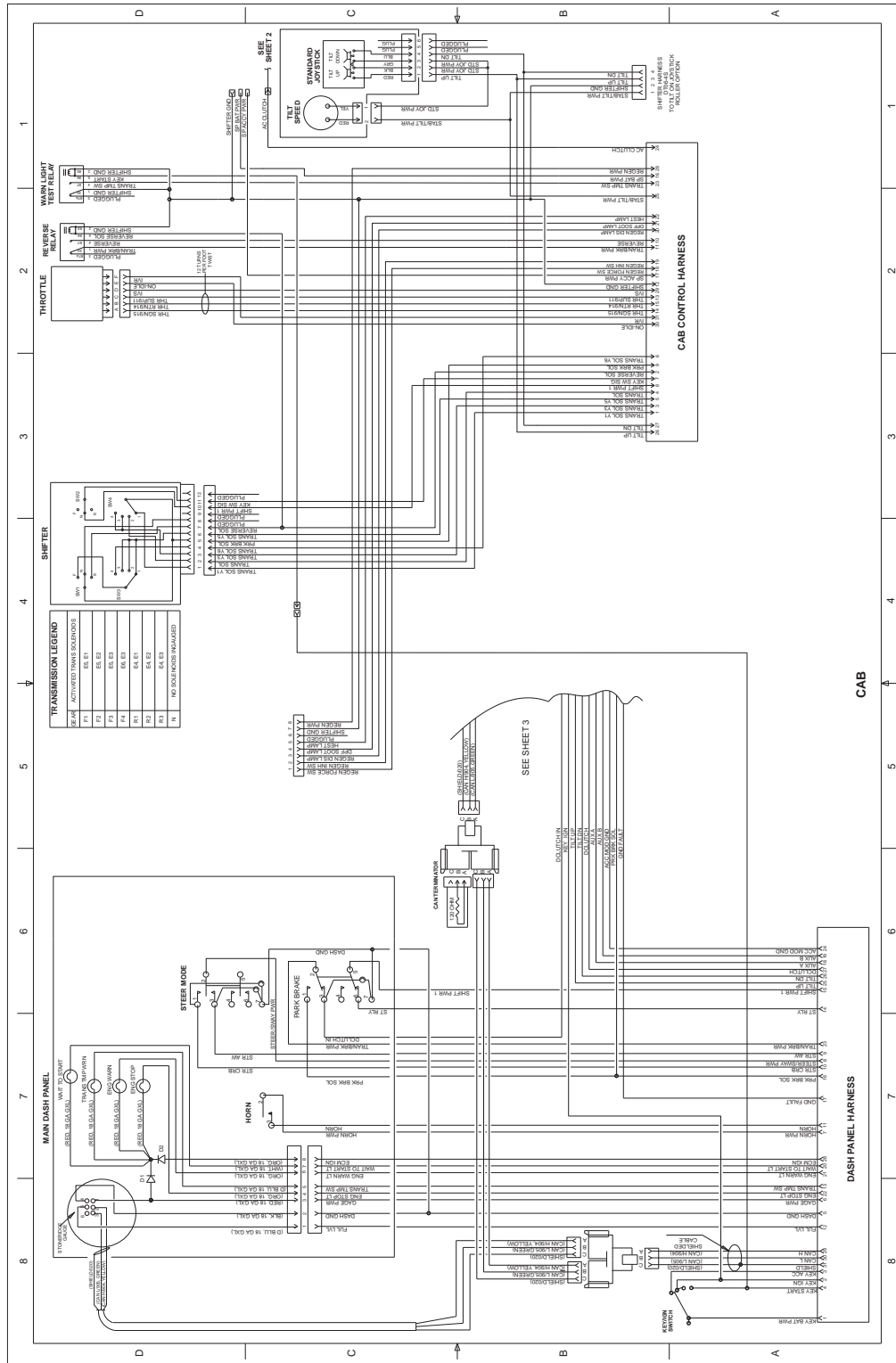


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9.5.2 S/N MDD00150 & After
S/N SXM00150 & After

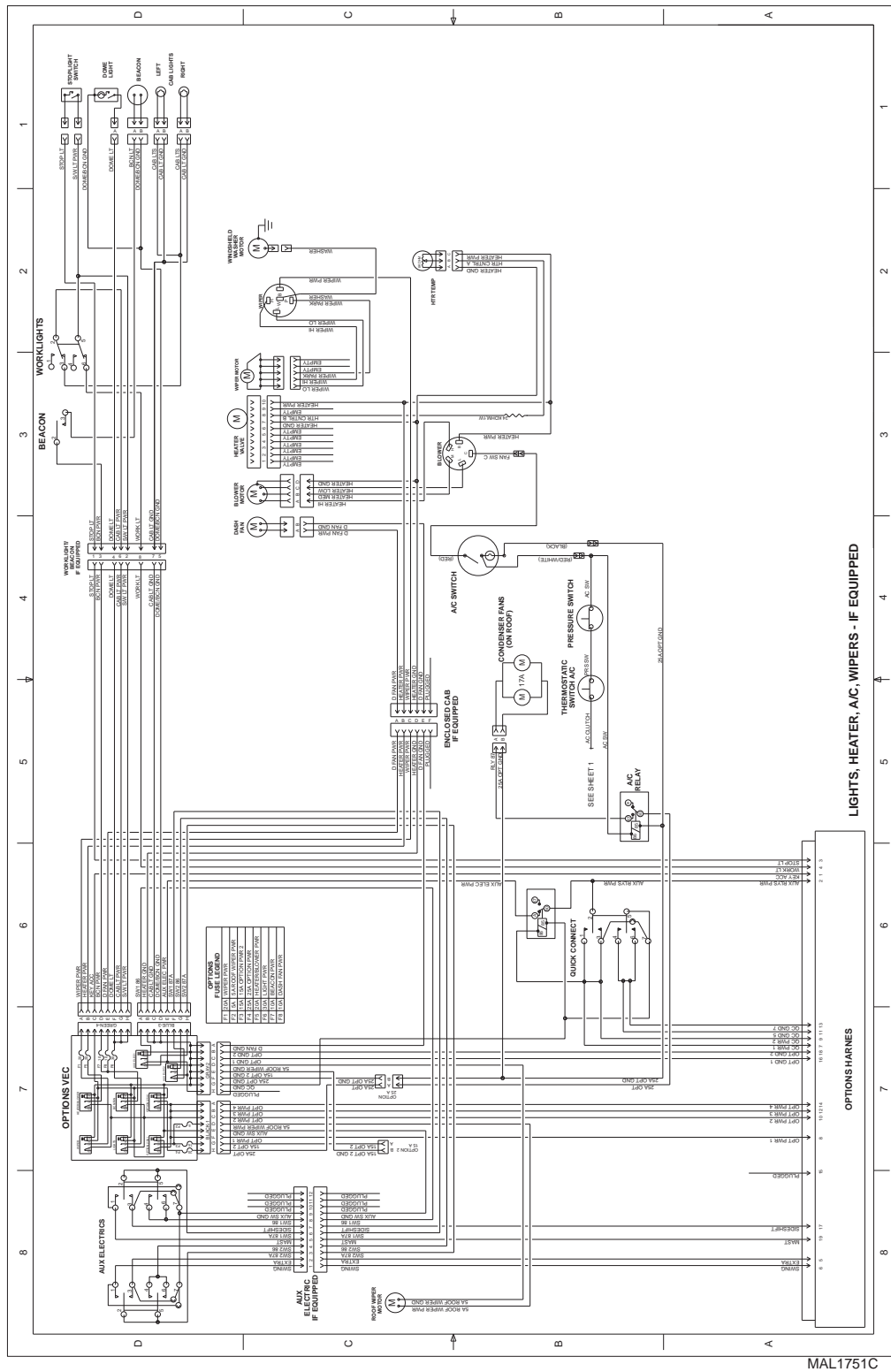
a. Cab Schematic

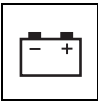




Electrical System

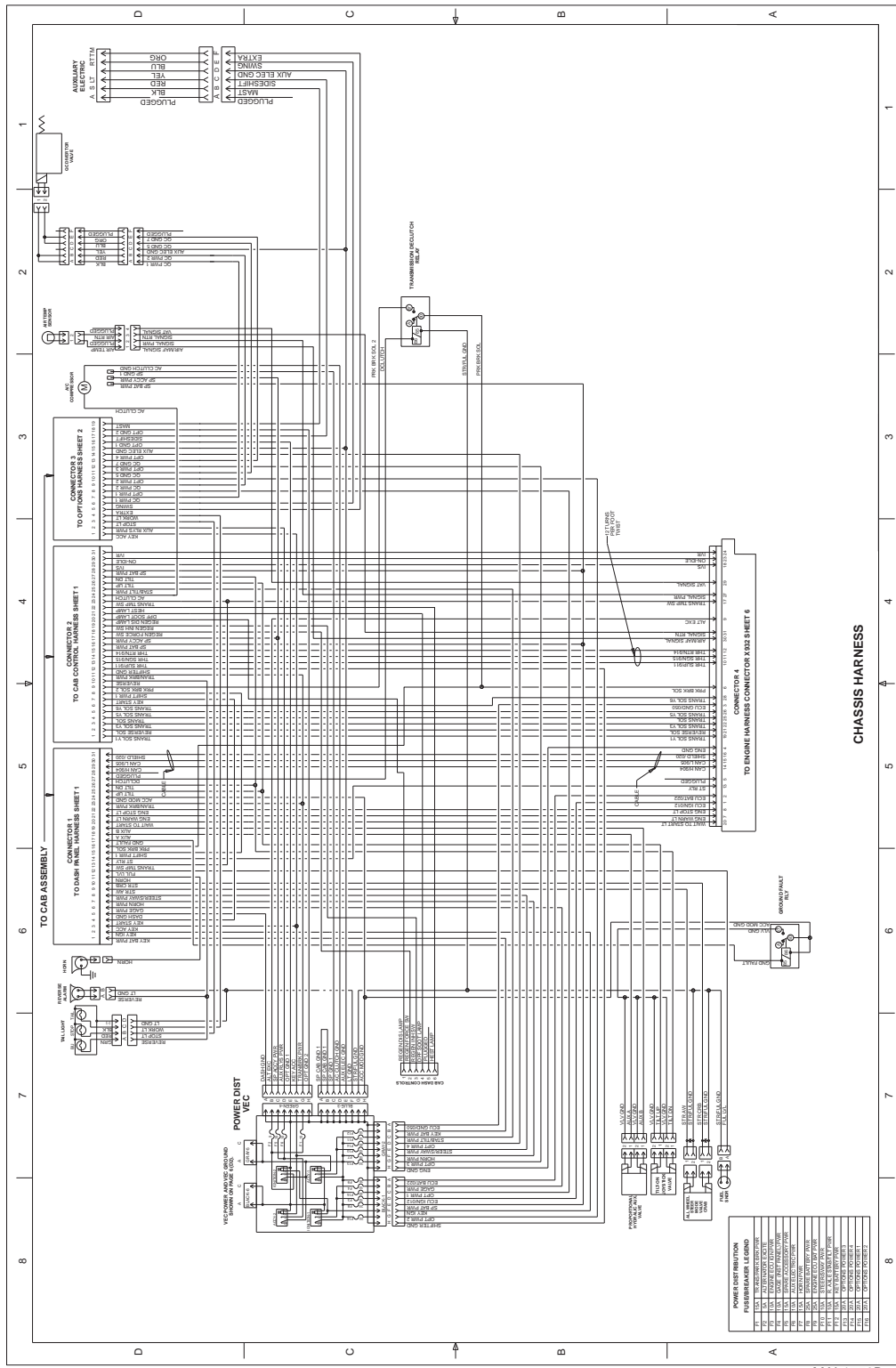
b. Lights, Heater, A/C & Wipers Schematic

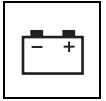




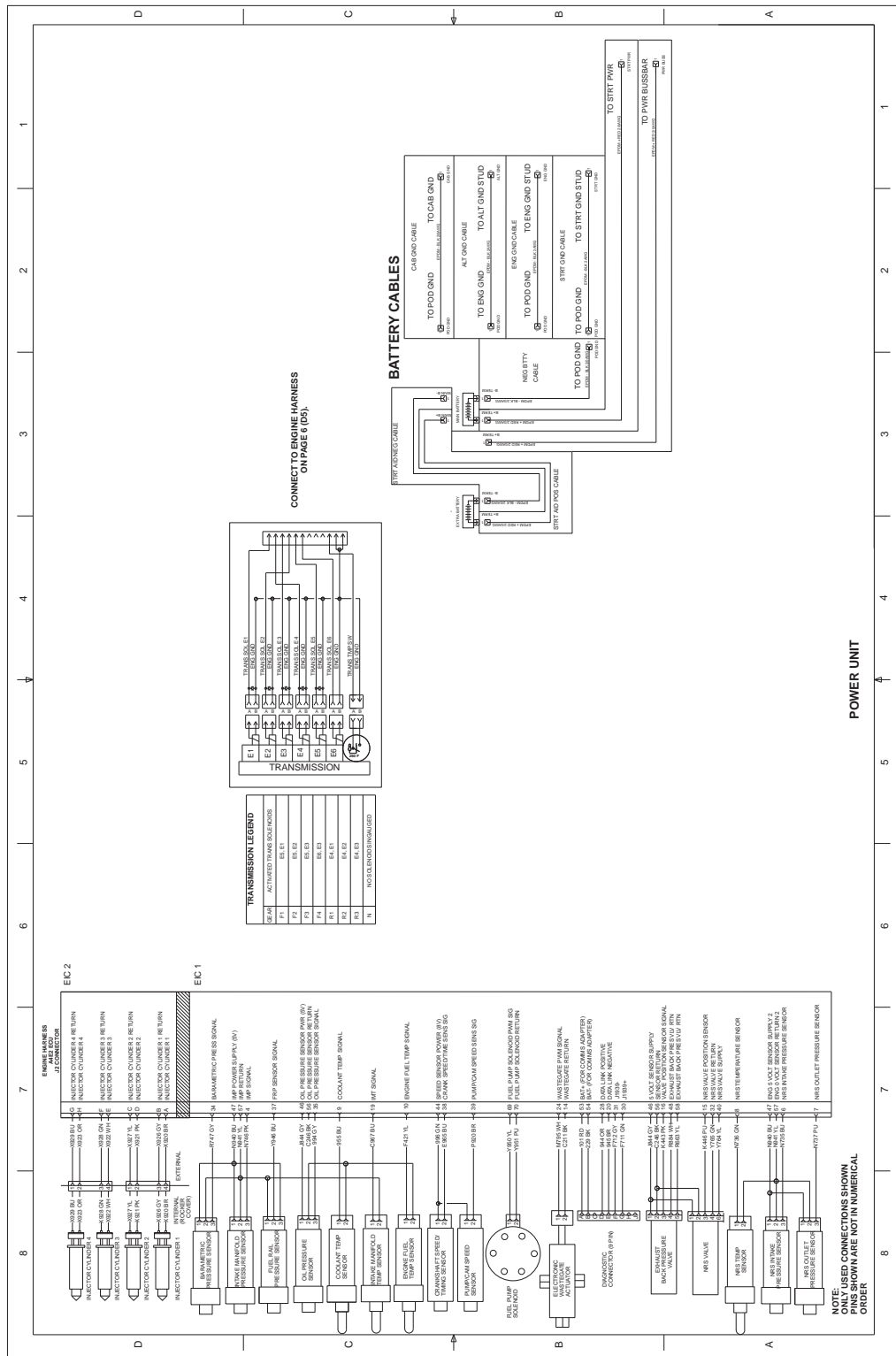
Electrical System

d. Chassis Schematic





e. Power Unit Schematic

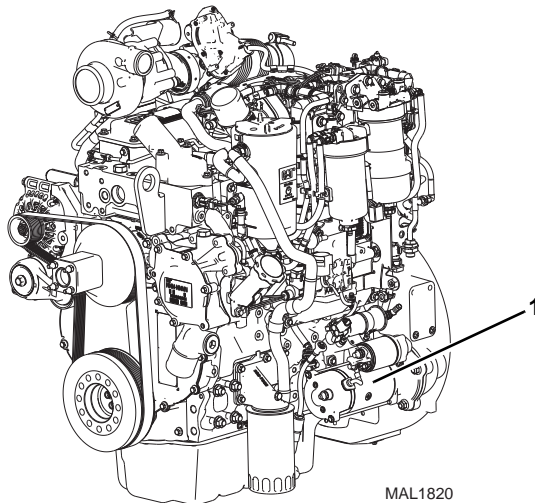


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9.7 ENGINE START CIRCUIT

9.7.1 Starter



The starter (1) is located on the left side of the engine (the right side of the machine).

a. Testing the Starter on the Engine

If the starter 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 the engine does not turn over, the starter is spinning but not engaging the flywheel. The starter drive or solenoid that pushes the drive forward to engage the flywheel may be defective. Missing or damaged teeth on the flywheel can also prevent the starter from cranking the engine.

3. If the starter only “clicks” it may indicate that the battery is discharged, or that there is a loose or corroded battery cable connection. Check the battery state of charge and battery condition first, then check the cables and cable connections.
4. For additional information on the starting circuit, refer to Section 9.5, “Electrical System Schematics.”

c. Starter Removal

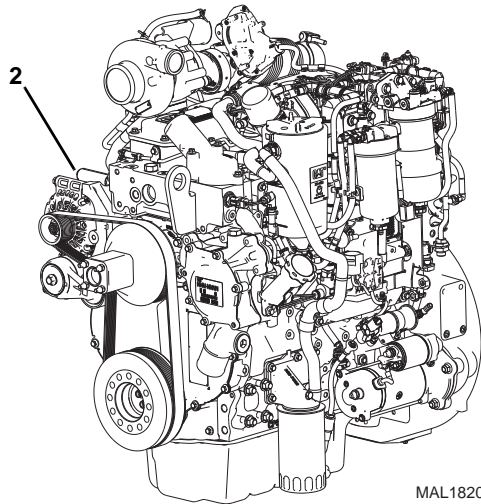
1. Open the engine cover.
2. Properly disconnect the battery.
3. Remove the wires from the solenoid stud. Remove the positive (+) battery cable from the starter. Label and disconnect the wire from the starter solenoid housing stud. Record how the wires are installed to ensure correct installation later.
4. Loosen, but **DO NOT** remove, the three fasteners securing the starter to the flywheel housing. Support the starter securely, as it is relatively heavy and will fall if not supported.
5. Support the starter and remove the fasteners securing the starter to the engine. Remove the negative (-) ground cable from its starter mounting bolt.
6. Remove the starter from the machine.

d. Starter Installation

1. Position the starter in its mounting opening on the flywheel housing. Position the ground cable over the correct starter mounting bolt. Secure the starter with the three fasteners.
2. Connect the positive (+) battery cable to the upper solenoid stud. Install the wires to the upper solenoid stud, and secure with lock washer and nut.
3. Connect the wire to the solenoid mounting stud.
4. Properly connect the battery.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.



9.8 CHARGING CIRCUIT



Before using a battery charger, an attempt can be made to recharge the battery by jump-starting the machine (Refer to the appropriate Operation & Maintenance Manual). Allow the engine to run, which will enable the alternator (2) 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.

9.8.1 Alternator

a. Alternator Removal

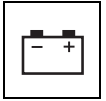
1. Open the engine cover. Allow the system fluids to cool.
2. Properly disconnect the battery.
3. Install a drive ratchet into the square hole in the serpentine belt tensioner bracket.
4. While lifting the automatic belt tensioner away from the belt, remove the fan serpentine belt.

Note: Record how the alternator is installed to ensure correct installation later.

5. Label and disconnect the wire leads attached to the alternator.
6. Remove the lower mounting capscrew securing the alternator to the lower mounting hole on the engine.
7. While supporting the alternator with one hand, remove the upper (longer) 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 & Maintenance Manual.)
4. Connect the previously labeled wire leads to the alternator.
5. Properly connect the battery.
6. Close and secure the engine cover.
7. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

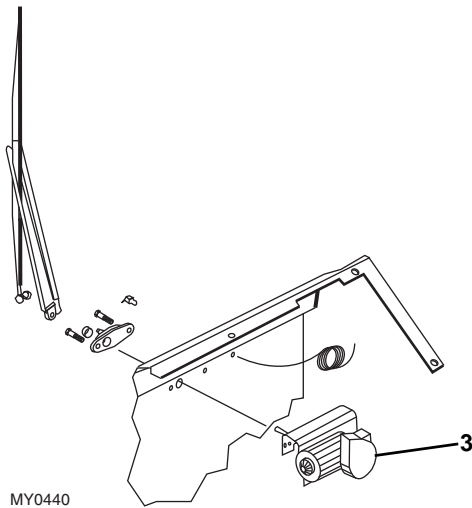


9.9 WINDOW WIPER/WASHER WINDSHIELD WIPER MOTOR

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 4.3.1, "Steering Column and Orbitrol Valve.")

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



5. Remove the screws that secure the main dash panel. Pull out the dash panel to gain access to the wiper motor (3).
6. Disconnect the cab harness connectors from the wiper motor.
7. Remove the linkage attached to the wiper motor.
8. Loosen and remove the three bolts holding the wiper motor to the mounting bracket.

Note: Retain all hardware removed from the wiper assembly for possible reuse on the replacement motor housing.

9. 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.

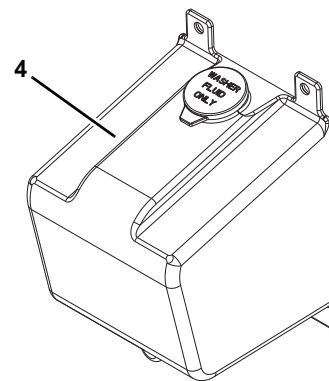
d. Installation and Testing

1. Install all required hardware to the motor assembly.
2. Align motor with the mounting holes and bolt the motor to the mounting bracket.
3. Connect the wiper linkage to the wiper motor shaft.

Note: Align the wiper linkage arm with the flat on the motor shaft to ensure wiper stroke covers window area, and it does not swipe past the glass area.

4. Connect the cab harness connectors to windshield wiper motor connectors.
5. Replace the main dash panel to its original orientation. Secure with the previously used screws.
6. Properly connect the battery.
7. 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.
8. If previously removed, install hydraulic hoses under the dash. (Refer to Section 4.3.1, "Steering Column and Orbitrol Valve.")

9.9.1 Windshield/Rear Window Washer Reservoir



The windshield washer motor and reservoir (4) is located in the cab behind the seat. It is labeled as a unit and cannot be serviced separately.



Electrical System

a. Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
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 hoses 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 the windshield washer hoses to the reservoir.
2. Connect the cab wiring harness connectors to the reservoir connectors.
3. Install the reservoir tank onto the mounting bracket.
4. Install the lock washers and nuts and secure.
5. Fill the washer fluid reservoir with washer fluid.
6. Properly connect the battery.
7. Turn the ignition key switch to the RUN position and press the washer switch. Verify that fluid is sprayed on the windshield.

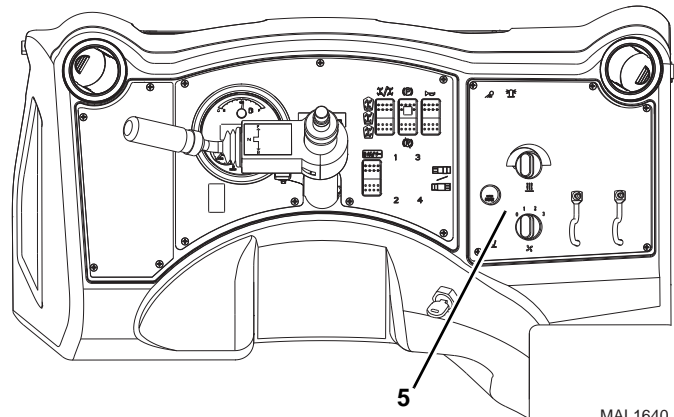
9.10 CAB HEATER AND FAN

9.10.1 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 the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.

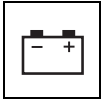


MAL1640

5. Remove the screws securing the right cab dash panel (5).
6. Pull out the panel to gain access to the heater control electrical connections. Disconnect the harnesses.
7. Remove the heater control knobs.
8. Remove the necessary hardware securing the heater control from the dash panel. Remove the control from the panel.

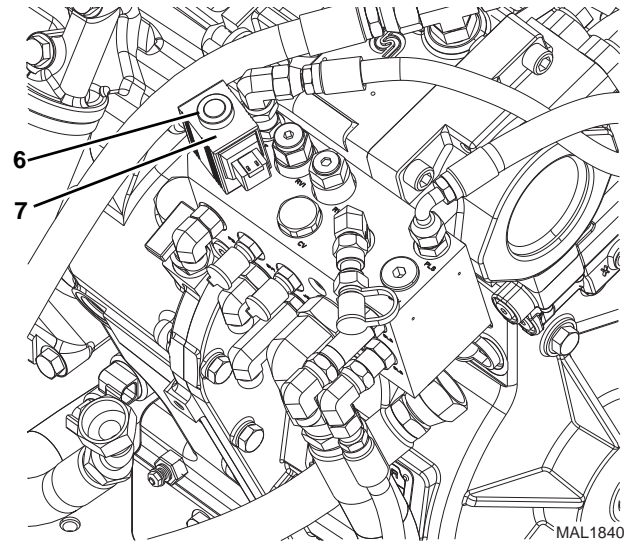
b. Disassembly

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. Install the heater controls to the dash panel with the previously used hardware.
3. Connect the cab electrical harness connector to the controls.
4. Install the control knobs.
5. Install the screws securing the dash panel to the cab.
6. Properly connect the battery
7. 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."
8. Start the machine and allow engine to warm to operating temperature. Check heat control at different levels.
9. Close and secure the engine cover.
10. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.



6. Remove the nut on the end of the park brake coil (6).
7. Remove the park brake coil.
8. Remove the park brake solenoid (7). (Remove only if the electrical coil is found to not be faulty.)

9.11 SOLENOIDS, SENSORS AND SENDERS

9.11.1 Park Brake Solenoid Valve

a. Park Brake Solenoid Valve Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery
5. Disconnect the wiring connector at the park brake solenoid lead.

b. Disassembly

DO NOT disassemble the solenoid. The solenoid is not serviceable. Replace solenoid if found to be defective.

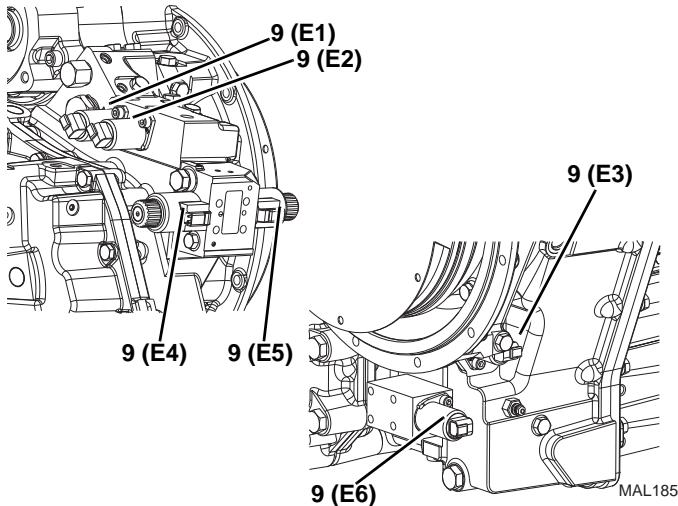
c. Park Brake Solenoid Valve Installation

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.

1. If necessary, install the park brake solenoid in its original orientation.
2. Slide the park brake coil over the solenoid. Tighten the nut to secure the solenoid. DO NOT overtighten.
3. Connect the wiring connector to the park brake coil lead.
4. Properly connect the battery
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.



9.11.2 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 (9) 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 appropriate manual.

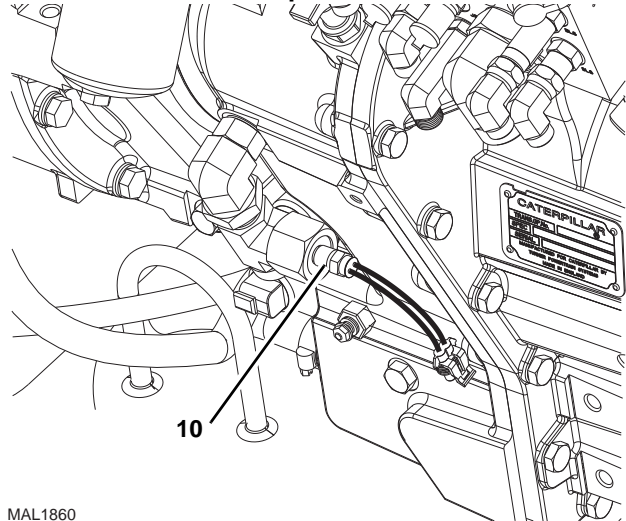
- Service Manual (Not Available at Publication)
- Parts Manual (P/N 31200724)

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 Caterpillar dealer if internal transmission repair is required during the warranty period.

9.11.3 Transmission Oil Temperature Switch

a. Transmission Oil Temperature Switch Removal



The transmission oil temperature switch (10) is located below the transmission filter.

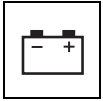
1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Unplug the transmission oil temperature switch connector from the wiring harness connector.
6. The switch is threaded into the transmission housing. Remove the switch.

b. Transmission Oil Temperature Switch Inspection and Replacement

Inspect the switch and the wiring harness connector terminals for continuity. Replace a defective or faulty switch with a new part.

c. Transmission Oil Temperature Switch Installation and Testing

1. Thread the transmission oil temperature switch into the transmission housing snugly, then connect the switch connector to the wiring harness connector.
2. Properly connect the battery.
3. Check for proper fluid level.

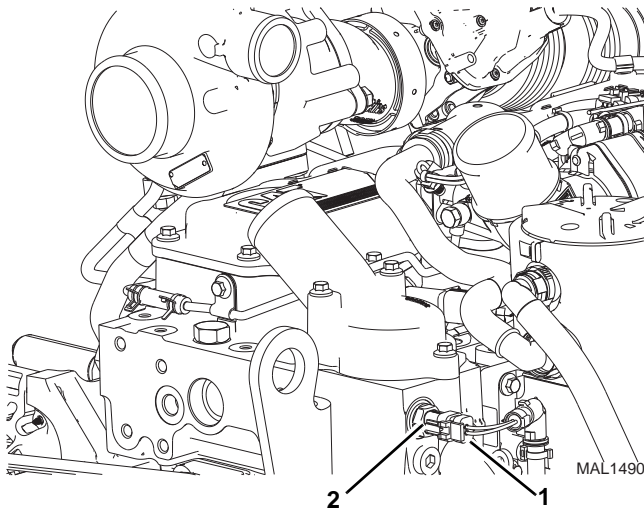


4. Start the engine, allow it to reach operating temperature and observe the operator display cluster for warning indication. If the switch is not defective, the problem could be elsewhere; possibly in a shorted wire, damaged transmission, improper or low fluid, etc.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

9.11.4 Engine Coolant Temperature Sender / Switch

a. Engine Coolant Temperature Sender Removal

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



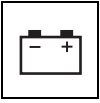
5. Unplug the engine coolant temperature sender connector (1) from the wiring harness connector.
6. The engine coolant temperature sender (2) is threaded into the engine block. Remove the sender.

b. Engine Coolant Temperature Sender / Switch Inspection and Replacement

Inspect the sender/switch and the wiring harness connector terminals for continuity. Replace a defective or faulty sender with a new part.

c. Engine Coolant Temperature Sender Installation and Testing

1. Thread the engine coolant temperature sender into the engine block snugly, then connect the sender connector to the wiring harness connector.
2. Properly connect the battery.
3. Check for proper coolant level.
4. Start the engine, allow it to reach operating temperature and observe the operator instrument cluster for warning indication. If the sender is not defective, the 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 display, etc.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

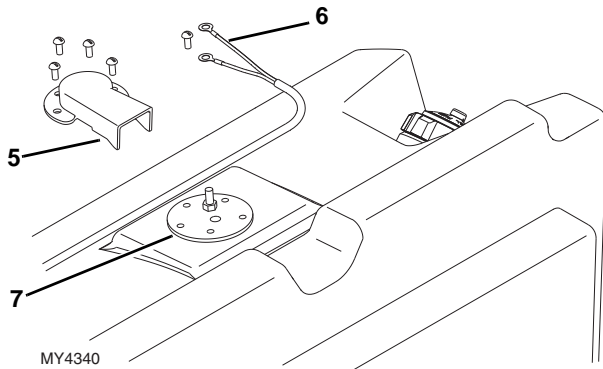


Electrical System

9.11.5 Fuel Level Sender

a. Fuel Level Indicator Testing

The fuel level sender wiring harness leads can be accessed from the top of the fuel tank.



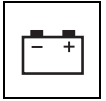
1. Loosen and remove the four screws holding the fuel sender cover (5) in place.
2. Disconnect the fuel level sender wiring harness leads (6) from the fuel sender (7). With the help of an assistant, touch both harness leads together.
3. From the operator cab, have the assistant turn the ignition key switch to the RUN position. **DO NOT** start the engine. Observe the fuel level indicator needle on the operator instrument cluster. The reading must be at the FULL mark.
4. Turn the ignition key switch to the OFF position. The fuel level indicator needle should return to the EMPTY position.

b. Fuel Level Circuit Tests

If the fuel level sender (7) is suspected of giving a false reading, perform the following checks:

1. If the fuel level indicator needle does not move, check the fuel tank for fuel.
2. Check for loose or defective wiring, faulty ground connections, and corrosion on the fuel tank sender and wiring lead.
3. If the fuel level indicator needle does not move after the ignition key switch is turned to the RUN position, use a test lamp to determine whether current is flowing from the ignition switch to the fuel level sender.
4. If the fuel level indicator does not move and a faulty or defective fuel level sender in the fuel tank has been ruled out, and in addition, wiring and connectors have been checked and ruled out, the fuel level indicator is defective and must be replaced.

5. Check that the ignition terminal has current and that the fuse in the fuse panel is not blown.
6. Check for broken, shorted, frayed, disconnected or damaged wiring between the fuel level indicator wiring at the cab, fuse and relay panel, ignition key switch, and from the fuel level sender on the fuel tank through the wiring in the cab.
7. Check the fuel level sender. A defective fuel level sender in the fuel tank may also prevent the fuel level indicator from moving. Refer to Section 9.5, "Electrical System Schematics," for further information.

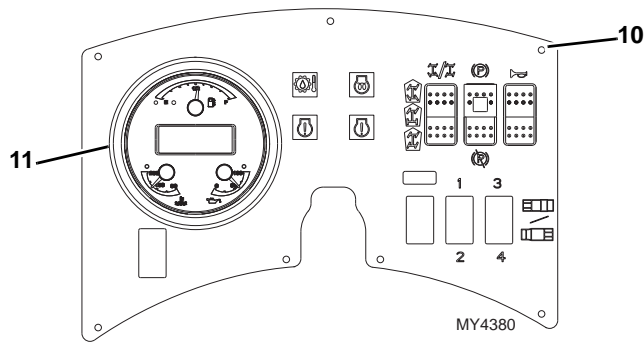


9.12 DISPLAY MONITOR/GAUGE

9.12.1 Gauges

a. Gauge Removal

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



5. Remove the seven screws (10) securing the dash panel.
6. Label and disconnect the wires from the gauge (11), remove the gauge bracket.
7. Pull the gauge out from the dash.

b. Disassembly

DO NOT disassemble the gauge. The gauge is not serviceable. Replace the gauge if found to be defective.

c. Gauge Installation and Testing

1. Install the gauge in the dash. Install the gauge bracket.
2. Connect the previously labeled wires to the gauge.
3. Install the dash panel with the previously used hardware.
4. Properly connect the battery.
5. Turn the ignition to the ON position to check the gauge values.
6. Close and secure the engine cover.
7. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

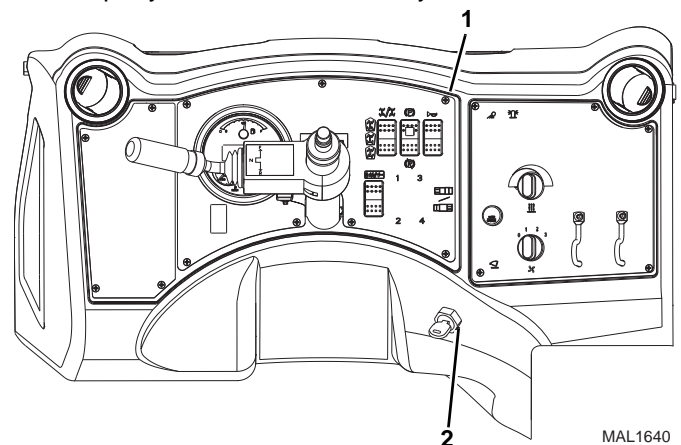
9.13 DASH SWITCHES

Note: For information on the front windshield wiper, rear window wiper and washer systems, refer to Section 9.9, "Window Wiper/Washer Windshield Wiper Motor."

9.13.1 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 control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.



5. Remove the seven screws (1) securing the dash panel.



Electrical System

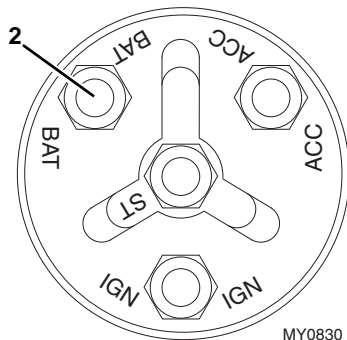
6. Remove the hex nut securing the ignition key switch (2) to the dash.
7. Label and disconnect the ignition switch wires and remove the switch from the machine.

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 BAT terminal (2) to each of the remaining terminals in their corresponding switch position.

If all terminals do not show proper continuity, replace the ignition switch.

d. Ignition Switch Installation

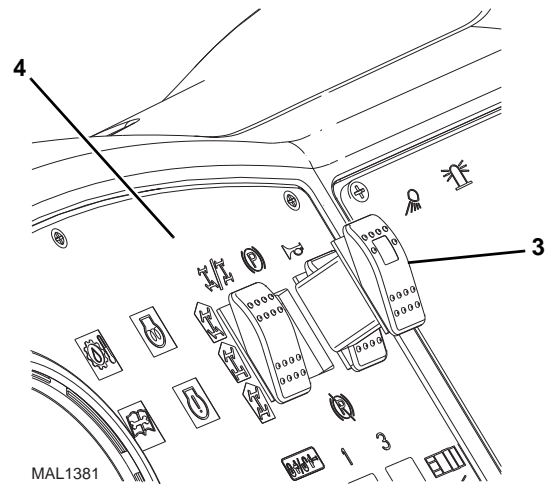
1. Connect the ignition key switch to the previously labeled wires.
2. Align the ignition switch in the dash so that when it is in the OFF position, the key slot is positioned vertically (straight up and down). Install the hex nut securing the ignition switch to the dash. **DO NOT** overtighten.
3. Install the dash panel with the previously used hardware.
4. Properly connect the battery
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

Note: If further information is needed, refer to Section 9.5, "Electrical System Schematics."

9.13.2 Dash Switches

a. Switch Removal

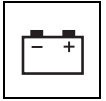
1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open the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



5. Each switch (3) is mounted in the dash panel (4).
6. Pull the switch out of the dash, disconnect the harness connector to the switch in question.

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

1. Connect the switch to the cab harness connector.
2. Position the switch over the rectangular opening in the dash and snap into position.
3. Properly connect the battery.
4. Start the machine and check the replaced switch for proper function.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.



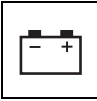
Electrical System

9.14 ENGINE DIAGNOSTIC

Flash Code	J1939 Code	CDL Code	Description
-	1076:5	18-5	Fuel Control Valve current below normal
-	1076:6	18-6	Fuel Control Valve current above normal
-	2659:7	E1319-2	Engine Exhaust Gas Recirculation Mass Flow Rate Not Responding - Derate
-	3464:7	1262-2	Engine Throttle Actuator 1 Control Command not responding properly
-	3474:14	E1026-1	Aftertreatment #1 Loss of Combustion - Warning
-	3474:31	E1026-2	Aftertreatment #1 Loss of Combustion - Derate
-	3483:11	E1305-1	Initial Assembly Aftertreatment #1 Regeneration Required - Warning
-	3556:7	E1070-1	Aftertreatment Fuel Injector #1 not responding - Warning
-	3703:31	993-2	DPF Active Regeneration Inhibited Due to Inhibit Switch
-	3714:31	E992-3	DPF Active Regeneration Inhibited Due to Temporary System Lockout - Shutdown
-	3715:31	E991-3	DPF Active Regeneration Inhibited Due to Permanent System Lockout - Shutdown
-	3720:15	E997-1	High DPF #1 Ash Loading - Warning
-	3720:16	E997-2	High DPF #1 Ash Loading - Derate
-	3750:31	E1239-1	DPF #1 Conditions Not Met for Active Regeneration
-	3837:13	2498-13	ARD Supply Air Pressure Sensor calibration required
-	3837:17	E1170-1	Low Aftertreatment #1 Secondary Air Pressure - Warning
-	3837:21	2498-21	ARD Supply Air Pressure Sensor data drifted low
-	3837:3	2498-3	ARD Supply Air Pressure Sensor voltage above normal
-	3837:4	2498-4	ARD Supply Air Pressure Sensor voltage below normal
-	5576:14	3468-14	Aftertreatment #1 Identification Number Module special instruction
-	5576:2	3468-2	Aftertreatment #1 Identification Number Module erratic, intermittent, or incorrect
-	5576:8	3468-8	Aftertreatment #1 Identification Number Module abnormal frequency, pulse width, or period
-	97:15	E232-1	High Fuel/Water Separator Water Level - Warning
-	97:16	E232-2	High Fuel/Water Separator Water Level - Derate

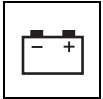


Flash Code	J1939 Code	CDL Code	Description
-	97:3	3547-3	Water in Fuel System Switch voltage above normal
111	651:2	1-2	Cylinder #1 Injector data incorrect
111	651:5	1-5	Cylinder #1 Injector current below normal
111	651:6	1-6	Cylinder #1 Injector current above normal
112	652:2	2-2	Cylinder #2 Injector data incorrect
112	652:5	2-5	Cylinder #2 Injector current below normal
112	652:6	2-6	Cylinder #2 Injector current above normal
113	653:2	3-2	Cylinder #3 Injector data incorrect
113	653:5	3-5	Cylinder #3 Injector current below normal
113	653:6	3-6	Cylinder #3 Injector current above normal
114	654:2	4-2	Cylinder #4 Injector data incorrect
114	654:5	4-5	Cylinder #4 Injector current below normal
114	654:6	4-6	Cylinder #4 Injector current above normal
115	655:2	5-2	Cylinder #5 Injector data incorrect
115	655:5	5-5	Cylinder #5 Injector current below normal
115	655:6	5-6	Cylinder #5 Injector current above normal
116	656:2	6-2	Cylinder #6 Injector data incorrect
116	656:5	6-5	Cylinder #6 Injector current below normal
116	656:6	6-6	Cylinder #6 Injector current above normal
133	105:15	E539-1	High Intake Manifold Air Temperature - Warning
133	105:16	E539-2	High Intake Manifold Air Temperature - Derate
133	105:3	172-3	Intake Manifold Air Temperature Sensor voltage above normal
133	105:4	172-4	Intake Manifold Air Temperature Sensor voltage below normal
141	190:15	E362-1	Engine Overspeed - Warning
141	190:8	190-8	Engine Speed Sensor abnormal frequency, pulse width, or period
142	723:8	342-8	Secondary Engine Speed Sensor abnormal frequency, pulse width, or period
143	637:11	261-11	Engine Timing Offset fault
144	2882:2	1743-2	Engine Operation Mode Selector Switch erratic, intermittent, or incorrect
151	107:15	E172-1	High Air Filter Restriction - Warning

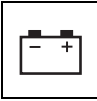


Electrical System

Flash Code	J1939 Code	CDL Code	Description
152	108:13	274-13	Atmospheric Pressure Sensor calibration required
152	108:21	274-21	Atmospheric Pressure Sensor data drifted low
152	108:3	274-3	Atmospheric Pressure Sensor voltage above normal
152	108:4	274-4	Atmospheric Pressure Sensor voltage below normal
154	91:08	91-8	Throttle Position Sensor abnormal frequency, pulse width, or period
154	91:2	91-2	Throttle Position Sensor erratic, intermittent, or incorrect
154	91:3	91-3	Throttle Position Sensor voltage above normal
154	91:4	91-4	Throttle Position Sensor voltage below normal
155	29:2	774-2	Secondary Throttle Position Sensor erratic, intermittent, or incorrect
155	29:3	774-3	Secondary Throttle Position Sensor voltage above normal
155	29:4	774-4	Secondary Throttle Position Sensor voltage below normal
155	29:8	774-8	Secondary Throttle Position Sensor abnormal frequency, pulse width, or period
157	100:01	E360-3	Low Engine Oil Pressure - Shutdown
157	100:17	E360-1	Low Engine Oil Pressure - Warning
157	100:21	100-21	Engine Oil Pressure Sensor data drifted low
157	100:3	100-3	Engine Oil Pressure Sensor voltage above normal
157	100:4	100-4	Engine Oil Pressure Sensor voltage below normal
159	1239:0	E499-3	Fuel Rail #1 Pressure Leak - Shutdown
159	157:16	E396-2	High Fuel Rail Pressure - Warning
159	157:18	E398-2	Low Fuel Rail Pressure - Warning
159	157:3	1797-3	Fuel Rail Pressure Sensor voltage above normal
159	157:4	1797-4	Fuel Rail Pressure Sensor voltage below normal
159	5571:0	E1264-3	High Pressure Common Rail Fuel Pressure Relief Valve Active - Shutdown
165	174:15	E363-1	High Fuel Supply Temperature - Warning
165	174:16	E363-2	High Fuel Supply Temperature - Derate
165	174:3	174-3	Fuel Temperature Sensor voltage above normal
165	174:4	174-4	Fuel Temperature Sensor voltage below normal
168	110:0	E361-3	High Engine Coolant Temperature - Shutdown



Flash Code	J1939 Code	CDL Code	Description
168	110:15	E361-1	High Engine Coolant Temperature - Warning
168	110:16	E361-2	High Engine Coolant Temperature - Derate
168	110:3	110-3	Engine Coolant Temperature Sensor voltage above normal
168	110:4	110-4	Engine Coolant Temperature Sensor voltage below normal
169	111:01	E2143-3	Low Engine Coolant Level - Shutdown
177	1188:5	526-5	Turbo Wastegate Drive current below normal
177	1188:6	526-6	Turbo Wastegate Drive current above normal
185	3241:3	535-3	Exhaust Temperature Sensor voltage above normal
185	3241:4	535-4	Exhaust Temperature Sensor voltage below normal
197	102:16	E1044-2	High Intake Manifold Pressure - Derate
197	102:18	E1045-2	Low Intake Manifold Pressure - Derate
197	3563:13	1785-13	Intake Manifold Pressure Sensor calibration required
197	3563:21	1785-21	Intake Manifold Pressure Sensor data drifted low
197	3563:3	1785-3	Intake Manifold Pressure Sensor voltage above normal
197	3563:4	1785-4	Intake Manifold Pressure Sensor voltage below normal
199	676:6	2246-6	Glow Plug Start Aid Relay current above normal
211	3487:5	2489-5	ARD Air Pressure Control Actuator current below normal
211	3487:6	2489-6	ARD Air Pressure Control Actuator current above normal
211	3487:7	E1041-2	ARD Air Pressure Control Actuator Not Responding To Command - Derate
212	3488:3	2490-3	ARD Air Pressure Control Actuator Position Sensor voltage above normal
212	3488:4	2490-4	ARD Air Pressure Control Actuator Position Sensor voltage below normal
214	3711:31	E593-2	Aftertreatment Insufficient Temperature to Complete Regeneration - Derate
215	4301:5	3182-5	Aftertreatment #1 Fuel Injector #1 Heater current below normal
215	4301:6	3182-6	Aftertreatment #1 Fuel Injector #1 Heater current above normal
216	3479:5	2461-5	ARD Fuel Pressure #1 Control current below normal
216	3479:6	2461-6	ARD Fuel Pressure #1 Control current above normal
218	5423:5	3427-5	Aftertreatment Fuel Pump Relay current below normal
218	5423:6	3427-6	Aftertreatment Fuel Pump Relay current above normal

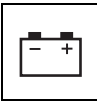


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Flash Code	J1939 Code	CDL Code	Description
219	3480:15	E1050-1	High Aftertreatment #1 Fuel Pressure #1 - Warning
219	3480:16	E1050-2	High Aftertreatment #1 Fuel Pressure #1 - Derate
219	3480:17	E1022-1	Low ARD Fuel Pressure #1 - Warning
219	3480:18	E1022-2	Low ARD Fuel Pressure #1 - Derate
219	3480:3	2460-3	ARD Fuel Pressure #1 Sensor voltage above normal
219	3480:4	2460-4	ARD Fuel Pressure #1 Sensor voltage below normal
222	3251:13	2458-13	DPF #1 Differential Pressure Sensor calibration required
222	3251:3	2458-3	DPF #1 Differential Pressure Sensor voltage above normal
222	3251:4	2458-4	DPF #1 Differential Pressure Sensor voltage below normal
223	3609:13	3464-13	DPF #1 Intake Pressure Sensor calibration required
223	3609:15	E1156-1	High DPF #1 Intake Pressure - Warning
223	3609:17	E1154-1	Low DPF #1 Intake Pressure - Warning
223	3609:21	3464-21	DPF #1 Intake Pressure Sensor data drifted low
223	3609:3	3464-3	DPF #1 Intake Pressure Sensor voltage above normal
223	3609:4	3464-4	DPF #1 Intake Pressure Sensor voltage below normal
224	3242:15	E1008-1	High DPF #1 Intake Temperature - Warning
224	3242:16	E1008-2	High DPF #1 Intake Temperature - Derate
224	3242:18	E1014-2	Low DPF #1 Intake Temperature - Derate
224	3242:3	2452-3	DPF #1 Intake Temperature Sensor voltage above normal
224	3242:4	2452-4	DPF #1 Intake Temperature Sensor voltage below normal
226	3719:0	E995-3	High DPF #1 Soot Loading - Shutdown
226	3719:16	E995-2	High DPF #1 Soot Loading - Derate
226	4783:12	3397-12	DPF #1 Soot Loading Sensor failure
226	4783:13	3397-13	DPF #1 Soot Loading Sensor calibration required
226	4783:2	3397-2	DPF #1 Soot Loading Sensor erratic, intermittent, or incorrect
226	4783:21	3397-21	DPF #1 Soot Loading Sensor data drifted low
226	4783:3	3397-3	DPF #1 Soot Loading Sensor voltage above normal
226	4783:4	3397-4	DPF #1 Soot Loading Sensor voltage below normal
226	4783:9	3397-9	DPF #1 Soot Loading Sensor abnormal update rate
227	412:15	E1092-1	High Engine Exhaust Gas Recirculation Temperature - Warning



Flash Code	J1939 Code	CDL Code	Description
227	412:16	E1092-2	High Engine Exhaust Gas Recirculation Temperature - Derate
227	412:3	3386-3	Engine Exhaust Gas Recirculation Intake Pressure Sensor voltage above normal
227	412:4	3386-4	Engine Exhaust Gas Recirculation Intake Pressure Sensor voltage below normal
228	2791:5	3405-5	Engine Exhaust Gas Recirculation Valve Control current below normal
228	2791:6	3405-6	Engine Exhaust Gas Recirculation Valve Control current above normal
228	2791:7	E1121-2	Engine Exhaust Gas Recirculation Valve Control Not Responding to Command - Derate
229	27:3	3407-3	Engine Exhaust Gas Recirculation Valve Position Sensor voltage above normal
229	27:4	3407-4	Engine Exhaust Gas Recirculation Valve Position Sensor voltage below normal
231	3358:13	3385-13	Engine Exhaust Gas Recirculation Intake Pressure Sensor calibration required
231	3358:21	3385-21	Engine Exhaust Gas Recirculation Intake Pressure Sensor data drifted low
231	3358:3	3385-3	Engine Exhaust Gas Recirculation Intake Pressure Sensor voltage above normal
231	3358:4	3385-4	Engine Exhaust Gas Recirculation Intake Pressure Sensor voltage below normal
232	172:3	2526-3	Air Inlet Temperature Sensor voltage above normal
232	172:4	2526-4	Air Inlet Temperature Sensor voltage below normal
233	626:5	2417-5	Ether Injection Control Solenoid current below normal
233	626:6	2417-6	Ether Injection Control Solenoid current above normal
237	411:13	3387-13	EGR Differential Pressure Sensor calibration required
237	411:3	3387-3	EGR Differential Pressure Sensor voltage above normal
237	411:4	3387-4	EGR Differential Pressure Sensor voltage below normal
243	3484:5	2465-5	Aftertreatment #1 Ignition Transformer Primary current below normal
243	3484:6	2465-6	Aftertreatment #1 Ignition Transformer Primary current above normal
244	3473:31	E1025-2	Aftertreatment #1 Loss of Ignition - Derate



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Flash Code	J1939 Code	CDL Code	Description
244	4265:5	3180-5	Aftertreatment #1 Ignition Transformer Secondary current below normal
244	4265:6	3180-6	Aftertreatment #1 Ignition Transformer Secondary current above normal
245	558:2	1634-2	Idle Validation Switch #1 erratic, intermittent or incorrect
246	2970:2	1635-2	Idle Validation Switch #2 erratic, intermittent or incorrect
251	3464:5	3514-5	Engine Throttle Actuator Control Command current below normal
251	3464:6	3514-6	Engine Throttle Actuator Control Command current above normal
252	51:3	3515-3	Engine Throttle Valve Position Sensor voltage above normal
252	51:4	3515-4	Engine Throttle Valve Position Sensor voltage below normal
415	631:2	253-2	Personality Module erratic, intermittent, or incorrect
426	1196:9	1639-9	Machine Security System Module abnormal update rate
429	158:2	1834-2	Ignition Key Switch loss of signal
511	168:2	168-2	Electrical System Voltage erratic, intermittent, or incorrect
511	168:3	168-3	Electrical System Voltage voltage above normal
511	168:4	168-4	Electrical System Voltage voltage Below normal
514	-	247-9	SAE J1939 Data Link abnormal update rate
516	3509:3	262-3	5 Volt Sensor DC Power Supply voltage above normal
516	3509:4	262-4	5 Volt Sensor DC Power Supply voltage below normal
517	678:3	41-3	8 Volt DC Supply voltage above normal
517	678:4	41-4	8 Volt DC Supply voltage below normal
527	630:2	268-2	Programmed Parameter Fault erratic, intermittent, or incorrect
528	3510:3	2131-3	5 Volt Sensor DC Power Supply #2 voltage above normal
528	3510:4	2131-4	5 Volt Sensor DC Power Supply #2 voltage below normal
551	N/A	N/A	No Diagnostic Code Detected



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