



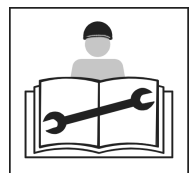
Service Manual

Models 534D-9, 534D-10 & 544D

534D-9 & 534D-10
S/N 0160000447 & After
544D
S/N 0160000192 & After

31200170

Revised
November 6, 2008



EFFECTIVITY PAGE

February 5, 2007 - A - Original Issue Of Manual

May 7, 2008 - B - Added second battery on page 2.6. Updated Tire Specs on page 2.8. Revised Warnings on pages 3.4, 3.21, 3.32, 4.3, 5.3, 5.11, 5.13, 5.14, 6.3, 8.3 & 8.21. Added Hyd Sub Assy Removal/Install on pages 3.30, 3.31 & 3.32. Changed Danger, Warning, Caution & Notice as required. Added Fork Info on page 3.43. Added Radiator Cap text on Page 1.4.

November 6, 2008 - C - Replaced Gradall branding with JLG brand.

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 **JLG** distributor.

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

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

Supplementary information is available from **JLG** in the form of Service Bulletins, Service Campaigns, Service Training Schools, the **JLG** 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. **JLG** 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 OPERATOR & SAFETY MANUAL

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

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

1.4 DO NOT OPERATE TAGS

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



1.5 SAFETY INFORMATION

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

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

1.5.1 Safety Alert System and Signal Words



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



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



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

1.6 SAFETY INSTRUCTIONS

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

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

1.6.1 Personal Hazards

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

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

1.6.2 Equipment Hazards

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

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

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

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



Safety Practices

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's 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.

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

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 Operator & Safety Manual supplied with machine for information.



Section 2

General Information and Specifications

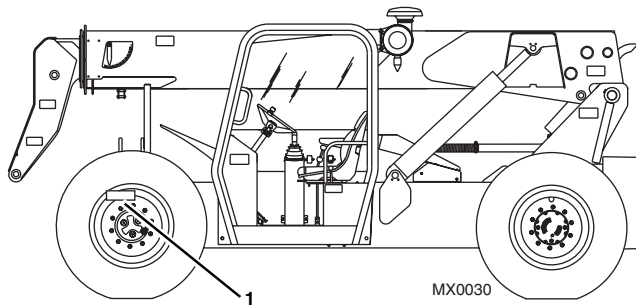
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General Information and Specifications

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 at the left front corner of the frame.



NOTICE

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

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

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



2.2 TORQUE CHARTS

2.2.1 ASTM Fastener Torque Chart (English)

VALUES FOR ZINC PLATED / YELLOW CHROMATE FASTENERS ONLY																		UNPLATED CAP SCREWS			
SAE GRADE 5 BOLTS & GRADE 2 NUTS																		SAE GRADE 8 BOLTS & GRADE 8 NUTS & SOCKET HEAD CAP SCREWS			
SIZE	THDS. PER INCH	BOLT DIA.	TENSILE STRESS AREA	TORQUE						TORQUE						CLAMP LOAD		TORQUE			
				CLAMP LOAD	DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271	CLAMP LOAD	DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271	CLAMP LOAD	WITHOUT LOC-WEL PATCH	WITH LOC-WEL PATCH					
		IN	SQ. IN.	LB.	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	LB.	IN-LB.	IN-LB	IN-LB	IN-LB	LB.	IN-LB	IN-LB				
4	40		0.00604	380	8	6	—	—	—	540	12	9	—	—	—	—	—				
	48	0.1120	0.00661	420	9	7	—	—	—	600	13	10	—	—	—	—	—				
6	32		0.00909	580	16	12	—	—	—	820	23	17	—	—	—	—	—				
	40	0.1380	0.01015	610	18	13	—	—	—	920	25	19	—	—	—	—	—				
8	32		0.01400	900	30	22	—	—	—	1260	41	31	—	—	—	—	—				
	36	0.1640	0.01474	940	31	23	—	—	—	1320	43	32	—	—	—	—	—				
10	24		0.01750	1120	43	32	—	—	—	1580	60	45	—	—	—	—	—				
	32	0.1900	0.02000	1285	49	36	—	—	—	1800	68	51	—	—	—	—	—				
1/4	20		0.0318	2020	96	75	—	105	—	2860	144	108	—	160	3180	160	168				
	28	0.2500	0.0364	2320	120	86	—	135	—	3280	168	120	—	185	3640	168	178				
IN				LB.	FT-LB	FT-LB	FT-LB	FT-LB	LB.	FT-LB	FT-LB	FT-LB	FT-LB	LB.	FT-LB	FT-LB	FT-LB				
5/16	18		0.0524	3340	17	13	16	19	4720	25	18	22	30	5240	25	28	28				
	24	0.3125	0.0580	3700	19	14	17	21	5220	25	20	25	30	5800	27	30	30				
3/8	16		0.0775	4940	30	23	28	35	7000	45	35	40	50	7750	45	50	50				
	24	0.3750	0.0878	5600	35	25	32	40	7900	50	35	45	55	8780	50	55	55				
7/16	14		0.1063	6800	50	35	45	55	9550	70	55	63	80	10630	70	77	77				
	20	0.4375	0.1187	7550	55	40	50	60	10700	80	60	70	90	11870	75	82	82				
1/2	13		0.1419	9050	75	55	68	85	12750	110	80	96	120	14190	110	120	120				
	20	0.5000	0.1599	10700	90	65	80	100	14400	120	90	108	130	15990	115	127	127				
9/16	12		0.1820	11600	110	80	98	120	16400	150	110	139	165	18200	155	170	170				
	18	0.5625	0.2030	12950	120	90	109	135	18250	170	130	154	190	20300	165	182	182				
5/8	11		0.2260	14400	150	110	135	165	20350	220	170	180	240	22600	210	231	231				
	18	0.6250	0.2560	16300	170	130	153	190	23000	240	180	204	265	25600	220	242	242				
3/4	10		0.3340	21300	260	200	240	285	30100	380	280	301	420	33400	365	400	400				
	16	0.7500	0.3730	23800	300	220	268	330	33600	420	320	336	465	37300	400	440	440				
7/8	9		0.4620	29400	430	320	386	475	41600	600	460	485	660	46200	585	645	645				
	14	0.8750	0.5090	32400	470	350	425	520	45800	660	500	534	725	50900	635	700	700				
1	8		0.6060	38600	640	480	579	675	51500	900	680	687	990	60600	865	950	950				
	12	1.0000	0.6630	42200	700	530	633	735	59700	1000	740	796	1100	66300	915	1000	1000				
1-1/8	7		0.7630	42300	800	600	714	840	68700	1280	960	1030	1400	76300	1240	1365	1365				
	12	1.1250	0.8560	47500	880	660	802	925	77000	1440	1080	1155	1575	85600	1380	1520	1520				
1-1/4	7		0.9690	53800	1120	840	1009	1175	87200	1820	1360	1453	2000	96900	1750	1925	1925				
	12	1.2500	1.0730	59600	1240	920	1118	1300	96600	2000	1500	1610	2200	107300	1880	2070	2070				
1-3/8	6		1.1550	64100	1460	1100	1322	1525	104000	2380	1780	1907	2625	115500	2320	2550	2550				
	12	1.3750	1.3150	73000	1680	1260	1506	1750	118100	2720	2040	2165	3000	131500	2440	2685	2685				
1-1/2	6		1.4050	78000	1940	1460	1755	2025	126500	3160	2360	2530	3475	140500	3040	3345	3345				
	12	1.5000	1.5800	87700	2200	1640	1974	2300	142200	3560	2660	2844	3925	158000	3270	3600	3600				
Note: These torque values do not apply to cadmium plated fasteners.																					
														SAE GRADE 5							
														SAE GRADE 8							



General Information and Specifications

2.2.2 ASTM Fastener Torque Chart (Metric)

VALUES FOR ZINC PLATED / YELLOW CHROMATE FASTENERS ONLY																	
SAE GRADE 5 BOLTS & GRADE 2 NUTS				SAE GRADE 8 BOLTS & GRADE 8 NUTS & SOCKET HEAD CAP SCREWS													
SIZE	THDS. PER INCH	BOLT DIA.	TENSILE STRESS AREA	TORQUE				TORQUE				UNPLATED CAP SCREWS					
				CLAMP LOAD	DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271	CLAMP LOAD	DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271	CLAMP LOAD	WITHOUT LOC-WEL PATCH	WITH LOC-WEL PATCH	
		IN	SQ. IN.	LB.	N, m	N, m	N, m	N, m	N, m	N, m	N, m	N, m	N, m	N, m	N, m	N, m	N, m
4	40	0.1120	0.00604	380	.8	—	—	—	540	1.4	1.0	—	—	—	—	—	—
	48		0.00661	420	1.0	.8	—	—	600	1.5	1.0	—	—	—	—	—	—
	32	0.1380	0.00909	580	1.8	1.4	—	—	820	2.6	2.0	—	—	—	—	—	—
6	40		0.01015	610	2.0	1.6	—	—	920	2.8	2.2	—	—	—	—	—	—
	32	0.1640	0.01400	900	3.4	2.4	—	—	1260	4.6	3.4	—	—	—	—	—	—
8	36		0.01474	940	3.4	2.6	—	—	1320	5	3.6	—	—	—	—	—	—
	24		0.01750	1120	5	3.6	—	—	1580	7	5	—	—	—	—	—	—
	32		0.02000	1285	6	4	—	—	1800	8	6	—	—	—	—	—	—
1/4	20	0.2500	0.0318	2020	11	8	—	12	2860	16	12	—	18	3180	18	19	19
	28		0.0364	2320	14	10	—	15	3280	19	14	—	21	3640	19	20	20
				IN	SQ. IN.	LB.	N, m	N, m	N, m	N, m	N, m	N, m	N, m	LB.	N, m	N, m	N, m
5/16	18	0.3125	0.0524	3340	23	18	22	26	4720	34	24	30	41	5240	34	38	38
	24		0.0580	3700	26	19	23	28	5220	34	27	34	41	5800	37	41	41
3/8	16	0.3750	0.0775	4940	41	31	38	47	7000	61	47	54	68	7750	61	68	68
	24		0.0878	5600	47	34	43	54	7900	68	47	61	75	8780	68	75	75
7/16	14	0.4375	0.1063	6800	68	47	61	75	9550	95	75	85	108	10630	95	104	104
	20		0.1187	7550	75	54	68	81	10700	108	81	95	122	11870	102	111	111
1/2	13	0.5000	0.1419	9050	102	75	92	115	12750	149	108	130	163	14190	149	163	163
	20		0.1599	10700	122	88	108	136	14400	163	122	146	183	15990	156	172	172
9/16	12	0.5625	0.1820	11600	149	108	133	163	16400	203	149	188	224	18200	210	230	230
	18		0.2030	12950	163	122	148	183	18250	230	176	209	258	20300	224	247	247
5/8	11	0.6250	0.2260	14400	203	149	183	224	20350	298	230	244	325	22600	285	313	313
	18		0.2560	16300	230	176	207	258	23000	325	244	277	359	25600	298	328	328
3/4	10	0.7500	0.3340	21300	353	271	325	386	30100	515	380	408	569	33400	495	542	542
	16		0.3730	23800	407	298	363	447	33600	569	434	456	630	37300	542	597	597
7/8	9	0.8750	0.4620	29400	583	434	523	644	41600	813	624	658	895	46200	793	874	874
	14		0.5090	32400	637	475	576	705	45800	895	678	724	983	50900	861	949	949
1	8	1.0000	0.6060	38600	868	651	785	915	51500	1220	922	931	1342	60600	1173	1288	1288
	12		0.6630	42200	949	719	858	997	59700	1356	1003	1079	1491	66300	1241	1356	1356
1-1/8	7	1.1250	0.7630	42300	1085	813	968	1139	68700	1735	1302	1396	1898	76300	1681	1851	1851
	12		0.8560	47500	1193	895	1087	1254	77000	1952	1464	1566	2135	85600	1871	2061	2061
1-1/4	7	1.2500	0.9690	53800	1518	1139	1368	1593	87200	2468	1844	1970	2712	96900	2373	2610	2610
	12		1.0730	59600	1681	1247	1516	1763	96600	3227	2413	2586	2983	107300	2549	2807	2807
1-3/8	6	1.3750	1.1550	64100	1979	1491	1792	2068	104000	3227	2413	2586	3559	115500	3145	3457	3457
	12		1.3150	73000	2278	1708	2042	2373	118100	3688	2766	2935	4067	131500	3308	3640	3640
1-1/2	6	1.5000	1.4050	78000	2630	1979	2379	2745	126500	4284	3200	3430	4711	140500	4122	4535	4535
	12		1.5800	87700	2983	2224	2676	3118	142200	4827	3606	3856	5322	158000	4433	4881	4881
UNPLATED CAP SCREWS																	
				TORQUE				TORQUE				UNBRAKO 1960 SERIES SOCKET HEAD					
				CLAMP LOAD	DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271	CLAMP LOAD	DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271	CLAMP LOAD	WITHOUT LOC-WEL PATCH	WITH LOC-WEL PATCH	
				LB.	N, m	N, m	N, m	N, m	LB.	N, m	N, m	N, m	N, m	LB.	N, m	N, m	
				—	—	—	—	—	—	—	—	—	—	—	—	—	—
				34	41	41	54	68	5240	34	27	34	41	5800	37	41	41
				61	68	75	85	108	7750	61	47	61	75	8780	68	75	75
				95	104	108	122	149	10630	95	75	85	108	10630	95	104	104
				102	111	102	122	149	11870	102	81	95	122	11870	102	111	111
				149	163	149	163	183	14190	149	108	130	163	14190	149	163	163
				156	172	156	183	210	15990	156	122	146	183	15990	156	172	172
				210	230	210	224	258	18200	210	176	209	258	20300	224	247	247
				285	313	285	325	359	22600	285	230	244	325	22600	285	313	313
				298	328	298	359	398	25600	298	244	277	359	25600	298	328	328
				342	374	342	398	456	33400	342	380	408	456	33400	342	374	374
				457	500	457	523	604	37300	457	434	456	604	37300	457	500	500
				542	597	542	630	724	46200	542	678	724	893	46200	542	597	597
				613	674	613	724	861	50900	613	724	861	983	50900	613	674	674
				681	744	681	813	931	50900	681	724	861	983	50900	681	744	744
				724	793	724	861	1003	50900	724	724	861	983	50900	724	793	793
				793	861	793	931	1079	50900	793	724	861	983	50900	793	861	861
				861	931	861	1003	1139	50900	861	724	861	983	50900	861	931	931
				931	1003	931	1079	1241	50900	931	724	861	983	50900	931	1003	1003
				1003	1079	1003	1139	1241	50900	1003	724	861	983	50900	1003	1079	1079
				1079	1139	1079	1241	1356	50900	1079	724	861	983	50900	1079	1139	1139
				1139	1241	1139	1241	1356	50900	1139	724	861	983	50900	1139	1241	1241
				1241	1356	1241	1356	1491	50900	1241	724	861	983	50900	1241	1356	1356
				1356	1491	1356	1491	1681	50900	1356	724	861	983	50900	1356	1491	1491
				1491	1681	1491	1681	1851	50900	1491	724	861	983	50900	1491	1681	1681
				1681	1851	1681	1851	2061	50900	1681	724	861	983	50900	1681	1851	1851
				1851	2061	1851	2061	2261	50900	1851	724	861	983	50900	1851	2061	2061
				2061	2261	2061	2261	2461	50900	2061	724	861	983	50900	2061	2261	2261
				2261	2461	2261	2461	2661	50900	2261	724	861	983	50900	2261	2461	2461
				2461	2661	2461	2661	2861	50900	2461	724	861	983	50900	2461	2661	2661
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				3061	3261	3061	3261	3461	50900	3061	724	861	983	50900	3061	3261	3261
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				5661	5861	5661	5861	6061	50900	5661	724	861	983	50900	5661	5861	5861
				5861	6061	5861	6061	6261	50900	5861	724	861	983	50900	5861	6061	6061
				6061	6261	6061											

Note: These torque values do not apply to cadmium plated fasteners.



SAE GRADE 5



SAE GRADE 8



2.2.3 Metric Fastener Torque Chart

VALUES FOR ZINC PLATED / YELLOW CHROMATE FASTENERS ONLY												
SIZE	PITCH	TENSILE STRESS AREA	CLASS 8.8 METRIC BOLTS & CLASS 8 METRIC NUTS					CLASS 10.9 METRIC BOLTS & CLASS 10 METRIC NUTS				
			CLAMP LOAD	TORQUE				CLAMP LOAD	TORQUE			
				DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271		DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271
		sq. mm	KN	N, m	N, m	N, m	N, m	KN	N, m	N, m	N, m	N, m
3	.5	5.03	2.19	1.3	1.0	1.2	1.4	3.13	1.9	1.4	1.5	2.1
3.5	.6	6.78	2.95	2.1	1.6	1.9	2.3	4.22	3.0	2.2	2.4	3.3
4	.7	8.78	3.82	3.1	2.3	2.8	3.4	5.47	4.4	3.3	3.5	4.8
5	.8	14.2	6.18	6.2	4.6	5.6	6.8	8.85	8.9	6.6	7.1	9.7
6	1	20.1	8.74	11	7.9	9.4	12	12.5	15	11	12	17
7	1	28.9	12.6	18	13	16	19	18	25	19	20	28
8	1.25	36.6	15.9	25	19	23	28	22.8	37	27	29	40
10	1.5	58.0	25.2	50	38	45	55	36.1	72	54	58	79
12	1.75	84.3	36.7	88	66	79	97	52.5	126	95	101	139
14	2	115	50.0	140	105	126	154	71.6	200	150	160	220
16	2	157	68.3	219	164	197	241	97.8	313	235	250	344
18	2.5	192	83.5	301	226	271	331	119.5	430	323	344	473
20	2.5	245	106.5	426	320	383	469	152.5	610	458	488	671
22	2.5	303	132.0	581	436	523	639	189.0	832	624	665	915
24	3	353	153.5	737	553	663	811	220.0	1060	792	845	1170
27	3	459	199.5	1080	810	970	1130	286.0	1540	1160	1240	1690
30	3.5	561	244.0	1460	1100	1320	1530	349.5	2100	1570	1680	2310
33	3.5	694	302.0	1990	1490	1790	2090	432.5	2600	2140	2280	2860
36	4	817	355.0	2560	1920	2300	2690	509.0	3660	2750	2930	4020
42	4.5	1120	487.0	4090	3070	3680	4290	698.0	5860	4400	4690	6440
Note: These torque values do not apply to cadmium plated fasteners. 8.8 METRIC CLASS 8.8 10.9 METRIC CLASS 10.9												



General Information and Specifications

2.3 SPECIFICATIONS

2.3.1 Travel Speeds

	534D-9	534D-10	544D
2 Wheel Drive	18 mph (29 km/h)	19 mph (30,5 km/h)	19 mph (30,5 km/h)
4 Wheel Drive	9 mph (14,4 km/h)	9.5 mph (15,3 km/h)	9.5 mph (15,3 km/h)

2.3.2 Hydraulic Cylinder Performance

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

FUNCTION	APPROXIMATE TIMES (seconds)		
	534D-9	534D-10	544D
Boom Extend (max boom angle)	15.3	14.5	18.3
Boom Retract (max boom angle)	12.8	13.4	17.6
Boom Lift	11.4	10.8	11.9
Boom Lower	8.6	8.1	9.2

2.3.3 Electrical System

Battery:	
Type, Rating	12 BCI, Negative (-) Ground, Maintenance Free
Quantity	John Deere - 1 / Cummins - 2
Reserve Capacity	1,000 Cold Cranking Amps @ 0° F (-18° C)
Group/Series	Group 31
Alternator (John Deere)	12V, 65 Amps
Alternator (Cummins)	12V, 95 Amps



2.3.4 Engine Performance Specifications

a. John Deere

Description	534D-9	534D-10	544D
Engine Make/Model	John Deere PE4045TF275	John Deere PE4045TF275	John Deere PE4045HF275
Displacement	276 in ³ (4,5 liters)	276 in ³ (4,5 liters)	276 in ³ (4,5 liters)
Low Idle	800 rpm	800 rpm	800 rpm
High Idle	2400 rpm	2500 rpm	2200 rpm
Horsepower	110 HP (82 kW) @ 2400 rpm	115 HP (86 kW) @ 2500 rpm	125 HP (93 kW) @ 2200 rpm
Peak Torque	289 lb-ft @ 1400 rpm	290 lb-ft @ 1400 rpm	376 lb-ft @ 1500 rpm
Fuel Delivery	Fuel Injection	Fuel Injection	Fuel Injection
Air Cleaner	Dry Type, Replaceable Primary and Safety Elements	Dry Type, Replaceable Primary and Safety Elements	Dry Type, Replaceable Primary and Safety Elements

b. Cummins

	534D-9 / 534D-10	544D
Engine Make/Model	Cummins QSB4.5	Cummins QSB4.5
Displacement	274 in ³ (4,5 liters)	274 in ³ (4,5 liters)
Low Idle	1000 rpm	1000 rpm
High Idle	2500 rpm	2500 rpm
Horsepower	110 hp (82 Kw) @ 2500 rpm	130 hp (97 Kw) @ 2500 rpm
Peak Torque	360 lb-ft (488 Nm) @ 1500 rpm	459 lb-ft (622 Nm) @ 1500 rpm
Fuel Delivery	Fuel Injection	Fuel Injection
Air Cleaner	Dry Type, Replaceable Primary and Safety Elements	Dry Type, Replaceable Primary and Safety Elements



General Information and Specifications

2.3.5 Tires

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

Note: Pressures for Foam and Water/Calcium Chloride filled tires are for initial fill ONLY.

a. 534D-9

Size	Tire Type	Minimum Ply/ Star Rating	Fill Type	Pressure
13.00 x 24	G - 2	Bias - 12 Ply	Pneumatic	70 psi (4,8 bar)
			Foam - Approx. 542 lb (246 kg)	65 psi (4,5 bar)
13.00 x 24	L-2 / G-2	Radial	Pneumatic	75 psi, (5,2 bar)
			Foam - Approx. 542 lb (246 kg)	75 psi (5,2 bar)
13.00 x 24	G - 3 Rock	Bias - 12 Ply	Pneumatic	70 psi (4,8 bar)
			Foam - Approx. 542 lb (246 kg)	65 psi (4,5 bar)
13.00 x 24			Solid	

b. 534D-10

Size	Tire Type	Minimum Ply/ Star Rating	Fill Type	Pressure
14.00 x 24	G - 2	Bias 12 ply	Pneumatic	70 psi (4,8 bar)
			Foam - Approx. 720 lb (327 kg)	62 psi (4,2 bar)
14.00 x 24	L-2 / G-2	Radial	Pneumatic	75 psi (5,2 bar)
			Foam - Approx. 720 lb (327 kg)	70 psi (4,8 bar)
14.00 x 24	G - 3 Rock	Bias 12 ply	Pneumatic	70 psi (4,8 bar)
			Foam - Approx. 720 lb (327 kg)	62 psi (4,2 bar)

c. 544D

Size	Tire Type	Minimum Ply/ Star Rating	Fill Type	Pressure
14.00 x 24	G - 2	Bias 12 ply	Water/Calcium Chloride - Approx. 623 lb (283 kg)	70 psi (4,8 bar)
			Foam - Approx. 720 lb (327 kg)	62 psi (4,2 bar)
14.00 x 24	L-2 / G-2	Radial	Water/Calcium Chloride - Approx. 623 lb (283 kg)	75 psi (5,2 bar)
			Foam - Approx. 720 lb (327 kg)	70 psi (4,8 bar)
14.00 x 24	G - 3 Rock	Bias 12 ply	Water/Calcium Chloride - Approx. 623 lb (283 kg)	70 psi (4,8 bar)
			Foam - Approx. 720 lb (327 kg)	62 psi (4,2 bar)



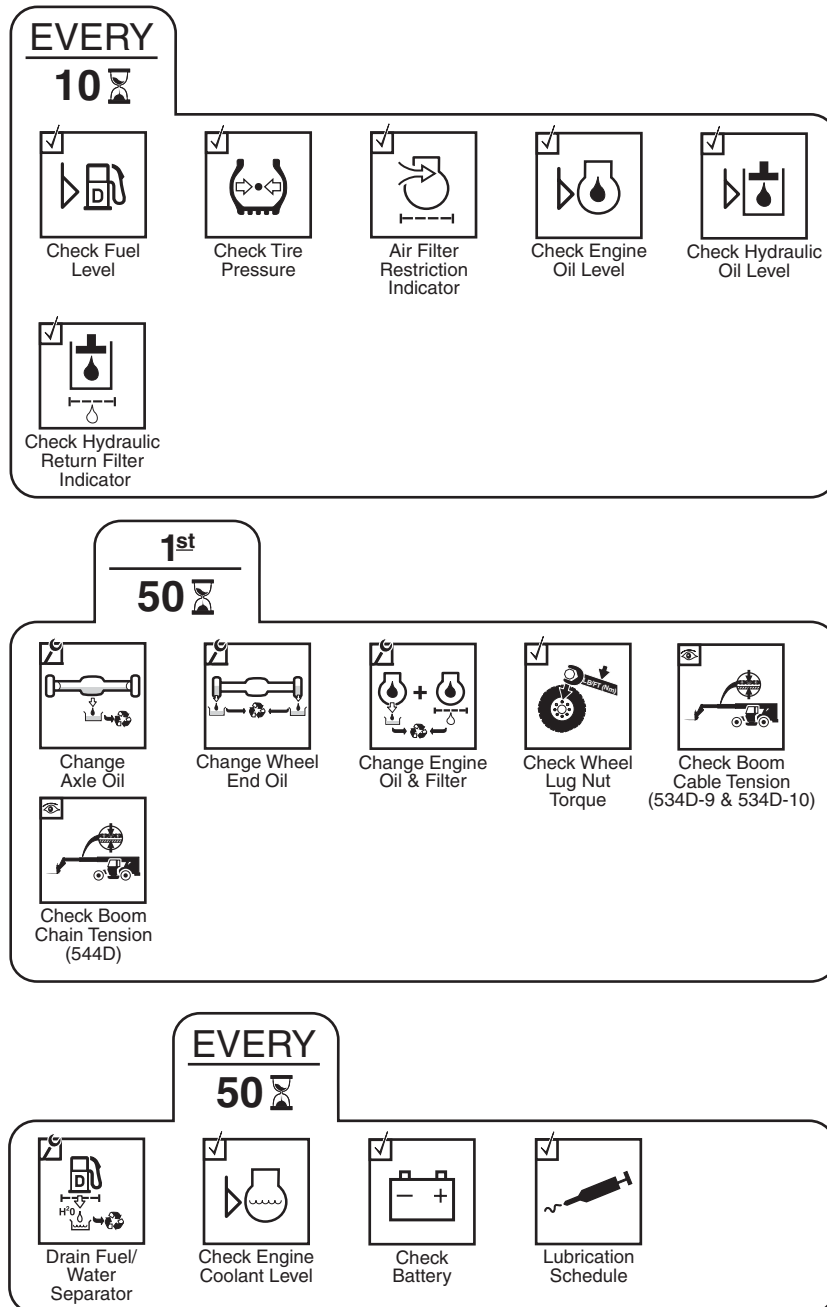
2.4 FLUID AND LUBRICANT CAPACITIES

Engine Crankcase Oil	
Capacity w/Filter Change (John Deere)	15.5 quarts (14,6 liters)
Capacity w/Filter Change (Cummins)	11 quarts (10,4 liters)
Filter Capacity	1 quart (0,9 liters)
Oil Type	15W-40 CD
Fuel Tank	
Capacity	40 gallons (151,4 liters)
Type of Fuel	Low Sulfur Diesel #2
Cooling System	
System Capacity (John Deere)	24.8 quarts (23,5 liters)
System Capacity (Cummins)	22 quarts (20,8 liters)
Type of Fluid	50/50 ethylene glycol & water
Front Axle	
Differential Housing Capacity	19.6 quarts (18,5 liters)
Type of Fluid	Mobilfluid 424 [®] Tractor Hydraulic Fluid (ISO 46)
Rear Drive Hubs	
Wheel End Capacity	1.5 quart (1,4 liters)
Type of Fluid	Mobilfluid 424 [®] Tractor Hydraulic Fluid (ISO 46)
Hydraulic System	
System Capacity - 534D-9, 534D-10	47 gallons (178 liters)
System Capacity - 544D	50 gallons (189 liters)
Reservoir Capacity	30 gallons (113,5 liters)
Type of Fluid	Mobilfluid 424 [®] Tractor Hydraulic Fluid (ISO 46)



2.5 SERVICE AND MAINTENANCE SCHEDULES

2.5.1 10, 1st 50 & 50 Hour



MX0080



2.5.2 250, 500, 1000 & 1500 Hour



EVERY
250

 Change Engine Oil and Filter*	 Check Front Axle Oil Level	 Check Front & Rear Wheel End Oil Levels	 Air Filter Vacuator Valve	 Check Fan Belt
 Check Boom Cable Tension (534D-9 & 534D-10)	 Check Boom Chain Tension (544D)	 Check Boom Bearing Pads	 Check Rear Axle Stabilization	

EVERY
500

 Change Fuel Filter	 Check Wheel Lug Nut Torque	
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EVERY
1000

 Change Front Axle Oil	 Change Front & Rear Wheel End Oil	 Change Hydraulic Tank Breather
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EVERY
1500

 Change Engine Coolant	 Change Hydraulic Fluid & Filters
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MX0090



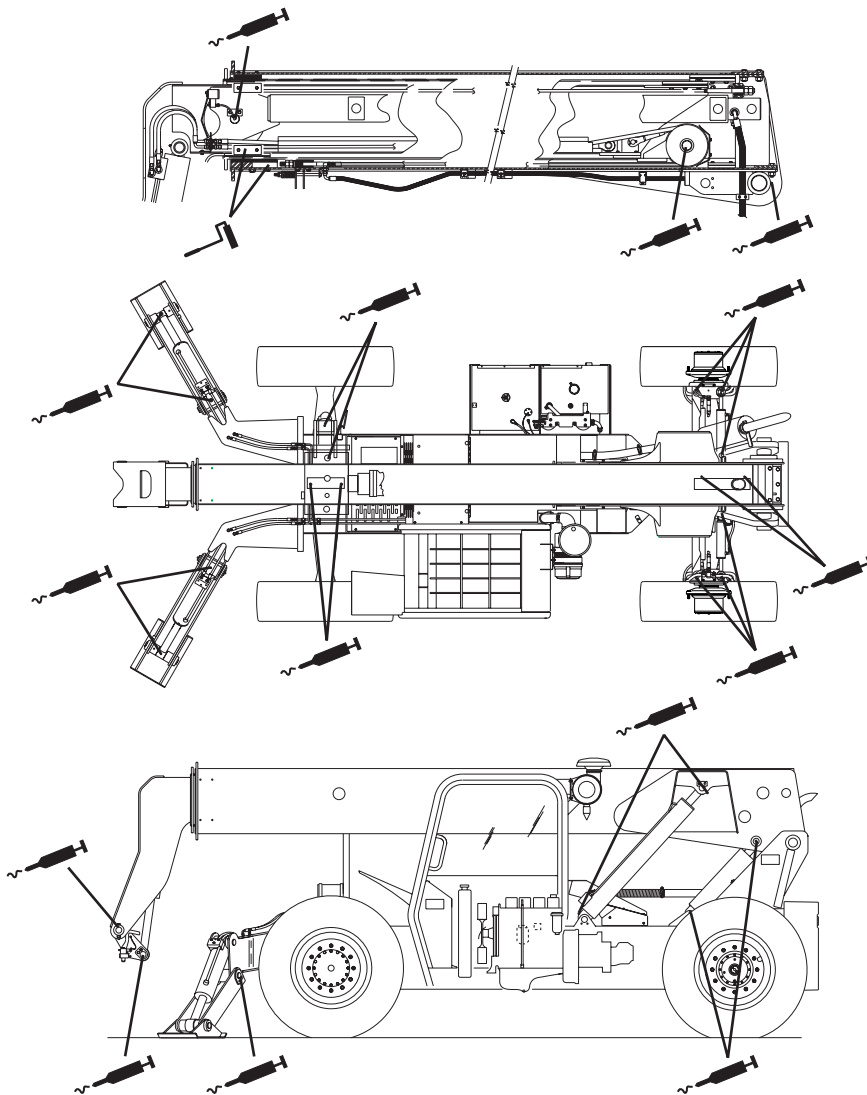
2.6 LUBRICATION SCHEDULES

2.6.1 534D-9, 534D-10

a. 50 Hour

EVERY
50 


MYSTIK TETRAMOLY
(NLGI 2 GC-LB)



OX03412

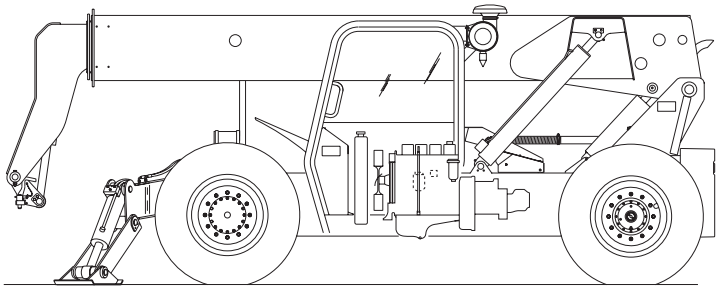
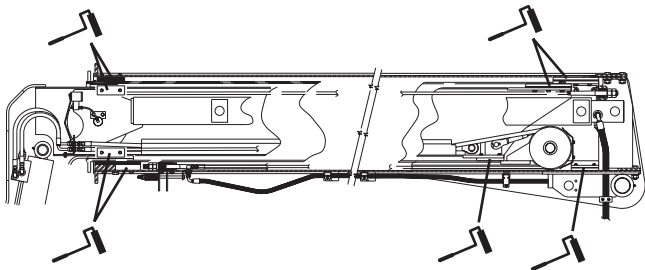


b. 250 Hour

EVERY
250 



MYSTIK TETRIMOLY
(NLGI 2 GC-LB)



OX03512



General Information and Specifications

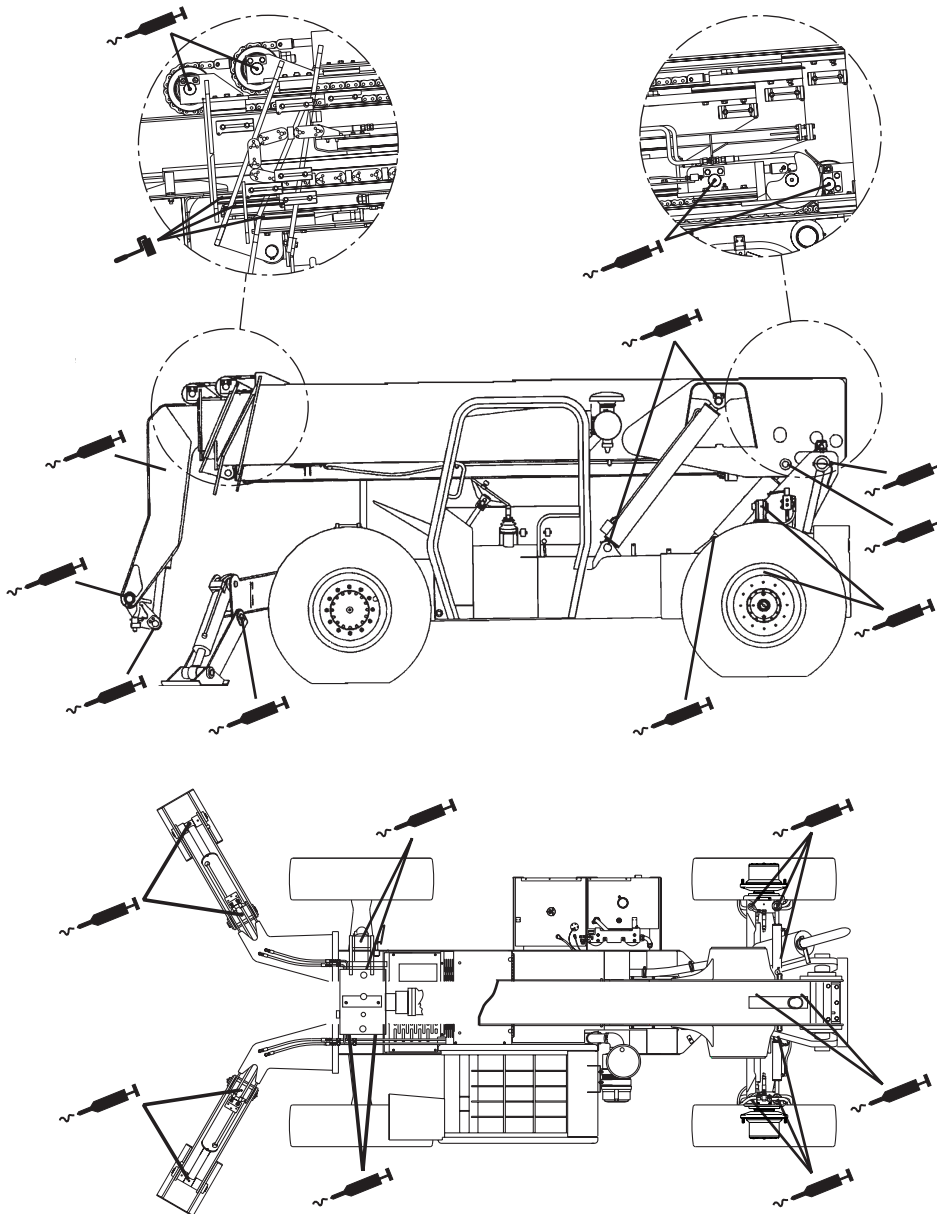
2.6.2 544D

a. 50 Hour



MYSTIK TETRIMOLY
(NLGI 2 GC-LB)

EVERY
50 



MX00512

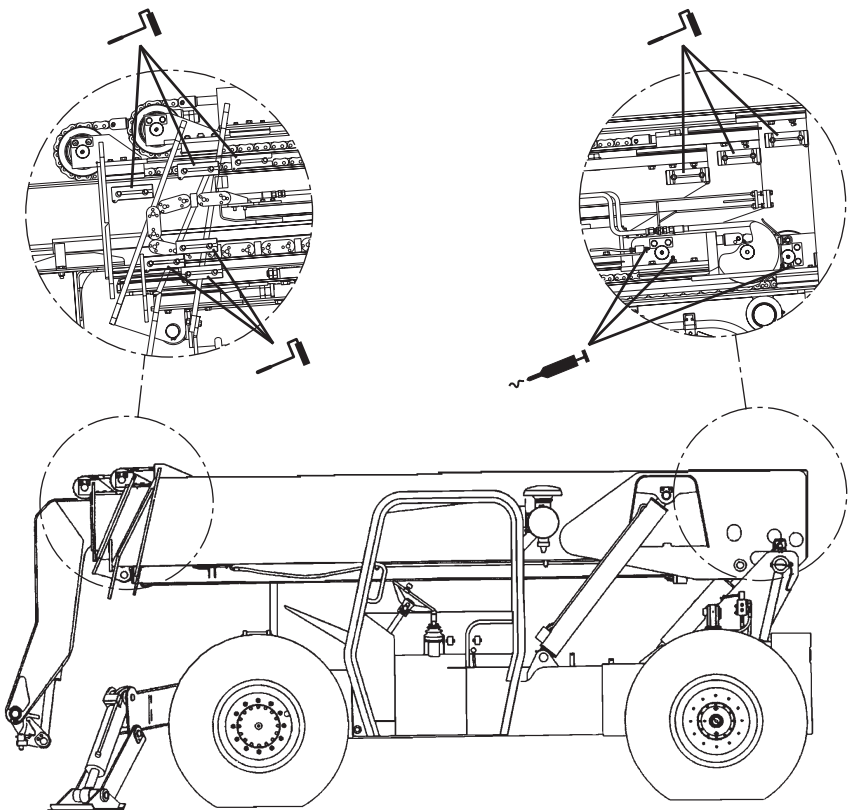


b. 250 Hour



MYSTIK TETRIMOLY
(NLGI 2 GC-LB)

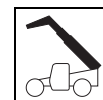
EVERY
50 



MX00712



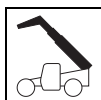
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Section 3 Boom

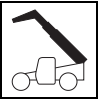
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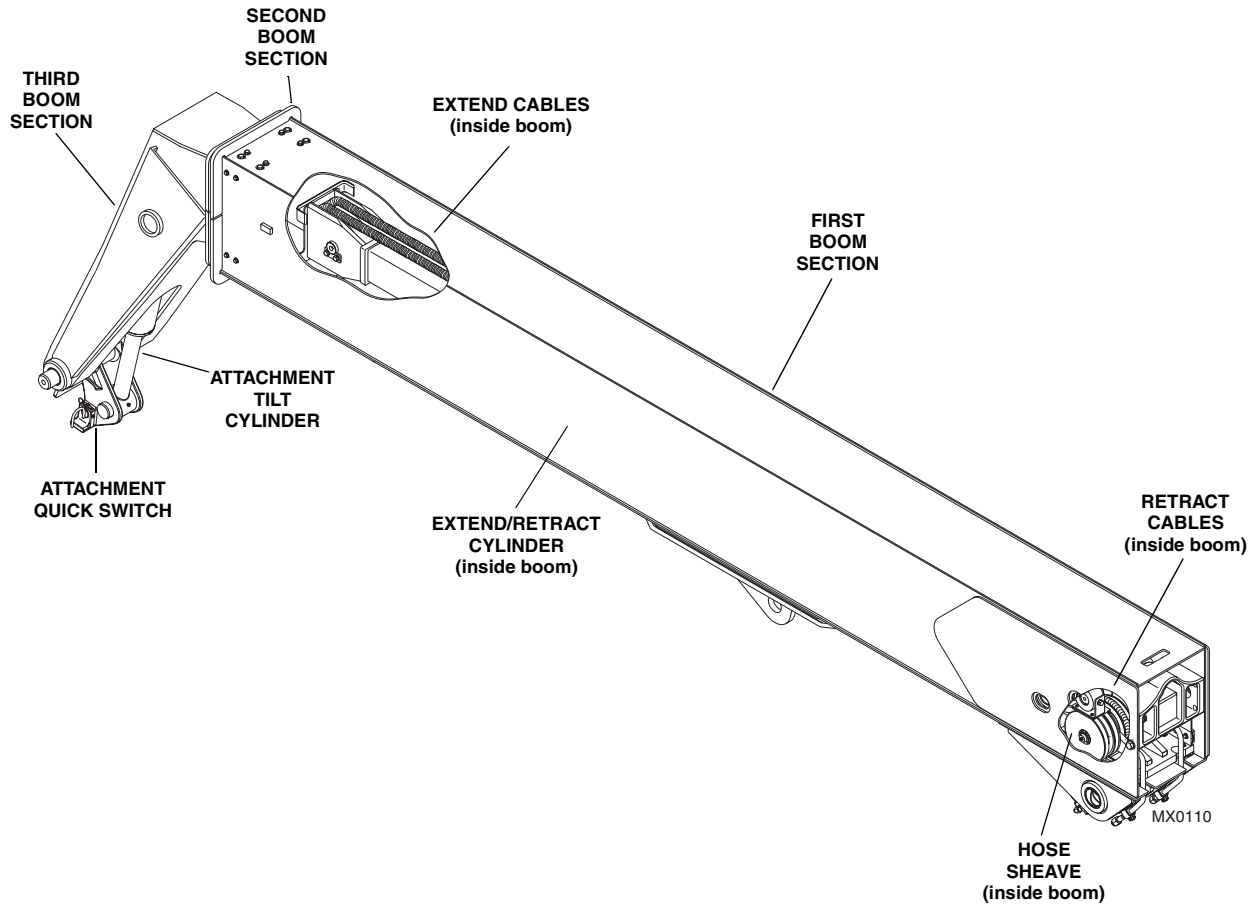
Boom

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3.1 BOOM SYSTEM COMPONENT TERMINOLOGY 534D-9, 534D-10

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





Boom

3.2 BOOM SYSTEM - THREE SECTION

3.2.1 Boom System Operation

The three section boom consists of the first, second and third assemblies with second and third section extend cables, and a single second and third section retract cable.

As the extend/retract cylinder, which is anchored at the rear of the first boom section, and the front of the push beam begins to extend, it forces the second and third boom sections out of the first boom section.

The boom sections are connected by extend and retract cables. These cables are routed around sheaves on the front of the push beam and the rear of the second boom section. As the extend/retract cylinder is forced out hydraulically, the second and third boom sections are pulled out by the extend cables.

As hydraulic pressure is applied to the retract port on the extend/retract cylinder, the retract cable pulls the second and third boom sections back into the first boom section.

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

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

3.3 BOOM MAINTENANCE - THREE SECTION (COMPLETE REMOVAL)

These instructions must be completed in sequence. The second and third boom sections are removed from the first boom section. The third boom section is removed from the second boom section.

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



WARNING

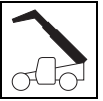
NEVER weld or drill the boom unless approved in writing by **JLG**. The structural integrity of the boom will be impaired if subjected to any repair involving welding or drilling.

3.3.1 Boom Removal

While the boom sections can be separated from each other on the machine, **JLG** recommends against this procedure. It is much safer, more efficient and more cost-effective to remove the complete boom assembly from the machine and place it on suitable supports for separation. Work can then progress at a normal working height.

Note: When removing a complete boom assembly use a hoist or crane with a minimum lift capacity of 6000 lbs.

1. Remove any attachment from the quick switch assembly. Refer to Section 3.16.1, "Disconnecting from an Attachment."
2. Park the machine on a hard, level surface, fully retract the boom, level the boom assembly, 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, stating that the machine should not be operated.
4. Open the engine cover. Allow the system fluids to cool.
5. Remove the battery negative (-) cable from the battery negative (-) terminal.
6. Place a sling around the first boom section at the balance point.
7. Take the weight off the boom assembly.
8. Label, disconnect and cap all hydraulic hoses attached to the boom. Cap all fittings and openings to keep dirt & debris from entering the hydraulic system.
9. Label, disconnect any electrical cables if equipped.
10. Remove the pin from the rod end of the compensation cylinder being careful not to drop the cylinder. Lower the cylinder to a secure position.
11. Remove the pin from the rod end of both lift cylinders being careful not to drop the cylinder. Lower the cylinder to a secure position.
12. Confirm that the boom assembly is balanced with the sling and remove the boom assembly pivot pin.
13. Lift the boom assembly from the machine and lower onto suitable supports

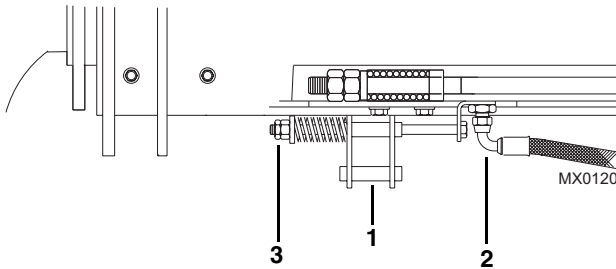


3.3.2 Second & Third Boom Section Removal

1. Set the complete boom on level ground and by repositioning the slings turn boom over on to the top side. Set the complete boom on suitable stands to begin tear down.

Note: With the complete boom setting upside down, the removal and replacing of each boom section, tilt cylinder, hoses, extend and retract cables and push beam are made much easier.

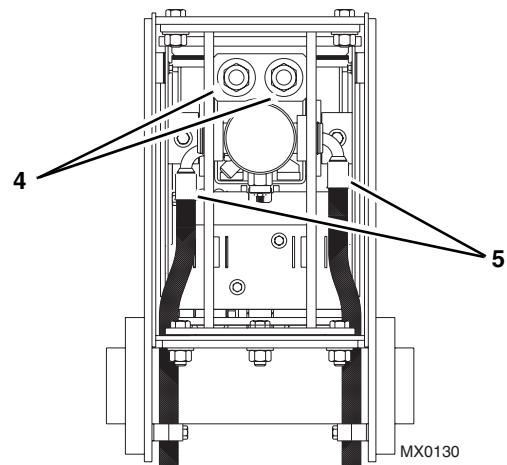
2. Remove all wear pads, shims and backing plates from the front inside of the first boom section. Label and tag each set of wear pads being removed.



3. Loosen the hose take-up brackets (1) on the bottom front of the first boom section. Disconnect both tilt hoses and both auxiliary hoses (2) inside the boom, below the take-up brackets. Plug the hose ends and cap the tube ends to prevent dirt and debris from entering the hydraulic system.

Note: If the machine is equipped with auxiliary hydraulics, separate the plug at the hose take-up area.

4. Loosen the lock-nut and jam-nut (3) on the retract cable at the front of the first boom section. Loosen and remove the bolts holding the retract cable adjusting block.



5. Remove the lock-nuts and jam-nuts (4) from the extend cables at the rear of the boom assembly.
6. Label, disconnect and cap the extend/retract hoses (5) from the cylinder. Cap all fittings and openings to prevent dirt and debris from entering the hydraulic system.
7. Remove the extend/retract cylinder mounting pin, hose guards and strong back from the rear of the boom assembly.
8. Place a sling around the second boom section, lift and slowly pull the second and third boom section approximately half way out of the first boom section. Lower the second and third boom sections onto a suitable support.
9. Relocate the sling or using two slings for better stability, balance the two boom sections and slowly pull them out of the first boom section being careful not to damage the hydraulic hoses or cables. Lower the second and third boom sections onto suitable supports.

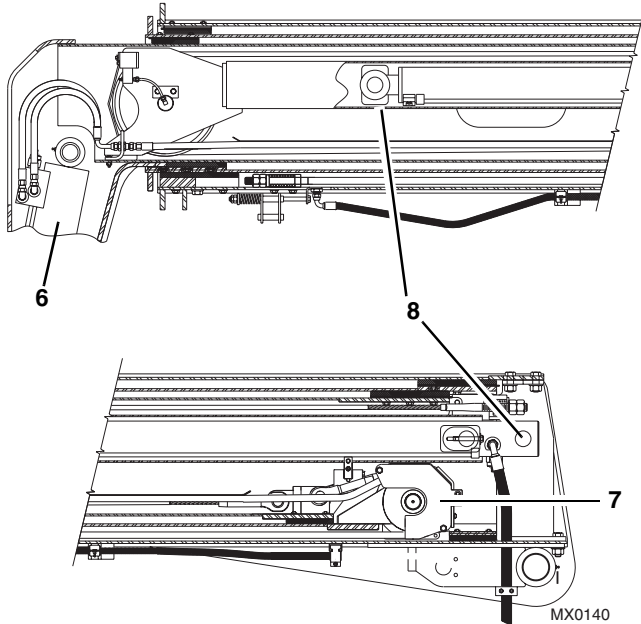
3.3.3 Third Boom Section & Push Beam Removal

1. Remove all wear pads, shims from the front inside of the second boom section. Label and tag each set of wear pads being removed
2. Label, disconnect and cap the tilt circuit hoses (6) from the tilt cylinder at the front of the third boom section. Label, disconnect and cap the auxiliary circuit hoses from the quick disconnect fittings at the front of the third boom section. Cap all fittings and openings to prevent dirt and debris from entering the hydraulic system.



Boom

3. Loosen and remove all extend cable sheave components from the front of the pivot beam.
4. Pull the extend cables free of the sheave brackets and lay them on the boom.



5. At the rear of the boom, loosen and remove all retract cable sheave components and the hydraulic hose rollers and components (7).
6. Loosen and remove all push beam pins (8).
7. Pull the push beam free from the front of the third boom section.
8. Place the hydraulic hoses inside the third boom section.
9. Place a sling around the third boom section, lift and slowly pull the third boom section approximately half way out of the second boom section. Lower the third boom section onto a suitable support.
10. Relocate the sling or using two slings for better stability, balance the third boom section and slowly pull the third boom section out of the second boom section. Lower the third boom section onto suitable supports.

Note: Before reassembly of the boom, check the bores, pins and bushings for damage. Repair as needed. Also check the diameters of the pins and bushings.

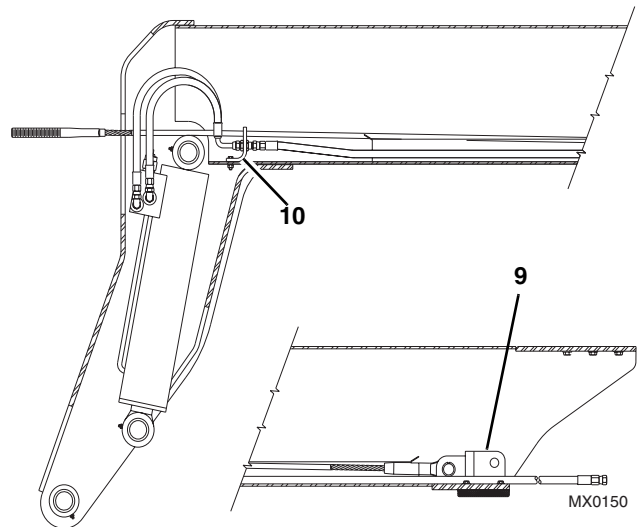
3.3.4 Third Boom Section Installation

Note: During reassembly use Loctite 242® on all bolt threads and use Loctite 545® on all hydraulic fittings

Note: Shim all wear pads to 1/16" of a tight fit. You may have to final adjust the wear pads after the boom assembly is installed on the machine and hydraulic power is available.

Note: Coat the interior of all bushings and sheaves with Mystik Tetrिमoly Grease prior to the installation of pins and bushings. Wear pads and slide areas must be lubricated with Mystik Tetrिमoly Grease or an equivalent.

1. Place the third boom section upside down on suitable supports.



2. Install the wear pads and spacers on the bottom and both sides at the rear of the third boom section. For ease of installation DO NOT install the top wear pads at this time.
3. Install the single retract cable and the double extend cables to the bracket (9) at the rear of the third boom section.
4. Install the tilt circuit hoses, auxiliary circuit hoses and if equipped, the electrical cables and brackets inside protected areas.
5. Install the hose brackets (10) in place at the front of the third boom section.
6. Lubricate wear pad paths and lay the tilt hoses, auxiliary hoses, cables and if equipped, electrical cable inside the third boom section to protect against being damaged when installing the third boom section into the second boom section.



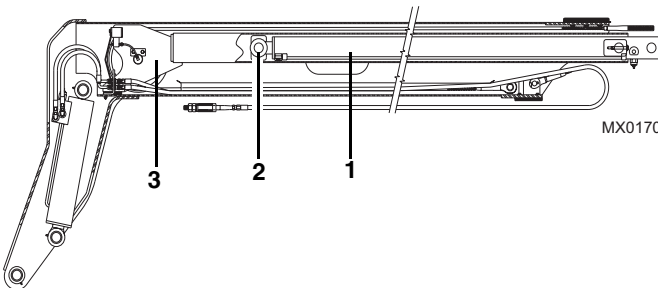
7. Connect the auxiliary hoses to the quick disconnects on the side of the boom head. Connect the electrical cable to the plug mounted below the auxiliary quick disconnects if equipped.
8. Install the tilt cylinder in the boom head, install the mounting pin and keeper bolt, locking the mounting pin and tilt cylinder into position.

3.3.5 Extend/Retract Cylinder and Push Beam Assembly and Installation

1. Install the extend/retract cylinder (1) into the push beam.
2. Install the mounting pin and hardware (2) at the extend/retract cylinder rod eye.
3. Install the push beam assembly (3) through the front of the third boom section leaving the sheave bracket exposed for accessibility.
4. Guide the threaded end of the extend cables through the sheave bracket.

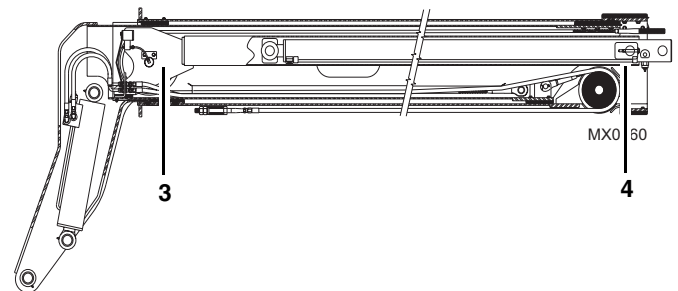
Note: The extend cable will not feed through sheave bracket with the sheave installed.

5. Lay the cables over the boom head and complete the sheave assembly installation; i.e. sheaves, pins, lube system and wear pad.
6. Guide the cable around the sheave and install the cable guide and guide bar.



7. With the push beam installed in the third boom section, the third boom section and push beam are ready to be installed into the second boom section.
8. Place the second boom section upside down on suitable supports.
9. Lubricate the inside second boom section on area's where the third boom section wear pads will slide.
10. Using a suitable sling, balance the third boom section and carefully slide 3 ft - 4 ft (0,9 m - 1,22 m) into the front of the second boom section.

11. Set the third boom section onto a suitable support and reset the sling under the boom head of the third boom section. Carefully slide the third boom section into the second boom section.
12. Install the push beam (3) fully into the second boom section, lining up the mounting pin bores at the rear of the second boom section.
13. Install the push beam mounting pins and locking hardware (4).
14. Leave 6 in - 8 in (152 mm - 203 mm) of the third boom section out to be able to install the wear pads in the front of the second boom section.
15. With the sling still under boom head, install the wear pads and spacers in the front of the second boom section.
16. Install the top wear pads and spacers on the top rear of the third boom section.
17. Install the wear pads and spacers on the bottom and both sides at the rear of the second boom section. For ease of installation DO NOT install the top wear pads at this time.
18. Lubricate wear pads, inside sheaves, bores and pins during assembly.



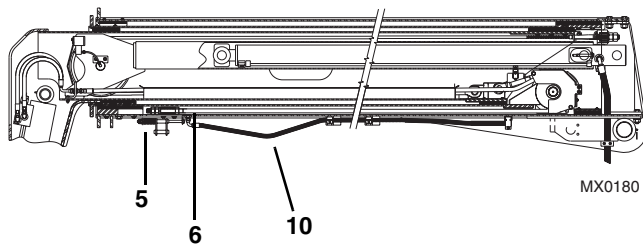
3.3.6 Second & Third Boom Section Installation

1. Place the first boom section upside down on suitable supports.
2. Lubricate the inside first boom section on area's where the second boom section wear pads will slide.
3. Using a suitable sling, balance the second and third boom sections and carefully slide 3 ft - 4 ft (0,9 m - 1,22 m) into the front of the first boom section.



Boom

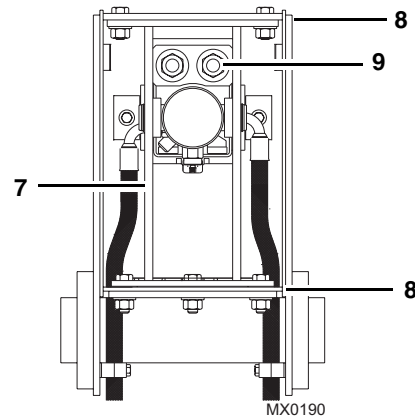
4. Set the second and third boom sections onto a suitable support and reset the sling under the boom head of the third boom section.
5. Carefully slide the two boom sections into the first boom section. Leave 6 in - 8 in (152 mm - 203 mm) in of the two boom sections out to be able to install the wear pad block and the wear pads in the front of the first boom section
6. Install the hose take-up assembly (5) components at the front of the first boom section.
7. Install the retract cable adjusting block (6). Install the retract cable. Do Not tighten the retract cable.
8. Install the wear pad block to the front inside of the first boom section. Use Loctite 242® and torque the wear pad block mounting bolts to 265-290 lb-ft (359 - 393 Nm).
9. Install the wear pads, spacers and shims at the front of the first boom section. Use Loctite 242® and torque the wear pad mounting bolts to 68-78 lb-ft (92 - 106 Nm).



17. On the bottom side of the first boom section install the hose clamps for the tilt and auxiliary circuit hoses.

Note: Do Not tighten clamps at this point.

18. At the area between the hose take-up bracket to the first hose clamp, adjust the hoses to form a 4 in (102 mm) partial loop between the bottom of the first boom section to the bottom of the hoses (10).
19. Tighten all hose clamps.



10. Place the strong back (7) in place at the rear of the first boom section and install the extend/retract cylinder mounting pin, spacers and retaining clips.
11. Measure the space between the top and bottom of the strong back (8) and the inside of the first boom section and shim as needed.
12. Install and torque the strong back mounting bolts.
13. Install the extend cables, springs, washers and lock nuts into the strong back (9).
14. Tighten the extend cables adjusting nuts until the gap between the cable flat washer and strong back is 1/32 in to 1/16 in (0,79 mm - 1,57 mm). Gap for both washers should be equal.

Note: When adjusting cables, make sure the cables are not turning.

15. Torque the cable jam nuts to 100 lb-ft (135 Nm).
16. Install the extend/retract hoses.



3.4 BOOM MAINTENANCE - THREE SECTION (INDIVIDUAL SECTION REMOVAL)

These general instructions help with the removal of individual boom sections with the boom still mounted on the machine. Safe practices and common sense must be followed when removing boom sections.

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 taking into consideration your particular situation.

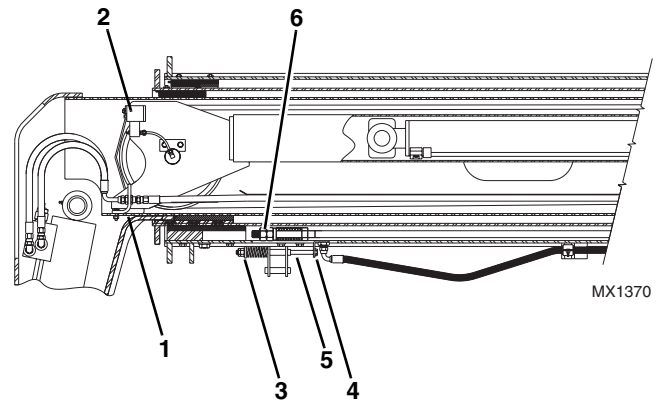
For more detailed instructions, see Section 3.3, "Boom Maintenance - Three Section (Complete Removal)."

3.4.1 Push Beam and Third Boom Section Removal

1. Park the machine on a firm, level surface, fully retract the boom, lower the boom to a level position, 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, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Remove the battery negative (-) cable from the battery negative (-) terminal.

Note: When removing a boom section(s), use a lifting device with a sufficient lift capacity. (A complete three section boom assembly weighs approximately 5700 lbs.)

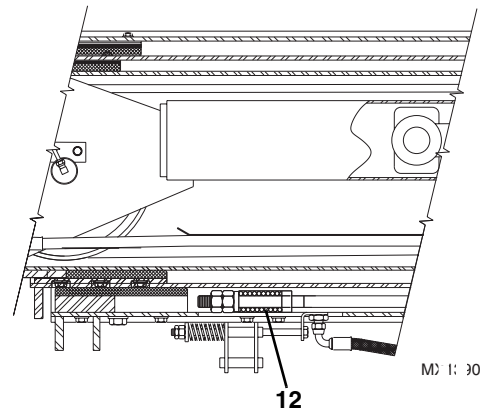
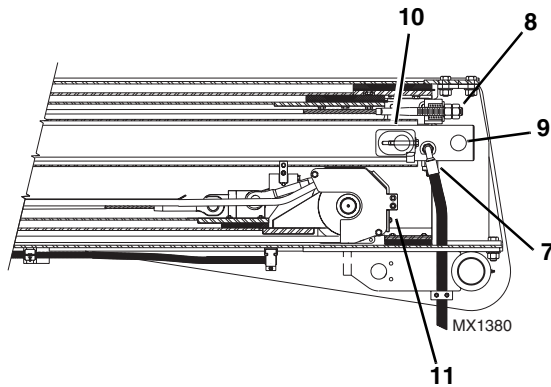
5. Label, disconnect and cap all hydraulic hoses attached at the tilt cylinder. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
6. Remove the tilt cylinder from the third boom section.
7. Disconnect and cap the tilt hoses attached at the bulkhead bracket. Disconnect and cap the auxiliary hoses attached at the bulkhead bracket if equipped.
8. Remove the bulkhead brackets (1).
9. Remove the guide plate and bar (2) from the top front of the push beam.



10. Release tension from the hoses on the hose take-up bracket (3).
11. Label, disconnect and cap all hydraulic hoses attached at the take-up bracket (4). Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
12. If equipped, label, loosen and separate all electrical cables at the take-up bracket.
13. Remove the take-up brackets (5).
14. Loosen and remove the jam nuts on the retract cable (6) at the bottom of the first boom section.
15. Label, disconnect and cap both hydraulic hoses (7) attached to the extend/retract cylinder. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
16. Loosen and remove the jam nuts on the two extend cables (8) at the strong back.
17. Remove the pin (9) holding the extend/retract cylinder at the strong back.
18. Loosen and remove the bolts holding the strong back to the rear of the first boom section. Remove the strong back.
19. Remove the two pins (10) holding the push beam at the rear of the second boom section.
20. Loosen and remove the wear pads from the front of the second boom section. Note the location of the wear pads, mounting bolts and number of shims from each location.
21. Loosen and remove the wear pads from the top rear and one side of the third boom section. Note the location of the wear pads, mounting bolts and number of shims from each location.
22. Remove hose guide (11) from the rear of the second boom section.



Boom



23. Slowly pull the push beam out of the front of the third boom section. The extend cables will come out along with the push beam.
24. When the head of the push beam is out of the third boom section, stop and pull the extend cables the remaining of the way out over the cable sheaves of the push beam.
25. Slowly pull the push beam free of the machine and place on the ground or suitable support.

Note: The extend/retract hydraulic cylinder can be removed from the push beam if necessary.

26. Pull the retract cable from between the second and first boom section at the rear of the boom.
27. Slowly pull the third boom section free of the machine and place on the ground or suitable support.

3.4.2 Second Boom Section Removal

1. Pull the tilt hoses, and if equipped, the auxiliary hoses, from the bottom rear of the boom sheaves.
2. Remove the wear pads from the front of the first boom section. Note the location of the wear pads, mounting bolts and number of shims from each location.
3. Remove the wear pads from the top rear and one side of the second boom section. Note the location of the wear pads, mounting bolts and number of shims from each location.
4. Loosen and remove the retract cable adjustment block (12) from the bottom front of the first boom section.

Note: It may be necessary to pull the boom section(s) out far enough to access the wear pads.

5. Slowly pull the second boom section out of the first boom section.

6. Lift the second boom section free of the machine and place on the ground or suitable supports.

3.4.3 Second and Third Boom Section Removal

It is best to remove the boom sections in the order in which they were assembled. If a section needs to be separated, this presents an excellent opportunity to check all sections for serviceability. The third and second sections can be removed as a assembly. The push beam/extend-retract cylinder can be either removed or left in place during the third and second boom section removal.

1. Release tension from the hoses on the hose take-up bracket (3).
2. Label, disconnect and cap all hydraulic hoses attached at the take-up bracket (4). Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
3. If equipped, label, loosen and separate all electrical cables at the take-up bracket.
4. Remove the take-up brackets (5).
5. Loosen and remove the jam nuts on the retract cable (6) at the bottom of the first boom section.
6. Loosen and remove the retract cable adjustment block (12) from the bottom front of the first boom section.
7. Label, disconnect and cap both hydraulic hoses (7) attached to the extend/retract cylinder. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
8. Loosen and remove the jam nuts on the two extend cables (8) at the strong back.
9. Remove the pin (9) holding the extend/retract cylinder at the strong back.



10. Loosen and remove the bolts holding the strong back to the rear of the first boom section. Remove the strong back.
11. Remove the wear pads from the front of the first boom section. Note the location of the wear pads, mounting bolts and number of shims from each location.
12. Remove the wear pads from the top rear and one side of the second boom section. Note the location of the wear pads, mounting bolts and number of shims from each location.

Note: It may be necessary to pull the boom section(s) out far enough to access the wear pads.

13. Slowly pull the two boom sections out of the first boom section. The extend cables, retract cable and the tilt/aux hoses will come out along with the boom sections.
Pay close attention to the retract cable and tilt/aux hoses during the boom section removal as not to allow the cable or hoses to become jammed between the second and first boom sections.
14. Lift the two boom sections free of the machine and place on the ground or suitable supports.

3.4.4 Second Boom Section Installation

1. Grease the inside wear pad paths of the first boom section and the outside wear paths of the second boom section.
2. Position the second boom section into the front of the first boom section. Leave room at the bottom front to install the retract cable adjustment block.
3. Install the retract cable adjustment block to the inside front of the first boom section.
4. Install the wear pads and shims in the front of the first boom section.
5. Install the wear pads and shims at the top rear and one side of the second boom section.
6. Feed the tilt hoses (and auxiliary hoses if equipped) through the bottom of the hose sheaves at the rear of the second boom section.

Note: Make sure the tilt/aux hoses do not cross each other between the first and second boom sections.

7. Install the hose take-up brackets and install the tilt/aux hoses to the correct fittings on the take-up brackets.

3.4.5 Third Boom Section Installation

1. Grease the inside wear pad paths of the second boom section and the outside wear paths of the third boom section.
2. With the retract cable fed through the front of the second boom section, position the third boom section into the front of the second boom section.
3. Feed the retract cable over the cable sheave at the rear of the second boom section and out the rear of the first boom section.
4. Install the wear pads and shims in the front of the second boom section.
5. Install the wear pads and shims at the top rear and one side of the third boom section.
6. Install the back of the push beam into the head of the third boom section. With the push beam installed 50% into the third boom section, feed the extend cables through the bottom and over the cable sheaves.
7. Install the push beam into position and pin into place at the rear of the second boom section. Pull the third and second boom section out of the first section together approximately 12 in. to allow slack in the tilt/aux hoses.
8. Install the bulkhead brackets at the front of the third boom section.
9. Feed the tilt/aux hoses through the trays at the bottom corners of the third boom sections.
10. Uncap and reconnect the previously labeled tilt/aux hoses to the fittings on the bulkhead brackets.
11. Push the third and second boom section back against the first boom section.
12. Install the strong back and pin the extend/retract to the strong back.
13. Uncap and reconnect the previously labeled extend/retract hoses to the fittings on the extend/retract cylinder.
14. Feed the extend cables through the strong back and install the jam nuts on each cable.
15. Install the guide and cable cover on the front of the push beam.
16. Install the tilt cylinder and hoses in the third boom section boom head.
17. Install the hose and cable cover at the rear of the second boom section.
18. Adjust the boom sections, cables and hoses to the proper dimensions.



3.5 BOOM CABLES - THREE SECTION

3.5.1 General Cable Information

The 534D-9 & 534D-10 Parts Manual covers part numbers, length and key specifications. Please review this manual to make certain that you are using the correct cable for your machine. DO NOT use cable other than that supplied by **JLG** for replacement. These cables are specifically designed for **JLG** Material Handlers.

- Cables are pre-stretched; lengths cited below are after pre-stretching.
- Threaded stud, Galvanized Plating.
- Safe Lock Closed Socket Terminal used on Extend Cable.
- Safe Lock or Spelter Socket used on Retract Cable.
- Boom Cable length tolerance: +0.5 in / -1.0 in (12,7 mm - 25 mm).
- Use two wrenches when torquing adjusting jam nuts. Use the flats on the threaded cable ends to hold the cable straight, eliminating twist.

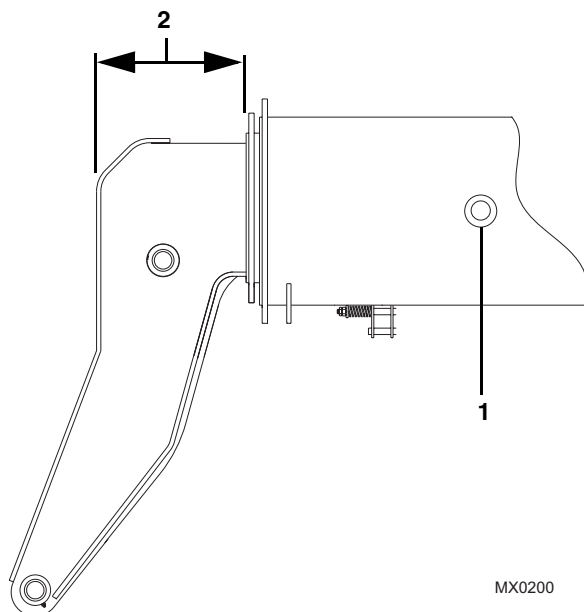
3.5.2 Cable Adjustments

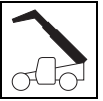
The cables are adjusted by tightening and/or backing off the adjusting nuts at the threaded end of the cable. Tightening the retract cable adjusting nuts pulls the third boom section in, to the rear. Tightening the extend cables adjusting nuts pulls the third boom section out, to the front. The opposite cable adjusting nut usually must be loosened whenever this procedure is performed.

The cables are properly adjusted whenever the following parameters are met.

534D-9, 534D-10:

The extend/retract cylinder rod eye pin **(1)** is centered in the side access hole of the push beam and/or the dimension **(2)** from the front of the third boom section to the front of the second boom section is 17.5 in (444,5 mm).

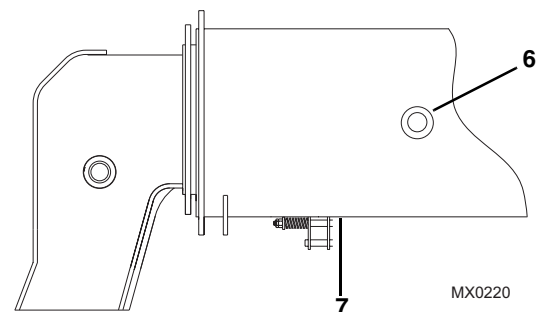
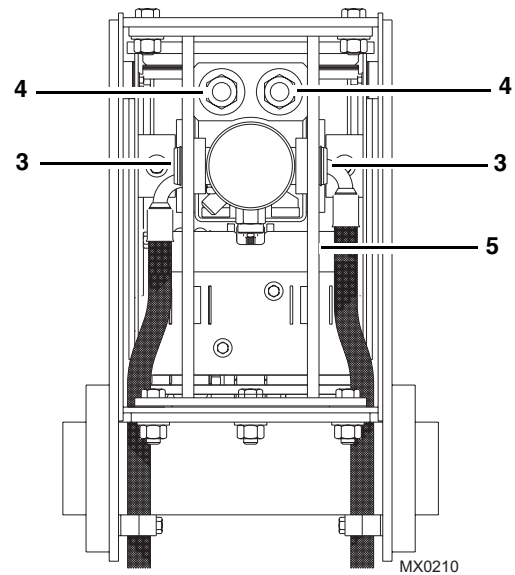




3.5.3 Retract Cable Removal

The removal of the retract cable is a difficult operation; but it can be accomplished. You must be able to reach into the rear of the boom assembly to unfasten the retract cable socket from the cable anchor bracket weldment. If you cannot reach this bracket, the boom sections must be separated.

1. Remove any attachment from the quick switch assembly. Refer to Section 3.16.1, "Disconnecting from an Attachment."
2. Park the machine on a hard, level surface, fully retract the boom, level the boom assembly, 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, stating that the machine should not be operated.
4. Open the engine cover. Allow the system fluids to cool.
5. Remove the battery negative (-) cable from the battery negative (-) terminal.
6. Remove the hose guards from the rear of the first boom section.
7. Label, disconnect and cap all extend/retract hydraulic hoses. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
8. Remove the extend/retract cylinder mounting pins **(3)** from the strong back/cylinder bracket.
9. Remove the extend cable lock nuts, washers and springs **(4)** from the strong back/cylinder bracket.
10. Pull the cable free of the strong back/cylinder bracket. Fasten a rope to the cable end to aid in reinstallation.
11. Remove the strong back/cylinder bracket mounting bolts and remove the strong back bracket **(5)** from the machine. Label and tag each set of shims being removed from above and below the strong back.
12. Remove the push beam mounting pins **(6)** and from the front of the third boom section, pull the push beam clear of third boom section.
13. Loosen the retract cable adjustment bolts **(7)** and remove all the retract cable sheave components.
14. Reaching inside the rear of the boom at the cable anchor bracket, remove the cotter pin from the retract cable pin. Remove the retract cable. The retract cable should now be free.
15. Pull the retract cable through the rear of the boom assembly. Remove the ropes and leave them in place to aid in reinstallation.

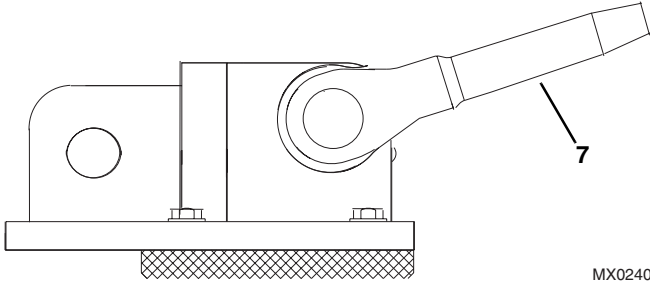




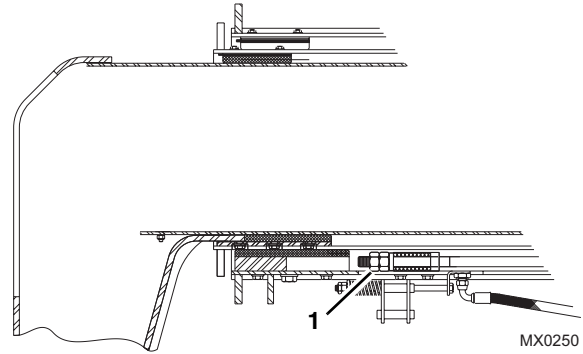
Boom

3.5.4 Retract Cable Installation

1. Fasten the rope left in the boom from the retract cable removal to the new retract cable and pull the cable through the boom sections to the approximate final position. Remove the rope.
2. Install the retract cable socket end (7) to the cable anchor bracket weldment.



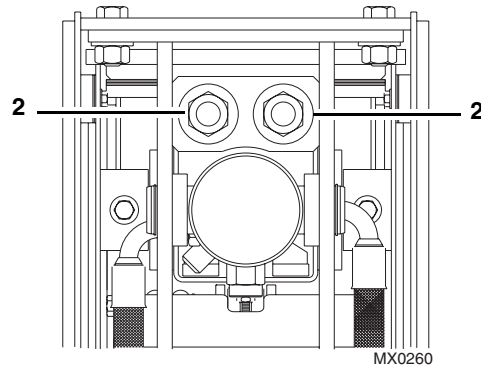
3. Install the retract cable threaded end through the rear cable sheave bracket and cable adjusting block.
4. Feed the retract cable into the inside bottom front of the first boom section to the retract cable adjustment access hole.
5. At the front of the third boom section, install the push beam and align the push beam mounting pins.
6. Install the push beam mounting pins and lock bolts.
7. Install the retract cable to the cable adjustment block at the bottom front of the first boom section.
8. Install the retract cable sheave and all the related components.
9. Install the cable guards.
10. Install the hose guards at the rear of the boom.
11. Place the strong back in place at the rear of the first boom section and install the extend/retract cylinder mounting pin, spacers and retaining clips.
12. Install the previously removed shims to the top and bottom of the strong back/cylinder bracket.
13. Install and torque the strong back mounting bolts.
14. Uncap and reconnect the previously labeled hydraulic hoses to the appropriate locations.
15. Install the extend cables, springs, washers and lock nuts into the strong back.



16. At the retract cable adjusting block (1) located at the bottom front of the first boom section, tighten the retract cable adjusting nut until the front of the threaded end lines up with the front edge of the access hole.
17. At the strong back, tighten the extend cable adjusting nut (2) until the gap between the cable flat washer and the strong back is 1/32 to 1/16 in (0,79 - 1,57 mm). Gap for both washers should be the same.

Note: When adjusting cables, make sure the cables are not turning.

18. Install the jam nut to the adjusting nut and torque to 100 lb-ft (135 Nm).
19. Refer to Section 3.5.2, "Cable Adjustments," for boom section specifications.

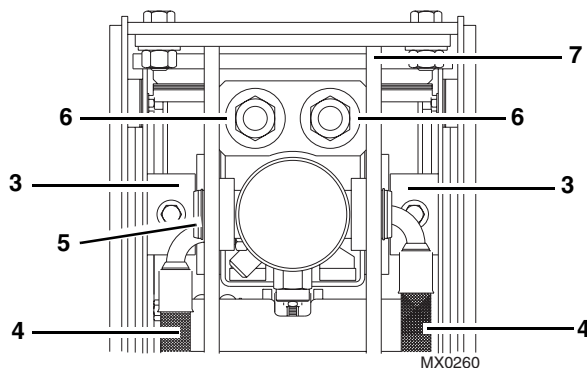


3.5.5 Extend Cable Removal

The removal of the extend cable is a difficult operation; but it can be accomplished. You must be able to reach into the rear of the boom assembly to unfasten the extend cable socket from the cable anchor bracket weldment. The bracket is welded to the rear bottom plate of the third boom section. If you cannot reach this bracket, the boom sections must be separated.



1. Remove any attachment from the quick switch assembly. Refer to Section 3.16.1, "Disconnecting from an Attachment."
2. Park the machine on a hard, level surface, fully retract the boom, level the boom assembly, 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, stating that the machine should not be operated.
4. Open the engine cover. Allow the system fluids to cool.
5. Remove the battery negative (-) cable from the battery negative (-) terminal.
6. Remove the hose guards (3) from the rear of the first boom section.
7. Label, disconnect and cap the extend/retract cylinder hoses (4). Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
8. Remove the extend/retract cylinder mounting pins (5) from the strong back/cylinder bracket.
9. Remove the extend cable lock nuts, washers and springs (6) from the strong back/cylinder bracket.
10. Pull the cable free of the strong back/cylinder bracket. Fasten a rope to the cable end to aid in reinstallation.
11. Remove the strong back/cylinder bracket mounting bolts and remove the strong back bracket (7) from the machine. Label and tag each set of shims being removed from above and below the strong back.

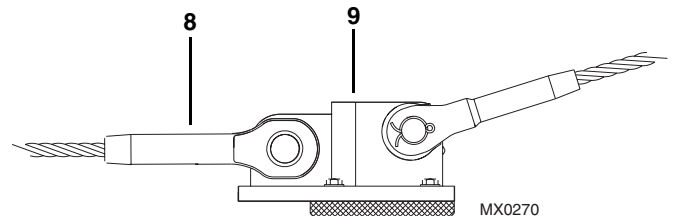


12. Remove the push beam mounting bolts. Pull the push beam extend cable sheave bracket free of the third boom section.
13. Remove all the extend cable sheave bracket components from the front of the push beam.

14. Pull the extend cable through the push beam extend cable sheave bracket.

3.5.6 Extend Cable Installation

1. Tie a rope to the extend cable threaded end and pull the cable to the anchor bracket weldment area.
2. Install the extend cable socket end (8) and the mounting hardware to the extend cable anchor bracket weldment (9).



3. Assemble all the extend cable sheave bracket components to the front of the push beam.

Note: The extend cable threaded end must be inserted through the sheave bracket before the sheave components are installed.

4. Install the push beam fully into the second boom section.
5. Install the push beam mounting hardware and the tilt and auxiliary circuit hose guards at the rear of the first boom section.
6. Place the strong back in place at the rear of the first boom section and install the extend/retract cylinder mounting pin, spacers and retaining clips.
7. Install the previously removed shims to the top and bottom of the strong back/cylinder bracket.
8. Install and torque the strong back mounting bolts.
9. Uncap and reconnect the previously labeled hydraulic hoses to the appropriate locations.
10. Install the extend cables, springs, washers and lock nuts into the strong back.

Note: Be certain that the extend cables are stress free and not twisted.

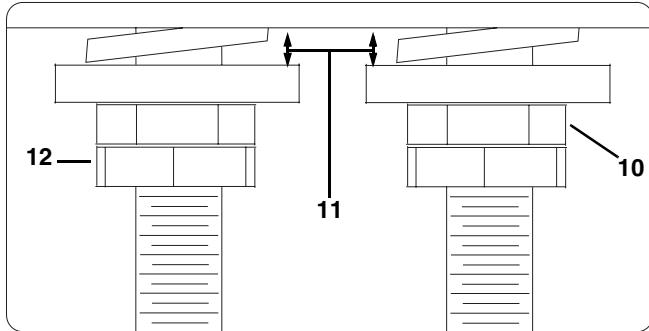
11. Remove the rope and install the extend cable springs, washers and lock nuts into the strong back.
12. Tighten the extend cables adjusting nuts (10) until the gap between the cable flat washer and the strong back (11) is 1/32 to 1/16 in (0,79 mm - 1,57 mm). The gap for both washers should be equal.



Boom

Note: When adjusting cables, make sure the cables are not turning.

13. Install the jam nut **(12)** to the adjusting nut and torque to 100 lb-ft (135 Nm).
14. Refer to Section 3.5.2, "Cable Adjustments," for boom section specifications.



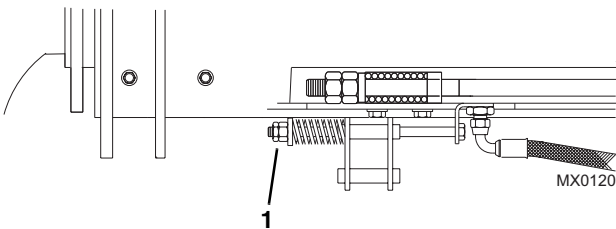
MX0280

3.5.7 Tilt and Auxiliary Circuit Hose Removal/Installation

Hoses that need replaced and are still in one piece can be removed and replaced by simply connecting a union to the fittings on the hoses being replaced and the new hoses. Disconnect the hoses at the back of the boom and pull them through the boom assembly until they are free. You may have to remove the hose guard at the roller assembly. Follow the procedure below if the above procedure cannot be followed.

3.5.8 Hose Removal

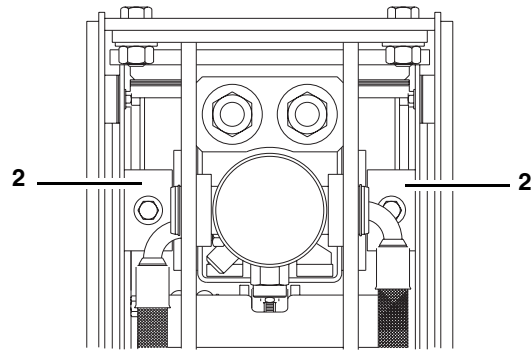
1. Loosen the adjusting nuts **(1)** at the hose take-up bracket to relieve the tension on the hose assemblies.
2. Loosen the hose from the take-up bracket. Plug the hose ends and cap the tube ends to prevent dirt and debris from entering the hydraulic system.



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3. From the rear of the boom, remove the hose guard **(2)** for the hose being removed.

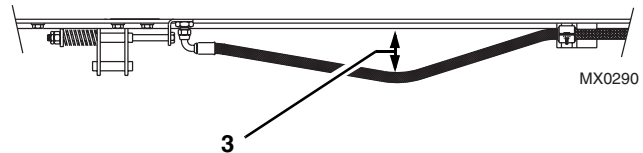
4. Loosen the hose from the bulkhead at the front of the boomhead. Plug the hose ends and cap the tube ends to prevent dirt and debris from entering the hydraulic system.
5. Tie a rope to the hose end and through the rear of the boom, pull the separated hose free of the boom assembly.



MX0260

3.5.9 Hose Installation

1. Tie a rope to the new hose end below the hose take-up bracket below the third boom section.
2. Slowly pull the rope from the rear of the boom and feed the hose around the roller and pull the hose through the protective channels in the third boom section to the boom head.
3. At the boom head, apply Loctite 545® to the hose fittings at the bulk head, connect and torque the hoses and install clamps.
4. Install the hose guard at the rear boom roller.
5. At the hose take-up bracket, apply Loctite 545® to the hose fittings, connect and torque the hoses.



MX0290

6. Tighten the hose take-up bracket adjusting nuts. Ensure the 4 in. (101 mm) dimension **(3)** is held at the hose area between the take-up bracket and the first hose clamp.



3.6 AUXILIARY ELECTRIC CABLE - THREE SECTION

The electric cable is fed through the right side of the boom assembly in a fashion similar to the auxiliary hydraulic hoses. The electric cable lies adjacent to the hydraulic hoses and moves in unison with them, whenever the boom sections are extended and retracted. The receptacle and socket connector are equipped with a strain relief fitting to prevent the wires from pulling loose. This strain relief is tie-wrapped to the cable. **DO NOT** install a cable without the strain relief connected.

The socket end of the electric cable is fastened to the front boom head of the third boom section. It is secured with a bracket at this location. A strain relief fitting is installed at the cable take-up weldment and support. These assemblies are located at the area adjacent to the hydraulic hose take-up weldment.

The receptacle and socket are equipped with six contact points. One contact point is usually extra and is plugged using **JLG** part number 83481301. Refer to the following chart for identification in the socket (as viewed from the wire insertion end).

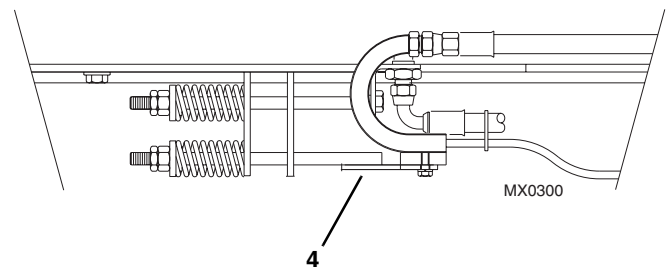
3.6.1 Electrical Wire Data

Socket Body Letter	Wire Color	Wire Function
"TM"	Orange	Panel
"A"	Blue	Open/Extra
"S"	Black	Mast
"RT"	Green	Swing
"LT"	Red	Side Shift
"C"	Green/Yellow	Ground

3.6.2 Electrical Cable Removal

1. Remove any attachment from the quick switch assembly. Refer to Section 3.16.1, "Disconnecting from an Attachment."
2. Park the machine on a hard, level surface, fully retract the boom, level the boom assembly, 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, stating that the machine should not be operated.

4. Open the engine cover. Allow the system fluids to cool.
5. Remove the battery negative (-) cable from the battery negative (-) terminal.
6. Unfasten the electrical socket and clamps at the front of the third boom section.
7. Remove the socket from the electrical cable.
8. Tie a rope to the cable end; this will aid in reinstallation.
9. Remove the hose guard from the right side roller at the rear of the boom.
10. Pull the electric cable to the rear, free of the boom.
11. Remove the cable take-up weldment (4) and support from the bottom front of the first boom section.
12. Pull the electric cable free of the boom through the cable take-up weldment.
13. Remove the remaining cable clamps and unplug the receptacle.



3.6.3 Electrical Cable Installation

It is assumed that the electric cable has been removed and the relating parts left off the boom assembly. The electric socket must not be installed at this time. The cable must be well tensioned in the area between the strain reliefs at the boom head on the third boom section and the boom cable take-up brackets.

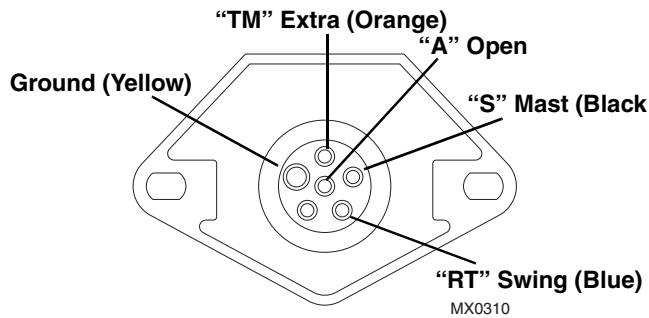
1. Tie the rope to the cable and feed it through the strain relief fitting and cable take-up weldment tube, then feed to the rear trough the cable take-up weldment located at the bottom front of the first boom section. The cable lies in the bottom plate area between the first and second boom sections.
2. Feed the electric cable around the right side hose roller, through the top protection channel, then to the boom head at the front of the third boom section.
3. Install the hose guard at the right side hose roller located at the rear of the second boom section.
4. Feed the cable through the tube weldment at the boom head at the third boom section and install the



Boom

strain relief fittings on the cable. Do not tighten at this time.

5. Pull the electric cable through the boom to the correct position at the boom head.
6. Install the cable wires into the socket, See Section 3.6.1, "Electrical Wire Data," for wire locations.
7. Install the socket into the bracket at the boom head. Tighten the strain relief fitting at the socket and tube. Install and tighten the cable clamps at the boom head.
8. Install the cable take-up weldment and support at the bottom front of the first boom section.
9. Tighten the strain relief fittings at the cable take-up weldment area.
10. Install the cable clamps to the bottom front of the first boom section.
11. Plug the receptacle connector into the frame cable wiring harness.



3.7 EXTEND/RETRACT CYLINDER REMOVAL AND INSTALLATION - THREE SECTION

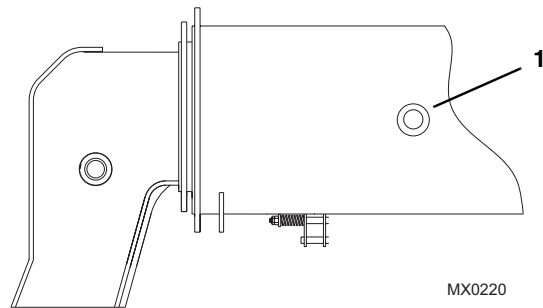
The extend/retract cylinder hydraulically extends and retracts the second boom section. A cable sheave arrangement is designed into the system to extend and retract the third boom section in proportion with the second boom section.

The 534D-9 and 534D-10 extend/retract cylinder is installed in a push beam. The base end of the cylinder mounts into a structure at the rear of the first boom section called a strong back. The rod eye end of the cylinder mounts into the push beam. The push beam is fastened to the rear of the second boom section. As the cylinder rod extends or retracts, the push beam moves the second boom section proportional.

Re-pack kits for the extend/retract cylinders are available from your Authorized **JLG** Distributor.

3.7.1 Extend/Retract Cylinder Removal

1. Remove any attachment from the quick switch assembly. Refer to Section 3.16.1, "Disconnecting from an Attachment."
2. Park the machine on a hard, level surface, retract the boom and line up the push beam extend/retract cylinder rod eye access holes (1) in all three boom sections, level the boom assembly, 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, stating that the machine should not be operated.
4. Open the engine cover. Allow the system fluids to cool.
5. Remove the battery negative (-) cable from the battery negative (-) terminal.

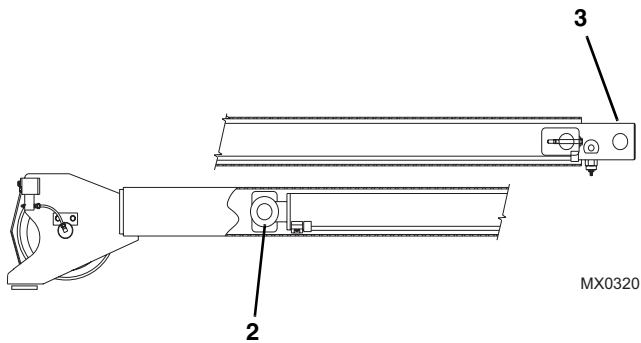


6. Remove the cylinder rod eye mounting pin.
7. Loosen and remove the extend/retract cylinder hoses at the rear of the boom assembly. Plug the hose ends to prevent dirt and debris from entering the hydraulic system.
8. Loosen and remove the fittings from the rear of the extend/retract cylinder barrel.
9. Attach a lifting tackle to the extend/retract cylinder, remove the mounting pins and carefully pull the extend/retract cylinder free of the machine through the strong back.
10. Place the extend/retract cylinder in a designated area for the next operation.



3.7.2 Extend/Retract Cylinder Installation

1. Install the extend/retract cylinder into the push beam and line up the rod eye to the access holes **(2)**. Be certain that the wear pad is installed at the rod end of the cylinder.
2. Install the rod eye mounting pin and secure.



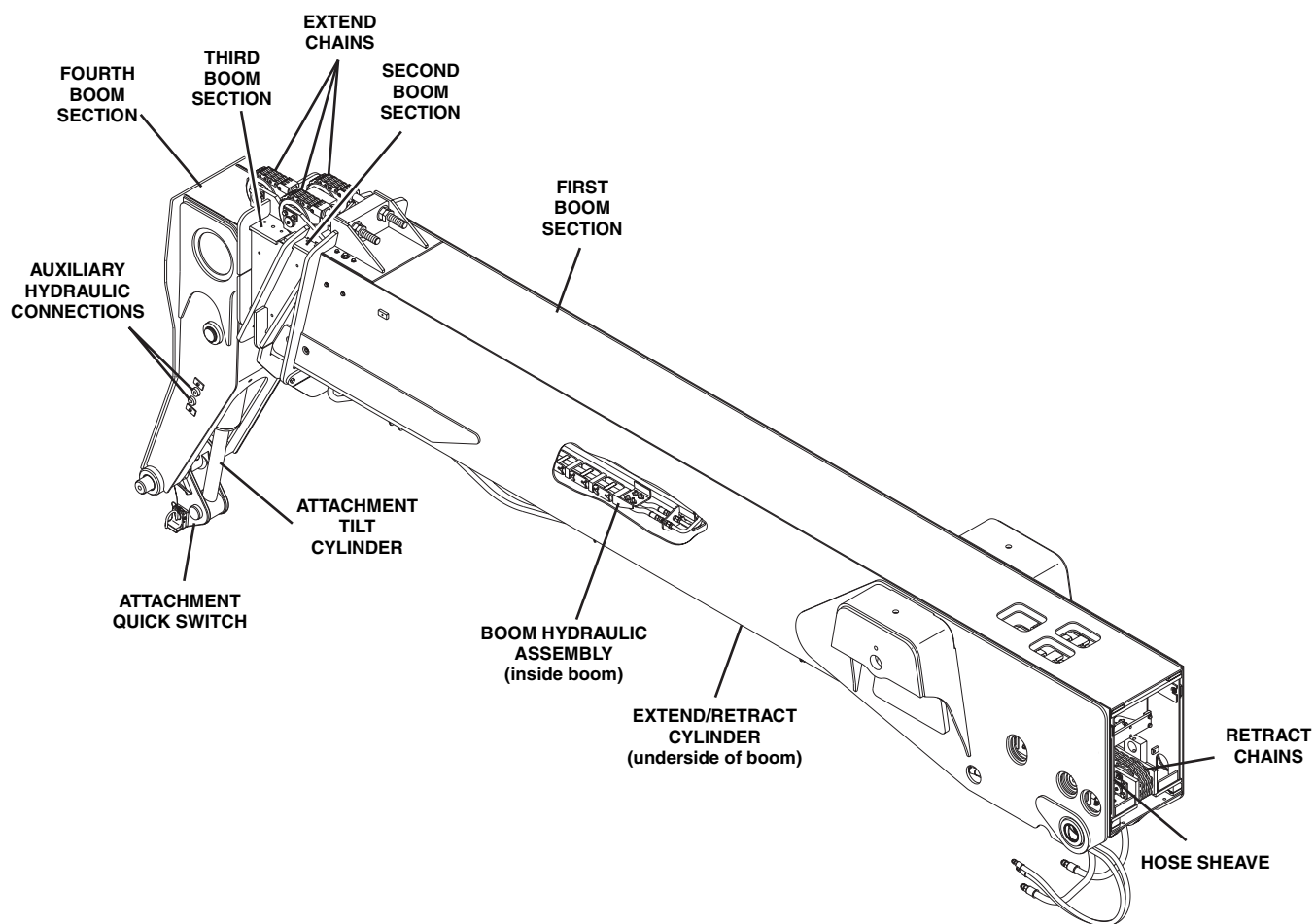
3. Install the extend/retract cylinder base mounting pin **(3)** into the strong back and secure.
4. Apply Loctite 545® to the extend/retract cylinder fittings and install into the cylinder barrel.
5. Apply Loctite 545® to the fittings and reconnect the hydraulic hoses.



Boom

3.8 BOOM SYSTEM COMPONENT TERMINOLOGY 544D

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



MY0100



3.9 BOOM SYSTEM - FOUR SECTION

3.9.1 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 chains 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 cylinder.

3.10 BOOM MAINTENANCE - FOUR SECTION (COMPLETE REMOVAL)

These instructions must be completed in sequence. The second, third and fourth boom sections are removed from the first boom section. The third and fourth boom sections are removed from the second boom section. The fourth boom section is removed from the third boom section.

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



WARNING

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

3.10.1 Boom Removal

1. Park the machine on a hard, level surface, fully retract the boom, lower the boom to a level position, 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, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Remove the battery negative (-) cable from the battery negative (-) terminal.

Note: When removing a complete boom assembly use a hoist or crane with a minimum lift capacity of 8500 lbs.

5. Fasten suitable slings to each end of the first boom section making sure a balance point is achieved.
6. Take the weight off the complete boom assembly.
7. Identify and tag all hydraulic hoses and electrical cables.
8. Loosen and separate all hydraulic hoses and electrical cables. Plug the hose ends and tube ends to prevent dirt and debris from entering the hydraulic system.
9. With the cylinder hoses blocked off, the boom sections will be locked in position, preventing run out.
10. Remove the lock bolts and pins from the rod ends of the compensation and lift cylinders.
11. Confirm that the crane has the weight of the boom.
12. Remove the lock bolt and boom pivot pin.
13. While lifting the boom assembly, make sure the compensation and lift cylinders are properly supported.
14. Lift the complete boom assembly free of the machine and place on the ground or suitable supports.

3.10.2 Extend/Retract Cylinder Removal

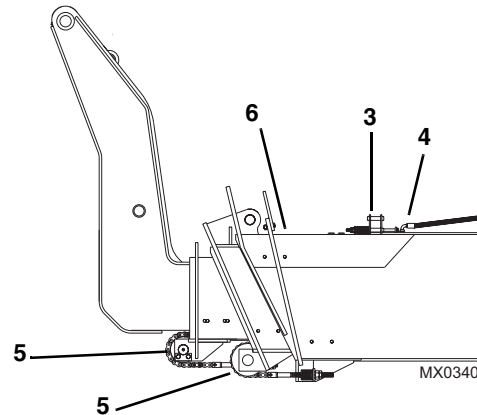
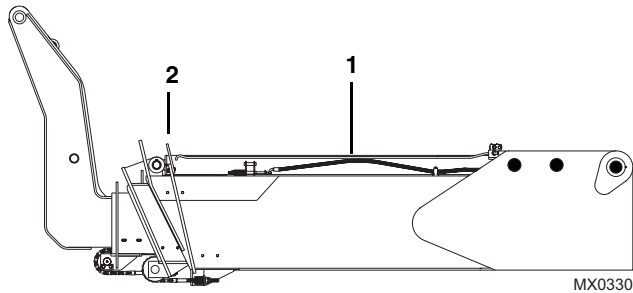
With the boom assembly now turned upside down, the extend/retract cylinder is easily removed.

1. Attach a suitable sling to the extend/retract cylinder (1) and take the weight off the cylinder to aid in pin removal.
2. Remove the extend/retract cylinder support (2) from the front of the extend/retract cylinder.



Boom

3. Remove the snap rings and pin from each end of the extend/retract cylinder.
4. Remove the extend/retract cylinder and store in a designated area.



3.10.3 Tilt Cylinder Removal

See Section 8.9.1, "General Cylinder Instructions."

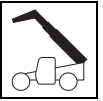
3.10.4 Second, Third & Fourth Boom Section Removal

Note: Work on the boom assembly is performed with the assembly up-side down.

It is best to remove the boom sections in the order in which they were assembled. If a section needs to be separated, this presents an excellent opportunity to check all sections for serviceability. The fourth, third and second sections should be removed as a package.

1. Loosen and remove the bottom rear wear pads and rear side wear pads from the second boom section. Leave all the top wear pads in place to aid sliding during the section removal. Tag each pad, backing plate, shim and bolts from each location
2. Release tension from the hoses on the hose take-up weldment (3).
3. Loosen the tilt circuit hoses, auxiliary circuit hoses and any electrical hoses (4) if equipped on the hose take-up weldment. Plug the hose ends and tube ends to prevent dirt and debris from entering the hydraulic system.

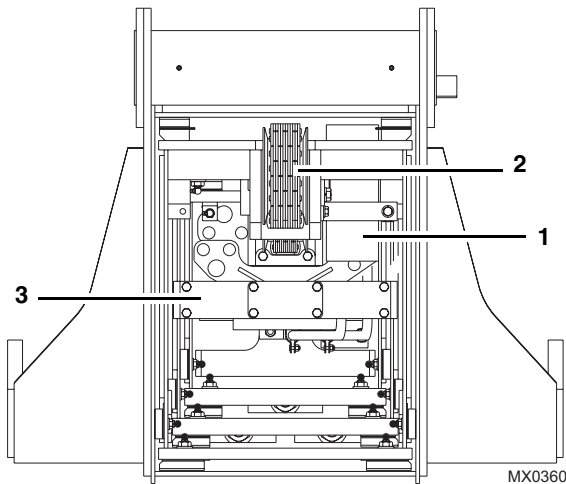
4. Disconnect the top front chains (5) from the chain clevis on the first and second boom section.
5. Release the chain tension from the front top chains.
6. Remove the front top chain rollers from the second and third boom sections.
7. Remove the chain adjustment block (6) from the first boom section.
8. Remove all wear pads from the front of the first boom section. Tag each pad, backing plate, shim and bolts from each location
9. Carefully pull the second, third and fourth boom sections together from the first boom section and place on suitable supports for further separation.



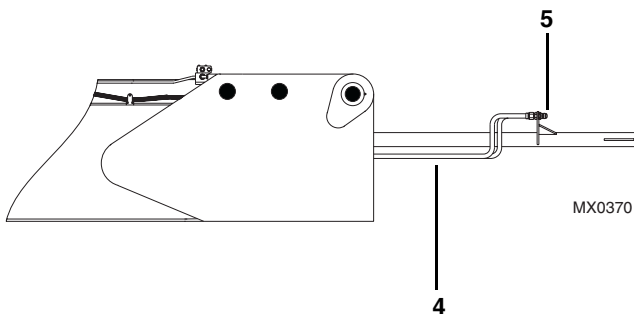
3.10.5 Third & Fourth Boom Section Removal

Note: Work on the boom assembly is performed with the assembly up-side down.

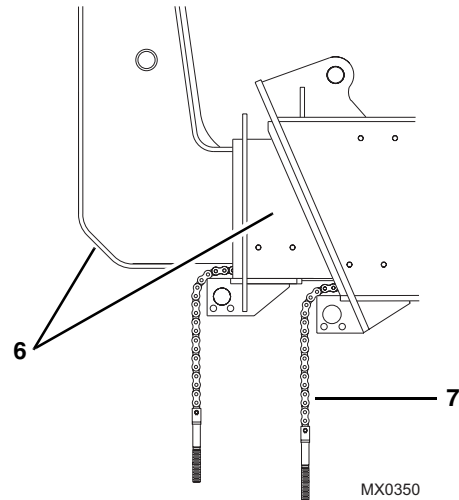
1. Loosen and remove the bottom rear and side wear pads from the third boom section. Tag each pad, backing plate, shim and bolts from each location
2. Remove standard and optional hose sheaves (1) from the rear of the second boom section.
3. Remove the chain and chain clevis (2) from the rear of the second boom section.
4. Remove the hydraulic sub-assembly bracket (3) and hardware from the rear of the third boom section.



5. Pull the Hydraulic sub-assembly (4) partially out through the rear of the boom to access the hoses.
6. Loosen and remove the hoses (5) from the rear of the hydraulic sub-assembly.



7. Release the tension on the clevis before proceeding.
8. Loosen and remove the chain adjustment block from the bottom of the boom.
9. Loosen and remove all the wear pads from the front of the second boom section. Tag each pad, backing plate, shim and bolts from each location.

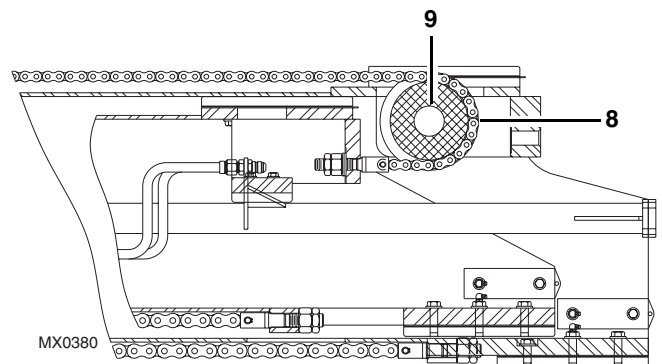


10. Carefully pull the third and fourth boom sections (6) from the second boom section.
11. Remove the chain (7) from the second boom section to the third boom section after the boom sections are free from each other.
12. Place the third and fourth boom section on suitable supports.

3.10.6 Fourth Boom Section Removal

Note: Work on the boom assembly is performed with the assembly up-side down.

1. Remove the bottom rear and side wear pads from the fourth boom section. Tag each pad, backing plate, shim and bolts from each location
2. Loosen and remove the 3/4 in (19 mm) chain (8) through the rear of the fourth boom section.



3. Loosen and remove the retract chain roller (9) at the rear of the third boom section.



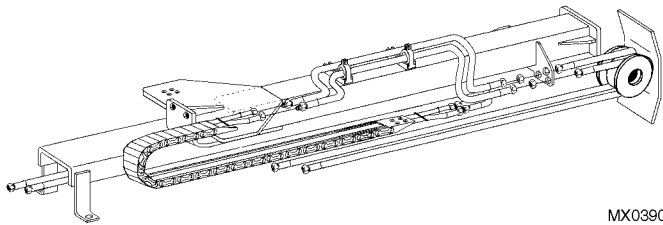
Boom

4. Loosen and remove the front wear pads and supports from the third boom section. Tag each pad, backing plate, shim and bolts from each location.
5. Carefully pull the fourth boom section out of the third boom section, taking care to protect the chains.
6. Disconnect the chains when the boom sections are free from each other.
7. Place the fourth boom section on suitable supports.

Note: Before reassembly of the boom, check the bores, pins and bushings for damage. Repair as needed. Also check the diameters of the pins and bushings.

3.10.7 Hydraulic Sub-Assembly

The hydraulic sub-assembly locates primarily in the fourth boom section. It is fastened to the bottom of the fourth boom section and at the rear of the third boom section. It's function is to control hose (and optional electric cable) movement as the boom sections extend and retract.



MX0390

Components on the left side of the assembly control the tilt cylinder of the machine. Components on the right side of the assembly control the auxiliary and electric options on the machine.

As the boom extends or retracts, the hydraulic carrier (fastened to the bottom of the fourth boom section) moves to the front or rear of the hydraulic carrier fastened to the back of the third boom section. The moveable hose carrier rolls forward or backward, protecting the looped hoses as they extend and retract.

a. Hydraulic Sub-Assembly Removal

1. Remove the guide bracket from the front of the hydraulic sub-assembly.
2. Install a sling on the hydraulic sub-assembly at the rear of the boom. Slowly pull it loose from the bottom bracket located on the bottom plate of the fourth boom section.
3. When the sub-assembly is approximately 25% free of the boom, fasten the two hose carriers together (using nylon 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.

4. Continue to withdraw the sub-assembly, fastening the hydraulic carriers together (using nylon tie-wraps or nylon straps) to keep them from separating.
5. When the hydraulic carrier is 75% tied together, pull the assembly free of the boom and set on suitable supports.

Note: Hydraulic and Electrical Options

Hoses and electric cables for options are installed on the right hand side of the sub-assembly per installation for the standard machine.

The electrical cable for that option should be centered between the hydraulic hoses as they pass through the hose carrier. The electric tubing is mounted above the hydraulic tubing. To prevent excessive cable movement, the cable should be well tensioned at assembly.

b. Hydraulic Sub-Assembly Installation

1. Clean and lubricate the inside of the boom sections where the hydraulic sub-assembly rides.
2. Install the guide bracket.
3. Collapse the hydraulic sub-assembly fully.
4. Fasten both hydraulic carriers together using nylon tie-wraps or nylon straps.
5. Using a sling, lift the balanced hydraulic sub-assembly and slowly insert it into the fourth boom section.
6. As the first tie-wrap nears the boom, remove the tie-wrap and continue inserting the sub-assembly and removing each tie-wrap until the sub-assembly is fully inserted.

Note: Be certain the hydraulic sub-assembly locks in place on the pin bracket at the bottom of the fourth boom section.

7. Re-connect the hydraulic hoses and any optional circuits.
8. Re-install the guide bracket.

Note: Use a long threaded rod and nuts (3/8x16) to aid in pulling the guide bracket into place if it protrudes too far from the back of the boom.

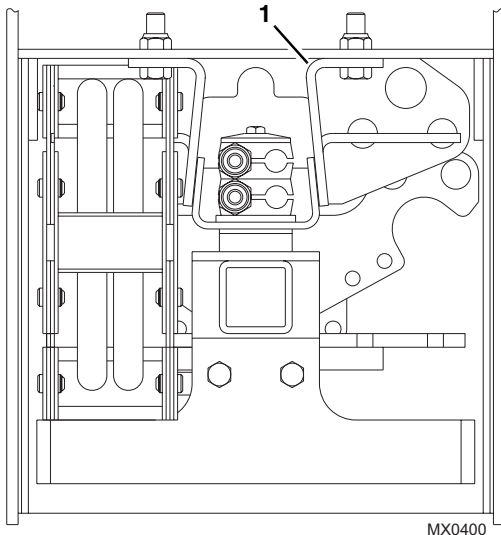
9. Reinstall the hose take-up compression spring. Torque the jam nut to 100 lb-ft (135 Nm). There should be 1 in. (25 mm) from the back of the jam nut to the end of the threads on the hose take-up weldment.



10. Torque all fasteners and hydraulic fittings per Section 2.2, "Torque Charts."

3.10.8 Fourth Boom Section Install

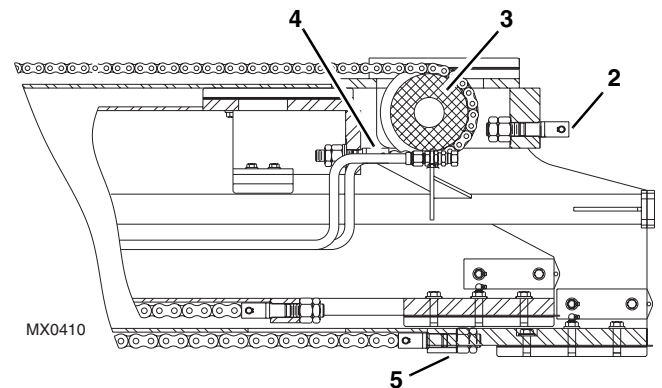
1. Place the clean and inspected fourth boom section on suitable supports.
2. Grease the wear pad and hose carrier assembly sliding path areas thoroughly.
3. Fasten the wear pad for the hose carrier to the inside of the boom.
4. Attach the bracket **(1)** for the hose carrier to the inside of the boom.
5. Make sure that the inside guide paths for the hose carrier assembly guide bracket are greased.



6. Install all the rear wear pads. Leave one shim out of each package to aid with the installation into the third boom section.
7. Attach the chain clevis and the keeper plate to the inside rear of the boom.
8. Assemble the grease fitting extensions for the bottom rear wear pads.
9. Grease the outside wear pad paths.
10. Lubricate the 1 in (25 mm) extend chain completely. Make sure the chain is inspected and is in good working condition. See Section 3.12, "Boom Extend and Retract Chains - Four Section."
11. Attach the chain to the chain clevis.
12. Attach the chain clevis to the top of the fourth boom section.

3.10.9 Third Boom Section Install

1. Place the clean and inspected third boom section on suitable supports.
2. Grease the inside wear pad paths.
3. Using a suitable sling, lift and position the fourth boom section in front of the third boom section.
4. Slowly insert the fourth boom section into the third boom section.
5. Install the top front wear pads to the third boom section. DO NOT torque the pad bolts.
6. Install the wear pad support. DO NOT torque the pad support bolts.
7. Install the bottom front wear pads. DO NOT torque the pad bolts.
8. Install the front side wear pads.
9. Torque the bolts on the front wear pads and supports.
10. Shim the rear wear pads on the fourth boom section if needed and torque to 68 - 78 lb-ft (92 - 106 Nm).
11. Install the wear pads on the bottom rear of the third boom section. Leave bolts loose for shimming.
12. Install the wear pads on the rear sides of the third boom section. Leave bolts loose for shimming.
13. Install the wear pads on the top rear of the third boom section. Leave bolts loose for shimming.



14. Install the grease fittings for the wear pad and chain roller assembly.
15. Install the chain clevis **(2)** to the rear of the third boom section.
16. Install the chain roller **(3)** at the bottom rear of the boom section.
17. Lay out and lubricate the 3/4 in (19mm) retract chain. Make sure the chain has been inspected and meets the adjustment parameters in Section 3.12, "Boom Extend and Retract Chains - Four Section."

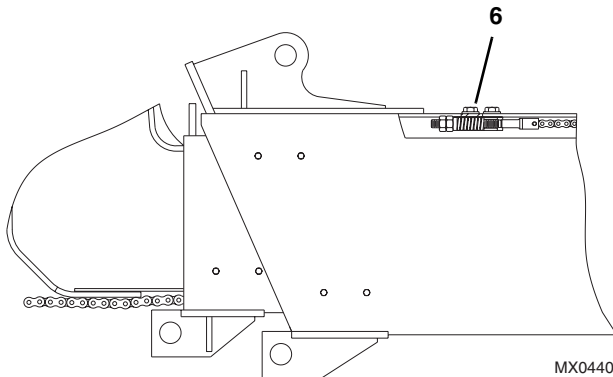


Boom

18. Connect the 3/4 in (19 mm) retract chain **(4)** to the clevis at the rear of the fourth boom section.
19. Connect the chain to the chain clevis and the clevis to the chain adjustment block.
20. The initial set-up from the jam nut to the back of the clevis pin is 3/4 in (19 mm).
21. Adjust the nut until the gap between the nut and the washer is 1/4 in (6,4 mm).
22. Torque the jam nut to 100 lb-ft (135 Nm). Lubricate the clevis threads with Anti-Seize Compound.
23. Lay out and lubricate the two 1 in (25 mm) extend chains. Make sure the chain has been inspected and meets the adjustment parameters in Section 3.12, "Boom Extend and Retract Chains - Four Section."
24. Attach the rear chain clevis to the chains.

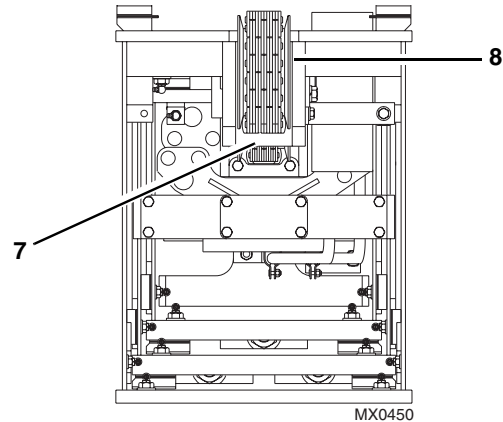
3.10.10 Second Boom Section Install

1. Place the clean and inspected second boom section on suitable supports.
2. Grease the inside wear pad paths.
3. Using a suitable sling, lift and position the fourth and third boom sections in front of the second boom section.
4. Attach the chain clevis **(5)** to the top rear of the third boom section.

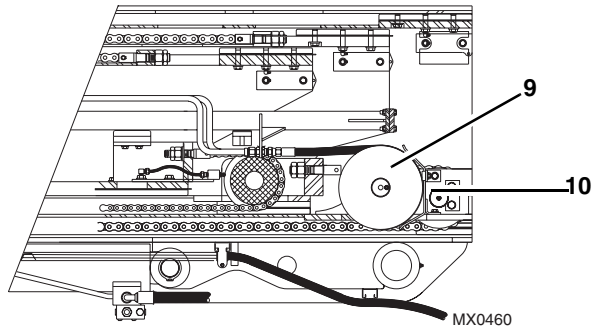


5. Slowly insert the fourth and third boom sections into the second boom section.
6. Bolt the chain adjustment block **(6)** to the bottom of the boom and torque the bolts to 340 - 365 lb-ft (460 - 495 Nm).
7. Install the top front wear pads to the second boom section. DO NOT torque the pad bolts.
8. Install the bottom front wear pad supports. DO NOT torque the pad support bolts.

9. Install the bottom front wear pads. DO NOT torque the pad bolts.
10. Install the front side wear pads.
11. Torque all the front wear pads and supports.
12. Shim the rear wear pads on the third boom section if needed and torque to 68-78 lb-ft (92 - 106 Nm).
13. Lay out and lubricate the 1 in (25 mm) chain on the bottom of the second boom section.
14. Install the bottom rear wear pads. DO NOT torque the pad bolts.
15. Install the top rear wear pads. DO NOT torque the pad bolts.
16. Install the lube fittings to the wear pad and chain roller assembly.
17. Connect the chain clevis **(7)** to the second boom section.



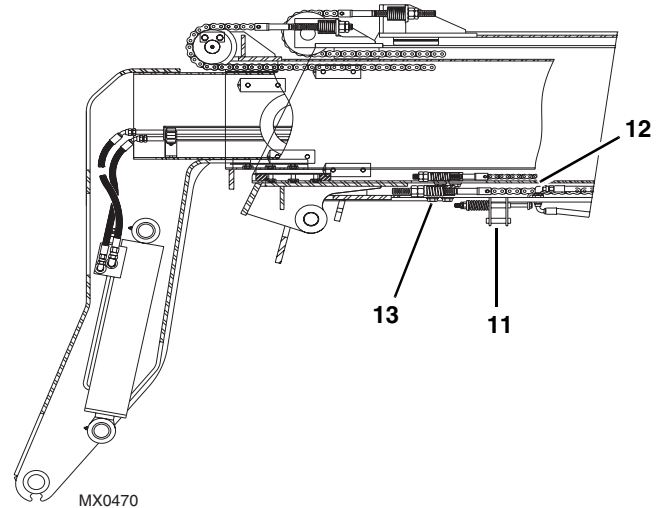
18. Assemble the rear bottom chain roller **(8)** to the second boom section.
19. Install the side rear wear pads on the second boom section. DO NOT torque the pad bolts.
20. Install the optional hose sheave **(9)** if equipped, to the right rear of the second boom section.
21. Install the standard hose sheave **(9)** to the left rear of the second boom section.
22. Attach the hoses, and optional auxiliary hoses and electrical cable if equipped to the hose carrier assembly at the rear of the boom.



23. At the rear of the boom, bolt on the bracket to the back of the hose carrier.
24. Install the hose guide bracket (10) for the electric and hydraulic options at the rear of the boom.
25. Attach the chain clevis to the chain.
26. If not already completed, install the hoses to the hose carrier at the rear of the boom.
27. Install the hose guide bracket to the rear of the second boom section.
28. Install the optional hydraulics and electric cables if equipped.
29. Install the male and female hydraulic couplers to the boom head weldment of the fourth boom section.

3.10.11 First Boom Section Install

1. Place the clean and inspected first boom section on suitable supports.
2. Install the hose take-up weldment (11) to the first boom section
3. Grease the inside wear pad paths of the first boom section and the outside wear pad paths of the second boom section.



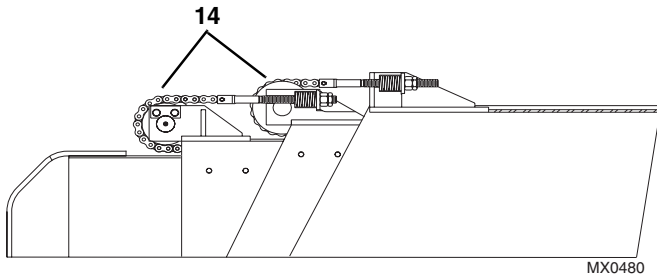
4. Using a suitable sling, lift and position the fourth, third and second boom sections into the front of the first boom section.
5. Connect the hose assembly (12) to the take-up weldment.
6. Install the chain adjustment block (13) to the first boom section.
7. Install the top front wear pads on the first boom section. DO NOT torque the pad bolts.
8. Install the front bottom wear pad support and wear pads on the first boom section. DO NOT torque the pad bolts.
9. Install the front side wear pads on the first boom section.
10. Torque all front wear pads and supports to the correct values.

Note: Shim ALL side wear pads as needed to maintain a minimum gap (1/16 in - 1.6 mm) the horizontal direction or a snug fit. The number of shims can vary at each shim point.

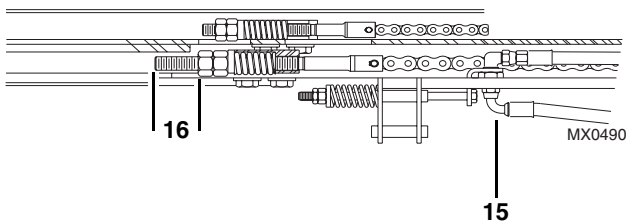
11. Adjust the wear pad shims on the top rear and sides of the second boom section.



Boom



12. Install the top front chain roller (14) to the second and third boom sections.
13. Install the hoses (15) to the bulkhead fittings on the hose take-up weldment.
14. Install the cushion clamps around the hoses on the first boom section.
15. Install the extend/retract cylinder and support to the first and second boom sections.
16. Attach the extend/retract cylinder hose assembly.
17. Connect the top front chain clevises to the chains, then connect the chains to the first and second boom sections.
18. Adjust the 1 in (25 mm) retract chain at the bottom front of the first boom section (16) to 2 7/8 in (73 mm) for the initial set-up.



19. Install the tilt cylinder and connect the hose assemblies to the hose carrier assembly and to the tilt cylinder.
20. If the machine is equipped with auxiliary hydraulics, install the auxiliary hoses and electrical cable to the boomhead of the fourth boom section.
21. The boom is now complete and ready to be turned over and installed on the machine.

3.10.12 Boom Assembly Installation

1. Re-check that the machine is safely secured.
2. Connect the lifting tackle, crane and re-lash the boom assembly at the balance point.
3. Install the tackle between the extend/retract cylinder and the boom.

Note: Make sure a tag line is installed.

4. Make a test lift to ensure that the rigging is hooked up correctly to lift the boom assembly in a balanced mode.
5. Lubricate all pins and bushings.
6. Lift the boom assembly into position on the machine.
7. Line up the base pin holes, insert pins and lock into place.
8. Install the lift cylinder onto the boom, insert the pins and lock into place.
9. Install the compensation cylinder onto the boom, insert the pins and lock into place.
10. Uncap and reconnect the hydraulic hoses and electrical cable. Torque the hose fittings per Section 2.2, "Torque Charts."
11. Start the machine and slowly operate the boom assembly full cycle at least 10 times.
12. Check for any hydraulic leaks and repair if necessary.
13. Cycle the boom assembly 10 more times to be certain that all air has been purged from the system.
14. Final adjust the boom wear pads, extend and retract chains, hose take-up assembly and any other area that needs to be serviced.

3.11 BOOM MAINTENANCE - FOUR SECTION (INDIVIDUAL SECTION REMOVAL)

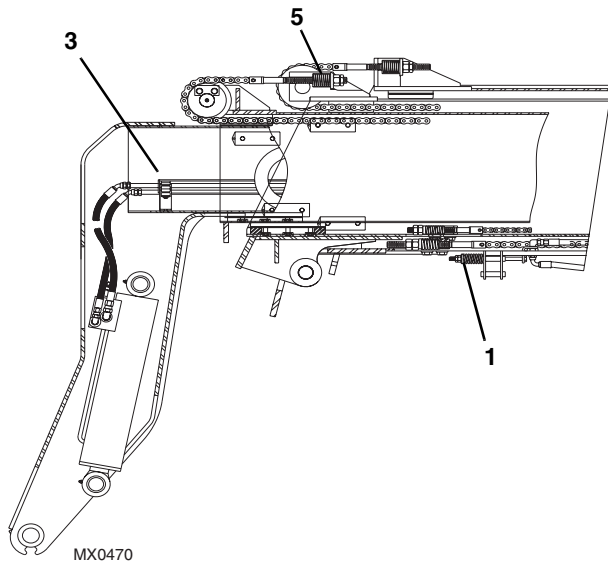
These instructions help with the removal of individual boom sections with the complete boom still mounted on the machine. Safe practices and common sense must be followed when removing boom sections.

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 taking into consideration your particular situation.

For more detailed instructions, see Section 3.10, "Boom Maintenance - Four Section (Complete Removal)."



3.11.1 Fourth Boom Section Removal

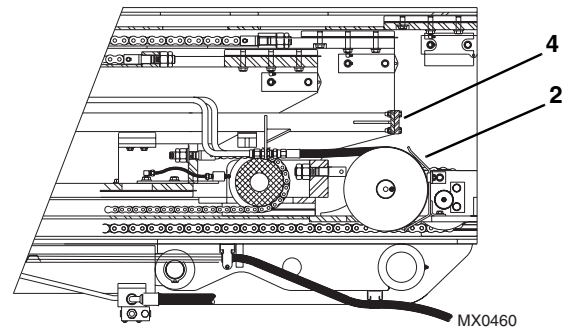


1. Park the machine on a firm, level surface, fully retract the boom, lower the boom to a level position, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Remove the battery negative (-) cable from the battery negative (-) terminal.

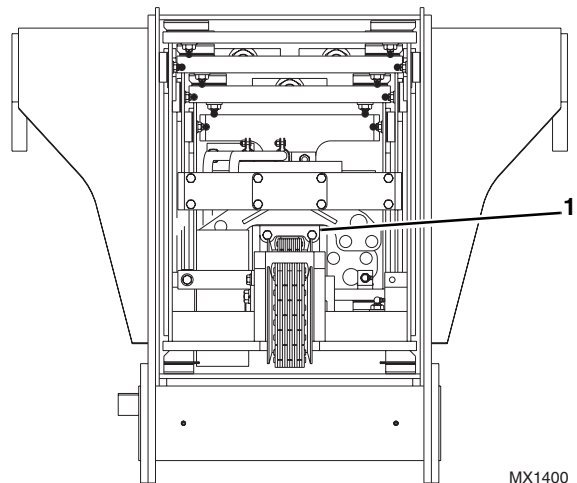
Note: When removing a boom section(s), use a lifting device with a sufficient lift capacity. (A complete four section boom assembly weighs approximately 8250 lbs.)

5. Release tension from the hoses on the hose take-up bracket (1).
6. Label, disconnect and cap all hydraulic hoses attached at each end of the hose carrier assembly. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
7. Remove the hose guide (2) at the rear of the second boom section.
8. If equipped, label, loosen and separate all electrical cables on each end of the hose carrier assembly.
9. Loosen and remove the guide bracket from the front of the hose carrier assembly.
10. Loosen and remove the two bolts (3) holding the hose carrier at the front of the fourth boom section.

11. Loosen and remove the four bolts (4) holding the hose carrier to the rear of the third boom section.



12. Slowly pull the hose carrier assembly out of the front of the fourth boom section.
13. When the hose carrier assembly is approximately 25% free of the boom, fasten the two hose carriers together (using nylon tie-wraps or suitable straps) to keep the hose carriers from separating.
14. Continue to withdraw the assembly, fastening the hydraulic carriers together.
15. When the hose carrier is 75% tied together, pull the assembly free of the boom and set on suitable supports.
16. Loosen the jam nuts on the extend chain at the top front of the second boom section. Disconnect the extend chain (5) from the chain clevis.
17. Pull the fourth boom section out far enough to create slack in the retract chain. Loosen and remove the retract chain bracket (1) which will allow the chain clevis to be lifted out of the mounting location.



18. Loosen and remove the wear pads from the front of the third boom section. Note the location of the wear pads, mounting bolts and number of shims from each location.

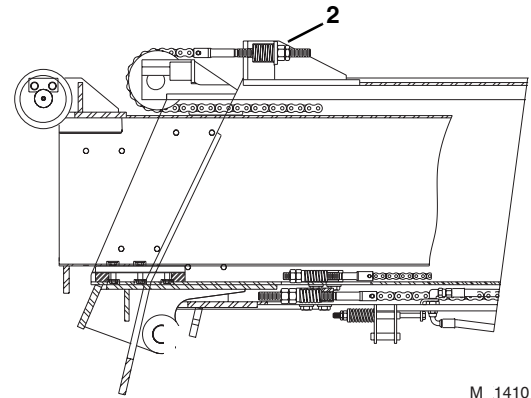


Boom

19. Loosen and remove the wear pads from the top rear and one side of the fourth boom section. Note the location of the wear pads, mounting bolts and number of shims from each location.

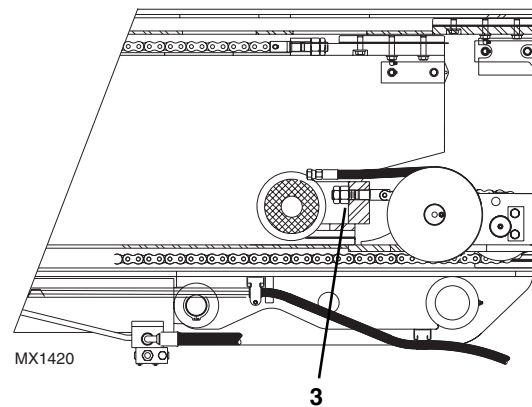
Note: It may be necessary to pull the boom section(s) out far enough to access the wear pads.

20. Slowly pull the fourth boom section out of the third boom section. The extend chain will come out along with the boom section. The retract chain will stay with the second boom section.
21. Lift the fourth boom section free of the machine and place on the ground or suitable supports.



3.11.2 Third Boom Section Removal

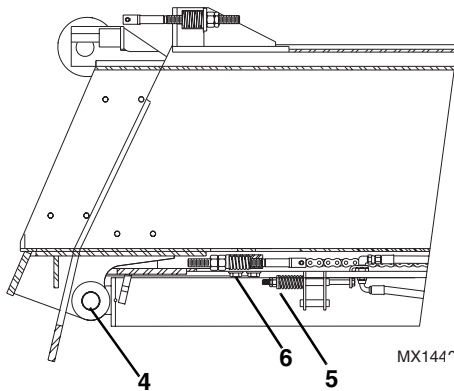
1. Loosen the jam nuts on the extend chains at the top front of the first boom section. Disconnect the extend chains (2) from the chain clevises.
2. Loosen the jam nuts on the retract chain at the bottom rear of the third boom section. Disconnect the retract chain (3) from the chain clevis.
3. Loosen and remove the wear pads from the front of the second boom section. Note the location of the wear pads, mounting bolts and number of shims from each location.



4. Loosen and remove the wear pads from the top rear and one side of the third boom section. Note the location of the wear pads, mounting bolts and number of shims from each location.
5. Slowly pull the third boom section out of the second boom section. The extend chains will come out along with the boom section. The retract chain will stay with the first boom section.
6. Lift the third boom section free of the machine and place on the ground or suitable supports.

3.11.3 Second Boom Section Removal

1. Remove the pin (4) from the rod end of the extend/retract cylinder.
2. Loosen and remove the wear pads from the front of the first boom section. Note the location of the wear pads, mounting bolts and number of shims from each location.
3. Loosen and remove the wear pads from the top rear and one side of the second boom section. Note the location of the wear pads, mounting bolts and number of shims from each location.



4. Loosen and remove the tilt/aux hose take-up bracket (5) from the bottom of the first boom section. Pull the tilt/aux hoses out from the rear of the boom.
5. Remove the bolts holding the chain adjustment block (6) to the first boom section.
6. Slowly pull the second boom section out of the first boom section. The third section retract chain will stay with the first boom section.
7. Lift the second boom section free of the machine and place on the ground or suitable supports.

3.11.4 Second, Third and Fourth Boom Section Removal

It is best to remove the boom sections in the order in which they were assembled. If a section needs to be separated, this presents an excellent opportunity to check all sections for serviceability. The fourth, third and second sections can be removed as a package.

1. Loosen and remove the wear pads from the top rear and one side of the second boom section. Leave all the bottom wear pads in place to aid sliding during the section removal. Note the location of the wear pads, mounting bolts and number of shims from each location.
2. Release tension from the hoses on the hose take-up bracket (5).
3. Loosen the tilt circuit hoses, auxiliary circuit hoses and any electrical hoses if equipped on the hose take-up bracket. Plug the hose ends and tube ends to prevent dirt and debris from entering the hydraulic system.
4. Disconnect the top front extend chains from the chain clevises on the first boom section.
5. Disconnect the bottom rear retract chain from the chain clevis on the third boom section.
6. Remove the chain adjustment block (6) from the first boom section.

7. Remove all wear pads from the front of the first boom section. Note the location of the wear pads, mounting bolts and number of shims from each location.
8. Carefully pull the second, third and fourth boom sections together from the first boom section and place on suitable supports for further separation.

3.11.5 Second Boom Section Installation

1. Grease the inside wear pad paths of the first boom section and the outside wear paths of the second boom section.
2. Position the second boom section into the front of the first boom section. Leave room at the bottom front to install the retract chain adjustment block and wear pads.
3. Install the retract chain adjustment block and bolt into place.
4. Install the wear pads and shims at the front of the first boom section.
5. Install the wear pads and shims at the rear of the second boom section.
6. From the rear of the boom, push the third boom section retract chain in place between the first and second boom sections. Place the chain clevis through the adjustment block and install the jam nuts. Do not tighten the jam nuts at this time.
7. From the rear of the boom, feed the tilt/aux hoses between the first and second boom sections.
8. Install the hose take-up brackets and connect the tilt/aux hoses to the proper fittings.

Note: Do Not install the rod end of the extend/retract cylinder to the second boom section at this time as it may be necessary to move the boom sections to access hoses, wear pads or chains.

3.11.6 Third Boom Section Installation

1. Grease the inside wear pad paths of the second boom section and the outside wear paths of the third boom section.
2. Position the third boom section with the extend chains connected at the rear and laying on the third boom section into the front of the second boom section. Leave room between the sections to install the wear pads.
3. Install the wear pads and shims at the front of the second boom section.
4. Install the wear pads and shims at the rear of the third boom section.



Boom

5. Wrap the two extend chains around the chain rollers on the second boom section and connect to the clevises on the front of the first boom section. Do not tighten the jam nuts at this time.
6. Wrap the retract chain around the chain roller on the second boom section and connect to the rear of the third boom section. Do not tighten the jam nuts at this time.

3.11.7 Fourth Boom Section Installation

1. Grease the inside wear pad paths of the third boom section and the outside wear paths of the fourth boom section.
2. Position the fourth boom section with the extend chain connected at the rear and laying on the fourth boom section into the front of the third boom section. Leave room between the sections to install the wear pads.
3. Install the wear pads and shims at the front of the third boom section.
4. Install the wear pads and shims at the rear of the fourth boom section.
5. Wrap the extend chain around the chain roller on the third boom section and connect to the clevises on the front of the second boom section. Do not tighten the jam nuts at this time.
6. Wrap the retract chain around the chain roller on the third boom section and connect to the rear of the fourth boom section. Install the retract chain bracket.
7. Position the hose carrier into the opening at the boom head of the fourth boom section.
8. Remove each nylon tie-wrap or suitable strap as the hose carrier is slid into place inside the fourth boom section.
9. Secure the hose carrier at the front of the fourth boom section and at the rear of the third boom section.
10. Wrap the tilt/aux hoses around the hose sheaves on the second boom section and connect to the proper fittings at the rear of the hose carrier.
11. Install the hose guide at the rear of the second boom section.
12. Uncap and reconnect the tilt/aux hoses to the hose carrier at the front of the fourth boom section.
13. Adjust the complete boom to the proper dimensions.

3.12 BOOM EXTEND AND RETRACT CHAINS - FOUR SECTION

The extend and retract chains are used to move the third and fourth boom sections in and out, proportional with the movement of the boom extend/retract cylinder.

• Extend Chains

The 1 in (25 mm) extend chains are located at the top of the boom assembly. The single fourth boom section chain attaches to the top rear of the fourth boom section, passes over a chain roller mounted on the third boom section and is secured to the top front of the second boom section.

The third boom section has two 1 in (25 mm) extend chains located at the top of the boom assembly. They attach to the top rear of the third boom section, pass over two rollers mounted at the front of the second boom section and are fastened to the top front of the first boom section.

• Retract Chains

The 3/4 in (19 mm) retract chain is fastened at the bottom inside rear of the fourth boom section. The chain passes over a roller mounted to the third boom section and is fastened to the bottom front of the first boom section.

The 1 in (25 mm) retract chain is fastened to the bottom inside rear of the third boom section. The chain passes over a roller mounted to the second boom section and is fastened to the front of the first boom section.

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



Environments in which material handling 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.

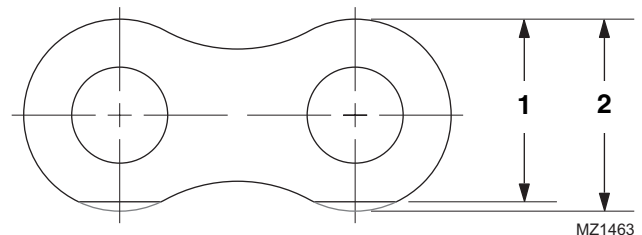
3.12.2 Inspection Guidelines

1. Park the machine on a firm, level surface, level the boom, 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:

Edge Wear

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



Elongation

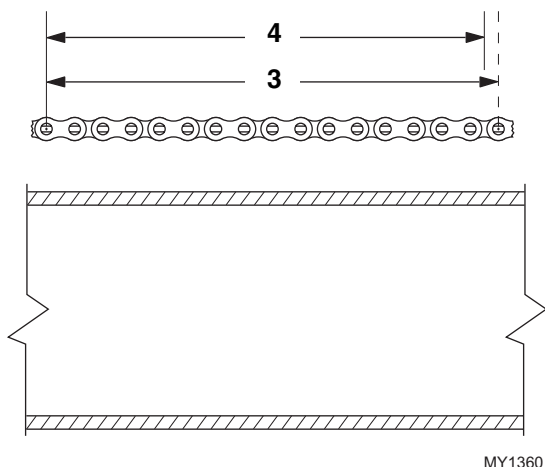
It is important to measure the chain in the section that moves over the sheaves because it receives the most frequent articulation. Measuring the chain near its clevis terminals could give an inaccurate reading. The ends of the chains, near the clevis terminal, will not have flexed as frequently, if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

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

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

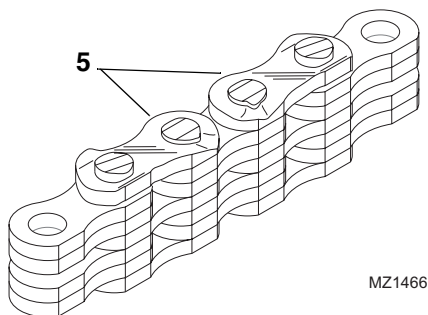


Boom



Distorted or Battered Link Plates

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



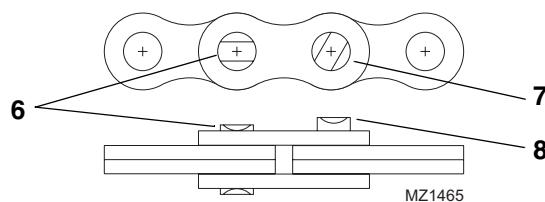
Turning or Protruding Pins

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.



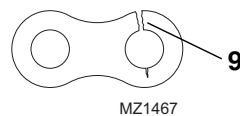
Cracked Plates

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.

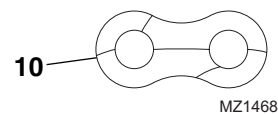
It is important, however to determine the cause of the crack before installing a new chain so the condition does not repeat itself.

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).



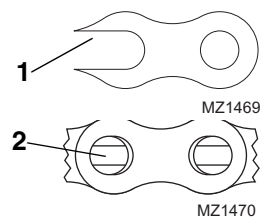
- **Corrosion Fatigue Cracking** - Corrosion fatigue cracks are very similar to fatigue cracks in appearance. Corrosion fatigue is the combined action of an aggressive environment and cyclic stress.

Other Modes of Failure

- **Ultimate Strength Failure** -

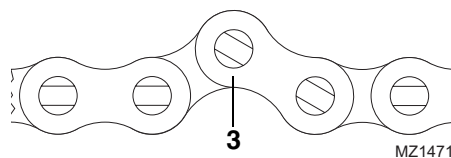
These types of failures are caused by overloads far in excess of the design load.

Either fractured plates (1) or enlarged holes (2) 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 (3) 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.

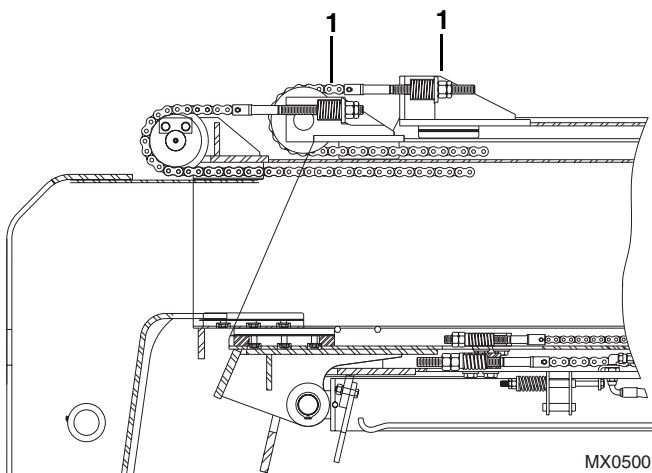
c. Expose Retract Chains for Inspection

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 boom should be removed and disassembled with the retract chains being inspected and replaced if necessary.

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

3.12.3 Adjusting Extend Chains

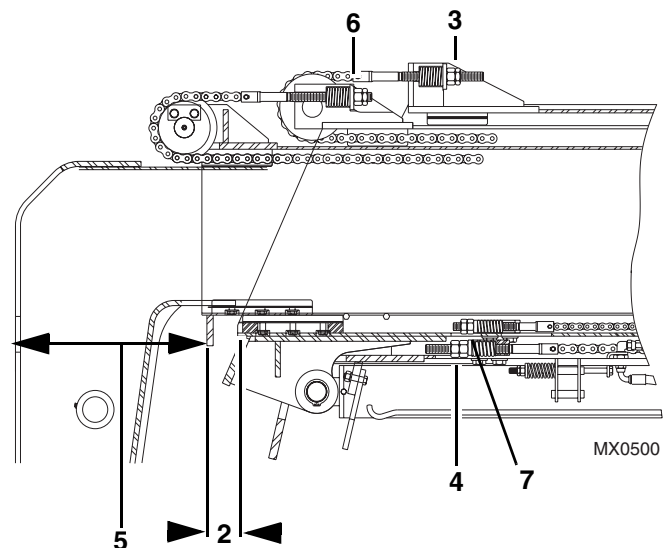
1. Raise the boom to a horizontal position and extend the boom halfway. Place the transmission control lever in (N) NEUTRAL, engage the park brake switch. Shut off machine.
2. Measure the gaps **(1)** between the flat washers and the rear face of the extend chain anchor at the top front of the first boom section. The correct gap measurement is 1/4 in (6 mm). If the gaps measure more or less than a 1/4 in (6 mm), then the chains must be adjusted.
3. Repeat the check for the single extend chain for the fourth boom section (anchored at the top of the top front of the second boom section).



4. If adjustment is needed, loosen the jam nuts on both extend chains.
5. Tighten the extend chain adjusting nuts until the gap between the chain flat washer and the boom anchor is 1/4 in.
6. Torque the jam nuts to 100 lb-ft (135 Nm). DO NOT use Loctite® on the nuts.
7. Repeat the above steps to adjust the single extend chain **(1)** for the fourth boom section (anchored at the top of the top front of the second boom section).

3.12.4 Adjusting Retract Chains

1. Fully retract the boom and raise the boom to a horizontal position. Place the transmission control lever in (N) NEUTRAL, engage the park brake switch. Shut off machine.
2. Measure the distance between the second and third boom sections **(2)** to determine the adjustment required. The correct dimension is 1/2 in (13 mm).



3. If adjustment is needed, loosen both extend chain adjusting nuts **(3)** (at the first boom section anchor) sufficient to allow realignment.
4. Loosen the retract chain jam nut **(4)** (located inside the bottom front of the first boom section).
5. Tighten the retract chain, adjusting the nut to obtain the 1/2 in (13 mm) dimension required.
6. Torque the jam nuts to 100 lb-ft (135 Nm). DO NOT use Loctite® on the nuts.
7. Measure the distance **(5)** between the third boom section and the outer face of the boomhead on the fourth boom section to determine the amount of



Boom

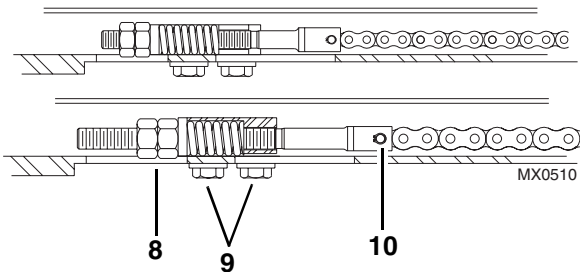
adjustment required. The correct dimension is 17 in (432 mm).

8. Loosen the adjusting nut **(6)** at the top front of the second boom section enough to permit adjustment.
9. Loosen the retract chain jam nut **(7)** at the bottom front of the second boom section.
10. Tighten the retract chain adjusting nut to obtain the 17 in (432 mm) dimension.
11. Torque the jam nuts to 100 lb-ft (135 Nm). DO NOT use Loctite® on the nuts.
12. Readjust the extend chains as described in Section 3.12.3, "Adjusting Extend Chains."

3.12.5 Retract Chain Removal

The following section explains the removal of the 1 in (25 mm) retract chains from the third to first boom sections without removing the boom assemblies.

1. Fully retract the boom and raise the boom to a horizontal position making sure that the chains are accessible through the front access holes. Place the transmission control lever in (N) NEUTRAL, engage the park brake switch. Shut off machine.
2. Attach a suitable sling to the extend/retract cylinder and take the weight off the extend/retract cylinder.
3. Remove the cylinder pin from the rod end of the extend/retract cylinder and lower the cylinder free of the boom. Lowering the extend/retract cylinder will allow access to the chains.
4. Remove tension from the chain by backing off the jam nut and adjusting nut **(8)**.

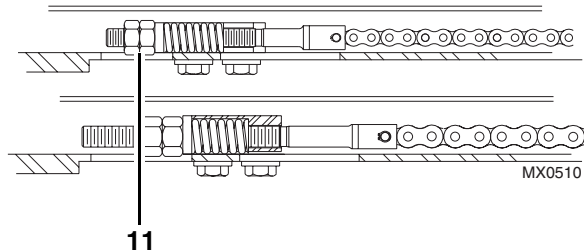


5. Remove the four bolts **(9)** from the chain adjustment block.
6. Remove the chain from the clevis **(10)** at the block.
7. Install a nylon tie-wrap through the in the removed chain, making a loop with the tie-wrap and tie a rope to the loop.
8. Move to the back of the boom and pull the chain to the rear to allow slack for removal.

9. Remove the chain from the clevis and drop it free from the boom.
10. Holding the rope at the front adjustment block, carefully pull the chain out through the back of the boom until it's free.
11. Untie the rope and leave it in place for reinstallation of the chain.

The following section explains the removal of the 3/4 in (19 mm) retract chains from the fourth to second boom sections without removing the boom assemblies.

1. Remove the jam nut **(11)** 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.

3.12.6 Retract Chain Installation

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

Note: Install the 3/4 in (19 mm) chain first.

1. Fasten a rope to the end of the 3/4 in (19 mm) chain in order to pull it back into the boom.
2. Attach the chain to the chain clevis at the rear of the fourth boom section.
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 cotter pin.
6. Torque the jam nuts to 100 lb-ft (135 Nm). DO NOT use Loctite® on the nuts.
7. For the 1 in (25 mm) chain, fasten a rope to the end of the 1 in (25 mm) chain in order to pull it back into the boom.
8. Attach the chain to the chain clevis at the rear of the fourth boom section.
9. Carefully pull the chain into the boom until it can be fastened to the chain clevis.
10. Remove the rope.
11. Fasten the chain into the clevis by installing the pin and cotter pin.
12. Install the chain adjustment block and mounting bolts.
13. Torque the chain adjustment block mounting bolts to 340 - 365 lb-ft (461 - 495 Nm).
14. Adjust the retract chains. See Section 3.12.4, "Adjusting Retract Chains."
15. Torque the jam nuts to 100 lb-ft (135 Nm). DO NOT use Loctite® on the nuts

3.12.7 Extend Chain Removal

The following section explains the removal of the 1 in. retract chains without removing the boom assemblies.

1. Extend the boom far enough to access the chain anchor and the clevis through the top rear access hole.
2. Secure the boom sections together to prevent uncontrolled boom runout when the extend chains are removed.
3. 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.
4. Remove the chain clevis pin and cotter pin to free the chain.
5. 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.
6. Pull the slack to the chain clevis at the front of the boom.
7. Remove the clevis pin and the cotter pin from the chain and chain clevis.
8. Install a nylon tie-wrap through the chain holes, forming a loop and tie a rope to the loop.

9. Carefully pull the chain out of the boom.

3.12.8 Extend Chain Installation

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

1. At the end of the chain(s) being inserted into the boom, install a nylon tie-wrap through the chain holes, forming a loop, and tie a rope to the loop.
2. Carefully pull the chain into the boom to the chain clevis anchor.
3. Fasten the chain to the clevis with a pin and cotter pin. Lock the 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 cotter pin. Lock the cotter pin.
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 runty.
7. Adjust the extend chains. See Section 3.12.3, "Adjusting Extend Chains."

d. Chain Lubrication

After inspection and before being returned to service, chains must be lubricated with a quality chain 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 the 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.

Lubrication of chains on machines working consistently in extreme hot or cold conditions requires special consideration.



Boom

3.13 BOOM SECTION SEPARATION ADJUSTMENT - FOUR SECTION

The second, third and fourth boom sections are set to dimensions between each section. The first and second boom sections are connected by the extend/retract cylinder which has no adjustment.

The third and fourth boom sections can be adjusted by loosening or tightening the extend chains and the retract chains.

- To increase the separation distance: Loosen the retract chains locknut on the rear of the third or fourth boom sections one or two turns and tighten the extend chain locknuts on the first and second boom sections equally the same number of turns. A minimum of one full thread on the clevis must protrude beyond the locknut.
- To decrease the separation distance: Loosen the extend chain locknuts at the front of the first or second boom sections equally one or two turns and tighten the retract chains locknut the same number of turns. A minimum of one full thread on the clevis must protrude beyond the locknut.

See Section 3.11.7, 3.12. "Boom Extend and Retract Chains - Four Section."

Note: If the second boom section to the third boom section separation distance cannot be achieved, contact the local JLG distributor or the JLG Service Department.

3.14 HYDRAULIC SUB-ASSEMBLY REMOVAL/INSTALLATION - FOUR SECTION

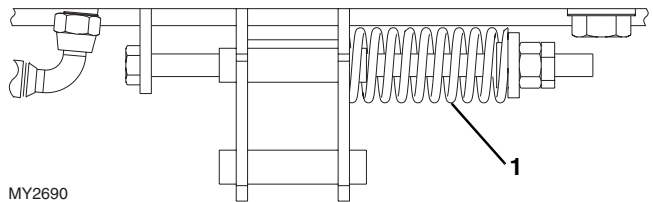
The hydraulic sub-assembly locates primarily in the fourth boom section. It is fastened at the bottom front of the fourth boom section and at the rear of the third boom section.

3.14.1 Hydraulic Sub-Assembly Removal

- Remove any attachment from the quick switch assembly. Refer to Section 3.16.1, "Disconnecting from an Attachment."

Note: Allow adequate room in front of the machine when removing and installing the hydraulic sub-assembly.

- 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.
- Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
- Open the engine cover. Allow the system fluids to cool.
- Remove the battery negative (-) cable from the battery negative (-) terminal.
- Loosen and remove both compression springs (1) from the hose take-up weldment at the bottom of the first boom section.

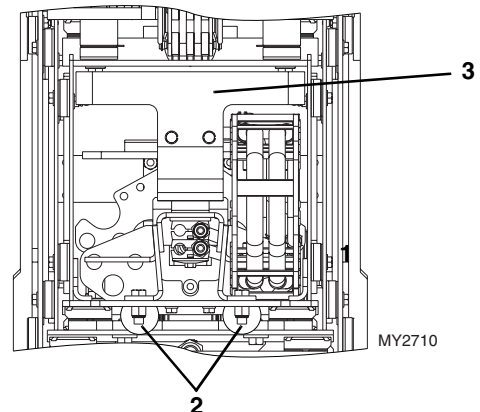


MY2690

- Label and disconnect the tilt and auxiliary hydraulic hoses attached to the sub-assembly 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.
- If equipped, label and disconnect any electrical connections at the front and rear of the boom assembly.

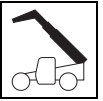
Note: Tag or identify each hose to the corresponding fitting it was removed from.

- Loosen and remove both cap screws and locknuts (2) from the sub-assembly bracket at the front of the fourth boom section.

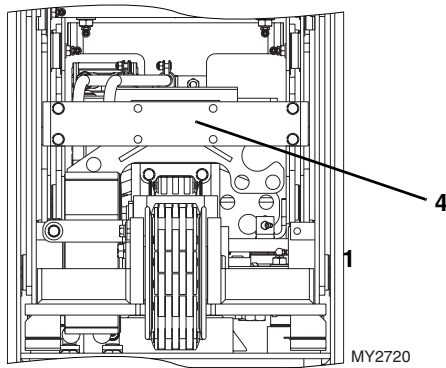


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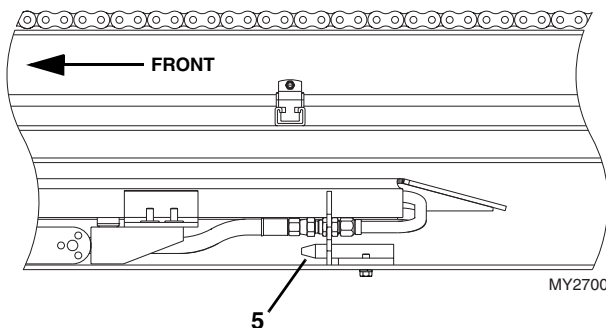
- Loosen and remove the guide bracket (3) from the front of the fourth boom section.



11. Loosen and remove the sub-assembly bracket (4) at the rear of the third boom section.



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



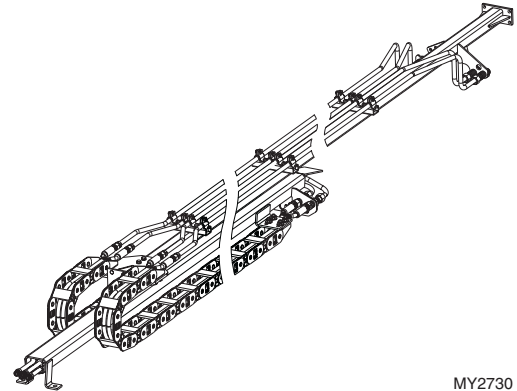
13. When the sub-assembly is pulled approximately 25% out of the boom, fasten the two hydraulic carriers together using plastic tie wraps or nylon straps to keep them from separating.

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

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

3.14.2 Assembling the Hydraulic Sub-Assembly

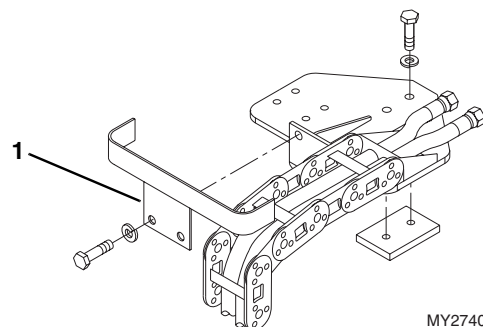
The following procedure is described with the assumption that all components have been removed and assembly proceeding from the beginning.



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.

3.14.3 Hydraulic Sub-Assembly Installation

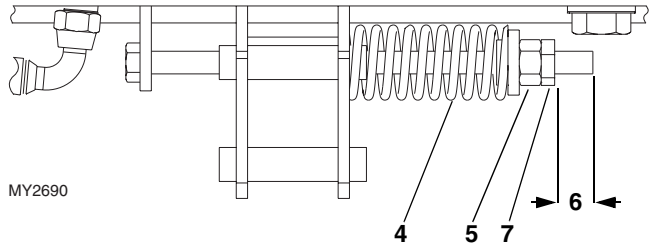
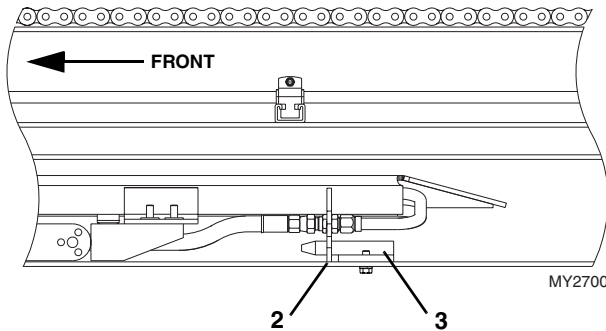
1. Clean and lubricate the side surfaces where the hydraulic sub-assembly rides.
2. Install the guide bracket (1) on the front of the hydraulic sub-assembly.





Boom

3. Fully collapse the hose carriers and secure together using plastic tie wraps or nylon straps to keep them from separating.
4. Install a sling around the balance point of the sub-assembly. With a suitable lifting device, slowly insert the sub-assembly into the front of the fourth boom section.
5. Remove the first plastic tie wrap or nylon strap as the hydraulic sub-assembly is being inserted into the front of the fourth boom section.
6. Continue inserting the hydraulic sub-assembly and removing the plastic tie wraps or nylon straps until the sub-assembly is fully inserted into the boom.
7. Verify that the bottom bracket (2) on the sub-assembly is in place on the bottom plate (3) of the fourth boom section.



13. Install the hose take-up compression springs (4) at the bottom of the first boom section. Tighten the adjusting nut (5) to measure 1 inch (25.0 mm) (6) between the face of the jam nut (7) and the end of the end of the threads on the hose take-up weldment.
14. Torque the jam nut against the adjusting nut to 100 ft-lbs.

8. Install the cap screws, washers and nuts to the sub-assembly bracket at the rear of the third boom section.
9. Install both cap screws and locknuts to the sub-assembly 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 hydraulic sub-assembly.
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.



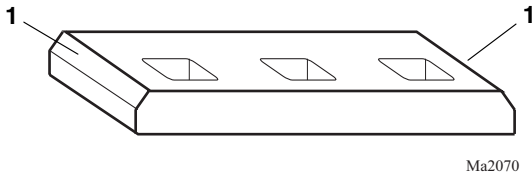
3.15 BOOM WEAR PADS

A total of 27 wear pads are installed on the boom sections of the 534D-9 and 534D-10 machines.

A total of 43 wear pads are installed on the boom sections of the 544D machines.

3.15.1 Wear Pad Inspection

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.



3.15.2 Boom Wear Pad Replacement

When replacing a wear pad on the boom, replace both wear pads on that side of the boom; e.g.: replace top front left and top front right wear pads at the same time.

Usually, shimming will remain the same when installing new wear pads. Some wear pads are secured to the boom using different bolts and washers. Keep bolts and washers with the same wear pad that is being replaced. When installing new wear pads, apply Loctite® #242 to all wear pad mounting bolts and torque to required specifications.

Wear pad bolt torques are:

3/8 in bolt: 28 - 30 lb-ft (38 - 41 Nm)

1/2 in bolt: 76 - 86 lb-ft (103 - 117 Nm)

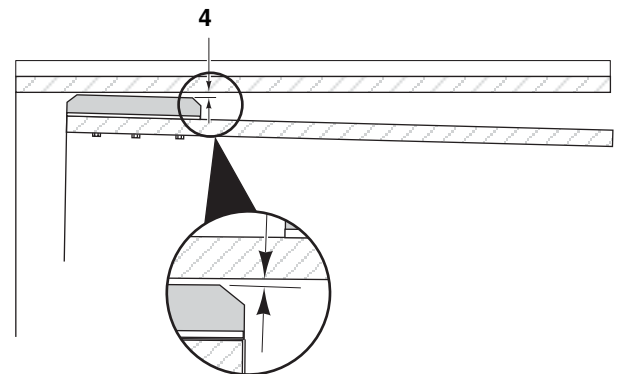
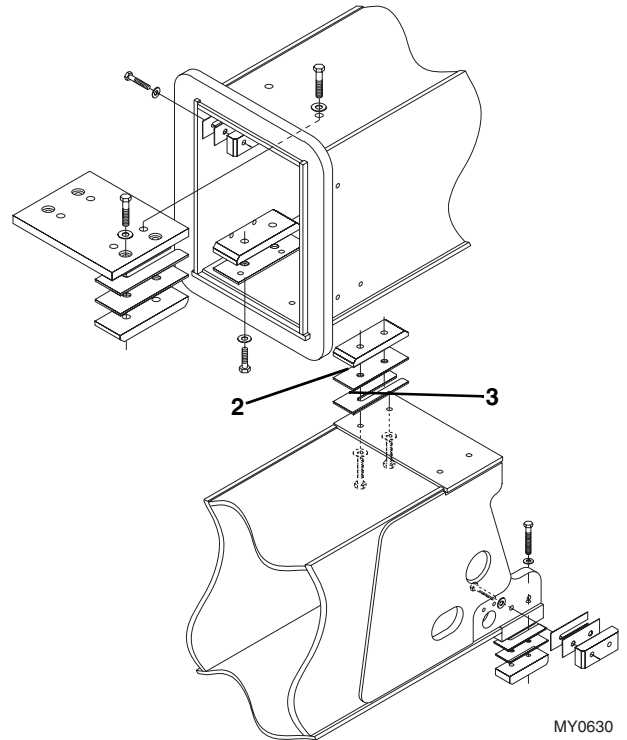
Hollow 3/8 in bolt: 20 - 25 lb-ft (27 - 34 Nm)

Hollow 1/2 in bolt: 45 - 50 lb-ft (61 - 68 Nm)

Note: The first shim next to a wear pad always needs to have the two hole configuration **(2)**. The remaining shims may have the large slot configuration.

Use shims **(3)** under the wear pads as required to maintain a maximum gap of 1/16 in (1,6 mm) **(4)** between the wear pad and the boom.

Shims are available in two thicknesses, 0.06 in (1.5 mm) and 0.04 in (1 mm).



3.15.3 Boom Wear Pad Lubrication

The boom has been factory lubricated for proper wear pad break-in and will normally require minor further lubrication. However, after replacing any wear pad(s), or after prolonged periods of inoperation, light lubrication of the boom wear surfaces with a factory authorized grease is recommended to keep the boom wear surfaces lubricated properly. Light lubrication of the boom wear surfaces is also recommended when the machine is stored, to help prevent rusting.



Boom

3.16 QUICK SWITCH ASSEMBLY

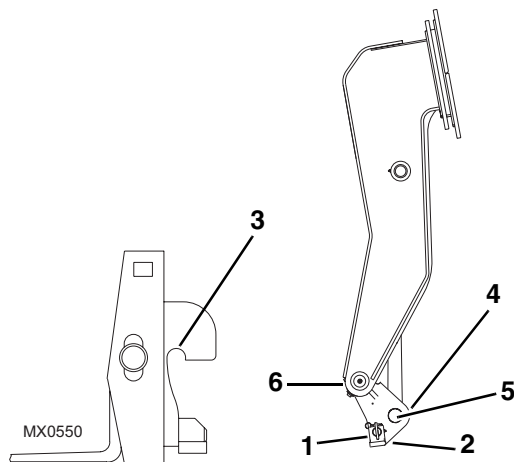
This machine is equipped with a quick switch assembly system for easy attachment changes.

3.16.1 Disconnecting from an Attachment

1. Park the machine on a hard, level surface.
2. Place the transmission control lever in the (N) NEUTRAL position and engage the parking brake switch
3. Level the boom and extend it out approximately 10 ft (3,05 m) and tilt the carriage backward.
4. Exit the machine using both hand holds.

Note: If removing a standard carriage with forks, spread the forks apart on the carriage shaft. This will help give the carriage better support to stand alone.

5. If equipped, label, disconnect the auxiliary electric harness.
6. If equipped, label, disconnect and cap the auxiliary hydraulic hoses.
7. If equipped, release the swing attachment saddles.
8. Remove the quick switch pin lock pin (1) and pull out the retaining pin (2) at the bottom of the quick switch assembly.
9. Return to the operator's compartment, fasten the seat belt and lower the attachment to the ground in a level position. Tilt the attachment forward. This will rotate the quick switch link back away from the attachment.
10. Lower and then retract the boom until the attachment pivot pins have disconnected from the attachment.



3.16.2 Connecting to an Attachment

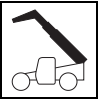
1. Retract quick switch to provide clearance. Check to be sure lock pin (1) is secured in out position with retainer pin.
2. Align attachment pivot pin with recess in attachment (3). Raise boom slightly to engage attachment pivot pin in recess.
3. Engage the quick switch (4).
4. Shut off engine. Exit cab and remove the lock pin (2) and the slide retainer pin (1) in fully. Secure the retainer pin in locked position using lock pin.
5. If equipped, swing attachment saddles down and pin in place.
6. If equipped, uncap and reconnect auxiliary hydraulic hoses.
7. If equipped, connect auxiliary electric harness.

3.16.3 Quick Switch Removal

1. Remove the lock bolt holding the tilt cylinder rod end pin to the quick switch assembly. Remove the Tilt Cylinder pin (5).
2. Support the quick switch assembly. Remove the capscrew and locknut securing the head pin (6) 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.

3.16.4 Quick Switch Installation

1. Assemble the quick switch to the boom head. Line up the quick switch between the mounts on the boom head. The quick switch should be centered in the boom head.
2. Coat the quick switch head pin with an anti-seize compound. Insert the quick switch head pin (6) through the quick switch and boom head. Secure with the previous capscrew and locknut.
3. Align the quick switch with the tilt cylinder rod end and insert the tilt cylinder pin (5). Align the tilt cylinder pin and screw in the locking bolt. Torque as required.



3.17 FORKS

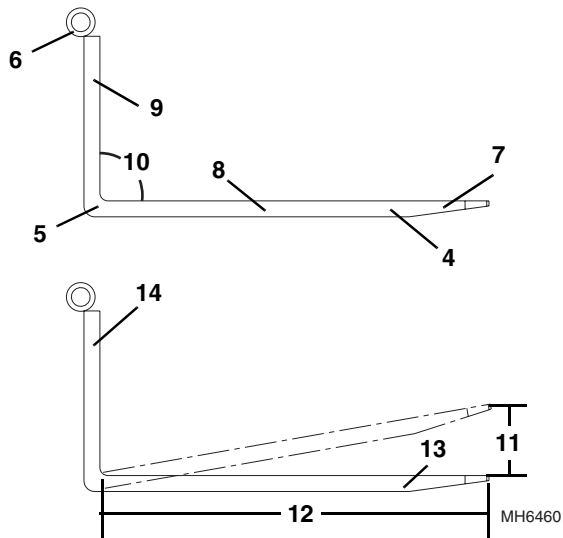
Forks should be cleaned and inspected prior to being attached to carriage. If the following criteria is not met, forks must be removed from service immediately.

Daily Inspection

1. Inspect forks (4) for cracks, paying special attention to heel (5) and mounting tubes (6).
2. Inspect forks for broken or bent tips (7) and twisted blades (8) and shanks (9).

Yearly Inspection

1. Straightness of the upper face of blade (8) and the front face of shank (9) should not exceed 0.5 percent of the length of blade or height of shank.
2. Angle (10) between upper face of blade and front face of shank should not exceed 93 degrees.
3. Thickness of blade (13) and shank (14) should not be reduced to 90 percent of original thickness.
4. Ensure fork length (12) 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 (13).





Boom

3.18 TROUBLESHOOTING

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

Boom Troubleshooting

Problem	Cause	Remedy
1. Boom will not extend or retract.	1. Broken hydraulic hose(s) or tube(s) and/or connections leaking.	1. Locate break, replace hose(s) or tube(s), tighten connections.
	2. Extend/Retract hydraulic system not operating properly.	2. Refer to Section 8.4, "Hydraulic Circuits."
	3. Faulty extend/retract cylinder.	3. Repair cylinder, Refer to Section 3.3.1, "Boom Removal."
	4. Broken chains or anchors.	4. Replace chains as needed.
2. Boom shifts to right or left when extending.	1. Boom side wear pads improperly shimmed or worn.	1. Shim wear pads to correct gap. Replace wear pads as needed. Refer to Section 3.15.2, "Boom Wear Pad Replacement."
3. Excessive boom pivot pin noise and/or wear.	1. Insufficient lubrication.	1. Lubricate at regular intervals. (Refer to Section 2.6, "Lubrication Schedules.")
	2. Worn bushing(s).	2. Replace bushing(s) and lubricate at regular intervals
4. Excessive compensation cylinder pivot pin noise and/or wear.	1. Insufficient lubrication.	1. Lubricate at regular intervals. (Refer to Section 2.6, "Lubrication Schedules".) Replace worn pins as needed.
	2. Worn bushing(s).	2. Replace bushing(s) and lubricate at regular intervals.



Boom Troubleshooting (Continued)

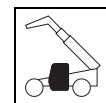
Problem	Cause	Remedy
5. Drooping chain, or jerky boom extend or retract functions.	1. Chain(s) tension not properly adjusted.	1. Adjust chain(s).
	2. Chain(s) stretched or binding.	2. Replace chains as needed. Refer to Section 3.13, "Boom Section Separation Adjustment - Four Section."
	3. Wear pads loose, contaminated, excessively worn or damaged.	3. Replace wear pad. Refer to Section 3.15.2, "Boom Wear Pad Replacement."
	4. Contaminated, corroded or rusted wear pad sliding surfaces.	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. Extend/Retract hydraulic system not operating properly.	5. Refer to Section 8.4, "Hydraulic Circuits."
	6. Damaged boom section.	6. Replace the damaged boom section. Refer to Section 3.10, "Boom Maintenance - Four Section (Complete Removal)."
6. Boom will not raise or lower.	1. Broken hydraulic hoses or tubes and/or connection leaks.	1. Locate break, replace hose(s) or tube(s), tighten connections.
	2. Lift/Lower hydraulic system not operating properly.	2. Refer to Section 8.4, "Hydraulic Circuits."
	3. Faulty Lift cylinder.	3. Repair cylinder. Refer to Section 3.3.1, "Boom Removal."
	4. Seized boom pivot pin bushing.	4. Replace bushing.
7. Excessive Lift/Lower cylinder pivot pin noise and/or wear.	1. Insufficient lubrication.	1. Lubricate at regular intervals. Refer to Section 2.6, "Lubrication Schedules." Replace worn pins as needed. Refer to Section 3.3.1, "Boom Removal."
	2. Worn self-aligning bushing(s).	2. Replace bushing(s) and lubricate at regular intervals. Refer to Section 2.6, "Lubrication Schedules."



Boom

Boom Troubleshooting (Continued)

Problem	Cause	Remedy
9. Rapid boom pad wear.	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.	1. Check wear pad gaps and correct as needed. Refer to Section 3.15.2, "Boom Wear Pad Replacement." 2. Reduce cycle times. 3. Remove contamination and/or corrosion from wear pad sliding surfaces and lubricate. If the surfaces cannot be reconditioned, replace the boom section(s). 4. Clean equipment frequently.
10. Auxiliary hydraulics will not operate.	1. Auxiliary hydraulic system not operating properly.	1. Refer to Section 8.4, "Hydraulic Circuits."
11. Excessive chain wear.	1. Improper chain adjustment. 2. Chain sheave(s) not properly lubricated. 3. Chain sheave(s) not rotating freely. 4. Improper chain lubrication.	1. Adjust to correct tension. Refer to Section 3.12, "Boom Extend and Retract Chains - Four Section." - Replace chains as needed. 2. Lubricate chain sheave. (Refer to Section 2.6, "Lubrication 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.

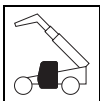


Section 4

Cab and Covers

Contents

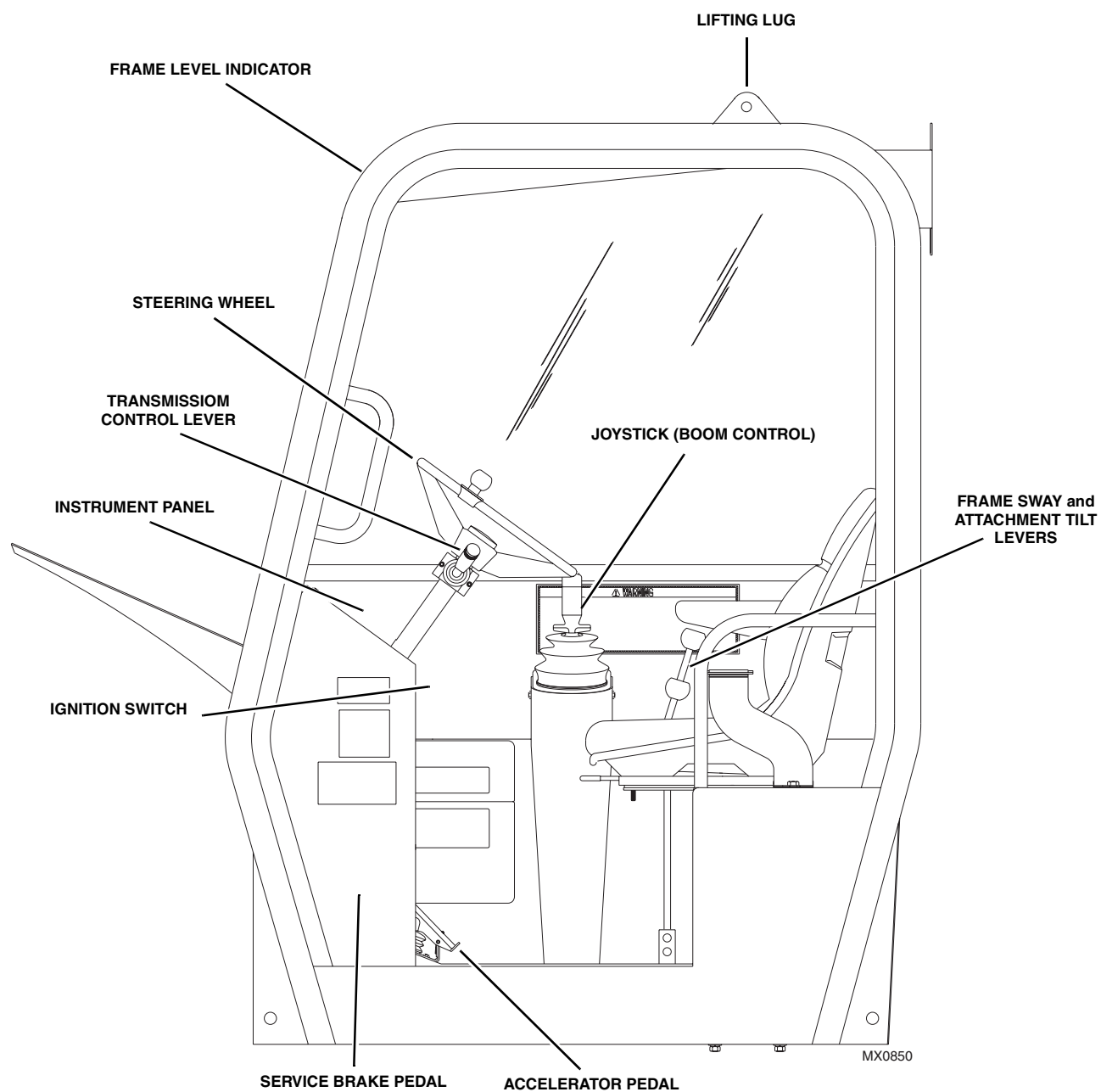
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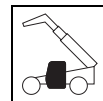


Cab and Covers

4.1 OPERATOR'S 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.





⚠ WARNING

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

4.2 OPERATOR'S CAB

4.2.1 Cab Safety

⚠ CAUTION

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

⚠ WARNING

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

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.

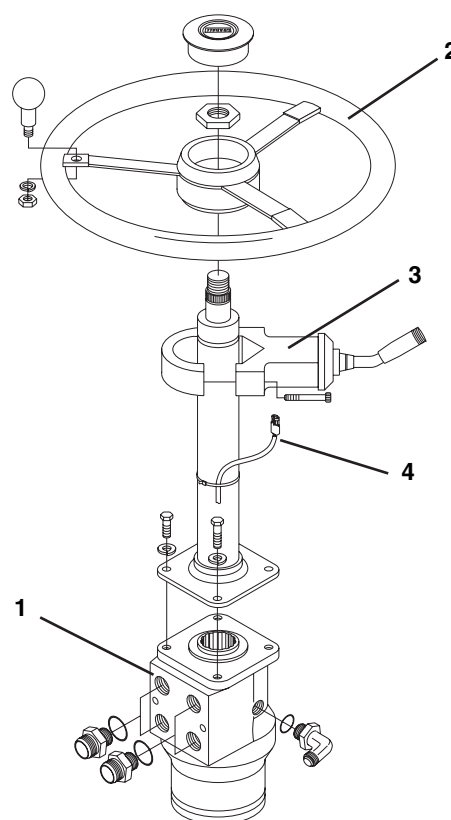
4.3 CAB COMPONENTS

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 travel select 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, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Remove the battery negative (-) cable at the battery negative (-) terminal.
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.



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6. Remove the steering wheel (2), disconnect and remove the travel select lever (3), disconnect the instrument panel harness connector (4).
7. Remove the steering assembly through the dash panel opening.
8. Support the steering valve, and remove the four hex-head capscrews and four lockwashers.

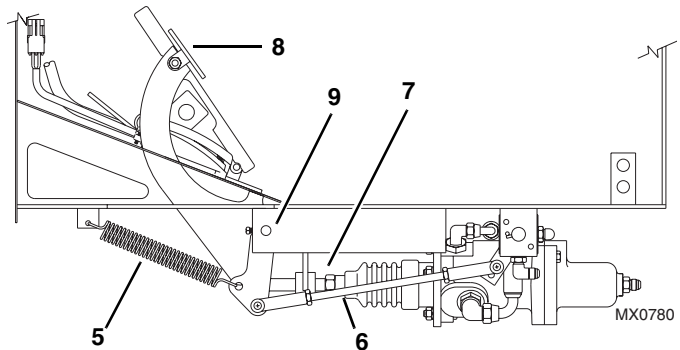
Note: *DO NOT* disassemble the orbitrol valve. The orbitrol valve is not serviceable and must be replaced in its entirety, if defective.



Cab and Covers

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, connect the instrument panel harness connector, install the steering wheel assembly. Torque the steering wheel nut to 29-34 lb-ft (39-46 Nm).
4. Install new o-rings into the steering valve fittings. Lubricate the o-rings with clean hydraulic oil.
5. Uncap and connect the previously labeled load sense hose to the steering valve.
6. Uncap and connect the remaining previously labeled four hoses to the steering valve.
7. Connect the battery negative (-) cable at the battery negative (-) terminal.
8. 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.
9. Close and secure the engine cover.



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 8.8.2, "Service Brake Valve," for removal information.

b. Brake Valve Installation

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

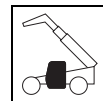
c. Service Brake Pedal Removal

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

6. Remove the bolt, nut and lockwasher (8) securing the brake pedal to the brake pedal weldment and remove the brake pedal.
7. Remove the bolt and lockwasher from the pivot pin, remove the pivot pin from the brake pedal bracket (9).
8. Remove the brake pedal weldment from the cab.

d. Service Brake Pedal Installation

1. Position the brake pedal weldment in its mounting location within the cab.
2. Secure the brake pedal weldment into position with the pivot pin (9).
3. Install the brake pedal (8) to the brake pedal weldment.
4. Be sure the brake pedal has the correct range of motion. Secure pivot pin with bolt and lockwasher.
5. Reconnect the return spring (5), inching brake linkage (6) and the brake master cylinder push rod (7).
6. Connect the battery negative (-) cable to the battery negative (-) terminal.
7. Close and secure the engine cover.

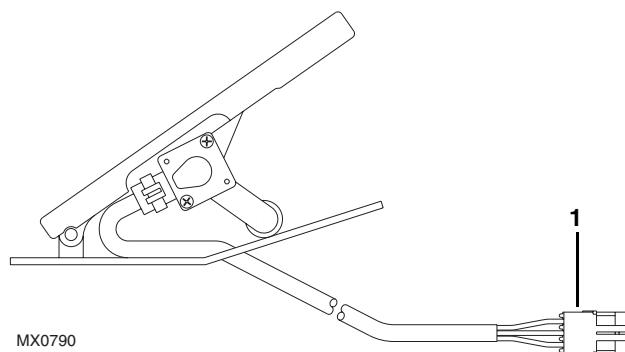


4.3.3 Throttle Pedal

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 travel select 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, stating that the machine should not be operated.
3. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
4. Remove belly pan from under cab and unplug throttle electrical connection (1) under cab floor.
5. Remove the four bolts holding the throttle pedal assembly to the cab floor.
6. Remove the throttle pedal assembly from the cab.

b. Throttle Pedal Installation



1. Position and secure the throttle pedal in its mounting location on the cab floor.
2. Reconnect the throttle cable connection.
3. Replace the belly pan under the cab.
4. Connect the battery negative (-) cable to the battery negative (-) terminal.
5. Check the engine rpm at high idle. If the rpm is not 2400 +/- 50 rpm (534D-9), 2500 +/- 50 rpm (534D-10) or 2200 +/- 50 rpm (544D) contact your **JLG** dealer.

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.
6. Close and secure the engine cover.

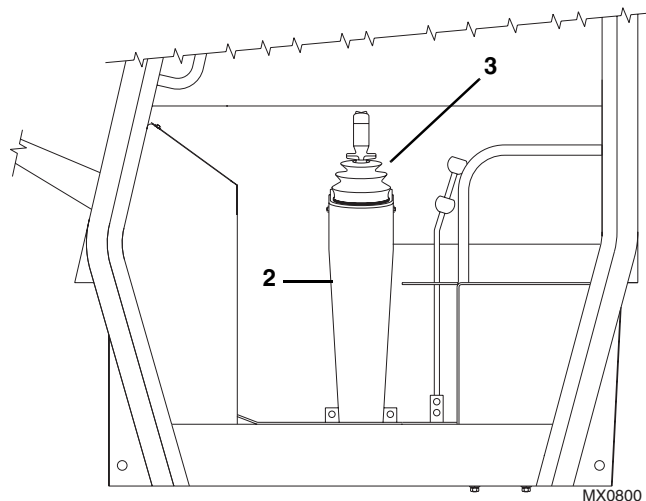
4.3.4 Boom Joystick Assembly

a. Boom Joystick Assembly Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
4. Remove the four bolts holding the cover (2) below the joystick and remove the cover.
5. Lift the joysticks rubber sleeve, remove the bolts securing the boom joystick to the cab (3).
6. Lift the boom joystick from its mounting position.
7. Label, disconnect and cap all hydraulic hoses attached to the boom joystick. Cap all fittings and openings to keep dirt & debris from entering the hydraulic system.

Note: If equipped with the optional on joystick tilt feature, disconnect the electrical connector along with the hydraulic hoses.

8. Remove the boom joystick assembly.



b. Boom Joystick Assembly Installation

1. Uncap and connect the previously labeled hydraulic hoses to their appropriate locations.

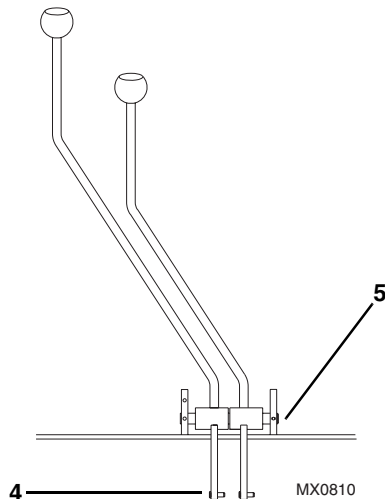
Note: If equipped with the optional on joystick tilt feature, connect the electrical connector to its proper location at this time.



Cab and Covers

2. Install the bolts securing the boom joystick to the cab.
3. Connect the battery negative (-) cable to the battery negative (-) terminal.
4. Test the boom extend/retract and boom lift/lower joystick function:
 - a. Move the joystick handle rearward, activating the boom lift function. The boom should RISE.
 - b. Move the joystick handle forward, activating the boom lower function. The boom should LOWER.
 - c. Move the joystick handle to the right, activating the boom extend function. The boom should EXTEND.
 - d. Move the joystick handle to the left, activating the boom retract function. The boom should RETRACT.
 - e. Depress the left side of the switch (optional) to activate the tilt up function. The attachment should TILT UP.
 - f. Depress the right side of the switch (optional) to activate the tilt down function. The attachment should TILT DOWN.
5. Close and secure engine cover.

4.3.5 Frame Sway and Attachment Tilt Levers



a. Lever Removal

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

2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
4. Disconnect the link (4) between the lever and the main control valve.
5. Remove the cotterpins and pull the shaft (5) out of the lever mounting brackets. Note the location of the spacers between the levers.
6. Remove the lever from the cab.

b. Lever Installation

1. Install the lever at the mounting bracket on the cab floor.
2. Install the shaft, spacers and cotter pins.
3. Install the link between the lever and the main control valve.
4. Install the lever knob.
5. Connect the battery negative (-) cable to the battery negative (-) terminal.
6. Test the lever functions:

Frame Sway and Attachment Tilt Levers

- a. Move the lever rearward, activating the attachment up function. The attachment should TILT UP.
- b. Move the lever forward, activating the attachment down function. The attachment should TILT DOWN.
- c. Move the Tilt lever rearward, activating the right frame sway function. The frame should SWAY to the RIGHT.
- d. Move the Tilt lever forward, activating the left frame sway function. The frame should SWAY to the LEFT.

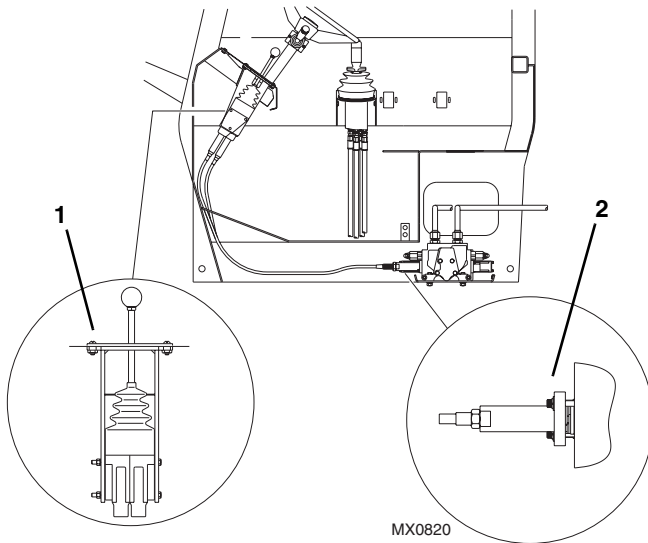
4.3.6 Left Hand Tilt and/or Left Hand Tilt/Sway Lever (If Equipped)

a. Lever Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.



3. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
4. Remove the four bolts holding the lever assembly (1) to the dash.
5. Remove the belly pad from under the cab.
6. Disconnect the cable assembly (2) at the main control valve.
7. Remove the assembly from the cab.



b. Lever Installation

1. Install the lever assembly in the cab dash.
2. Reconnect the cable end to the main control valve.
3. Install the belly pan.
4. Connect the battery negative (-) cable to the battery negative (-) terminal.
5. Test the lever function and adjust cable if needed.

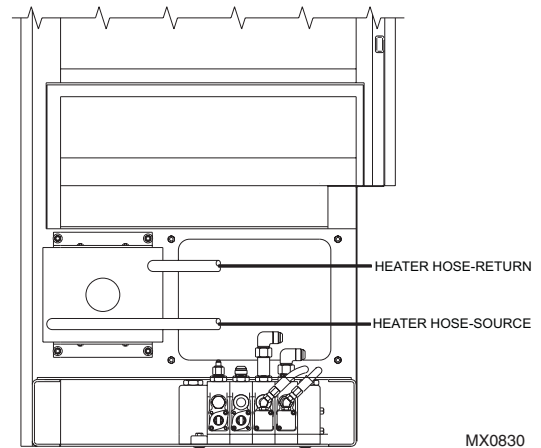
4.3.7 Windshield Wiper Assembly

Refer to Section 9.8, "Windshield Wiper Motor (If Equipped)," for removal and installation information.

4.3.8 Heater System (If Equipped)

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 travel select 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, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Remove the belly pan, rear cover and access cover (beside heater) from the cab
6. Place a suitable container beneath the heater core. Slowly turn the radiator cap to the first stop, and allow any pressure to escape. Remove the radiator cap.
7. Shut both coolant valves located on the engine.
8. Loosen, label and remove both heater hoses attached at the heater and drain the coolant to a container with a cover, and label as "Used Antifreeze." Dispose of the used coolant at an approved recycling facility.
9. Label and disconnect any electrical connections.
10. Loosen and remove the heater.





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b. Heater Assembly Installation

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. Install the belly pan, rear cover and access cover.
5. Open both coolant valves on the engine. Open the radiator cap and check the coolant level. Fill if necessary. The cooling system capacity is listed in Section 2.4, "Fluid and Lubricant Capacities."
6. Connect the battery negative (-) cable to the battery negative (-) terminal.

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.

7. Wait for the engine to cool and check the coolant level. Add coolant as required to bring the coolant to the proper level.

4.4 CAB REMOVAL

WARNING

The protection offered by this ROPS/FOPS will be impaired if subjected to any modification or structural damage. Any modification to this machine must be approved by JLG to assure compliance with ROPS/FOPS certification for this cab/machine configuration. If damaged, the **CAB CANNOT BE REPAIRED**. It must be **REPLACED**.

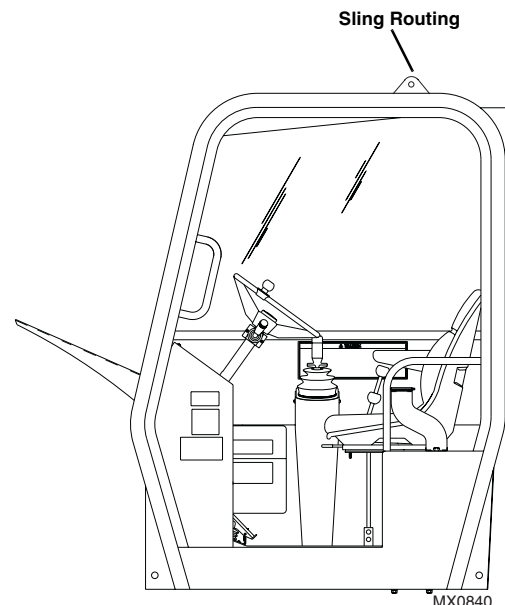
Inspect the cab, its welds and mounts. If modification, damage, a cracked weld and/or fatigued metal is discovered, replace the cab. Contact the **JLG** distributor or the **JLG** Service Department with any questions about the suitability or condition of a cab.

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, ground the attachment, place the travel select lever in the (N) NEUTRAL position, engage the parking brake and shut the engine OFF.
2. Open the engine cover. Allow the system fluids to cool.
3. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
4. Shut both coolant valves located on the engine.
5. Plug and label both coolant hoses.
6. Remove the air cleaner tubing from the side of the cab. Cover the intake opening on the engine to prevent dirt or debris from entering the engine.
7. Disconnect the wiring harness between the cab and frame.

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

8. Working under the cab, label, disconnect all hydraulic hoses. Cap all fittings and openings to keep dirt & debris from entering the hydraulic system.
9. Disconnect the throttle electrical cable from under the cab.



10. Install eyebolts and route a sling with a suitable lifting capacity.
11. Remove the four cab-to-frame bolts, flat washers and nuts.



12. Remove the mirrors and all other cab components as needed, if not previously removed.
13. Carefully begin to lift the cab. Stop and check that all wiring, hydraulic hoses and fasteners are disconnected or removed.
14. 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.
15. 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.
16. Inspect the condition of the fittings, clamps, hydraulic hoses, etc. Replace parts as indicated by their condition.
17. 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. Install eyebolts and route a sling with a suitable lifting capacity.
3. 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.
4. Install the four bolts, washers and nuts and torque to 480 lb-ft (651 Nm).
5. Connect the throttle electrical cable from under the cab.
6. Route any hoses through the opening at the right rear corner of the cab.
7. Working under the cab, uncap and reconnect the previously labeled hydraulic hoses to the appropriate locations.
8. Connect the wire harness at the right front side of the cab.

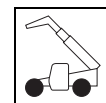
9. Connect the heater hoses to the engine. Secure with two hose clamps. Open both coolant valves on the engine.
10. Fill the cooling system completely with a 50/50 mixture of ethylene glycol and water. The cooling system capacity is listed in Section 2.4, "Fluid and Lubricant Capacities."
11. Connect the battery negative (-) cable or cables to the battery negative (-) terminal.
12. Carefully examine all cab components, fasteners, etc., one last time before engine start-up. Rectify any faulty conditions.
13. 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.

14. 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.



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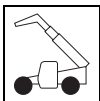


Section 5

Axles, Wheels and Tires

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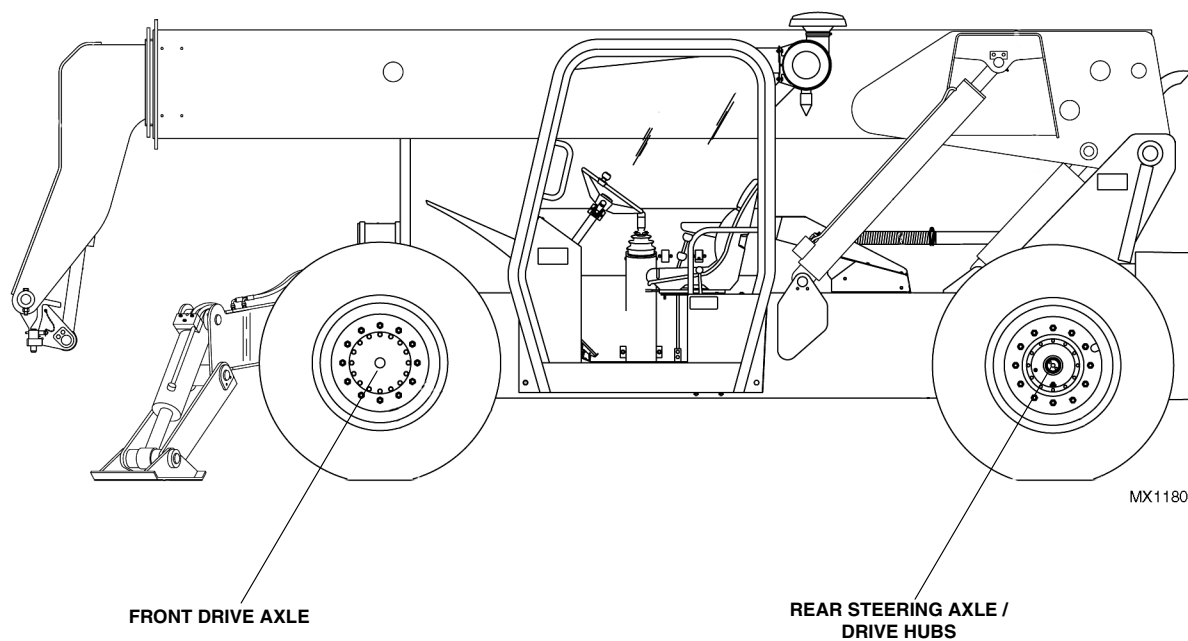
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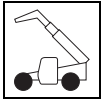


Axles, Wheels and Tires

5.1 AXLES, WHEEL AND TIRE 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, wheels and tires. The following illustration identifies the components that are referred to throughout this section.





5.2 GENERAL INFORMATION

WARNING

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

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

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

5.3 AXLE ASSEMBLIES

5.3.1 Axle Serial Number Plate

The front axle serial number plate is located on a mounting pad on the front side of the center section of the 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.

5.3.2 Axle Specifications

General axle specifications are found in Section 2.4, "Fluid and Lubricant Capacities."

5.3.3 Axle Internal Service

Detailed axle service instructions (covering the axle, differential, brakes and wheel-end safety, repair, disassembly, reassembly, adjustment and troubleshooting information) are provided in the CA357248 Carraro Axle Service Manual (JLG P/N 31200372).

5.3.4 Axle Maintenance

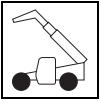
CLEANING: Clean parts with machined or ground surfaces (such as gears, bearings and shafts) with emulsion cleaners or petroleum-based cleaners. **DO NOT** steam clean internal components and the interior of the planetary hub and axle housing. Water can cause corrosion of critical parts. Rust contamination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

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

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

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

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



Axles, Wheels and Tires

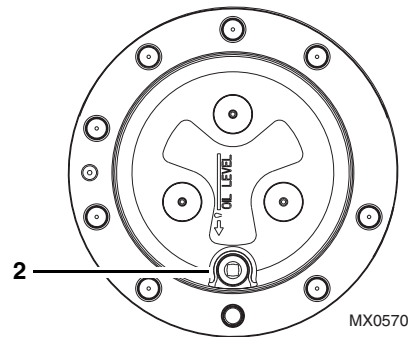
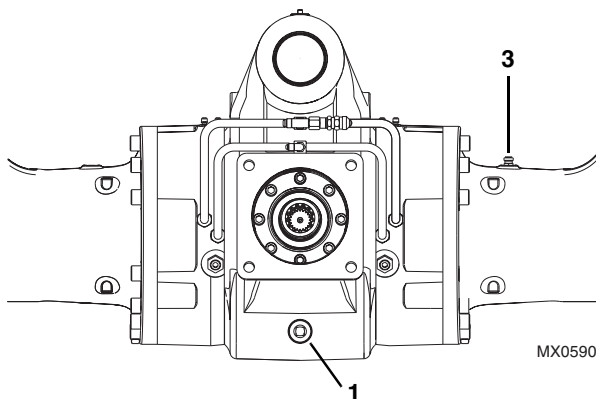
5.3.5 Axle Removal

The front axle assembly is equipped with a parking brake mechanism and a limited-slip feature. The following steps outline a typical axle removal procedure.

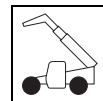
Cleanliness is extremely important. Before attempting to remove the axle, thoroughly clean the machine. Avoid spraying water or cleaning solution on the stabilizer solenoids and other electrical components. If using a steam cleaner, seal all openings before steam cleaning.

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

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, raise the boom to access the front axle, place the travel select 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, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Remove the deck cover and disconnect the battery negative (-) cable from the battery negative (-) terminal.
5. If the axle will be disassembled after removal, place a suitable receptacle under the axle (1) and wheel hubs (2) drain plugs.
6. Use the breather (3) to relieve any pressure in the axle before removing the drain plug.
7. 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.

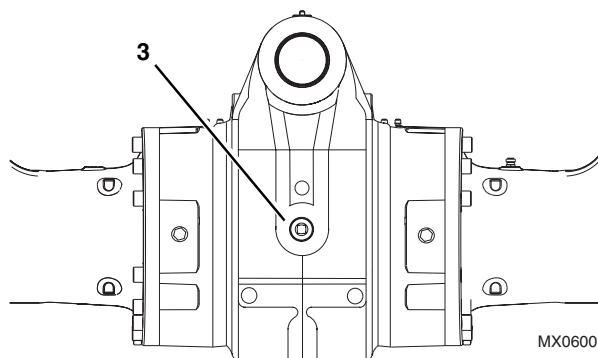


8. Label, disconnect and cap the brake lines at the axle. Cap all fittings and openings to prevent dirt & debris from entering the hydraulic system.
 9. Block the front and rear of both tires on the rear axle. Ensure that the machine will remain in place during axle removal before proceeding.
 10. Raise 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.
 11. 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.
 12. Mark and 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.
13. Remove the four bolts holding the drive motor assembly to the carrier assembly. Pull the drive motor back from the carrier assembly and support.
 14. On the front axle remove the retaining ring securing the sway cylinder pin to the frame. Tap the pin out, and move the cylinder to prevent it from interfering with axle removal.
 15. Remove the bolts and locknut securing the axle pivot pin to the frame. Tap the pivot pin out and note the location of the shims on each side of the axle.
 16. Remove the axle 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.

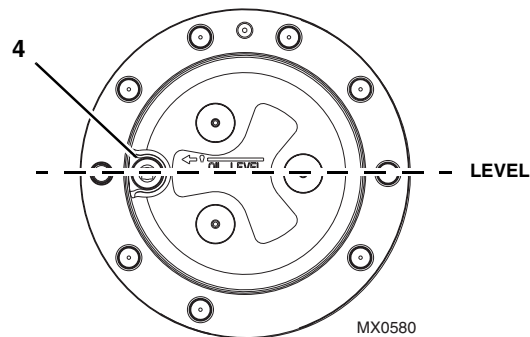


5.3.6 Axle Installation

1. Before proceeding, ensure that the machine will remain in place during axle installation. Block the front and rear of both tires on the rear axle.
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 housing with the holes in the frame.
5. Install the pivot pin and replace the shims on each end of the axle. Install the pivot pin lockbolt and nut.
6. Move the sway cylinder into position on the axle cylinder anchor. Insert the pin through the cylinder and cylinder anchor. Secure the cylinder-mount pin with the retaining clip.
7. Tighten the axle oil drain plug, loosen and remove the axle oil fill plug (3). (Refer to Section 2.4, "Fluid and Lubricant Capacities," for proper oil and capacities.



8. Rotate wheel hubs 90 degrees so the drain plug (4) becomes the fill plug. Refer to Section 2.4, "Fluid and Lubricant Capacities," for proper oil and capacities.

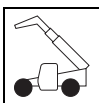


9. Install the wheel and tire assemblies. Refer to Section 5.6.2, "Installing Wheel and Tire Assembly onto Machine."
10. Carefully remove the jack, hoist or overhead crane and sling supporting the axle.
11. Carefully raise the machine using a suitable jack or hoist. Remove the supports from beneath the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

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

13. Install new o-rings into the fittings. Lubricate the o-rings with clean hydraulic oil.
14. Uncap and connect the brake lines at their axle fittings.
15. Install the drive motor assembly.
16. Check the hydraulic reservoir oil level.
17. Connect the battery negative (-) cable from the battery negative (-) terminal and install the deck cover.
18. Close and secure the engine cover.
19. Start the engine. Operate the frame sway function several times in both directions and check the function of the brakes. Check for hydraulic leaks, and tighten or repair as necessary.

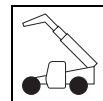
Note: The service brake circuit will need to be bled after axle installation. Refer to Section 8.8.3, "Brake Test."



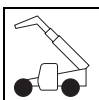
Axles, Wheels and Tires

5.3.7 Axle Assembly 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, "Fluid 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 Mobilfluid 424® (ISO 46). Refer to Section 2.4, "Fluid 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 Mobilfluid 424® (ISO 46). Refer to Section 2.4, "Fluid and Lubricant Capacities."
	8. Axle housing damaged.	8. Replace damaged parts.
2. Intermittent noise when traveling.	1. Differential ring and/or pinion gears damaged.	1. Determine cause and repair as needed.

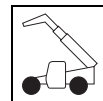


Problem	Cause	Remedy
3. Oil leaking from axle (differential housing and/or axle housings).	1. Drain and/or inspection plugs loose and/or o-rings damaged or missing.	1. Replace o-rings as needed and tighten plugs to 96 lb-ft (130 Nm).
	2. Hose fittings loose.	2. Tighten fittings.
	3. Axle shaft seal damaged or missing and/or worn or damaged shaft sealing surfaces.	3. Replace seal and/or joint coupling fork shaft (axle shaft).
	4. Input shaft multi-seal ring damaged or missing and/or worn or damaged pinion (input) shaft sealing surfaces.	4. Replace multi-seal ring and/or input shaft. Adjust ring and pinion alignment and bearing preload as described in the Carraro Repair Manuals.
	5. Axle casing to brake housing and/or brake housing to differential assembly o-rings and/or seals worn or damaged.	5. Replace o-rings and seals.
	6. Axle housing mounting nuts and capscrews loose.	6. Tighten housing nuts and capscrews to 288 lb-ft (390 Nm).
	7. Differential and/or axle housing(s) damaged.	7. Replace housing(s) as needed.
4. Oil leaking from wheel end housing (planet carrier).	1. Oil level plugs loose and/or o-rings damaged or missing.	1. Replace o-rings as needed and tighten plugs to 96 lb-ft (130 Nm).
	2. O-ring between hub and housing (planet carrier) damaged or missing.	2. Replace o-ring.
	3. Shaft seal damaged or missing and/or worn or damaged shaft sealing surfaces.	3. Replace seal and/or fork joint shaft.
	4. Housing capscrews loose.	4. Tighten housing capscrews to 41 lb-ft (55 Nm).
	5. Housing (planet carrier) damaged.	5. Replace housing (planet carrier).
5. Oil leaking from steering cylinder.	1. Hose fittings loose.	1. Tighten fittings.
	2. Steering cylinder o-rings and/or seals worn or damaged.	2. Replace o-rings and seals.
	3. Piston rod seal worn or damaged.	3. Replace piston rod seal.
	4. Cylinder tube damaged.	4. Replace cylinder tube.



Axles, Wheels and Tires

Problem	Cause	Remedy
6. Axle overheating.	1. Oil level too high. 2. Axle and/or wheel end housings filled with incorrect oil or oil contaminated or oil level low.	1. Fill oil to correct level with Mobilfluid 424® (ISO 46). Refer to Section 2.4, "Fluid and Lubricant Capacities." 2. Drain axle and fill to correct level with Mobilfluid 424® (ISO 46). Refer to Section 2.4, "Fluid and Lubricant Capacities."
7. High steering effort required.	1. Steering (hydraulic) system not operating properly. 2. Excessive joint housing swivel bearing preload. 3. Worn or damaged swivel bearings.	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.
8. Slow steering response.	1. Steering (hydraulic) system not operating properly. 2. Steering cylinder leaking internally.	1. Refer to Section 8.4, "Hydraulic Circuits." 2. Repair or replace steering cylinder as needed.
9. Excessive noise when brakes are engaged.	1. Brake discs worn. 2. Brake discs damaged.	1. Check brake discs for wear. Refer to Section 2.4, "Fluid and Lubricant Capacities." 2. Replace brake discs.
10. Brakes will not engage.	1. Brake (hydraulic) system not operating properly. 2. Brake piston o-rings and seals damaged (leaking).	1. Refer to Section 8.4, "Hydraulic Circuits." 2. Replace o-rings and seals.
11. Brakes will not hold the machine or braking power reduced.	1. Brake discs worn. 2. Brake (hydraulic) system not operating properly. 3. Brake piston o-rings and seals damaged (leaking).	1. Check brake discs for wear. Refer to Section 2.4, "Fluid and Lubricant Capacities." 2. Refer to Section 8.4, "Hydraulic Circuits." 3. Replace o-rings and seals.



5.4 REAR DRIVE HUBS

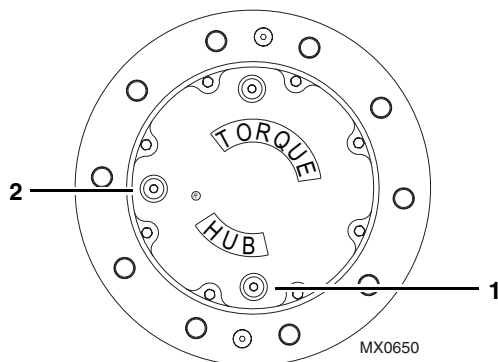
5.4.1 Rear Drive Hub Service

Detailed drive hub service instructions (covering repair, disassembly, reassembly and adjustment) are provided in the MH439-0695 Auburn Power Wheel Service Manual (JLG P/N 31200374).

Note: The removal, disassembly and installation of the rear drive hub applies for either side.

a. Rear Drive Hub Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake, straighten all wheels and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Remove the battery negative (-) cable from the battery negative (-) terminal.
5. Block the front and rear of both tires on the front axle.
6. 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 hub removal.
7. Mark and remove the wheel and tire assembly from the hub that is being removed. Refer to Section 5.6.1, "Removing Wheel and Tire Assembly from Machine."



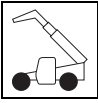
8. Remove the drain plug (1) and allow the wheel hub oil to drain into the receptacle. Transfer the used axle oil into a suitable covered container, and label the container as "Used Oil." Dispose of used oil at an approved recycling facility.
9. Refer to Section 8.7.2, "Rear Drive Motors," for drive motor removal.
10. Support the drive hub using a suitable jack, hoist or overhead crane and sling.
11. Remove the eight bolts holding the drive hub to the steering knuckle.

Note: Mark the location of the two 12 point hub mounting bolts.

12. Set the drive hub on a suitable support or table.

b. Rear Drive Hub Installation

1. Before proceeding, ensure that the machine will remain in place during drive hub installation. Block the front and rear of both tires on the front axle.
2. Using a suitable jack, hoist or overhead crane and sling, balance the hub and prevent it from tipping, turning or falling while positioning it at the steering knuckle. Keep the hub supported and balanced on the jack, hoist or overhead crane and sling throughout the installation procedure.
3. Position the hub at the steering knuckle and align the hub housing with the holes in the knuckle.
4. Install the eight bolts and torque to 280 lb-ft +/- 10 lb-ft (380 Nm +/- 13,5 Nm).
5. Refer to Section 8.7.2, "Rear Drive Motors," for drive motor installation.
6. Refer to Section 5.6.2, "Installing Wheel and Tire Assembly onto Machine."
7. Align the fill mark (2) on the hub and fill to the proper level with Mobilfluid 424® (ISO 46).
8. Connect the battery negative (-) cable from the battery negative (-) terminal.
9. Close and secure the engine cover.
10. Remove the blocks from the front and rear of both tires on the front axle.
11. Start the machine and check proper operation. Check for fluid leaks. Check the hydraulic fluid level in the tank and add fluid as required.



5.5 REAR STEER AXLE

5.5.1 Rear Axle Removal

The rear steer axle assembly is equipped with two steer cylinders, two drive hubs and two motors and can be removed as a complete assembly. The following steps outline a typical axle removal procedure.

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

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

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select 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, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Remove the battery negative (-) cable from the battery negative (-) terminal.

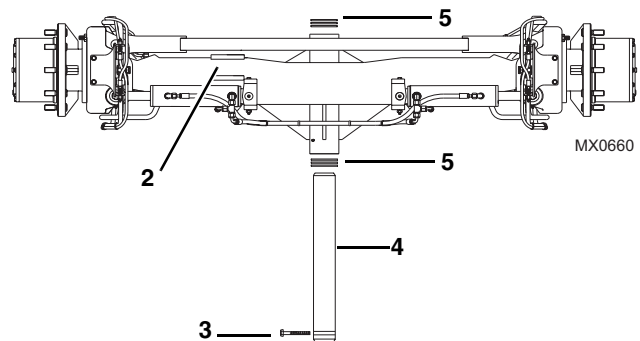
Note: If removing rear drive motors, refer to Section 8.7.2, "Rear Drive Motors." If removing rear drive hubs, refer to Section 5.4.1, "Rear Drive Hub Service."

5. Label, disconnect and cap the hoses on both drive motors and on both steer cylinders. Wipe up any spilled oil.
6. Block the front and rear of both tires on the front axle. Ensure that the machine will remain in place during axle removal before proceeding.
7. 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.
8. Support the rear axle with a suitable jack, hoist or overhead crane and sling. **DO NOT** raise the axle or the machine.
9. Mark and 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.

10. On the rear axle, remove the retaining pin (2) securing the stabilizer cylinder pin to the frame. Tap the pin out, and move the cylinder to prevent it from interfering with axle removal.

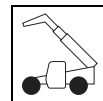
Note: The stabilizer cylinder is standard equipment on the 544D and optional equipment on the 535D-9 & 534D-10.



11. Remove the bolt and locknut (3) securing the axle pivot pin to the frame. Tap the pivot pin (4) out and note the location of the shims (5) on each side of the axle.
12. 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.

5.5.2 Rear Axle Installation

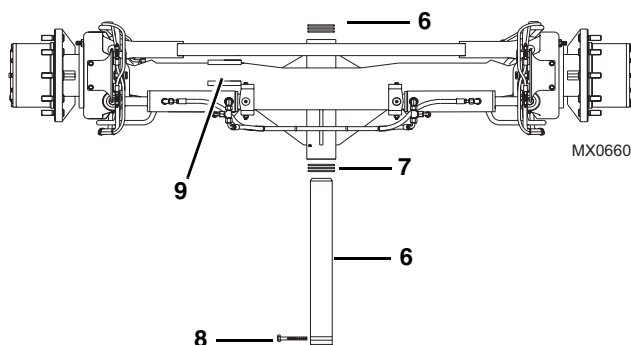
1. Before proceeding, ensure that the machine will remain in place during axle installation. Block the front and rear of both tires on the front axle.
2. If applicable, raise the machine using a suitable jack or hoist. Place suitable supports beneath the frame and lower the machine onto the supports, 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 housing with the holes in the frame.
5. Install the pivot pin (6) and replace the shims (7) on each end of the axle. Install the pivot pin lockbolt and nut (8).
6. Move the stabilizer cylinder into position on the axle cylinder anchor. Insert the pin through the cylinder and cylinder anchor (9). Secure the cylinder-mount pin with the retaining pin.
7. Uncap and connect the hoses on both drive motors and on both steer cylinders. Wipe up any spilled oil.

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

8. Install new o-rings into the fittings. Lubricate the o-rings with clean hydraulic oil.



9. Install the wheel and tire assemblies. Refer to Section 5.6.2, "Installing Wheel and Tire Assembly onto Machine."
10. Carefully remove the jack, hoist or overhead crane and sling supporting the axle.
11. Carefully raise the machine using a suitable jack or hoist. Remove the supports from beneath the frame and lower the machine to the ground.
12. Remove the blocks from the front and rear of both tires on the front axle.
13. Check the hydraulic reservoir oil level.
14. Start the engine. Operate the steering function several times in both directions. Check for hydraulic leaks, and tighten or repair as necessary.

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.

JLG recommends 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 a JLG approved replacement tire, JLG recommends that replacement tires have the following characteristics:

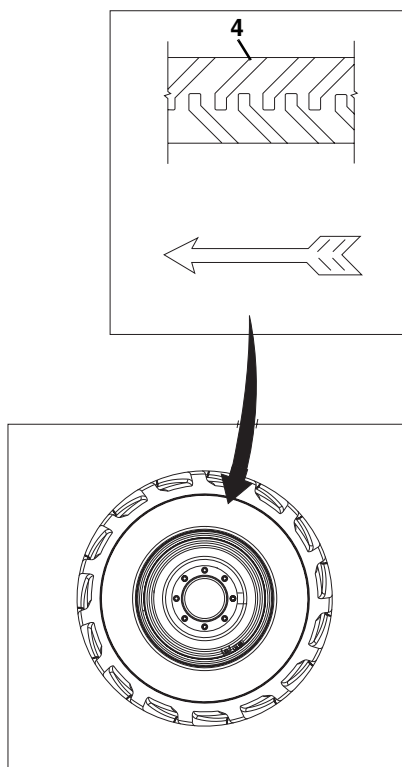
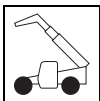
- Equal or greater ply/load rating and size of original.
- Tire tread contact width equal or greater than original.
- Wheel diameter, width and offset dimensions equal to the original.
- Approved for the application by the tire manufacturer (including inflation pressure and maximum tire load).

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. JLG does not recommend the use of hydrofill as a tire-fill substance 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.

The wheel and tire assemblies must be installed with the directional tread pattern "arrows" (4) facing in the direction of forward travel.



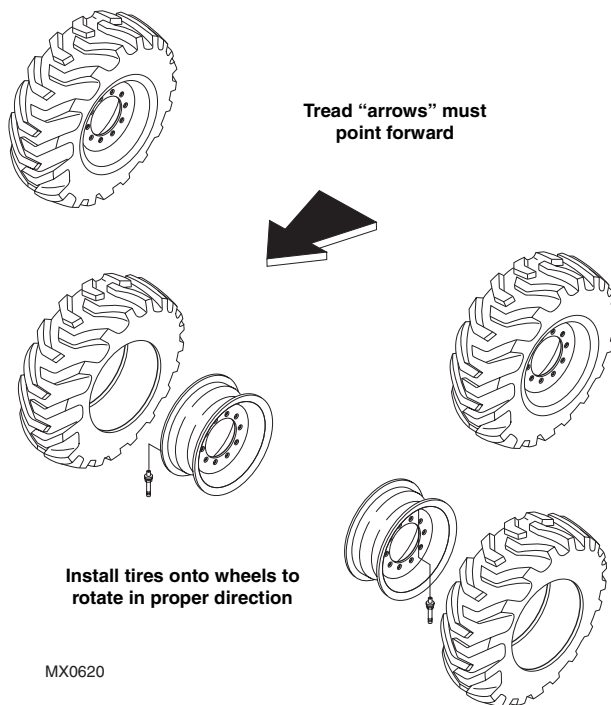
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5.6.1 Removing Wheel and Tire Assembly from Machine

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 a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
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.

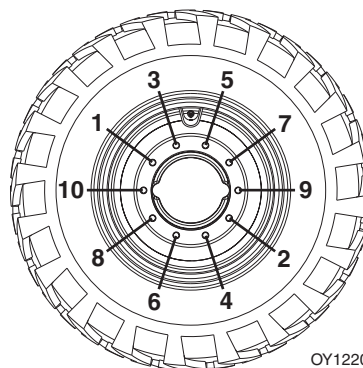
5.6.2 Installing Wheel and Tire Assembly onto Machine

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



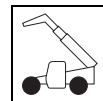
MX0620

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).



OY1220

5. Remove machine from supports.



5.7 BRAKES

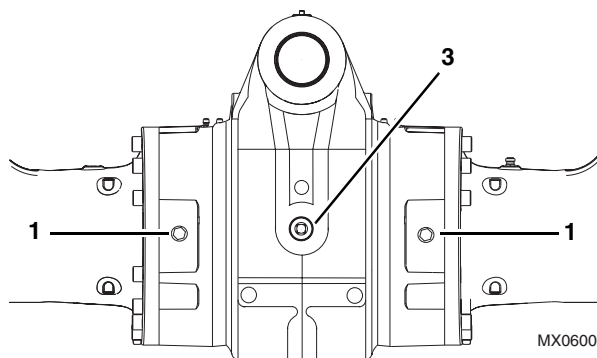
Check the brake disks for wear every 1,000 hours of operation or yearly. For more information on brake disk inspection, refer to the appropriate axle repair manual.

5.7.1 Brake Disk Inspection.

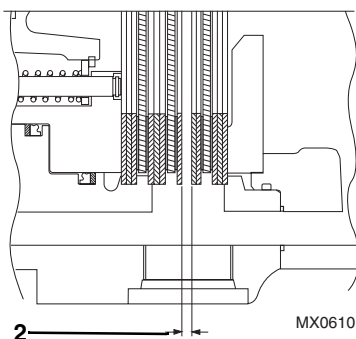
! WARNING

ALL WHEELS must be blocked to prevent machine from moving or rolling away.

1. Securely block all four wheels.
2. Remove the oil-level plug (1) on each side of the axle.
3. Have an assistant sit in the cab and apply the brakes, keeping pressure applied.
4. Using a feeler gauge, check the gap (2) between the brake disks. If the gap is less than 0.18 in (4,5 mm), replace the brake disks.



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



5. Repeat steps 3 and 4 for the other side of the axle.

6. Fill the axle with Mobilfluid 424® (ISO 46) through the axle fill hole (3) until the oil level is even with both axle level holes (1).
7. See chart of approved fluids. The axle capacity is 19.6 qt (18,5 Liters) for the front axle. Fill axle slowly, the oil has to run across the differential. Allow time for the oil to run across the differential. Axle level is correct when oil is up to both level plugs.

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.

Towing is only possible by using the "towing" feature built into the hydrostatic pump and disengaging the park brake on the front axle.

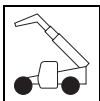
1. Securely block all four wheels.

! WARNING

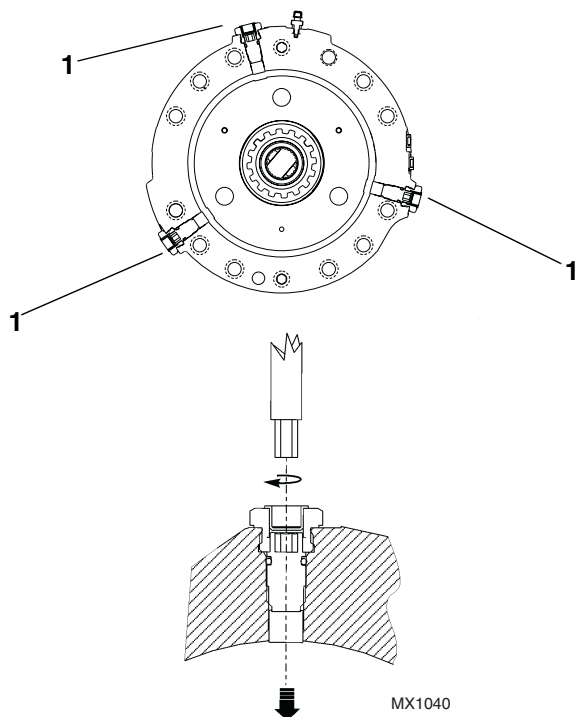
ALL WHEELS must be blocked to prevent machine from moving or rolling away.

2. Locate the six brake release bolts (1) at the base of the front axle. Mark a line on the socket so you can accurately count the number of turns each bolt makes as you perform the procedure.
3. Alternately screw the release bolts clockwise in 1/2 turn increments. Turn until resistance is felt.
4. Alternately screw the bolts clockwise 5 to 5 1/2 turns in 1/2 turn increments.
5. Hold the base of the reverse relief valve (2) using a 32mm (1-1/4") wrench. Use a 22mm (7/8") wrench to turn the second section of the reverse relief valve (3) two complete turns out. Repeat the procedure on the forward relief valve (4).
6. Carefully remove the blocking from each tire and tow the machine to a secure location.

Note: This procedure does not alter any relief settings.



Axles, Wheels and Tires



After the machine has been towed to a secure location, reactivate the parking brake.

1. Block all four wheels.

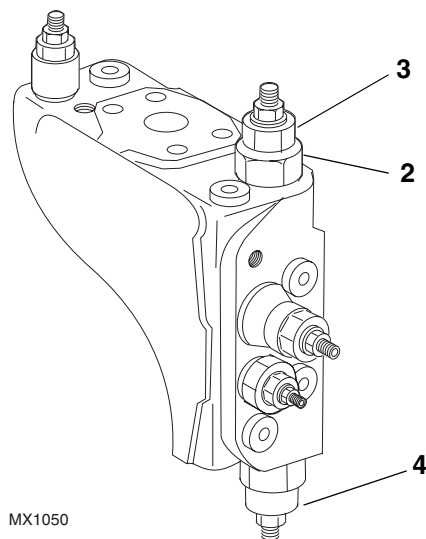


WARNING

ALL WHEELS must be blocked to prevent machine from moving or rolling away.

2. Hold the base of the reverse relief valve using a 32mm (1-1/4") wrench. Use a 22mm (7/8") wrench to turn the second section of the reverse relief valve two complete turns in. Repeat the procedure on the forward relief valve.
3. Using a torque wrench, alternately unscrew the brake release bolts (1) outward in 1/2 turn increments until the torque drops off sharply.
4. Again, alternately unscrew the bolts outward until you feel the bolts flange begin to contact against the special screw.
5. Screw the bolts inward (clockwise) 1/4 turn.
6. The parking brake should now be reactivated and the front wheels locked.
7. Remove the blocks from the four tires.
8. Verify that the parking brake works.

Note: If the parking brake does not work, check all activation operations step by step.





Section 6

Hydrostatic Drive Pump

Contents

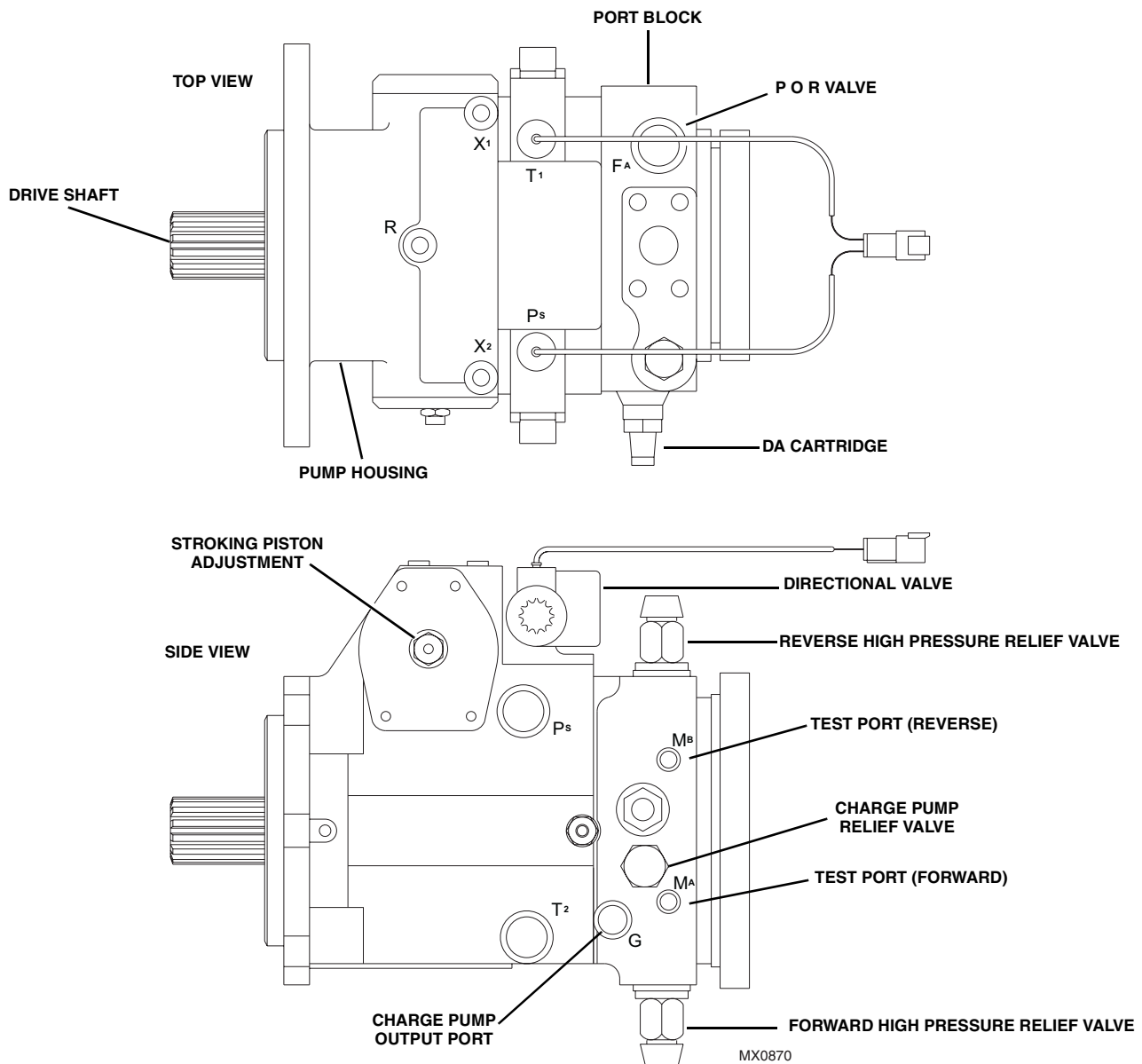
PARAGRAPH	TITLE	PAGE
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Hydrostatic Drive Pump

6.1 DRIVE PUMP 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 drive pump. 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.

6.2 DRIVE PUMP DESCRIPTION

Instructions in this section pertain mainly to general specifications, towing, maintenance information, and drive pump removal and installation procedures. For internal drive pump service instructions and detailed specifications contact your local **JLG** distributor. See

6.3 DRIVE PUMP SERIAL NUMBER

The drive pump serial number plate is located on the front of the drive pump case. Information specified on the serial number plate includes the drive pump model number, the drive pump serial number and other data. Information on the serial number plate is required in correspondence regarding the drive pump.

6.4 DRIVE PUMP SPECIFICATIONS

6.4.1 Drive Pump Maintenance

Cleanliness is of extreme importance. Before attempting any repairs, thoroughly clean the exterior of the drive pump to help prevent dirt from entering while performing maintenance checks and procedures.

Your local **JLG** distributor can provide a suggested maintenance schedule with references to pertinent procedures and instructions in this manual. To help prevent drive pump problems before they occur, follow the maintenance schedule.

Note: Lubrication and Maintenance chart decals are located inside the engine compartment access door. These decals contain a general maintenance schedule that should be followed to maintain the machine in good operating condition. Refer to Section 2.5, "Service and Maintenance Schedules." The same schedule information is presented in the appropriate Operation & Safety Manual, with a detailed account of how to perform the procedures.

6.4.2 Drive Pump Maintenance Schedule

Complete hydraulic maintenance information is located in the appropriate Operation & Safety Manual.

Periodically, depending on operating conditions and other factors, back flush the hydraulic oil cooler, which is located in front the radiator. ALWAYS back flush the hydraulic oil cooler after removing the drive pump for repair or replacement.

The hydraulic oil cooler outlet hose, routed to the lower oil cooler fitting, is located on the top of the drive pump. The drive pump oil cooler inlet hose, routed to the upper oil cooler fitting, is located on the top of the drive pump. (Refer to Section 7.7.3, "Radiator/Oil Cooler and Replacement.")

Disconnect and back flush the oil cooler portion of the radiator or the oil cooler (located behind the radiator) with oil and compressed air until all foreign material is removed. If necessary, remove the radiator or oil cooler from the machine, and clean the oil cooler circuit using oil, compressed air and steam.

Note: *DO NOT* use flushing compounds for cleaning purposes.

6.5 DRIVE PUMP REPLACEMENT

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

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

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

6.5.1 Drive Pump Removal



WARNING

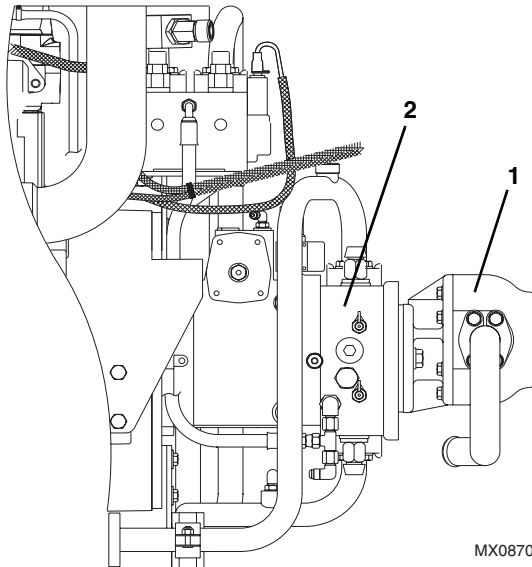
NEVER lift a drive pump alone; enlist the help of at least one assistant or use a suitable hoist or overhead crane and sling.

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



Hydrostatic Drive Pump

2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Remove rear cover to allow easier access to the drive pump.
5. Remove belly pan from under engine.
6. Drain the hydraulic oil reservoir. Refer to Section 8.5, "Hydraulic Reservoir."
7. Remove the battery negative (-) cable from the battery negative (-) terminal.
8. Thoroughly clean the drive pump and surrounding area, including all hoses and fittings, before proceeding.
9. Place a suitable receptacle under the drive pump.



10. Label and disconnect both shift solenoid wiring harness connectors.
11. Label, disconnect and cap the all hydraulic hoses and tubes attached to the drive pump. Cap all fittings and openings to keep dirt & debris from entering the hydraulic system.
12. Wipe up any spilled hydraulic oil.
13. Loosen and remove both bolts holding the implement pump (1) to the drive pump (2).
14. Pull the implement pump away from the drive pump.
15. Connect a lifting strap or chain to the top of the drive pump, and to a suitable hoist or overhead crane. Operate the hoist or crane to remove slack from the chain, but **DO NOT** raise the drive pump at this time.
16. Loosen and remove the two bolts holding the drive pump to the engine bellhousing.

17. Carefully remove the drive pump from the machine. Avoid causing damage to the drive pump or surrounding parts.
18. Lift the drive pump clear of the machine and lower it onto suitable supports or secure it to a stand built especially for drive pump or engine service. Secure the drive pump so that it will not move or fall.

6.5.2 Drive Pump Inspection and Internal Repair

Note: Contact the **JLG** Service Department if internal drive pump repair is required.

6.5.3 Drive Pump Installation

1. Use a hoist or overhead crane and sling attached to the drive pump. Raise and position the drive pump within the chassis.
2. Align the input shaft, align the drive pump bolt holes with the two holes in the bell housing. Install the two bolts and washers and torque to 240 lb-ft (240 Nm).
3. Remove the hoist or overhead crane and sling.
4. Align the input shaft, align the bolt holes of the implement pump to the drive pump. Install the two bolts and washers and torque to 160 lb-ft (217 Nm).
5. Connect the drive pump shift solenoid wiring harness connectors.
6. Secure the wiring harness to the drive pump housing.
7. Uncap and connect all the hydraulic hoses and tubes.
8. Install the rear cover and belly pan.
9. Refill the hydraulic oil reservoir. Refer to Section 8.5, "Hydraulic Reservoir."
10. Connect the (-) negative battery cable.
11. Start engine and check for any hydraulic leaks.
12. Close and secure the engine cover.



6.6 HYDROSTATIC DRIVE PERFORMANCE CHECKS

These tests ensure that the Hydrostatic Drive System operates to the proper specifications. All tests should be done in a safe, open area. Apply the park brake and leave the shifter in neutral unless otherwise noted. The boom and attachment should rest on the ground unless the machine is being driven.

Color-coded plastic caps seal the adjustments on components in the hydraulic system. If a JLG Distributor makes an adjustment, the component should be sealed with a blue cap.

The following tools are needed for proper adjustments:

1. Tachometer
2. JLG pressure testing kit (P/N 77134197)
3. Mechanic's hand tools (Metric included)
4. Blue plastic caps: P/N 80934459 (small) and P/N 80934460 (large)

Testing and Adjustment Precautions

1. Read and understand the Operating & Safety Manual. Be sure you are familiar with the machine's response to controls.
2. Read and understand all material relating to area to be checked, adjusted or repaired.
3. This section of the manual covers hydraulic testing and adjustments. Read and understand material related to hydraulics before proceeding with service of any kind on the hydraulic system. When performing maintenance, be sure there is no residual or trapped hydraulic pressure.
4. If you are working with a helper, be sure he understands the procedure. Be certain each of you know what to expect from the other, and when to expect it.
5. Always wear safety glasses, hard hat and any other locally required safety related protective apparel when performing testing and adjusting procedures.
6. Thoroughly clean all areas before working on them. Slippery and contaminated surfaces can cause serious accident or mechanical failure if not removed.
7. Always secure machine components that could suddenly start in motion and cause injury or damage.
8. Remove the key from the ignition and place a sign in the cab informing all who come in contact with the machine.
9. Double check all bolt torques.
10. Check that all lubrication fluids are at the correct level.
11. Remove any restraints before restarting and operating the machine following repairs.
12. Clear all personnel from area adjacent to the machine when first operating after a repair or adjustment.
13. Clean machine and work area before returning to service.

6.6.1 Hydraulic Oil Reservoir

Make sure that the machine is level before retracting all cylinders. Proper level is to full mark +/- 1/4 inch in the sight gauge located on the outside of the reservoir. The reservoir capacity is 30 gallons. Refer to Section 2.4, "Fluid and Lubricant Capacities," for system capacities.

6.6.2 Hydraulic Filter Condition

Dirty suction filters can restrict oil flow to the charge pump. This can lower the control pressure which can affect the machine's ability to move, especially when ambient pressure is below 32° F (0° C).

To check the hydraulic filter condition, warm the hydraulic system oil to operating temperature (100° F - 38° C minimum). Check the filter restriction indicator on the return filter. The indicator should not show filter bypass with the engine running at full throttle and the park brake engaged. If the indicator shows bypass, replace the suction and return filters.

For proper maintenance schedule see Section 2.5, "Service and Maintenance Schedules."

6.6.3 Engine Speed

Low engine RPM can reduce control pressure. Control pressure determines machine speed. This condition can slow the machine at full RPM.

Check engine speed with an adequate tachometer. At low idle the engine speed should be 800 rpm. At high idle with no load, the engine speed should be 2400 rpm (534D-9), 2500 rpm (534D-10), 2200 rpm (544D). If either the low or high idle is not within specification, contact your JLG Service Distributor.



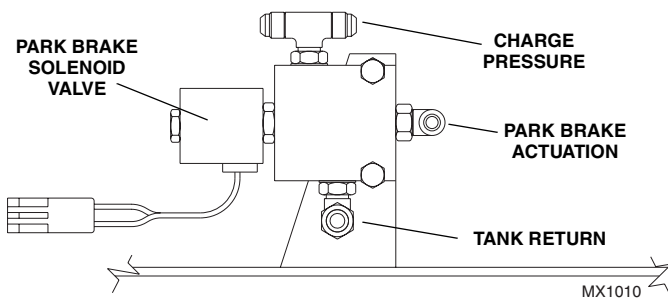
Hydrostatic Drive Pump

6.6.4 Park Brake

Park brake wear can cause park brake failure and reduce braking effectiveness on a slope.

With the park brake engaged, start the engine. Position the 2WD/4WD switch in the 2WD position. With the rear wheels aligned straight ahead, move the shift lever to the forward position and run the engine at high idle. If the brakes are working properly, the machine will not drive through the brakes.

High backpressure in the actuation line can affect the brake holding power. To determine whether the brake is at fault, remove the brake actuation line and plug. Check the park brake operation again. If the machine does not move, the brake is working properly.



Backpressure should be less than 20 psi (1,38 bar) with the oil at operating temperature. To check this pressure, tee a low pressure gauge (1,000 psi - 69 bar), hose and adapter in the brake actuation line. If it is higher, check for proper operation of the park brake solenoid valve. Disconnect the brake actuation line and tank return line at the valve and plug them. There should be no oil flowing from the open port on the back of the park brake solenoid valve. The brake actuation line should not be kinked. There should be no restriction back to the reservoir.

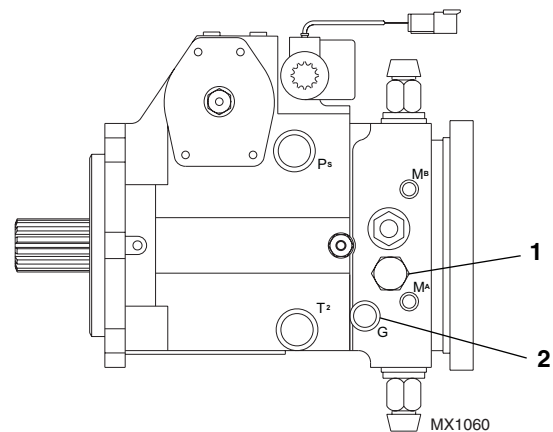
To check for friction disc wear, the axle must be disassembled and reassembled according to the Carraro Maintenance Manual. Detailed axle service instructions are provided in the CA357248 Carraro Axle Service Manual (JLG P/N 31200372).

6.6.5 Charge Pressure

To ensure proper park brake operation, charge pressure needs to be at the proper specification. Since temperature can affect results, make sure to test system with hydraulic oil at a minimum of 100°F (38° C). Control pressure is modified charge pressure. If charge pressure is low, control pressure may be low and machine speed reduced. Thus, drive performance is adversely affected by low charge pressure.

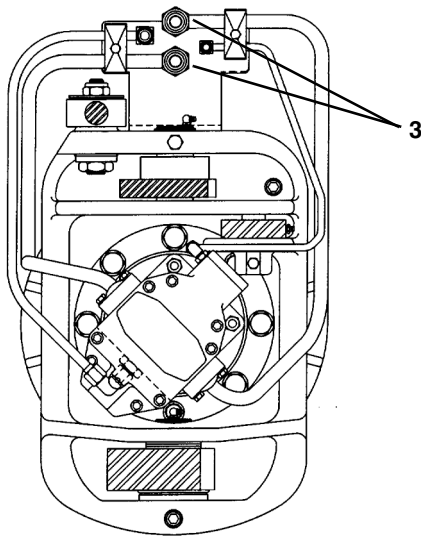
Install a low pressure gauge (1,000 PSI - 69 bar), hose and adapter on the charge pump test port. It is located near the front inside of the hydraulic reservoir. Make sure the gauge can be observed in the operators cab and apply the park brake. Start the engine and run at low idle. The gauge should read approximately 380 psi (26 bar). At high idle the gauge should read a maximum of 480 psi (33 bar) and never less than 380 psi (26 bar).

Note: Throughout the test operation, charge pressure should not drop below 380 psi (26 bar) and should move toward 480 psi (33 bar) as RPM rises, regardless of how many functions are being operated simultaneously.



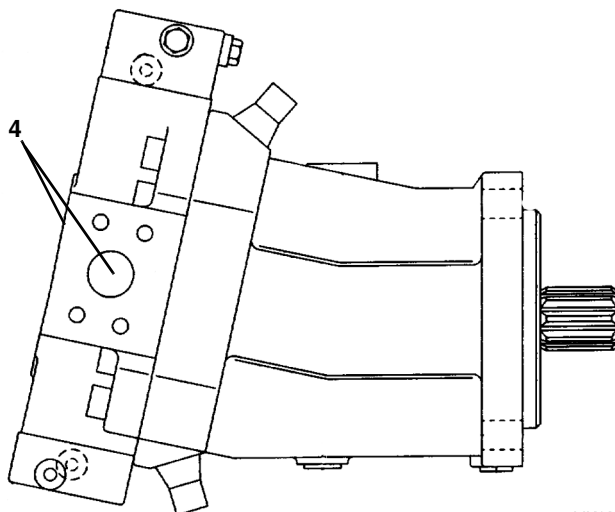
The charge pump relief (1) adjusts as necessary. To adjust the charge pump relief, loosen the locknut and turn the adjusting screw clockwise to increase pressure; turn counter clockwise to decrease pressure. Be sure to note the amount of relief turns in either direction. When finished, tighten the locknut and install a blue plastic cap.

To pinpoint the loss of charge pressure, start at the pump. Make sure the machine is in 4WD when testing rear motors. Remove the hose from the G port (charge pump outlet port) (2) on the pump, install a low pressure gauge (1,000 psi - 69 bar) on the fitting and plug the hose. Check the charge pressure again and observe the gauge. If the charge pressure comes back to specifications, the loss of pressure is in one of the auxiliary valves. These valves include the 2WD/4WD valve, traction lock valve, park brake solenoid valve and the joystick. Isolate each of these valves to check for loss of charge pressure.



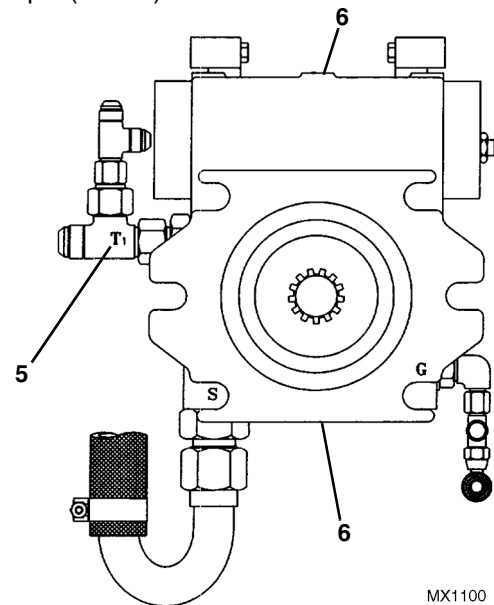
MX1080

Another test to determine the loss of charge pressure is to cap off lines to the drive motors (3). Reinstall hoses from previous test. Install low pressure gauge (1,000 psi - 69 bar) on the charge pressure test port. Check each motor separately. Start at the left rear motor. Remove the hoses to the motor at the tubes and plug with ORS #12 plugs. Cap the motor work ports also to prevent dirt from entering the motor with ORS #12 caps. Start the machine and observe the gauge for charge pressure. Engage drive forward and reverse against the park brake and observe the gauge for charge pressure simultaneously. Record the findings. If charge pressure recovers, the motor is defective. If the charge pressure does not recover, repeat test for the right rear motor.



MX1090

Isolate the front drive motor from the circuit if the rear motors are not defective. To isolate it will require two blocking plates. Install these plates between the front drive motor work ports and the drive hoses (4). Remove the flange halves and place the blocking plates on the ports and reinstall the hoses and the flanges. Again, start the machine and observe the pressure gauge for charge pressure. If the charge pressure recovers, the motor is defective. To confirm, check charge pressure with drive against the park brake. Charge pressure should remain at 380 psi (26 bar).



MX1100

The charge pump efficiency also needs to be checked if previous tests prove inconclusive. Check charge flow out of T1 port on the side of the pump (5). At 950 RPM, there should be 4 GPM of flow. At 2400 rpm, there should be 12 GPM of flow. Disconnect run tee and plug. Measure charge pump flow out of fitting against above specification. The flow readings are checked at 480 psi (33 bar). If the test is positive on flow, proceed to the next step.

To check internal leakage of the main pump, block off ports A and B (6) at the main pump. If the drive motors have already been isolated, continue testing. Install two high pressure (10,000 psi - 689 bar) gauges, hoses and adapters in drive pump ports Ma and Mb. Start machine and operate at low idle. If the pump is good, pressure at the Ma and Mb test ports should read 380 psi (26 bar). Adjust relief valve to see if pressure responds. Engage forward drive with park brake set, raise engine speed to high idle and record drive pressure and charge pressure. Repeat this procedure for reverse. Drive pressure should be 6300 psi (434 bar) in each direction. Charge pressure should remain at 380 psi (26 bar) and rise to approximately 480 psi (33 bar) near full throttle.



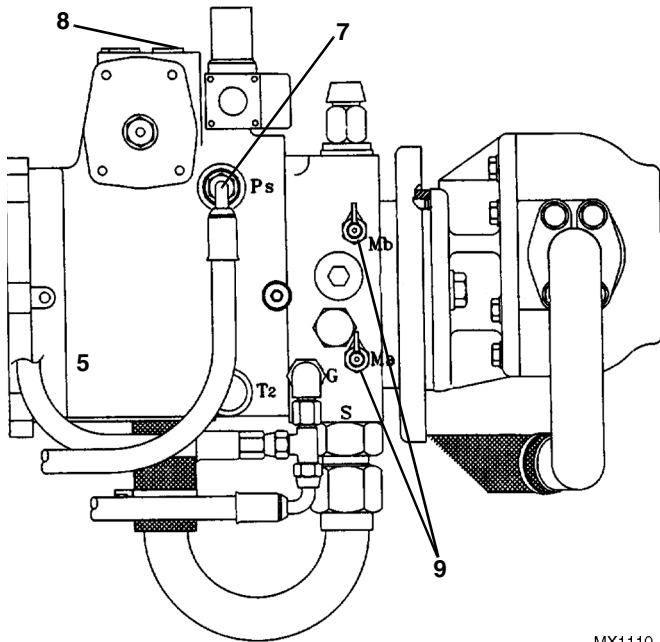
Hydrostatic Drive Pump

If charge pressure is not achieved, main pump is leaking internally.

Note: Do Not stall pump for more than 15 seconds each time.

6.6.6 Control Pressure

For the machine to move at proper engine speed, control pressure should match engine speed.



MX1110

Install a low pressure gauge (1,000 psi - 69 bar), hose and adapter on the drive pump control pressure Ps port (7). Remove the hose from the port and plug.

Note: Before starting, make sure the gauge can be observed in the operator's cab.

Apply park brake, start engine and run at high idle (2400 RPM). With the pump in neutral, the gauge should read 380 psi (26 bar). This reading may vary +/- 15 psi (1,0 bar).

Use a tachometer to monitor engine speed. Start the engine and run at 1100 RPM. While watching the pressure gauge, move the shift lever to the forward position. The gauge should read 100 psi (6,9 bar). Next repeat the test for reverse. If the machine does not start to move at 1100 RPM engine speed in both directions equally at 100 psi (6,9 bar) control pressure, the stroking piston needs centered mechanically.

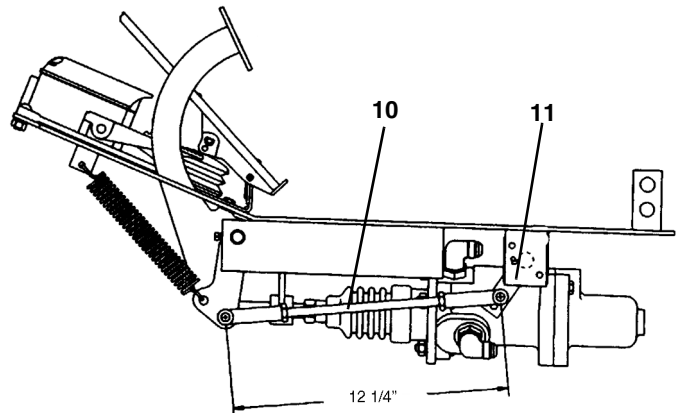
To check this adjustment, install a clean hose between control ports X1 and X2 (8). They are located on the top of the drive pump. Remove and plug control hoses from

the top of the drive pump ports X1 and X2. Install two high pressure (10,000 psi - 689 bar) gauges, hoses and adapters in the drive pump ports Ma and Mb on the side of the pump (9). Start the engine and operate at low idle. Observe the gauges. Pressure at the Ma port must be equal to the pressure at the Mb port. If the pressure is not equal, loosen the locknut on the stroking piston adjustment and turn the adjusting screw to equalize the pressures. Tighten the locknut to secure the adjustment. Repeat this procedure with low pressure (1,000 psi - 69 bar) gauges to fine tune.

If the inching valve and forward/reverse valve work correctly but adjustment does not produce the desired pressure change, replace the control pressure (DA) cartridge located on the left side of the drive pump.

6.6.7 Inching

Loss of control pressure can affect machine speed. Install a low pressure (1,000 psi - 69 bar) gauge, hose, #6 run tee and adapter between the hose and Ps port (7) on the side of the drive pump. Apply the park brake and run the engine at high idle. The gauge reading should be the same as in previous control pressure test. Depress the brake pedal. The control pressure should start to fall after one-half inch of pedal travel. This pressure should drop as the pedal travels farther and the service brakes apply. The controlled linkage (10) length should be 12 1/4" (311 mm) from the centerline of the yoke pins. The lever arm (11) position on the inching valve should set 1/8" (3,2 mm) off the pin as a starting point.



MX1120

Another check for inching adjustment is to install a high pressure gauge (10,000 psi - 689 bar), hose and adapter on the Ma port (9) on the side of the drive pump. With the park brake on, move the shift lever to the forward position. At high idle, depress the inching/brake pedal slowly. When the roller on the pedal touches the brake valve plunger, the gauge should read 2,300 psi (159 bar) +/- 100 psi (6,9 bar).

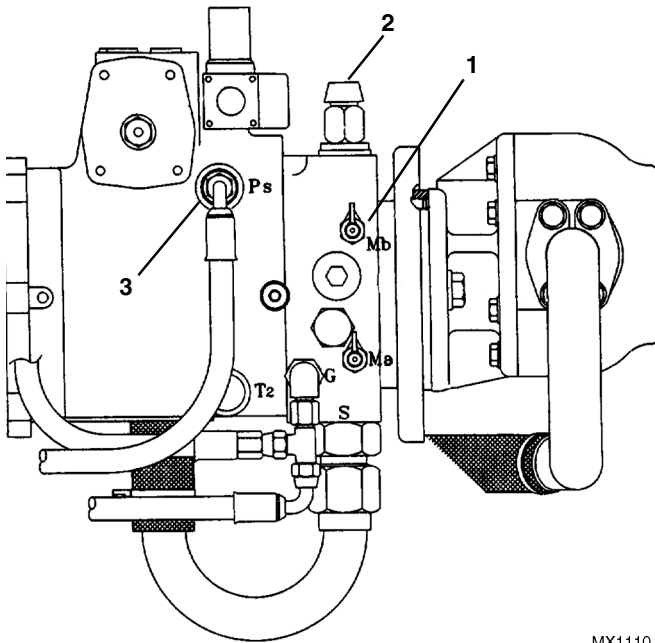


6.6.8 Front Motor Begin Point

The front motor begin point is when the motor begins to stroke toward minimum displacement.

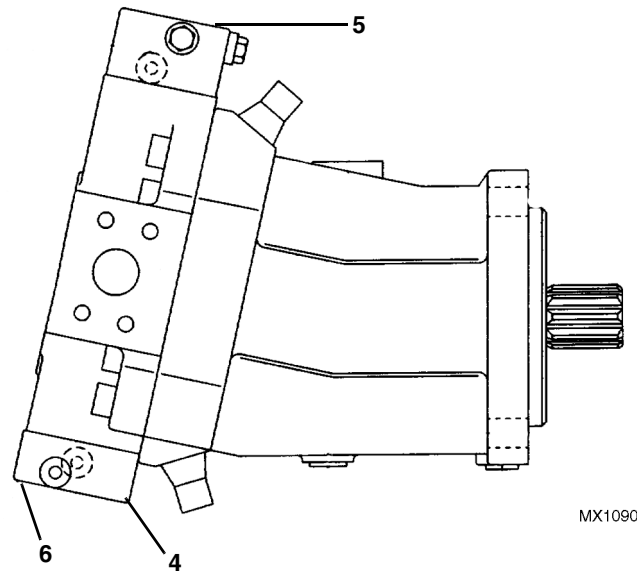
Without proper adjustment, machine speed on a flat, smooth surface will not meet specifications. The motor may not be shifting to a maximum speed position.

Install a digital or high pressure gauge (10,000 psi - 689 bar), hose and adapter on the Mb port (1) on the drive motor. Adjust the reverse high pressure relief valve (2) to 3,000 psi (207 bar) by loosening the locknut. Install an adapter, test port, #6 run tee and low pressure gauge (1,000 psi - 69 bar) into the Ps port (3) on the pump. (Ps port is the connection for the inching valve hose). Set the parking brake and choke the tires to prevent movement of the machine. The machine should be in 2WD.



MX1110

Shut off machine and remove the plugs from the G port (4) and M port (5) on the front drive motor. Install test ports in place of each plug. Attach a digital or high pressure gauge (10,000 psi - 689 bar) to each test port.



MX1090

Note: During the next two steps, to prevent excessive heat in the hydraulic oil and possible damage to hydraulic components, do not operate for more than 30 seconds at a time.

Start the engine and raise the rpm until the gauge on the Ps port is reading 240 psi (16,5 bar). Maintain this rpm and pressure throughout the test. With the pressure on the Ps port at 240 psi (16,5 bar), the pressure at G port should read 3,300 psi (227,5 bar). Adjust the "begin" point screw (6) on the drive motor so that the gauge on the M port reads approximately 1,650 psi (114 bar).

Note: Begin point screw adjustment is very sensitive.

Note: The pressure at the M port will not be steady. This is the pressure that shifts the motor to maintain minimum displacement.

Under normal operating conditions, the 3,000 psi (307 bar) at the G port required to shift the motor will not be constant. When this pressure is reached, the motor shifts. Since the pressure supplied is constant, the motor will not stay in a partially shifted position. Reset the reverse high pressure relief valve to 6000 psi (414 bar). Use procedure in Section 6.6.9, "Drive Pump Pressure," to adjust this relief.

Note: Wrench size required: 4 mm allen and 10 mm box.

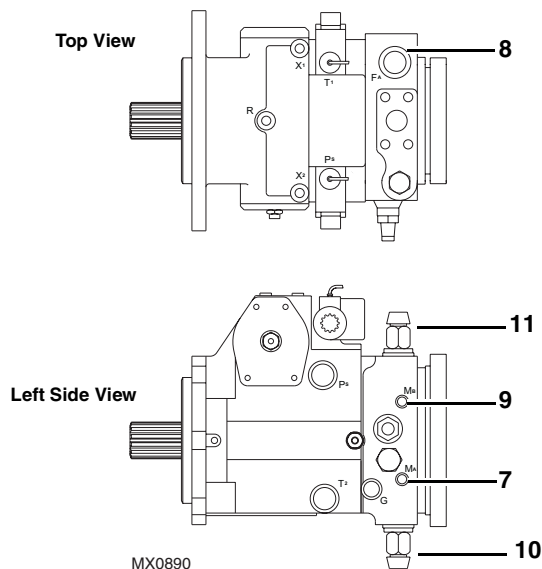


Hydrostatic Drive Pump

6.6.9 Drive Pump Pressure

Drive pump pressure determines the drive power of the machine. Low drive pressure will result in less power.

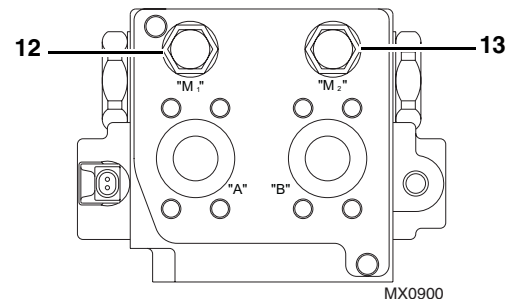
Install a digital or high pressure gauge (10,000 psi - 689 bar), hose and adapter on the MA port (7). Apply the park brake and put the 2WD/4WD switch in the 2WD position. Move the shift lever to the forward position and run the engine at full throttle. The gauge reading should be 6,300 psi (434 bar). Adjust the POR relief valve (8) located on top of the pump as necessary. To adjust this relief valve, loosen the lock-nut and turn the adjusting screw clockwise to increase pressure and counterclockwise to decrease pressure. Move the gauge to the MB port (9) of the drive pump to repeat the procedure with the shift lever in the reverse position.



There are also high pressure/anti-cavitation relief valves on the drive pump. These could influence drive system pressure with a low setting or missing o-ring. On machines with 6,300 psi (434 bar) drive pressure, adjust these valves to 6,800 psi (469 bar) drive pressure. Normally, these high pressure relief valves do not require checking. However, if there is a drive power problem and adjustment of the POR relief valve on the main pump does not change the pressure, these valves may have to be adjusted. Install a digital or high pressure gauge (10,000 psi - 689 bar), hose and adapter on the MA port on the pump. To check these high pressure relief valves, raise the setting on the POR valve on the drive pump. Loosen the lock-nut on the POR valve and turn the adjusting screw clockwise one turn to increase pressure. With the gauge on the MA port, set the park brake, move the shift lever to the forward position and run the engine at full throttle. Adjust the forward high pressure relief (10)

to 6,800 psi (469 bar). Move the gauge to the MB port of the drive pump to repeat the procedure with the shift lever in the reverse position. Adjust the reverse high pressure relief (11) to 6,800 psi (469 bar). Leave the gauge and adapter in the MB port. Reset the POR valve back to the original setting. With the park brake on, put the shifter in reverse and run the engine at full throttle. The pressure should be 6,300 psi (434 bar). Adjust the POR valve as required.

The traction lock valve also has two high-pressure/anti-cavitation relief valves. Normally, these require no adjustment. However, they can adversely affect drive system pressure if, say, they are set to low, or an o-ring is missing. To check these valves, raise the POR valve setting above 6,800 psi (469 bar). Set the forward high pressure relief valve (12) on the pump to 6,800 psi (469 bar). Then lower the forward high pressure relief valve on the traction lock valve under 6,800 psi (469 bar). Turn the valve in 1/8 turn and secure the lock-nut. Repeat the procedure for reverse (13). Then reset the POR valve to 6,300 psi (434 bar).



6.6.10 Machine Operation

Complete the following checks to ensure that the traction lock valve, 2WD/4WD solenoid valve and the begin point on the front drive motor are operating correctly.

With the machine at operating temperature, drive the machine in a flat, smooth open area. Set the machine for 4WD operation. Depress the traction lock switch. Drive the machine at full speed. Release the traction lock switch; the machine should pick up speed. Shift the machine to 2WD and repeat this test. The machine should speed again. If maximum speeds are in question, check machine speed. Run the machine in 2WD and 4WD in forward and reverse at maximum RPM for one minute. In 2WD, the machine will travel 100 feet (30,5 m) in 3.6 - 4.0 seconds. In 4WD, the machine will travel 100 feet (30,5 m) in 10.6 - 11.6 seconds. The machine must be traveling at full speed at the start of the measured distance.



Section 7 Engine

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Engine

7.1 INTRODUCTION: JOHN DEERE 4045TF275 & 4045HF275

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.

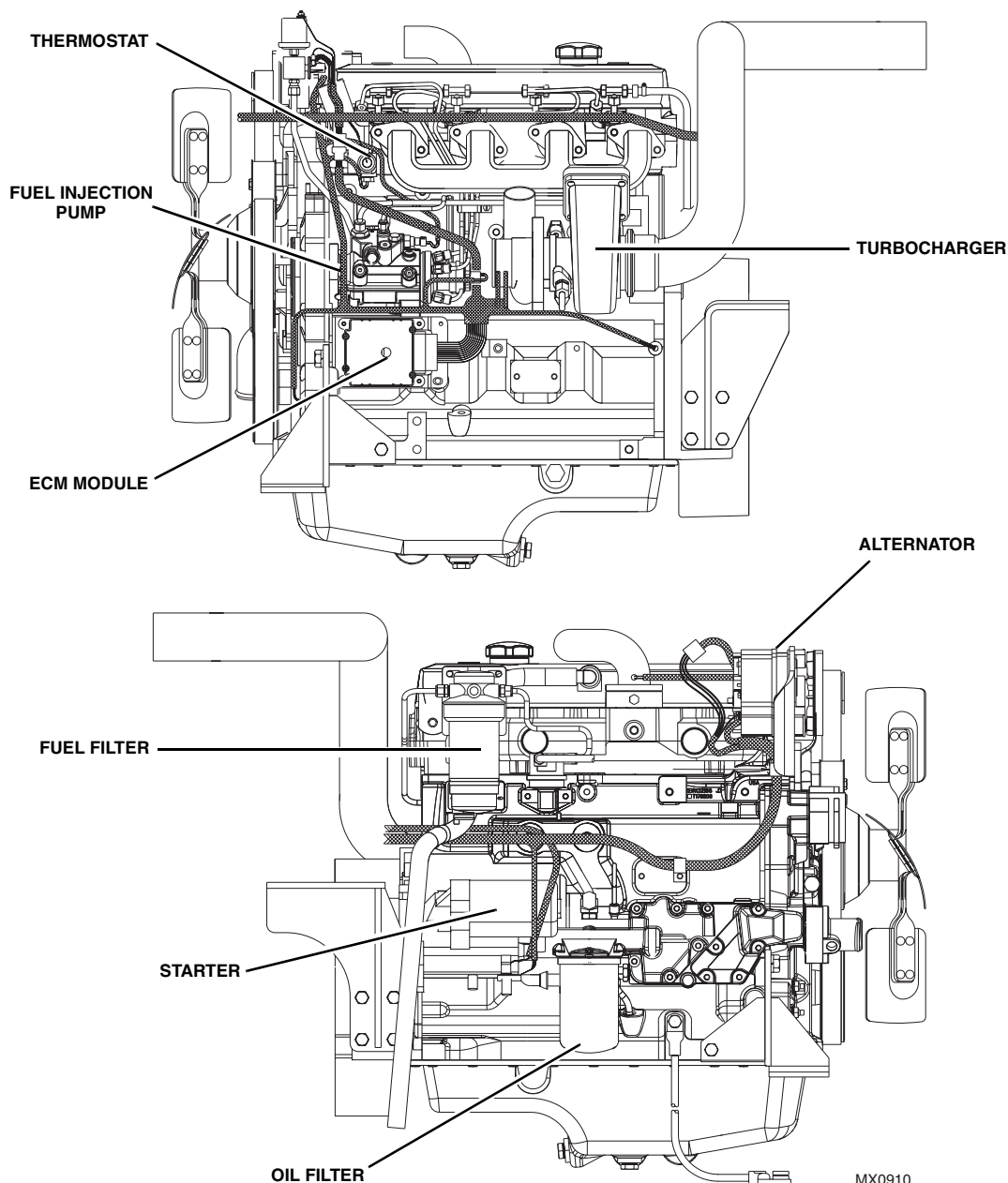
NOTICE

*These instructions cover only the routine maintenance, removal, installation and troubleshooting of the engine. Refer to the local John Deere Engine Distributor and the applicable John Deere 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 John Deere serial number is stamped on a plate which is secured to the engine block, near the fuel injector pump. Information contained in the serial number is required in correspondence with the engine manufacturer.

7.3 SPECIFICATIONS AND MAINTENANCE INFORMATION

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

Note: Detailed John Deere engine service instructions (covering disassembly, inspection, internal repair, assembly, adjustment and troubleshooting information) are provided in the appropriate John Deere engine service manual.



7.4 INTRODUCTION: CUMMINS QSB4.5

7.4.1 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.

NOTICE

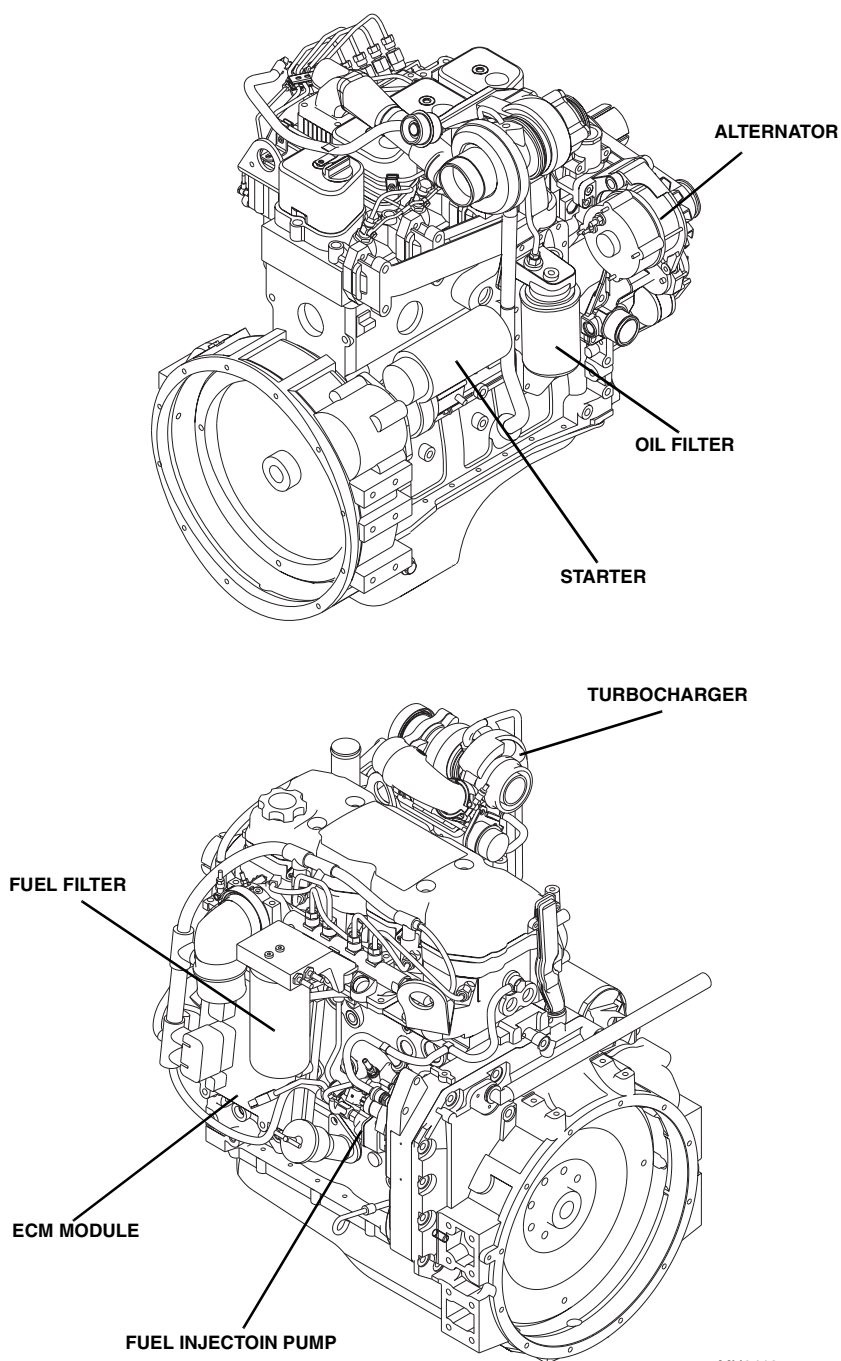
These instructions cover only the routine maintenance, removal, installation and troubleshooting of the engine. Refer to the local Cummins Engine Distributor and the applicable Cummins Engine Service Manual for assistance with comprehensive engine diagnosis, repair and component replacement. A gradual running-in (break-in) of a new engine is not necessary. Full load can be applied to a new engine as soon as the engine is put into service and the coolant temperature is at least 60° C (140° F). 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.



Engine

7.4.2 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.





7.5 ENGINE SERIAL NUMBER

The Cummins QSB4.5 serial number is stamped on a plate which is typically located on the engine rocker cover, but may be located on the side of the gear housing. Information contained in the serial number is required in correspondence with the engine manufacturer.

7.6 SPECIFICATIONS AND MAINTENANCE INFORMATION

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

Note: Detailed Cummins engine service instructions (covering disassembly, inspection, internal repair, assembly, adjustment and troubleshooting information) are provided in the appropriate Cummins engine service manual.

7.7 COOLING SYSTEM

7.7.1 Radiator Pressure Cap

For a 210° F (99° C) system, use a 13 psi (90 kPa) radiator cap. An incorrect or malfunctioning cap can result in the loss of coolant and a hot-running engine.

7.7.2 Thermostat Replacement

John Deere Engine

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.

Cummins Engine

The Cummins engine thermostat is not a serviceable item. For more information, contact your local authorized service distributor.

a. Thermostat Removal (John Deere)

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Remove the battery negative (-) cable from the battery negative (-) terminal.
5. Slowly turn the radiator cap to the first stop and allow any pressure to escape. Remove the radiator cap.
6. Place a funnel at the base of the radiator to channel the drained coolant into the container. Loosen the drain plug 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 plug.
7. Disconnect the Engine Water Temperature Sender.
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.

NOTICE

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. Connect the battery negative (-) cable to the battery negative (-) terminal.
4. Open the radiator cap, and fill the radiator completely with a 50/50 mixture of ethylene glycol and water. Replace and tighten the radiator cap. Add coolant to the overflow bottle until the bottle is 1/4 to 1/2 full. This overfilling will compensate for any air trapped in the cooling system.



Engine

5. Run the engine to operating temperature. Visually check for leaks with the engine running. Check the coolant level in the overflow bottle and fill, or drain, as necessary.

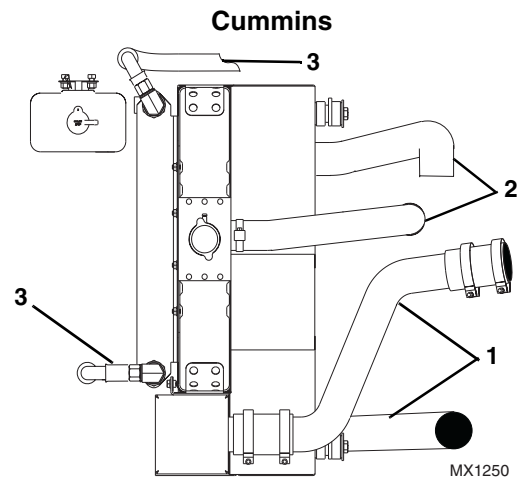
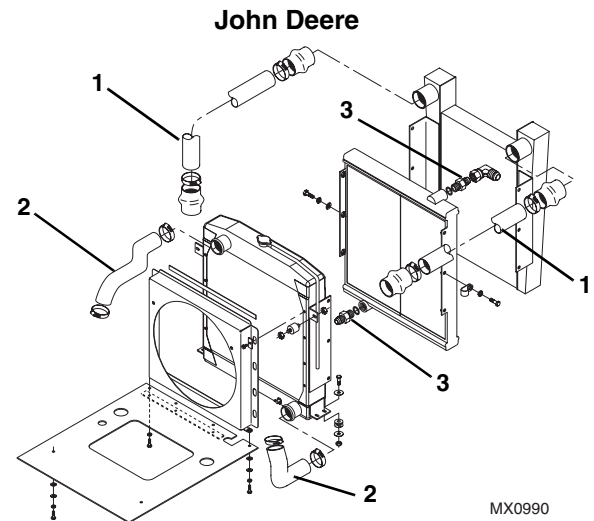
7.7.3 Radiator/Oil Cooler and Replacement

Before considering radiator or oil cooler replacement for other than obvious damage, conduct a cooling system pressure test check 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/Oil Cooler Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Remove the battery negative (-) cable from the battery negative (-) terminal.
5. Slowly turn the radiator cap to the first stop and allow any pressure to escape. Remove the radiator cap.
6. Remove the dust shield under the engine.
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 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. Tighten the radiator drain cock.
9. Loosen and remove the coolant overflow tank (Cummins Only).



10. Loosen and remove both charge air tubes (1) from the charge air cooler.
11. Loosen the radiator clamp on the top and bottom radiator hoses (2). Work the hose off the radiator. Position the hose out of the way to allow radiator removal, or remove the hose from the engine. Inspect the hose, and replace if necessary.
12. Label, disconnect and cap all hydraulic hoses (3) attached to the oil cooler. Cap all fittings and openings to prevent dirt and debris from entering the hydraulic system.
13. Loosen the radiator fan shroud if necessary.
14. Remove the nuts and washers from the four radiator mounts.
15. Carefully lift the radiator/oil cooler 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/Oil Cooler Installation

1. Install the isolator mounts to the bottom of the radiator. Place the radiator/oil cooler in the engine compartment at its original orientation. Secure the radiator with the previously used hardware.

Note: Be sure there is adequate clearance between the radiator and the engine fan.

2. Install the radiator fan shroud.
3. Uncap and reconnect the previously labeled hydraulic hoses to the appropriate locations.
4. Install both radiator hoses, and with the clamp installed over the hose, work the hose onto the radiator, and tighten the clamp.
5. Install both charge air tubes to the charge air cooler.
6. Install the coolant overflow tank (Cummins Only).
7. Open the radiator cap and fill the radiator completely with a 50/50 mixture of ethylene glycol and water. Replace and tighten the radiator cap. Refer to Section 2.4, "Fluid and Lubricant Capacities," for proper capacities.
8. Connect the battery negative (-) cable to the battery negative (-) terminal.
9. Run the engine to operating temperature. Visually check for leaks with the engine running. Check the coolant level in the overflow bottle and fill, or drain, as necessary.
10. Install the engine dust shield.

7.8 ELECTRICAL SYSTEM

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

7.9 FUEL SYSTEM

7.9.1 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: Use only diesel fuel designed for diesel engines. Some heating fuels contain harmful chemicals that can seriously affect engine efficiency and performance.

NOTICE

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 0° C (32° F). When temperatures are below 0° C (32° F), 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.

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 centistrokes to provide adequate fuel system lubrication.

Note: When using diesel fuel with a sulfur content below 1.3 percent, the filter change interval may be increased by 75 hours. Do not use fuel with a sulfur content above 1.3 percent is not recommended.

7.9.2 Fuel Tank

John Deere

Note: The fuel tank is a one piece unit. It is located on the right side of the machine directly behind the hydraulic oil reservoir. 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 travel select lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.



Engine

3. Open the engine cover. Allow the system fluids to cool.
4. Remove the battery negative (-) cable from the battery negative (-) terminal.
5. Remove the fuel tank/hydraulic oil reservoir cover.

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.

6. Remove fuel tank drain plug, and drain fuel into an approved and suitable container. Dispose of fuel properly.
7. Label, disconnect and cap the fuel lines from the bottom of the fuel tank.
8. Disconnect the fuel gauge harness.
9. Remove screws securing fuel sender to the tank. Remove fuel sender from tank.
10. Remove the four mounting bolts under the fuel tank.
11. Lift the empty fuel tank from the side of the machine.

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 **JLG Service Department**.

To clean the fuel tank:

1. Have a dry chemical (Class B) fire extinguisher near the work area.
2. Remove the fuel 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 a **JLG Service Department**.

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 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 side of the machine.
2. Install the four fuel tank mounting bolts.
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, "Fluid and Lubricant Capacities."
7. Check fuel tank for leaks.
8. Connect the battery negative (-) cable to the battery negative (-) terminal.
9. Install the fuel tank/hydraulic oil reservoir cover.
10. Close and secure the engine cover.

7.9.3 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 Operator & Safety Manual.

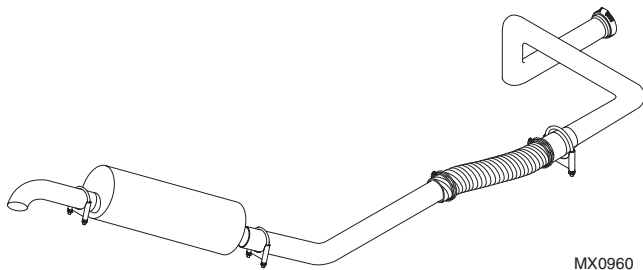


3. Fill the fuel tank with fresh, clean diesel fuel as required.

Cummins

Refer to Section 8.5.1, "Hydraulic Oil Reservoir Draining," for fuel tank information.

7.10 EXHAUST SYSTEM



7.10.1 Exhaust System Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Remove the battery negative (-) cable from the battery negative (-) terminal.
5. Loosen and remove the nuts from the exhaust pipe at the exhaust manifold.
6. Disconnect and remove the clamps attaching the flex pipe to the exhaust pipe.
7. Disconnect and remove the clamp connecting the muffler and the exhaust pipe.
8. Disconnect and remove the clamp connecting the tail pipe to the muffler and remove the tail pipe.
9. Remove the exhaust system from the machine.

7.10.2 Exhaust System Installation

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

1. Install the exhaust pipe with a new seal to the exhaust manifold.

Note: Replace the nuts and the exhaust manifold studs if damaged.

2. Install the exhaust pipe clamp.

3. Install the muffler to the exhaust pipe and bolt the muffler to the frame.
4. Install the flex pipe and clamps between the exhaust pipes.
5. Adjust the muffler, exhaust and tail pipes for proper clearance then tighten all clamps.
6. Connect the battery negative (-) cable to the battery negative (-) terminal.
7. Start engine and check for exhaust leaks at all exhaust connections. Adjust or repair as needed.
8. Close and secure the engine cover.

7.11 AIR CLEANER ASSEMBLY

NOTICE

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

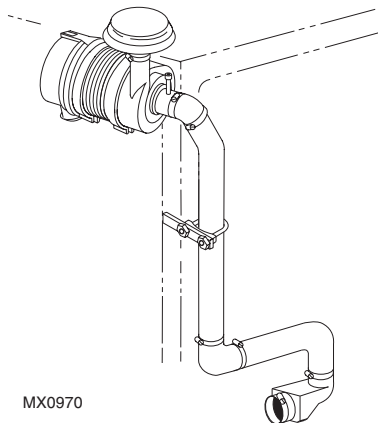
Note: Refer to the appropriate Operation & Safety Manual for your machine for the correct element change procedure.

7.11.1 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 travel select lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Remove the battery negative (-) cable from the battery negative (-) terminal.
5. Remove the clamp securing the air intake elbow to the air cleaner assembly. Lift the air intake elbow off the air cleaner.
6. Remove the capscrews and nuts securing the air cleaner mounting bracket to the air cleaner mounting plate. Remove the air cleaner assembly.



Engine



7.11.2 Air Cleaner Assembly Installation

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

1. With the air cleaner assembly attached, install the air cleaner mounting bracket using capscrews and nuts.
2. Place the loosened clamps over the air outlet elbow and install elbow on the air cleaner assembly.
3. Adjust and tighten both clamps before starting the machine.
4. Connect the battery negative (-) cable to the battery negative (-) terminal.
5. Close and secure the engine cover.

7.12 ENGINE REPLACEMENT

7.12.1 Engine Removal

Note: The radiator and oil cooler must be removed from the machine before engine removal. Refer to Section 7.7, "Cooling System." Several additional components must be removed before engine removal. They will be addressed in the following procedures.

Note: The hydrostatic drive pump can be left in place with the engine or separated from the engine before engine removal. See Section 6.5.1, "Drive Pump Removal."

1. Level the machine, ground the attachment, place the travel select lever in NEUTRAL (N), engage the parking brake and shut off the engine.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.

4. Remove the battery negative (-) cable from the battery negative (-) terminal.
5. Remove the engine cover, rear cover and the engine dust shield.
6. Place a funnel at the base of the radiator to channel the drained coolant into the container. Loosen the drain plug 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 plug.
7. Loosen and remove both charge air tubes from the charge air cooler (544D w/ John Deere engine and all Cummins engines).
8. Loosen the radiator hose clamps at the engine. Work the hose off the engine. Position the hose out of the way to allow radiator removal. Inspect the hose, and replace if necessary.

Note: Disregard the following directions in step 10 and 11 if pump is being left on machine and continue to step 12.

9. Drain the hydraulic oil reservoir or install a vacuum at the hydraulic oil reservoir filler neck.
 10. Disconnect and plug the hydraulic oil cooler hoses and cap the fittings on the oil cooler.
 11. Unplug the wire harness at the hydrostatic drive pump. Disconnect, label and plug the hoses on the hydrostatic drive pump if pump is being removed with the engine.
 12. Loosen and remove the twelve bolts holding the pump mounting plate to the engine bellhousing.
 13. Loosen and remove the mounting bolts and nuts holding the radiator/cooler to the frame.
 14. Attach a suitable strap to the radiator/cooler assembly and carefully remove.
 15. Loosen the clamps on each heater hose on the engine. Plug the heater hoses if necessary.
- Note:** The engine harness is routed and attached to the engine using hold-down clamps and plastic wire ties at various places on the engine. Before removing engine, ensure that the harness has been completely separated (disconnected) from the engine. Move the harness clear of the engine, and with the help of an observer, ensure that engine clears the harness during removal.
16. Label and disconnect all wire harness connections on the engine.
 17. Disconnect the fuel lines at the engine. Install a plug in the end of fuel inlet and return line.



18. Remove the exhaust flex pipe from the exhaust pipe. Remove the exhaust pipe from the exhaust manifold.
19. Loosen the clamps on the air intake at the engine and on the 90° elbow.
20. Remove the air intake elbow, tube and 90° elbow. Cover the end of the air intake tube still attached to the side of the cab.

Note: Disregard the following directions in step 23, 24 and 25 if pump is being left on machine and continue to step 26.

21. Label, disconnect and cap all hydraulic hoses and tubes attached to the traction lock valve. Cap all fittings and openings to prevent dirt and debris from entering the hydraulic system.
22. Remove tubes and traction lock valve.
23. Loosen and remove both hydrostatic drive pump mounting bolts. Pull pump back until clear of engine.
24. Loosen and remove the three engine mount bolts and washers.
25. Secure the engine with a lifting strap or chain from the appropriate lifting points. Use a suitable hoist or overhead crane. Have an assistant ensure that the engine clears all frame components during removal.
26. Place engine on a flat, level surface.

7.12.2 Engine Disassembly, Inspection and Service

Engine disassembly, internal inspection, service, repair and assembly procedures are covered in the appropriate service manual. Contact the local power unit parts distributor for further information.

Note: If the engine is being replaced, there may be external components that will be required to be transferred from the original engine to the replacement engine depending upon who you purchase the new engine from and the configuration of your replacement engine. Refer to the appropriate user manual for detailed procedures that cover the transfer of original engine components to the replacement engine.

7.12.3 Engine Installation

1. Secure the engine with a lifting strap or chain from the appropriate lifting points. Use a suitable hoist or overhead crane.
2. Inspect the engine mounting bracket isolators. Replace isolator if cracked or worn.
3. Lift the engine and slowly push and lower into the engine bay. Have an assistant ensure that the

engine clears all frame, hose and harness components during engine installation.

4. Align the motor mount holes and install the bolts. Tighten the motor mount bolts.
5. Push the hydrostatic drive pump splined shaft into the coupler. Install and tighten both bolts.
6. Torque the hydrostatic pump bolts to 240 lb-ft (325 Nm), +25/-0 lb-ft (+34/-0 Nm).
7. Connect the fuel inlet and return lines to the engine.

Note: The engine harness is routed and attached at various places on the engine using hold-down clamps and plastic wire ties. Before installing engine and with the help of an observer, ensure that engine clears the harness during installation.

8. Connect all the labeled wire harness connections on the engine and hydrostatic drive pump.
9. Install brackets and the traction lock valve.
10. Uncap and reconnect the previously labeled tubes and hoses to the appropriate locations on the drive pump and traction lock valve.
11. Install both heater hoses to the engine and tighten clamps.
12. Install the complete radiator/cooler assembly and tighten the mounting bolts
13. Install the hose clamps on the radiator hoses and work onto the engine. Tighten the clamps.
14. Connect the drive pump inlet and outlet hoses on the oil cooler.
15. Install the charge air tubes to the charge air cooler (544D w/ John Deere engine and all Cummins engines).
16. Install the exhaust pipe to the exhaust manifold. Install the v-band clamp holding the exhaust pipe to the exhaust manifold.
17. Install the flex pipe and tighten the clamps on the exhaust pipe.
18. Install the engine cover, rear cover and dust shield.
19. Connect the battery negative (-) cable to the battery negative (-) terminal.
20. Open the radiator cap and fill the radiator completely with a 50/50 mixture of ethylene glycol and water. Replace and tighten the radiator cap. Add coolant to the overflow bottle until the bottle is 1/4 to 1/2 full. This overfilling will compensate for any air trapped in the cooling system.
21. Open the hydraulic oil reservoir and fill with Mobilfluid 424® Tractor Hydraulic Fluid (ISO 46).



Engine

22. If installing new hydraulic oil filters, fill with Mobilfluid 424® Tractor Hydraulic Fluid (ISO 46) before installing on the filter head.

23. 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. Start and idle the engine.

24. Run engine to normal operating temperature then shut off the engine. While the engine is cooling, check for leaks.

25. Allow the engine to cool. Check the radiator coolant level, and top off with a 50/50 mixture of ethylene glycol and water. Replace the radiator cap.

26. Check for leaks from the engine, main hydraulic pump and lines, drive pump, 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 NEUTRAL (N).

27. Purge the hydraulic system of air by operating all boom functions through their entire range of motion several times. Check the hydraulic oil level.

28. Check for proper operation of all components.

29. Turn the engine OFF.

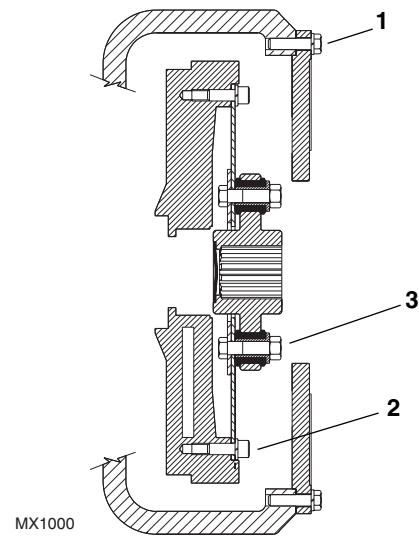
7.13 ENGINE DRIVE PLATE/COUPLING

7.13.1 Drive Plate/Coupling Removal

1. Level the machine, ground the attachment, place the travel select lever in NEUTRAL (N), engage the parking brake and shut off the engine.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.

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

3. Refer to Section 6.5.1, "Drive Pump Removal," or Section 7.12.1, "Engine Removal."



4. Loosen and remove the bolts (1) holding the pump mounting plate to the engine bell housing. Remove the mounting plate.
5. Remove the bolts (2) holding the drive plate to the flywheel.
6. With the drive plates removed, loosen and remove the bolts (3) holding the coupling to the drive plate.
7. Replace the drive plate and/or the coupler if damaged.

7.13.2 Drive Plate/Coupling Installation

1. Install the new coupler (3) on the drive plate and torque the bolts with lock washers to 40-45 lb-ft (54-61 Nm).
2. Mount the drive plate/coupler assembly (2) to the flywheel, install the bolts and torque to 40-45 lb-ft (54-61 Nm).
3. Install the pump mounting plate (1) to the engine bell housing and torque the bolts to 40-45 lb-ft (54-61 Nm).
4. Refer to Section 6.5.3, "Drive Pump Installation," or Section 7.12.3, "Engine Installation," for the remainder of the installation.



7.14 ENGINE TROUBLESHOOTING

Trouble	Possible Causes (see key, below)
Low Cranking Power	1, 2, 3, 4
Will Not Start	5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 31, 32, 33
Difficult Starting	5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 24, 29, 31, 32, 33, 61, 63
Lack of Power	8, 9, 10, 11, 12, 13, 14, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 31, 32, 33, 61, 63
Misfiring	8, 9, 10, 12, 13, 14, 16, 18, 19, 20, 25, 26, 28, 29, 30, 32
Excessive Fuel Consumption	11, 13, 14, 16, 18, 19, 20, 22, 23, 24, 25, 27, 28, 29, 31, 32, 33, 63
Black Exhaust	11, 13, 14, 16, 18, 19, 20, 22, 24, 25, 27, 28, 29, 31, 32, 33, 61, 63
Blue/White Exhaust	4, 16, 18, 19, 20, 25, 27, 31, 33, 34, 35, 45, 56, 62
Low Oil Pressure	4, 36, 37, 38, 39, 40, 42, 43, 44, 58
Knocking	9, 14, 16, 18, 19, 22, 26, 28, 29, 31, 33, 35, 36, 45, 46, 59
Erratic Running	7, 8, 9, 10, 11, 12, 13, 14, 16, 20, 21, 23, 26, 28, 29, 30, 33, 35, 45, 59
Vibration	13, 14, 20, 23, 25, 26, 29, 30, 33, 45, 47, 48, 49
High Oil Pressure	4, 38, 41
Overheating	11, 13, 14, 16, 18, 19, 24, 25, 45, 50, 51, 52, 53, 54, 57
Excessive Crankcase Pressure	25, 31, 33, 34, 45, 55, 60
Poor Compression	11, 19, 25, 28, 29, 31, 32, 33, 34, 46, 59
Starts and Stops	10, 11, 12

Key to Possible Causes

- | | | |
|---|--|--|
| 1. Battery charge low | 21. Blocked fuel tank vent | 43. Faulty suction pipe |
| 2. Bad electrical connection | 22. Incorrect grade of fuel | 44. Restricted oil filter |
| 3. Faulty starter motor | 23. Sticking throttle or restricted movement | 45. Piston seizure/pick up |
| 4. Incorrect grade of lubricating oil | 24. Exhaust pipe restriction | 46. Incorrect piston height |
| 5. Low cranking speed | 25. Leaking cylinder head gasket | 47. Damaged fan |
| 6. Fuel tank empty | 26. Overheating | 48. Faulty engine mounting |
| 7. Faulty stop control operation | 27. Cold running | 49. Incorrectly aligned flywheel housing or incorrectly aligned flywheel |
| 8. Fuel inlet restricted | 28. Incorrect tappet adjustment | 50. Faulty thermostat |
| 9. Faulty fuel lift pump | 29. Sticking valves | 51. Restriction in water jacket |
| 10. Clogged fuel filter | 30. Incorrect high pressure pipes | 52. Loose fan belt |
| 11. Restricted air cleaner | 31. Worn cylinder bores | 53. Restricted radiator |
| 12. Air in fuel system | 32. Pitted valves and seats | 54. Faulty water pump |
| 13. Faulty fuel injection pump | 33. Broken, worn or sticking piston ring(s) | 55. Restricted breather pipe |
| 14. Faulty fuel injectors or incorrect type | 34. Worn valve stems and guides | 56. Damaged valve stem oil deflectors (if fitted) |
| 15. Incorrect use of cold start equipment | 35. Restricted air cleaner | 57. Coolant level too low |
| 16. Faulty cold start equipment | 36. Worn or damaged bearings | 58. Blocked sump strainer |
| 17. Broken fuel injection pump drive | 37. Insufficient oil in sump | 59. Broken valve spring |
| 18. Incorrect fuel pump timing | 38. Inaccurate gauge | 60. Exhauster or vacuum pipe leak |
| 19. Incorrect valve timing | 39. Oil pump worn | 61. Turbo impeller damaged or dirty |
| 20. Poor compression | 40. Pressure relief valve sticking open | 62. Turbo lubricating oil seal leak |
| | 41. Pressure relief valve sticking closed | 63. Induction system leaks |
| | 42. Broken relief valve spring | |



Engine

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Section 8

Hydraulic System

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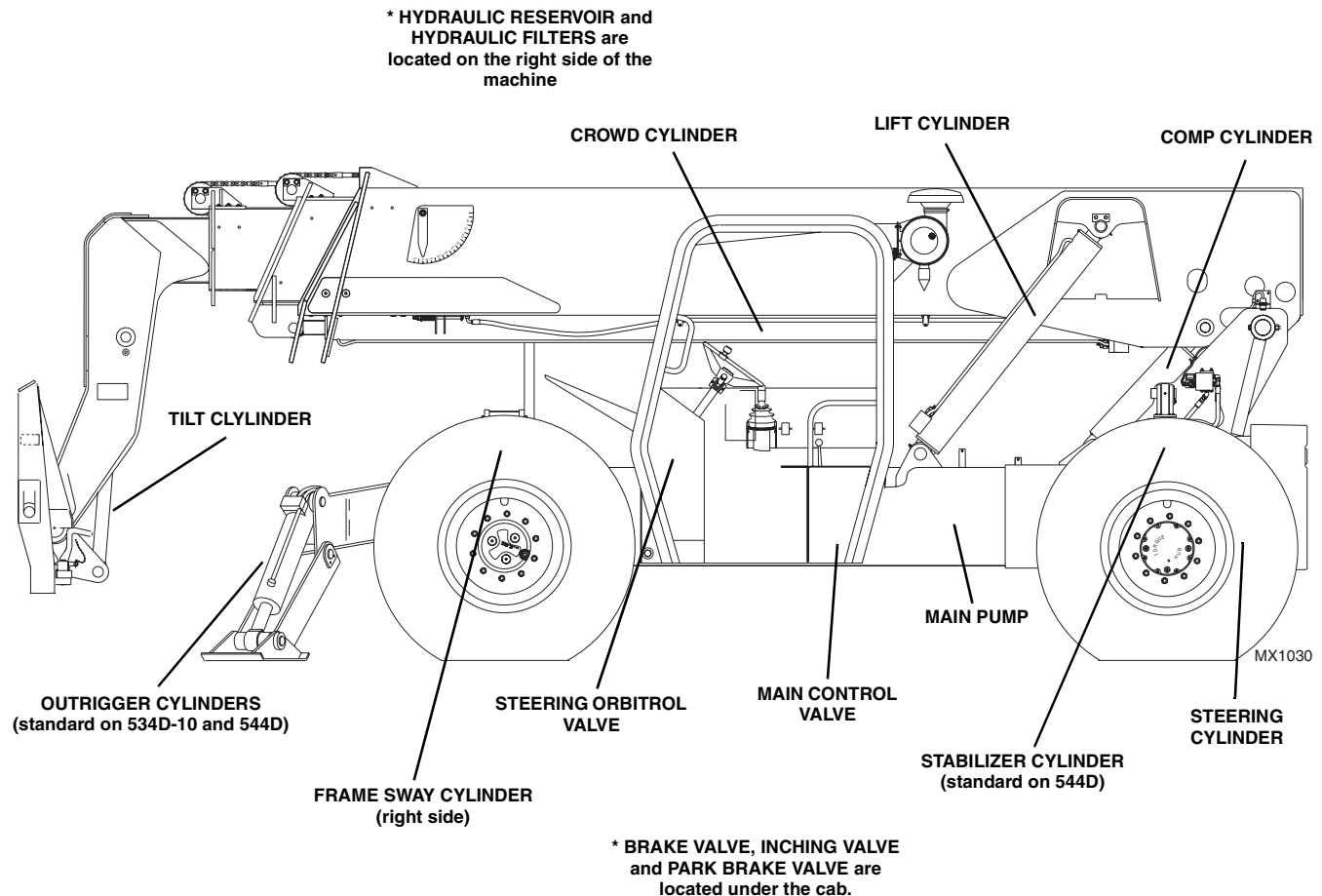
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Hydraulic System

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.



Hydraulic System

8.3 HYDRAULIC PRESSURE DIAGNOSIS

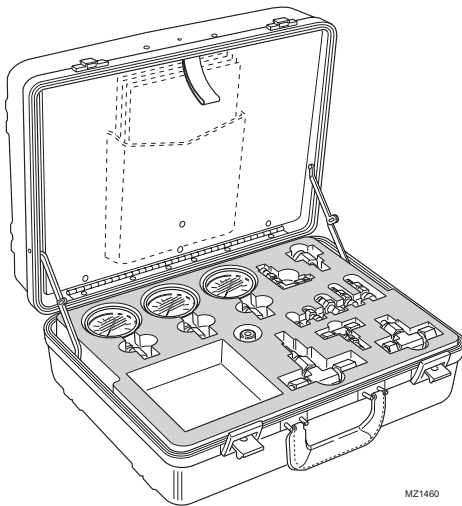
JLG Parts Department has a kit available to use for hydraulic system maintenance and troubleshooting: the JLG Pressure Test Kit. The kit is contained in a durable polyethylene carrying case for demanding field service conditions.

Pressure Test Kit

The hydraulic pressure test kit is used to pressure test the various hydraulic components in the hydraulic system.

The kit includes:

- Gauges for testing high and low pressure circuits
- Fittings, couplers and hoses



Contact JLG Parts Department at 717-485-6472 for ordering information.

Part Number	Description	Approximate Weight	Price and Availability
70000652	Hydraulic Pressure Test Kit	10 lbs.	Consult Factory
70000101	Digital Hydraulic Pressure Test Kit	7 lbs.	Consult Factory

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 travel select lever in (N) NEUTRAL, level the boom and turn the engine OFF.
2. The test ports are located at the front of the filter head bracket, top center of the front axle, rear of the main (implement) pump and on the left side of the hydrostatic drive pump. 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 between 100-120°F (38-49° 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 clockwise will increase the pressure; turning the screw counter-clockwise will decrease the pressure.
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.



8.3.2 Pressure and Speed Settings

534D-9 and 534D-10	Engine Speed	Settings
Main Control Valve Relief	High	3100 psi +200/-0 (213,7 bar +13,8/-0)
Tilt/Comp Relief	Low	3250 psi +100/-100 (224 bar +6,9/-6,9)
Auxiliary Relief	Low	2000 psi +100/-100 (138 bar +6,9/-6,9)
Crowd Extend Relief	Approx 1/2 Throttle	2700 psi +100/-100 (186 bar +6,9/-6,9)
Charge Pressure	Low / High	380-480 psi (26-33 bar)
Hydrostatic Drive Relief	High	6300 psi +200/-100 (434 bar +13,8/-6,9)
Brake Supply	Low	580 psi +50/-50 (40 bar +3,4/-3,4)
Maximum Service Brake Pressure	Low	638 psi +50/-50 (44 bar +3,4/-3,4)
Steering Pressure (against steering stops)	Low	2500 psi +100/-100 (172 bar +6,9/-6,9)
Engine RPM	Low / High	800 RPM - 2400 RPM (D-9) 2500 RPM (D-10)

544D	Engine Speed	Settings
Main Control Valve Relief	High	3500 psi +200/-0 (241 bar +13,8/-0)
Tilt/Comp Relief	Low	3000 psi +100/-0 (207 bar +6,9/-0)
Sway Relief	Low	3000 psi +100/-0 (207 bar +6,9/-0)
Auxiliary Relief	Low	2000 psi +100/-100 (138 bar +6,9/-6,9)
Crowd Extend Relief	Approx 1/2 Throttle	2700 psi +100/-100 (186 bar +6,9/-6,9)
Charge Pressure	Low / High	380-480 psi (26-33 bar)
Hydrostatic Drive Relief	High	6300 psi +200/-100 (434 bar +13,8/-6,9)
Brake Supply	Low	580 psi +50/-50 (40 bar +3,4/-3,4)
Maximum Service Brake Pressure	Low	638 psi +50/-50 (44 bar +3,4/-3,4)
Steering Pressure (against steering stops)	Low	3000 psi +100/-100 (207 bar +6,9/-6,9)
Engine RPM	Low / High	800 RPM - 2200 RPM

Note: All readings and adjustments are to be done with warm oil (minimum of 100° F).



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. Charge Pressure

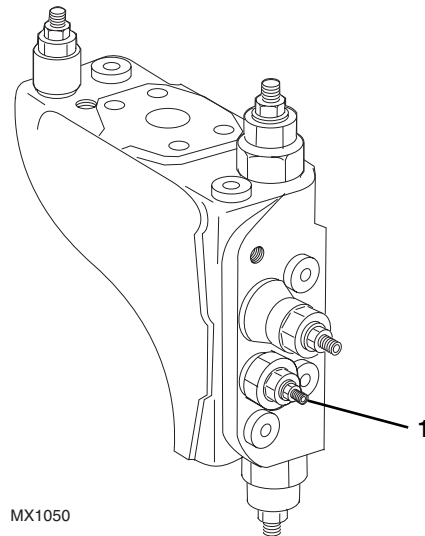
To ensure proper park brake operation, charge pressure needs to be at proper specification. Control pressure is modified charge pressure. If charge pressure is low, control pressure may be low and machine speed reduced. Thus, drive performance is adversely affected by low charge pressure. A digital pressure gauge is recommended.

1. Start the machine and warm the hydraulic system to operating temperature.
2. Shut off the machine and install a digital or a 10,000 psi (689 bar) gauge to the test port located at the right side in front of the return filter. Make sure the gauge can be observed from the operator's cab.
3. Start the machine, leave the park brake applied.
4. With the engine running at low idle, the gauge should read a minimum of 380 psi (26 bar).
5. With the engine running at high idle, the gauge should read a maximum of 480 psi (33 bar).

Note: Throughout test operation, charge pressure should not drop below 380 psi (26 bar) and should move toward 480 psi (33 bar) as RPM rises, regardless of how many functions are being operated simultaneously.

b. Adjusting Charge Pressure

1. Shut the machine off. The charge pump relief (1) is located at the left side of the hydrostatic drive pump. Remove the plastic tamper proof cap.
2. Loosen the jam nut on the relief and using an allen wrench; turn the relief clockwise to increase pressure or counter-clockwise to decrease pressure. Start the machine and set the pressure to 380 psi (26 bar) at low idle.
3. Tighten the jam nut and recheck the pressure at low and high idle. 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, electrical schematic, and/or Section 6.6, "Hydrostatic Drive Performance Checks," to help correct the problem.



c. Steering Pressure

1. Start the machine and warm the hydraulic system to operating temperature.
2. Shut off the machine and install a digital or a 10,000 psi (689 bar) gauge to the test port located at the left side in front of the return filter. Make sure the gauge can be observed from the operator's cab.
3. Start the machine, leave the park brake applied.
4. Turn the steering wheel left or right until the wheel hits the steering stop.



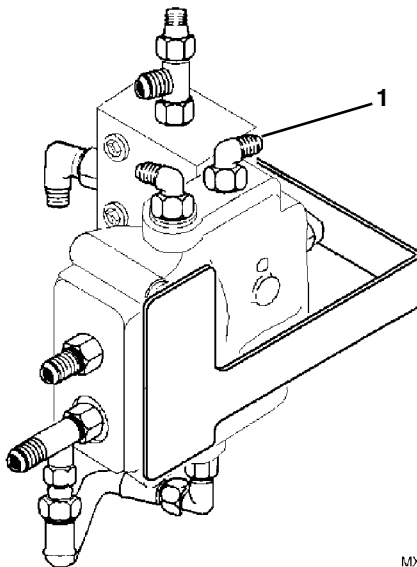
Note: High idle may be needed to allow the steering to bottom against the steering stop.

5. With the engine running at low idle, turn the steering wheel into the steering stop. The gauge should read 2500 psi +/- 100 psi (172 bar +/- 6,9) 534D-9/10, 3000 psi +/- 100 psi (207 bar +/- 6,9) 544D.

Note: Do not stall the steering orbitrol valve for more than 10 seconds as to not allow an excessive amount of heat buildup.

d. Adjusting Steering Pressure

1. Shut the machine off. The steering valve relief is located in the top rear of the flow divider valve at the left inside rear of the frame.
2. Remove the hose and fitting (1) from the flow divider.

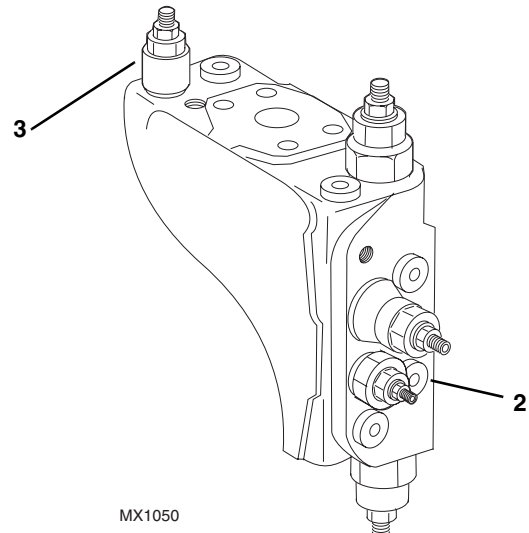


MX1190

3. The relief adjustment is located in the port. Using an allen wrench, turn the relief clockwise to increase pressure or counter-clockwise to decrease pressure.
4. Replace the fitting and hose.
5. Start the machine and turn the steering wheel against the stop. If the reading is not correct, repeat steps 2, 3, 4 and 5.
6. If the proper pressure cannot be set, use the accompanying hydraulic schematic, electrical schematic, to help correct the problem.

e. Hydrostatic Drive Pressure.

1. Start the machine and warm the hydraulic system to operating temperature.
2. Shut off the machine and install a digital or a 10,000 psi (689 bar) gauge to the bottom test port (Ma)(2) located at the left side of the hydrostatic drive pump. Make sure the gauge can be observed from the operator's cab.



MX1050

3. Start the machine, leave the park brake applied and make sure the 2WD/4WD switch is in the 2WD position.
4. Engage the shift lever to the forward position and run the engine at high idle. The gauge should read 6300 psi + 200 /- 100 psi (434 bar +13,8/-6,9 bar).

Note: Do not stall the drive pump for more than 10 seconds as to not allow an excessive amount of heat buildup.

f. Adjusting Hydrostatic Drive Pressure

1. Shut the machine off. The POR relief valve (3) is located at the top right of the hydrostatic drive pump.
2. Remove the plastic tamper proof cap, loosen the jam nut on the relief valve and using an allen wrench; turn the relief clockwise to increase pressure or counter-clockwise to decrease pressure.
3. Start the machine, leave the park brake applied and make sure the 2WD/4WD switch is in the 2WD position, engage the shift lever to the forward position. If the reading is within specification, shut the machine off, install the tamper proof cap and remove the gauge from the test port.
4. Install the gauge to the top test port (Mb) and repeat step 3.



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5. If the proper pressure cannot be set, use the accompanying hydraulic schematic, electrical schematic, and/or Section 6.6, "Hydrostatic Drive Performance Checks," to help correct the problem.

g. Service Brake Pressure

1. Start the machine and warm the hydraulic system to operating temperature.
2. Shut off the machine and install a digital or a 1000 psi (69 bar) gauge to the test port located at the top center of the front axle. Make sure the gauge can be observed from the operator's cab.
3. Start machine and switch OFF park brake.
4. Depress brake pedal as far as possible to obtain maximum service brake pressure. The gauge should read 638 psi +/- 50 psi (44 bar +/- 3,4 bar) at low idle.

h. Adjusting Service Brake Pressure

1. The brake pressure is non-adjustable.
2. If the proper pressure cannot be set, use the accompanying hydraulic schematic, electrical schematic, to help correct the problem.

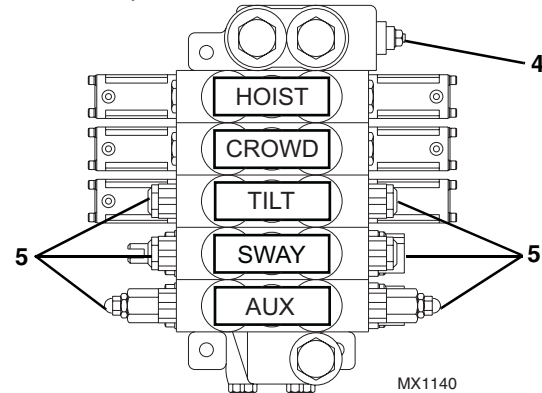
i. Main Control Pressure

1. Start the machine and warm the hydraulic system to operating temperature.
2. Shut off the machine and install a digital or a 10,000 psi (689 bar) gauge to the test port located at the left side in front of the return filter. Make sure the gauge can be observed from the operator's cab.
3. Start the machine, leave the park brake applied.
4. Running the engine at high idle, bottom the extend/retract cylinder. The gauge should read 3100 psi + 200 /- 0 psi (213,7 bar +13,8/-0 bar) 534 D-9/10, 3500 psi + 200 /- 0 psi (241 bar + 13,8/-0 bar) 544D.

j. Adjusting Main Control Pressure

1. Shut the machine off. The main relief valve (4) is located at the right rear corner of the main control valve.
2. Loosen the jam nut on the relief valve and using an allen wrench; turn the relief clockwise to increase pressure or counter-clockwise to decrease pressure.
3. Start the machine, leave the park brake applied, run the engine at high idle and bottom the extend retract cylinder. The gauge should read 3100 psi + 200 /- 0 psi (213,7 bar +13,8/-0 bar) 534 D-9/10, 3500 psi + 200 /- 0 psi (241 bar + 13,8/-0 bar) 544D.

4. If the proper pressure cannot be set, use the accompanying hydraulic schematic, electrical schematic, and/or the troubleshooting guide to help correct the problem.



k. Tilt, Sway and Auxiliary Pressures

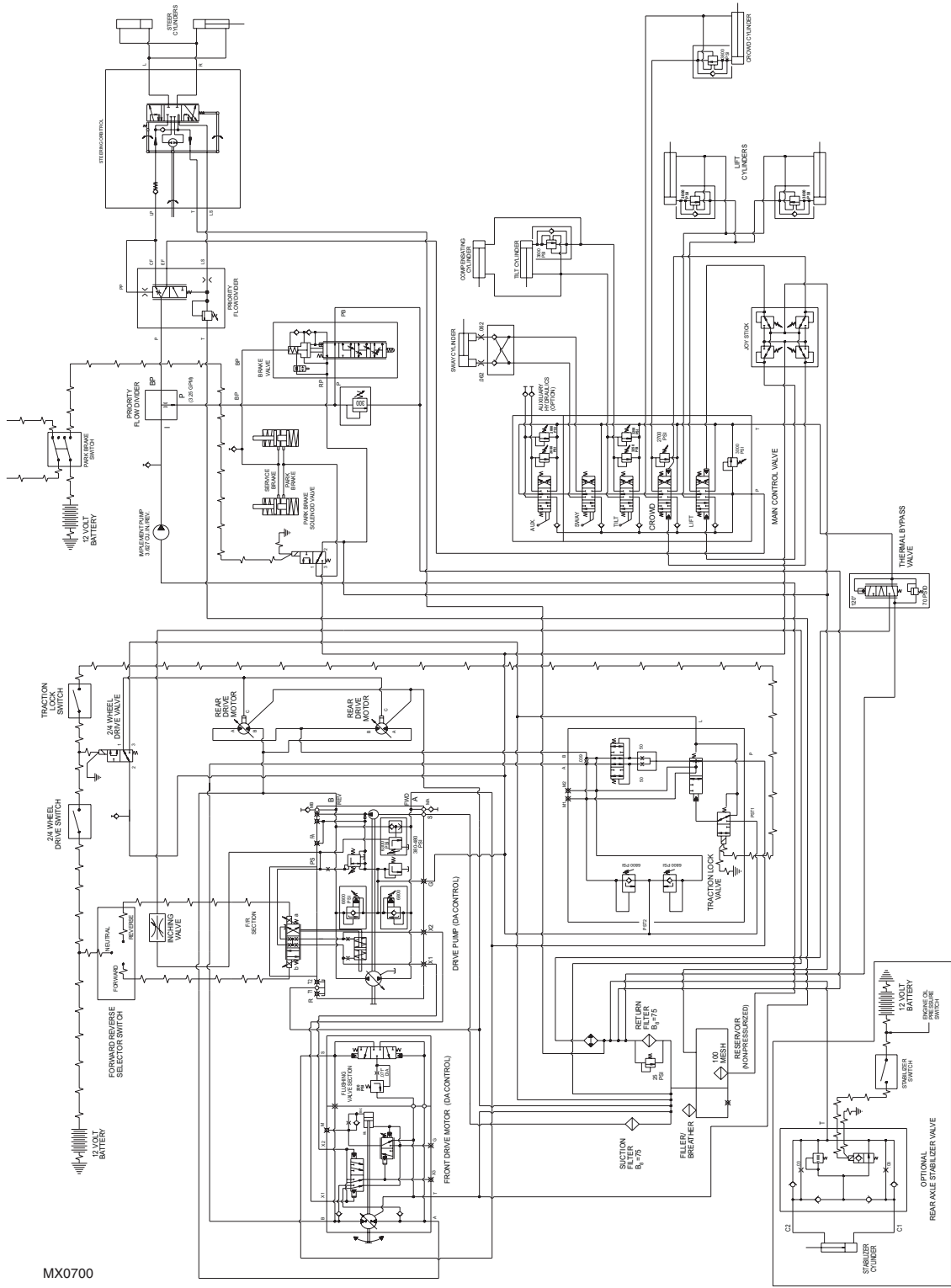
1. Start the machine and warm the hydraulic system to operating temperature.
2. Shut off the machine and install a digital or a 10,000 (689 bar) psi gauge to the test port located at the left side in front of the return filter. Make sure the gauge can be observed from the operator's cab.
3. Start the machine, leave the park brake applied, run the engine at low idle and bottom the individual section in both directions. The gauge should read 3250 psi + 100 /- 0 psi (224 bar +6,9/-0 bar) 534D-9/10, 3000 psi + 100 /- 0 psi (207 bar +6,9/-0 bar) 544D for the tilt section and the sway section. The auxiliary section should read 2000 psi +/-100 psi (138 bar +/- 6,9 bar).

l. Adjusting Tilt, Sway and Auxiliary Pressures

1. Shut the machine off. The relief valves (5) are located at each end of the valve sections from the left side in at main control valve.
2. Loosen the jam nut on the relief valve and using an allen wrench; turn the relief clockwise to increase pressure or counter-clockwise to decrease pressure.
3. Start the machine, leave the park brake applied, run the engine at low idle and bottom the individual section in both directions. The gauge should read 3250 psi + 100 /- 0 psi (224 bar +6,9/-0 bar) 534D-9/10, 3000 psi + 100 /- 0 psi (207 bar +6,9/-0 bar) 544D for the tilt section and the sway section. The auxiliary section should read 2000 psi +/-100 psi (138 bar +/- 6,9 bar).
4. If the proper pressure cannot be set, use the accompanying hydraulic schematic, electrical schematic, to help correct the problem.



8.4.2 Hydraulic Schematic-534D-9

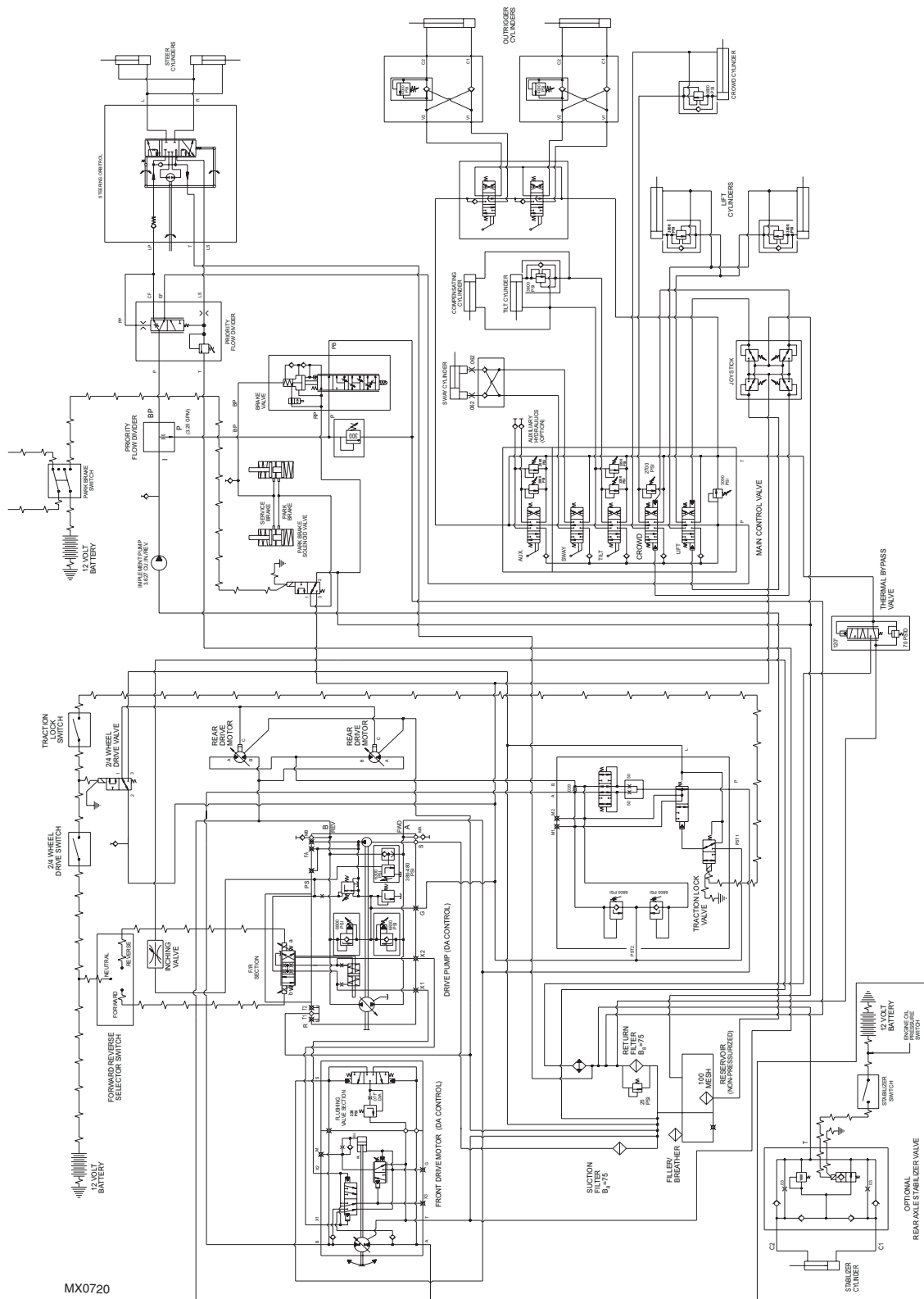


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Hydraulic System

8.4.3 Hydraulic Schematic-534D-10



534D-9, 534D-10 & 544D





8.5 HYDRAULIC RESERVOIR

The hydraulic reservoir (1) is located on the right side of the frame behind the fuel tank.

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, stating that the machine should not be operated.
3. Open the engine cover and the hydraulic oil reservoir/fuel tank cover. Allow the system fluids to cool.
4. Disconnect the battery negative (-) cable from the battery negative (-) terminal.
5. Open the filler cap on the hydraulic oil reservoir. Remove the drain plug on the bottom of the hydraulic oil reservoir.
6. Transfer the used hydraulic oil into a suitable covered container, and label as "Used Oil". Dispose of used oil at an approved recycling facility. Clean and reinstall the drain plug.
7. Wipe up any hydraulic fluid spillage in, on, near and around the machine and the work area.

8.5.2 Hydraulic Oil Reservoir Filling

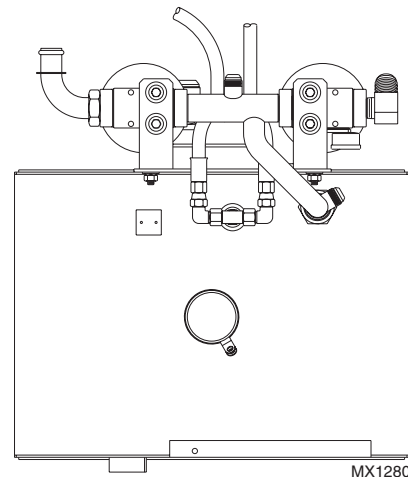
1. Be sure the reservoir is clean and free of all debris.
2. Install new hydraulic oil filters.
3. Fill the reservoir with Mobilfluid 424® (ISO Grade 46) oil. Refer to Section 2.4, "Fluid and Lubricant Capacities."
4. Connect the battery negative (-) cable to the battery negative (-) terminal.
5. Close and secure the engine cover and the hydraulic oil reservoir/fuel tank cover.

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, stating that the machine should not be operated.
3. Open the engine cover and the hydraulic oil reservoir/fuel tank cover. Allow the system fluids to cool.
4. Disconnect the battery negative (-) cable from the battery negative (-) terminal.
5. Drain the hydraulic oil reservoir. Refer to Section 8.5.1, "Hydraulic Oil Reservoir Draining."
6. Remove the hydraulic oil reservoir/fuel tank cover.
7. Label, disconnect and cap all hydraulic hoses attached to the hydraulic oil reservoir. Cap all fittings and openings to keep dirt & debris from entering the hydraulic system.
8. Remove the bolts securing the hydraulic oil reservoir to the frame.
9. 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 **JLG Service Department**.

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

Note: If a leak is suspected in the fuel or hydraulic oil tank, contact **JLG Service Department**.

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 filters.
6. Fill the hydraulic oil reservoir according to specifications. Refer to Section 2.4, "Fluid and Lubricant Capacities."
7. Check the hydraulic oil reservoir for leaks.
8. Connect the battery negative (-) cable to the battery negative (-) terminal.
9. Install the hydraulic oil reservoir/fuel tank cover.
10. Close and secure the engine cover.

8.6 ENGINE IMPLEMENT PUMP

8.6.1 Pump Description

For internal service instructions contact your local JLG distributor.

8.6.2 Pump Failure Analysis

The pump is the "heart" of the hydraulic system, and whenever there is a problem in the system, the pump often is blamed. However, pump failure is seldom due to failure of pump components. Pump failure usually indicates another problem in the hydraulic system.

According to pump manufacturer statistics, 90-95 percent of pump failures are due to one or more of the following causes:

- Aeration
- Cavitation
- Contamination
- Excessive Heat
- Over-Pressurization
- Improper Fluid

In the event of pump failure, investigate further to determine the cause of the problem.

8.6.3 Pump Replacement

a. Pump Removal

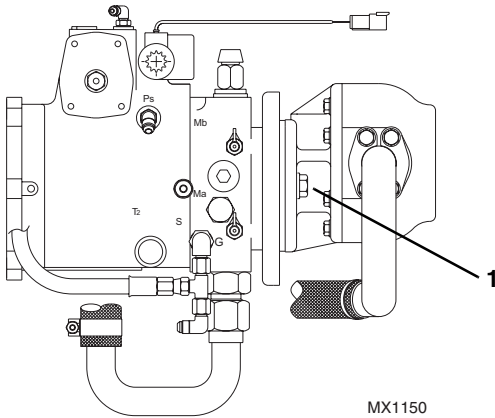
1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover and the hydraulic oil reservoir/fuel tank cover. Allow the system fluids to cool.
4. Disconnect the battery negative (-) cable from the battery negative (-) terminal.
5. Drain the hydraulic reservoir. Refer to Section 8.5.1, "Hydraulic Oil Reservoir Draining."
6. Relieve any trapped pressure in the hydraulic system.
7. 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.



Hydraulic System

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



9. Remove the two bolts and two lockwashers (1) securing the pump to the engine. Remove the o-ring located between the engine 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 or repairs performed by anyone other than an authorized dealer could void the warranty.

b. Pump Installation

1. Place the pump and a new, oiled o-ring into position on the engine. Align the pump shaft with the internal engine gear, so that the machined teeth mesh together.
2. Align the bolt holes with the pump mount holes. Secure the pump to the transmission with the two bolts and washers.
3. Uncap and connect the previously labeled hydraulic hoses to their appropriate locations.
4. Fill the hydraulic reservoir. Refer to Section 8.5.2, "Hydraulic Oil Reservoir Filling."
5. 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.
6. Check all routing of hoses and tubing for sharp bends or interference with any rotating members. All tube and hose clamps must be tight.
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 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."

1. Check the system functions.

8.7 DRIVE MOTORS

8.7.1 Front Drive Motor

The front drive motor is mounted to the carrier of the front drive axle and powers the machine in 2WD and 4WD.

a. Front Drive Motor Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, raise the boom to access drive motor, 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, stating that the machine should not be operated.
3. Open the engine cover and the hydraulic oil reservoir/fuel tank cover. Allow the system fluids to cool.
4. Remove the deck cover and disconnect the battery negative (-) cable from the battery negative (-) terminal.
5. With the engine OFF, relieve any trapped pressure in the hydraulic system.
6. Thoroughly clean the drive motor and surrounding area, including all hoses and fittings, before proceeding.
7. Place a suitable container to catch hydraulic fluid drainage beneath the frame.

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

8. Label, disconnect and cap all the hydraulic hoses attached to the drive motor. Cap all fittings and openings to prevent dirt and debris from entering the hydraulic system.
9. Wipe up any hydraulic fluid spillage in, on, near and around the machine and the work area.
10. Loosen and remove the four bolts holding the drive motor to the carrier housing.
11. Pull the drive motor back from the axle carrier and place on a suitable support or table.



b. Front Drive Motor Disassembly

Although individual parts are available for the drive motor, it is recommended that any disassembly and reassembly is done by an authorized JLG Service Center.

c. Front Drive Motor Installation

1. Apply Molybdenum on the splined shaft and "Ultra Blue" silicon sealant at the base of the drive motor.
2. Align the splined shaft on the drive motor with the axle carrier and slide into place.
3. Apply Loctite® 242 and install the four bolts holding the drive motor to the carrier. Torque to 265 lb-ft +25/-0 (359 Nm +34/-0).
4. Uncap and reconnect the previously labeled hydraulic hoses to the appropriate locations.

Note: *Uncap each hose as you install them to prevent unnecessary fluid spillage.*

5. Connect the battery negative (-) cable to the battery negative (-) terminal. Install the deck cover.
6. Add hydraulic oil as needed.
7. Start and warm machine to operating temperature and add hydraulic oil if needed.

8.7.2 Rear Drive Motors

The rear drive motors are mounted on each rear drive hub. The motors are active in 4WD only.

Note: *The removal, disassembly and installation of the rear drive motor applies for either side.*

a. Rear Drive Motor 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, stating that the machine should not be operated.
3. Open the engine cover and the hydraulic oil reservoir/fuel tank cover. Allow the system fluids to cool.
4. Disconnect the battery negative (-) cable from the battery negative (-) terminal.
5. With the engine OFF, relieve any trapped pressure in the hydraulic system.
6. Thoroughly clean the drive motor and surrounding area, including all hoses and fittings, before proceeding.

7. Place a suitable container to catch hydraulic fluid drainage beneath the axle.

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

8. Label, disconnect and cap all the hydraulic hoses and tubes attached to the drive motor. Cap all fittings and openings to prevent dirt and debris from entering the hydraulic system.
9. Wipe up any hydraulic fluid spillage in, on, near and around the machine and the work area.
10. Loosen and remove the four nuts holding the drive motor to the drive hub housing studs.
11. Pull the drive motor back from the housing studs and place on a suitable support or table.

b. Rear Drive Motor Disassembly

Although individual parts are available for the drive motors, it is recommended that any disassembly and reassembly is done by an authorized JLG Service Center.

c. Rear Drive Motor Installation

1. Apply Molybdenum on the splined shaft and "Ultra Blue" silicon sealant at the base of the drive motor.
2. Align the splined shaft on the drive motor with the drive hub housing and slide into place over the housing studs.
3. Apply Loctite® 242 and install the four nuts and lock washers holding the drive motor to the drive hub housing.
4. Uncap and reconnect the previously labeled hydraulic hoses and tubes to the appropriate locations.

Note: *Uncap each hose and tube as you install them to prevent unnecessary fluid spillage.*

5. Connect the battery negative (-) cable to the battery negative (-) terminal.
6. Add hydraulic oil as needed.
7. Start and warm machine to operating temperature and add hydraulic oil if needed.



8.8 CONTROL VALVES

8.8.1 Main Control Valve

The main control valve is mounted on the frame of the cab below the seat.

The main control valve assembly consists of five 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, 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, stating that the machine should not be operated.
3. Open the engine cover and the hydraulic oil reservoir/fuel tank cover. Allow the system fluids to cool.
4. Disconnect the battery negative (-) cable from the battery negative (-) terminal.
5. With the engine OFF, relieve any trapped pressure in the hydraulic system.
6. Thoroughly clean the main control valve and surrounding area, including all hoses and fittings, before proceeding.
7. Place a suitable container to catch hydraulic fluid drainage beneath the frame.
8. Label, disconnect and cap all the hydraulic hoses, tubes and wires at the main control valve.
9. Wipe up any hydraulic fluid spillage in, on, near and around the machine and the work area.
10. Remove the three bolts, washer and nuts (3) securing the main control valve to the frame.

b. Main Control Valve Disassembly

1. To disassemble the individual sections of the main control valve, remove the nuts from one end of the tie rods (4). Pull the tie rods out through the sections.
2. Disassemble each section assembly as required.

Note: Some sections include a pre-adjusted relief valve that regulates pressure in a specific circuit.

NOTICE

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

1. Carefully separate the outlet section from the auxiliary section.
2. Remove the o-rings from between the two sections.
3. Carefully separate each remaining sections.
4. Remove both end caps from each end of the valve sections then remove each control spool.
5. Remove any check valves, compensator valves, anti-cavitation valves or shock valves from individual valve section if equipped.
6. Keep all parts being removed from individual valve sections tagged and kept together.

c. Main Control Valve Parts Cleaning

Clean all components with a suitable cleaner, such as 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.

e. Main Control Valve Assembly

Note: ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.

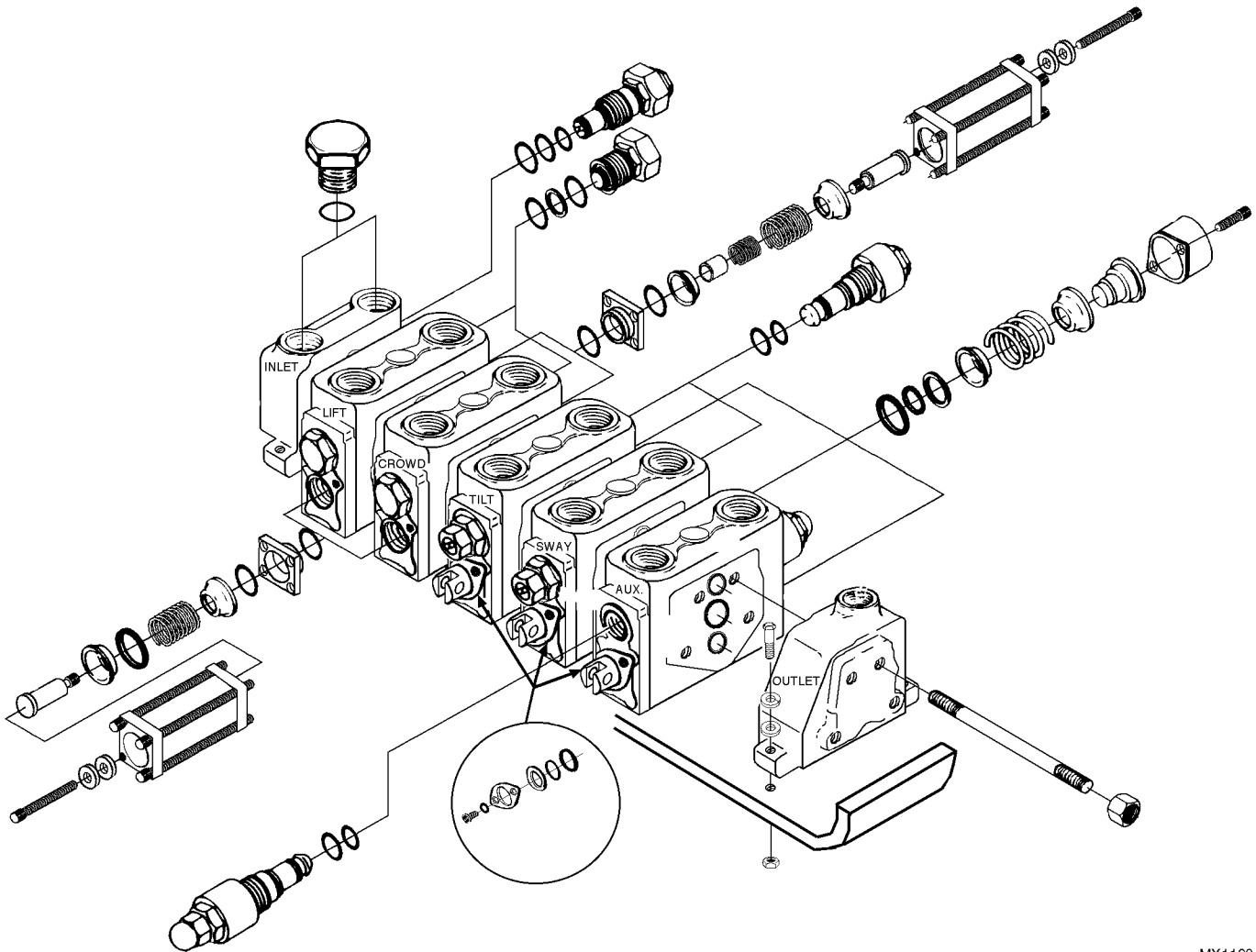
Assemble each Valve Section

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



Assemble the Main Control Valve.

1. Place all three tie rods with the washers and nuts through the inlet main control valve section.
2. Stand the end main control valve section on end.
3. Install the proper o-rings and load sense shuttle on the inner face of the inlet main control valve section. Align the hoist control valve section over the three tie rods and slide onto the inlet main control valve section.
4. Using the proper o-rings, repeat step three for the crowd control valve section, the tilt valve section, the sway valve section, the tilt valve section, auxiliary valve section and last the outlet end valve section.
5. Install the three washers and nuts on the tie rods. Torque to 23-27 lb-ft (57 Nm).



544D MAIN CONTROL VALVE

MX1160



f. Main Control Valve Installation

1. Install the main control valve onto the frame, aligning the bolts with the holes in the end sections of the main control valve. Slide the main control valve into position, and tighten the bolts.
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. 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.
6. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

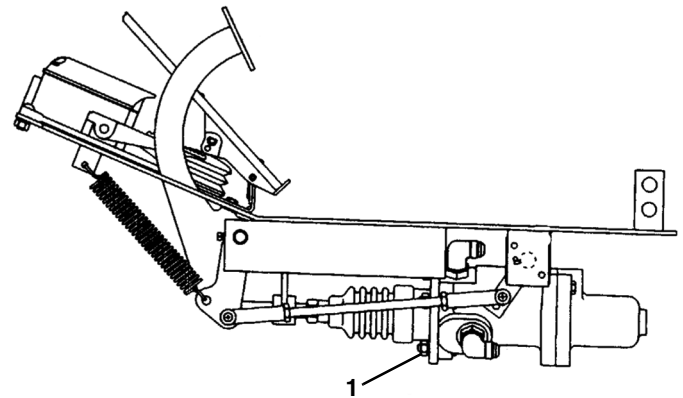
Note: Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.

7. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
8. Close and secure the engine cover and the hydraulic oil reservoir/fuel tank cover.

g. Main Control Valve Test

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

8.8.2 Service Brake Valve



MX1170

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, stating that the machine should not be operated.
3. Open the engine cover and the hydraulic oil reservoir/fuel tank cover. Allow the system fluids to cool.
4. Disconnect the battery negative (-) cable from the battery negative (-) terminal.
5. Remove belly pan from under cab.
6. Label, disconnect and cap all hose attached to the service brake valve. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
7. Remove the four capscrews, four nuts and four lockwashers (1) mounting the service brake valve to the service brake bracket.

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



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b. Service Brake Valve Installation

1. Install the service brake valve with the four capscrews, four lockwashers and four nuts onto the service brake bracket.

Note: ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.

2. Use new oiled o-rings as required. Uncap and connect the previously labeled hoses to the service brake valve.
3. Check the routing of all hoses, and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all tube and hose clamps.
4. Connect the battery negative (-) cable to the battery negative (-) terminal.
5. 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.
6. 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.

7. Replace belly pan.
8. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.

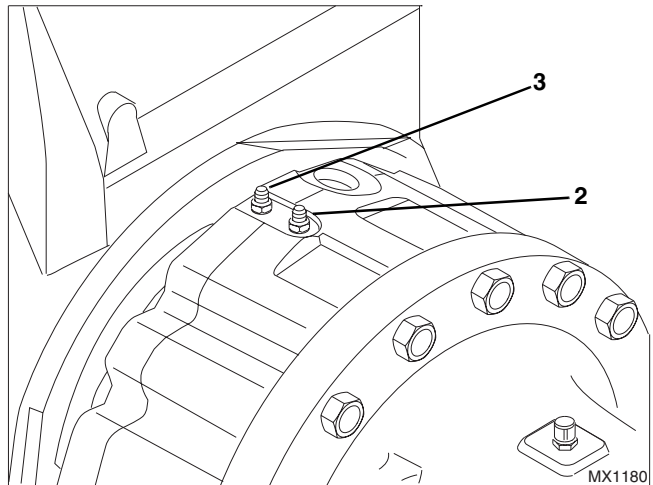
8.8.3 Brake Test

Carefully bleed the brake lines as soon as the brake valve is installed in the machine. Air in the system will not allow the brakes to apply properly. There are four brake bleeder locations on the front axle with the outer bleeders being for the service brakes. Work with an assistant to perform this procedure.

1. Place the travel select lever in (N) NEUTRAL, engage the park brake.
2. Install a test port line between the charge pressure test port and the service brake pressure test port.
3. Start the machine, disengage the park brake and apply the service brake.

Note: If an assistant is not available, block the brake pedal between the pedal pad and the lower edge of the dash.

4. Remove the plastic cap from the service brake bleeder (2). 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.
5. **DO NOT** open the 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 brake bleeder when air bubbles no longer appear in the oil running through the transparent tubing. Release the brake pedal. Remove the tubing from the brake bleeder.
6. Conduct a pressure and function check of the service brake. Refer to Section 8.4.1, "Hydraulic Pressures."



Note: The inner bleeder is used to bleed the park brake.

1. Place the travel select lever in (N) NEUTRAL, engage the park brake.
2. Remove the plastic cap from the park brake bleeder (3). 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. Start the machine.
4. **DO NOT** open the brake bleeder without holding the tubing firmly on the bleeder. There is 380/480 psi (26/33 bar) at the park brakes. Carefully open the bleeder with a 12 mm wrench. Close the brake bleeder when air bubbles no longer appear in the oil running through the transparent tubing. Remove the tubing from the brake bleeder.



8.8.4 Steering Orbitrol Valve

The steering orbitrol valve (4) is located at the base of the steering wheel shaft. 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."

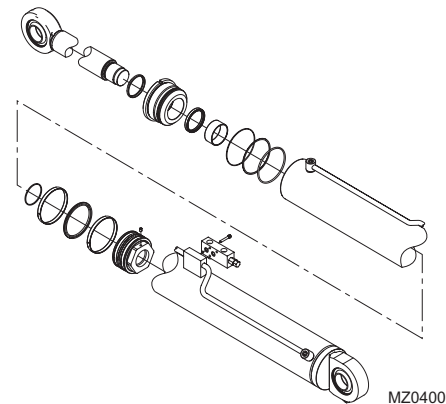
8.9 HYDRAULIC CYLINDERS

8.9.1 General Cylinder Instructions

a. Cylinder Removal

1. Remove any attachment from the machine. Park the machine on a firm level surface and fully retract the boom. Allow sufficient work space around the hydraulic cylinder being removed. Support the boom if the lift/lower cylinder is being removed. Place the travel select 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, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Label, disconnect and cap or plug hydraulic hoses in relation to the cylinder. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
5. Attach a suitable sling to an appropriate lifting device and to the cylinder. Make sure the device used can actually support the cylinder.
6. Remove the lock bolt and/or any retaining clips securing the cylinder pins. Remove the cylinder pins.
7. Remove the cylinder.
8. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.

8.9.2 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. Escaping hydraulic fluid under pressure could penetrate the skin.

NOTICE

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 from the side of the cylinder barrel.

NOTICE

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 as required to allow access to the base of the cylinder.



NOTICE

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 from the tube. A considerable amount of force will be needed to remove the head gland. Carefully slide the head gland down along the rod toward the rod eye, away from the cylinder barrel.

NOTICE

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 along with the head gland 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.

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.

9. Remove the piston head from the rod and carefully slide the head gland off the end of the rod.
10. 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.*

c. 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.

8.9.3 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.

NOTICE

Protect the finish of the 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 and install the set screw in the piston head. Refer to Section 8.9.6, "Cylinder Torque Specifications," for torque specifications for the piston head and the set screw.

NOTICE

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.

NOTICE

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. Screw the head gland into the cylinder barrel and tighten with a spanner wrench. Refer to Section 8.9.6, "Cylinder Torque Specifications," for torque specifications for the head gland.
7. If applicable, install new counter balance valve into block on the cylinder barrel.

8.9.4 General Cylinder Installation

1. Grease the bushings at the ends of the hydraulic cylinder. Using an appropriate sling, lift the cylinder into it's mounting position.
2. Align cylinder bushing and install pin, lock bolt or retaining clip.
3. Connect the hydraulic hoses in relation to the labels or markings made during removal.
4. Before starting the machine, check fluid level of the hydraulic fluid reservoir and if necessary fill to full mark with Mobilfluid 424® (ISO 46).
5. 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.
6. Inspect for leaks and check level of hydraulic fluid in reservoir. Add hydraulic fluid if needed. Shut the engine OFF.

7. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
8. Close and secure the engine cover.

8.9.5 Cylinder Pressure Checking

Install a digital or a 10,000 (689 bar) psi gauge to the test port located at the left side in front of the return filter. Make sure the gauge can be observed from the operator's cab. Refer to Section 8.4.1, "Hydraulic Pressures," for a specific hydraulic cylinder circuit pressure setting.

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.*



Hydraulic System

8.9.6 Cylinder Torque Specifications

534D-9/10

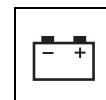
Description	Lock Nut	Cylinder Gland
Lift Cylinder	1300-1350 lb-ft (1763-1830 Nm)	250-400 lb-ft (339-542 Nm)
Crowd Cylinder	825-875 lb-ft (1119-1186 Nm)	250-400 lb-ft (339-542 Nm)
Tilt Cylinder	1300-1350 lb-ft (1763-1830 Nm)	250-400 lb-ft (339-542 Nm)
Comp Cylinder	1300-1350 lb-ft (1763-1830 Nm)	250-400 lb-ft (339-542 Nm)
Sway Cylinder	650-700 lb-ft (881-949 Nm)	250-400 lb-ft (339-542 Nm)
*Stabilizer Cylinder	650-700 lb-ft (881-949 Nm)	250-400 lb-ft (339-542 Nm)
Steering Cylinder	400-425 lb-ft (542-576 Nm)	250-400 lb-ft (339-542 Nm)
**Outtrigger Cylinder	1300-1350 lb-ft (1763-1830 Nm)	250-400 lb-ft (339-542 Nm)
Note: Apply Amoco Rycon #2 EP Grease to cylinder gland threads and torque to spec.		
Note: All bearings in the cylinder glands use Loctite® 638.		
*Stabilizer Cylinder optional on 534D-9 & 534D-10.		
**Outriggers not available on 534D-9.		

544D

Description	Lock Nut	Cylinder Gland
Lift Cylinder	1300-1350 lb-ft (1763-1830 Nm)	250-400 lb-ft (339-542 Nm)
Crowd Cylinder	1300-1350 lb-ft (1763-1830 Nm)	250-400 lb-ft (339-542 Nm)
Tilt Cylinder	1300-1350 lb-ft (1763-1830 Nm)	250-400 lb-ft (339-542 Nm)
Comp Cylinder	1300-1350 lb-ft (1763-1830 Nm)	250-400 lb-ft (339-542 Nm)
Sway Cylinder	650-700 lb-ft (881-949 Nm)	250-400 lb-ft (339-542 Nm)
Stabilizer Cylinder	650-700 lb-ft (881-949 Nm)	250-400 lb-ft (339-542 Nm)
Steering Cylinder	400-425 lb-ft (542-576 Nm)	250-400 lb-ft (339-542 Nm)
Outtrigger Cylinder	1300-1350 lb-ft (1763-1830 Nm)	250-400 lb-ft (339-542 Nm)
Note: Apply Amoco Rycon #2 EP Grease to cylinder gland threads and torque to spec.		
Note: All bearings in the cylinder glands use Loctite® 638.		

Note: If reusing the cylinder gland, torque the cylinder gland until the locking capscrew hole align. Reinstall the capscrew.

Note: If installing a new cylinder gland, torque the gland to spec and drill a 0.47 " to 0.152" hole in the parting line of the head and case within plus or minus 0.30" either side of the line. This hole is to be 0.438" deep and perpendicular to the centerline within plus or minus 5°. Do Not drill in line with the spanner holes or wrench flats within 0.500".

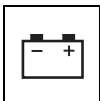


Section 9

Electrical System

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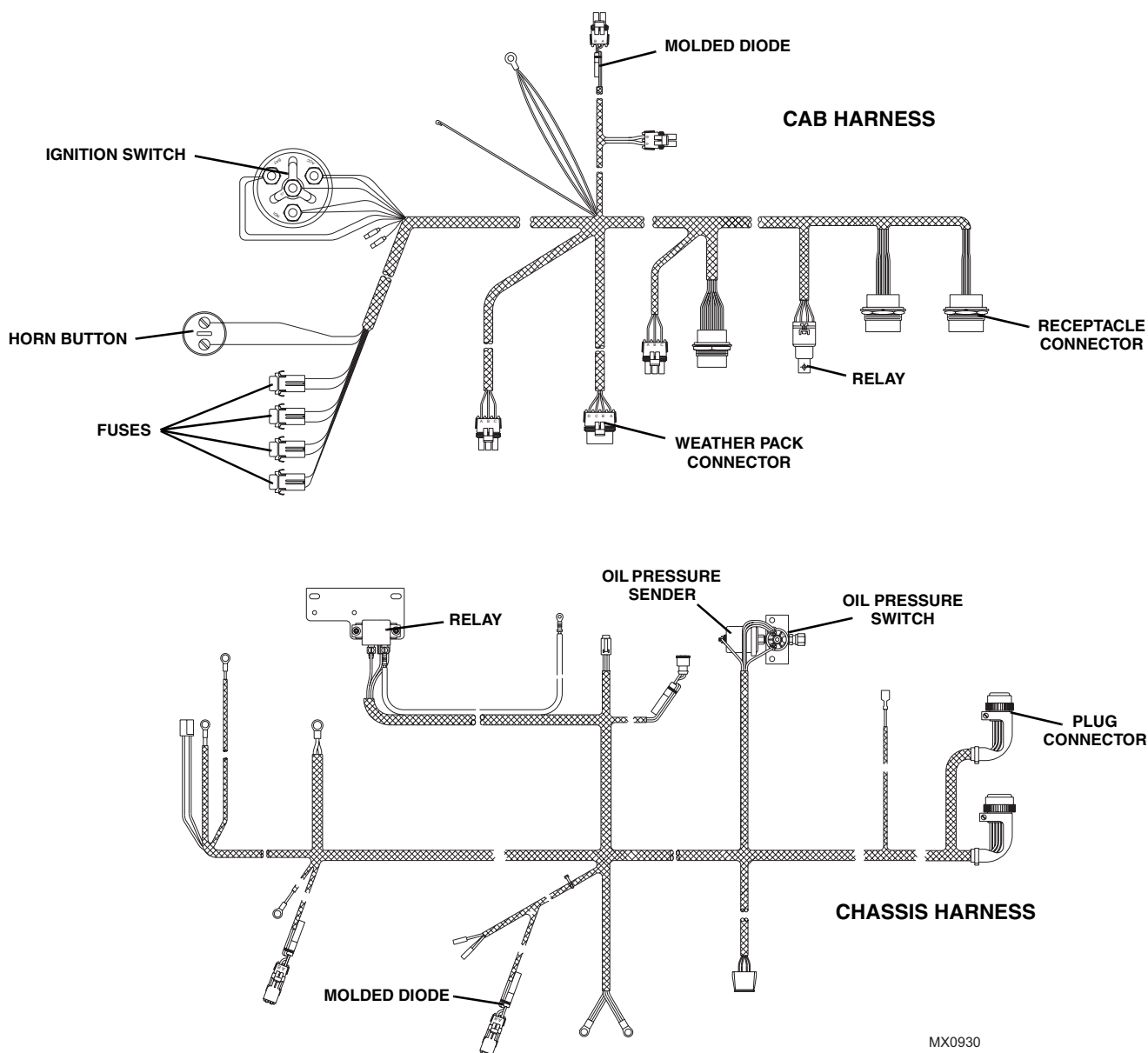


Electrical System

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 (Cab and Engine Harness)



MX0930



9.2 SPECIFICATIONS

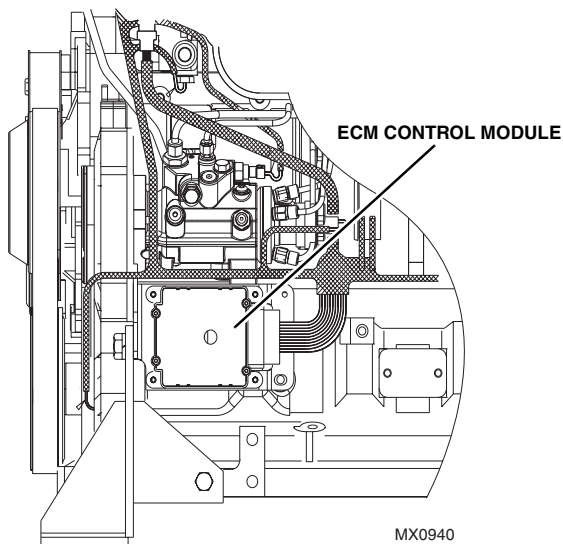
Electrical system specifications are listed in Section 2, "General Information and Specifications."

9.3 SERVICE WARNINGS

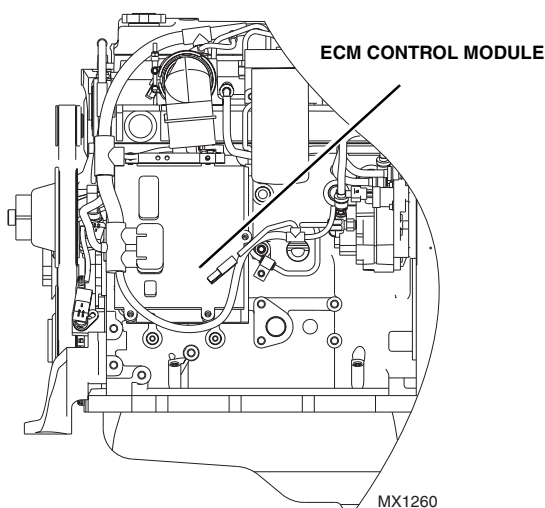
CAUTION

When doing welding anywhere on the machine disconnect the wire harness from the Engine Control Module mounted beside the engine and disconnect both cables from the battery(s) and clamp both cables together.

John Deere



Cummins



9.4 FUSES AND RELAYS

9.4.1 Cab

The fuse panel is located at the bottom right corner of the dash.

The relay is located at the right front corner of the cab, under the dash.

9.4.2 Engine Compartment

The relay is located at the right rear corner of the engine.



9.5.1 Electrical Schematic 534D-9, 534D-10 - John Deere



534D-9, 534D-10 & 544D





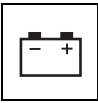
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534D-9, 534D-10 & 544D

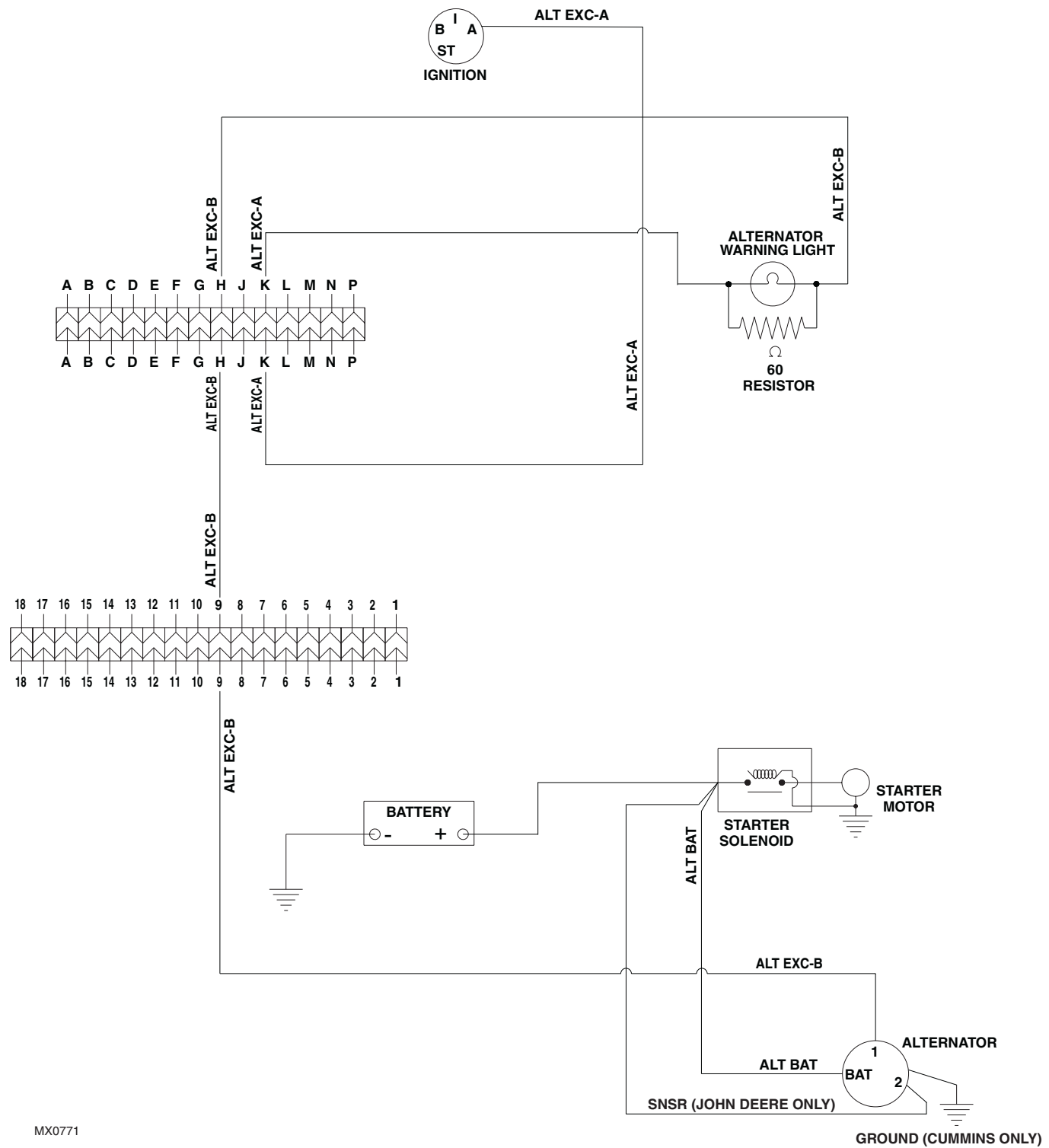
534D-9, 534D-10 & 544D





Electrical System

9.5.5 Charge Circuit 534D-9, 534D-10, 544D



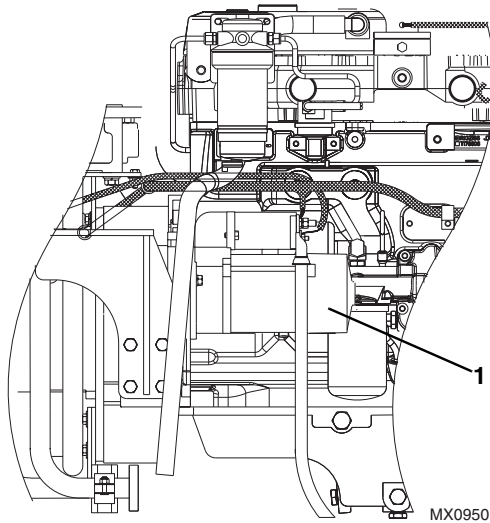
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9.6 ENGINE START CIRCUIT

9.6.1 Starter

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



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

Remove the starter only if it fails. To remove the starter:

1. Open the engine cover.
2. Remove the battery negative (-) cable at the negative battery (-) terminal.
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 bolts 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 bolts 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 bolts. Torque bolts to 32 lb-ft (43,3 Nm).
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. Connect the negative (-) battery cable to the negative (-) battery terminal.
5. Close and secure engine cover.



9.7 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 & Safety Manual). Allow the engine to run, which will enable the alternator to charge the battery.

If the engine alternator charging warning indicator illuminates, perform the following checks:

1. Check the 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.

9.7.1 Alternator

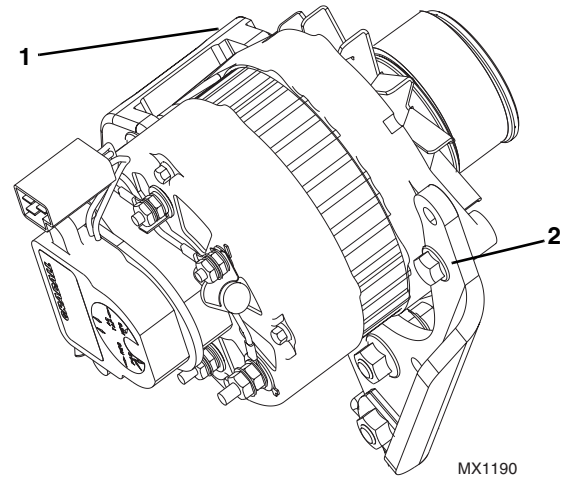
a. Alternator Removal

1. Open the engine cover.
2. Remove the battery negative (-) cable at the negative battery (-) terminal.
3. Install a 1/2" square 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.

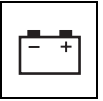
Note: Record how the alternator is installed to ensure correct installation later.

5. Label and disconnect the wire leads.
6. Remove the lower mounting bolt (1) securing the alternator to the lower mounting hole on the engine.
7. While supporting the alternator with one hand, remove the upper mounting bolt (2) from the 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 mounting bolt through the alternator 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 bolt. Tighten the lower bolt and upper capscrew securely.
3. Place a 1/2" square drive ratchet into the square hole on the serpentine belt tensioner bracket. Apply pressure against the tensioner bracket and route the serpentine belt onto the alternator and engine pulleys. Release and check the tensioner pulley to verify that it is pivoting freely in order to provide the proper tension on the belt. Check for proper belt alignment. (Refer to the appropriate Operation & Safety Manual.)
4. Connect the wire leads.
5. Connect the negative (-) battery cable to the negative (-) battery terminal.
6. Close and secure engine cover.

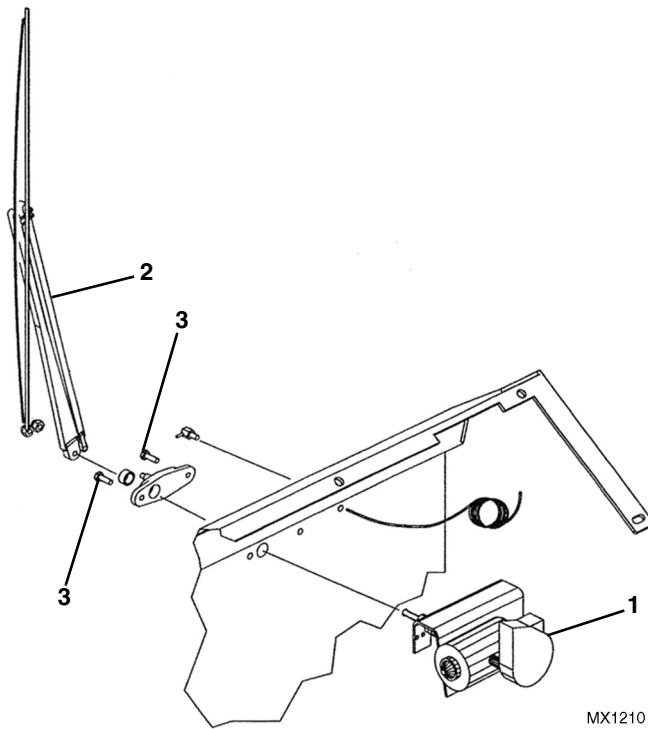


9.8 WINDSHIELD WIPER MOTOR (IF EQUIPPED)

a. Removal

Note: It may be necessary to remove several hydraulic hoses from under the dash in order to remove and install the wiper motor housing. (Refer to Section 4.3.1, "Steering Column and Orbitrol Valve.")

1. Remove the battery negative (-) cable at the negative battery (-) terminal.
2. Disconnect the cab harness connector (1) from the wiper motor.



MX1210

3. Remove the wiper assembly (2).
4. Loosen and remove the two bolts (3) 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.

5. 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. Align motor with the mounting holes and bolt the motor to the mounting bracket.
2. Connect the cab harness connector to windshield wiper motor connector.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.
4. 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.
5. Install the wiper assembly.

Note: Align the wiper blade with the left side of the cab windshield to ensure wiper stroke covers window area, and it does not swipe past the glass area.

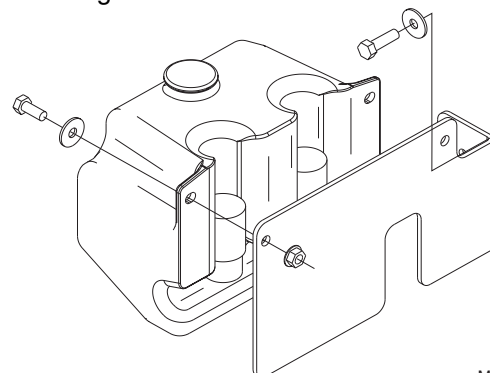
6. If previously removed, install hydraulic hoses under the dash. (Refer to Section 4.3.1, "Steering Column and Orbitrol Valve.")

9.8.1 Windshield Washer Reservoir and Pump

The windshield washer motor and reservoir is located in the cab compartment as a unit and cannot be serviced separately.

a. Removal

1. Remove the battery negative (-) cable at the negative battery (-) terminal.
2. Remove the nuts and the lock washers from the washer mounting bolts.
3. Pull the washer reservoir out and away from the mounting bracket.



MZ0190



Electrical System

4. Rotate the washer reservoir, label and remove the cab harness connectors from the washer reservoir connectors.
5. 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. Connect the negative (-) battery cable to the negative (-) battery terminal.
7. Turn the ignition key switch to the RUN position and press the washer switch. Verify that fluid is sprayed on both the windshield and rear glass.

9.9 CAB HEATER AND FAN (IF EQUIPPED)

9.9.1 Cab Heater Controls

See Section 9.12.2, "Dash Switches."

9.10 SOLENOIDS, SENSORS AND SENDERS

9.10.1 Circuit Solenoids

Depending if the machine is equipped with options, there could be a total of four solenoids in the following locations.

Park Brake - Standard

Traction Lock - Standard

Stabilizer - Standard (544D)
Option (534D-9, 534D-10).

Tilt on Joystick - Option

With the exception of the traction lock solenoid, the remaining solenoids can be temporarily switched for trouble shooting purposes.

a. Solenoid Removal Park Brake Solenoid Removal

1. Remove belly pan from under the cab.
2. Clean area around solenoid to be removed.
3. Remove the battery negative (-) cable at the negative battery (-) terminal.
4. Disconnect the wiring connector at the valve solenoid lead.
5. Loosen and remove the coil mounting nut.
6. Remove the valve solenoid being careful not to lose or damage any o-rings. Note the location of any orifices, check valves and o-rings if equipped.

Traction Lock Solenoid Removal

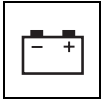
1. Remove cover from behind engine.
2. Clean area around solenoid to be removed.
3. Remove the battery negative (-) cable at the negative battery (-) terminal.
4. Disconnect the wiring connector at the valve solenoid lead.
5. Loosen and remove the coil mounting nut.
6. Remove the valve solenoid being careful not to lose or damage any o-rings. Note the location of any orifices, check valves and o-rings if equipped.

Stabilizer Solenoid Removal

1. Clean area around solenoid to be removed.
2. Remove the battery negative (-) cable at the negative battery (-) terminal.
3. Disconnect the wiring connector at the valve solenoid lead.
4. Loosen and remove the coil mounting nut.
5. Remove the valve solenoid being careful not to lose or damage any o-rings. Note the location of any orifices, check valves and o-rings if equipped.

Tilt Control Solenoid Removal

1. Remove rear cover from behind cab.
2. Clean area around solenoid to be removed.
3. Remove the battery negative (-) cable at the negative battery (-) terminal.
4. Disconnect the wiring connector at the valve solenoid lead.
5. Loosen and remove the coil mounting nut and remove the coil.
6. Remove the valve solenoid being careful not to lose or damage any o-rings. Note the location of any orifices, check valves and o-rings if equipped.

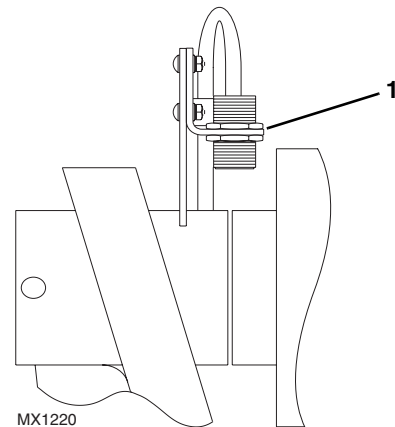


b. Solenoid Disassembly

DO NOT disassemble a solenoid. Replace a defective solenoid with a new part.

c. Solenoid Installation

1. Install the solenoid using new o-rings and tighten. Install coil and tighten mounting nut. **Do Not Over Tighten.**
2. Connect the wire connector to the solenoid
3. Start the machine and slowly move joystick to engage function. If further trouble shooting is required, refer to Section 9.5, "Electrical System Schematics," or Section 8.4, "Hydraulic Circuits."



7. If stabilizer sensor is not activated, adjust the sensor and/or sensor bracket to illuminate sensor.

9.10.2 Stabilizer Proximity Sensor

The Stabilizer Proximity Sensor activates when the boom raises above 45° (light on switch will light).

a. Stabilizer Sensor Removal

1. The stabilizer sensor (1) is located at the left rear corner of the first boom section pivot pin.
2. Remove the battery negative (-) cable at the negative battery (-) terminal.
3. Unplug the stabilizer sensor connector from the wiring harness connector.
4. Measure and record distance from end of sensor to the sensor bracket.
5. Loosen and remove jam nut and sensor.

b. Stabilizer Sensor Inspection and Replacement

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

c. Stabilizer Sensor Installation and Testing

1. Install stabilizer sensor and tighten jam nut to recorded measurement.
2. Connect the stabilizer sensor connector.
3. Install the battery negative (-) cable at the negative battery (-) terminal.
4. Place an angle finder gauge on the top rear of the first boom section.
5. Start machine, retract the boom and raise the boom until the angle gauge reads 45°.
6. The red LED light in the stabilizer sensor should be illuminated.

9.10.3 Engine Senders

Engine Coolant Temperature Sender

a. Engine Coolant Temperature Sender Removal

1. The engine coolant sender is located by the alternator.
2. Remove the battery negative (-) cable at the negative battery (-) terminal.
3. Remove the engine coolant temperature sender wire from the sender.
4. The sender is threaded into the engine block. Remove the sender.

b. Engine Coolant Temperature Sender Inspection and Replacement

Inspect the sender and the wiring harness 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 wire to the sender.
2. Connect the battery negative (-) cable at the negative battery (-) terminal.
3. Check for proper coolant level.



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4. Start the engine, allow it to reach operating temperature and observe the operator's 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.

Engine Oil Pressure Sender

a. Engine Oil Pressure Sender Removal

1. The engine oil pressure sender is located on the cab firewall.
2. Remove the battery negative (-) cable at the negative battery (-) terminal.
3. Remove the engine oil pressure sender wire from the sender.
4. The sender is threaded into the mounting block. Remove the sender.

b. Engine Oil Pressure Sender Inspection and Replacement

Inspect the sender and wiring terminal for continuity. Replace a defective or faulty sender with a new part.

c. Engine Oil Pressure Sender Installation and Testing

1. Thread the engine oil pressure sender into the mounting block snugly, then connect the sender wire to the sender.
2. Connect the battery negative (-) cable at the negative battery (-) terminal.
3. Check for proper oil level.
4. Start the engine, and observe the operator's display for warning indication. If the sender is not defective, the problem could be elsewhere; possibly in a shorted wire, improper-running engine, low oil, obstructed or faulty oil pump, defective instrument display.

Engine Oil Pressure Switch

a. Engine Oil Pressure Switch Removal

1. The engine oil pressure switch is located on the cab firewall.
2. Remove the battery negative (-) cable at the negative battery (-) terminal.
3. Remove and label the engine oil pressure switch wires.

4. The switch is threaded into the mounting block. Remove the switch.

b. Engine Oil Pressure Switch Inspection and Replacement

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

c. Engine Oil Pressure Switch Installation and Testing

1. Thread the engine oil pressure switch into the mounting block.
2. Connect the previously labeled wires to the switch.
3. Connect the battery negative (-) cable at the negative battery (-) terminal.
4. Check for proper oil level.
5. Start the engine, and observe the operator's display for warning indication. If the switch is not defective, the problem could be elsewhere; possibly in a shorted wire, improper-running engine, low oil, obstructed or faulty oil pump, defective instrument display.

9.10.4 Fuel Level Sender

a. Fuel Level Indicator Testing

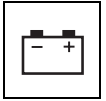
1. The fuel level sender wiring harness leads can be accessed from the top of the fuel tank. Disconnect the fuel level sender wiring harness leads. With the help of an assistant, touch both harness leads together.
2. From the operator's cab, have the assistant turn the ignition key switch to the RUN position. **DO NOT** start the engine. Observe the fuel level indicator needle on the operator's instrument cluster. The reading must be at the FULL mark.

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 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.

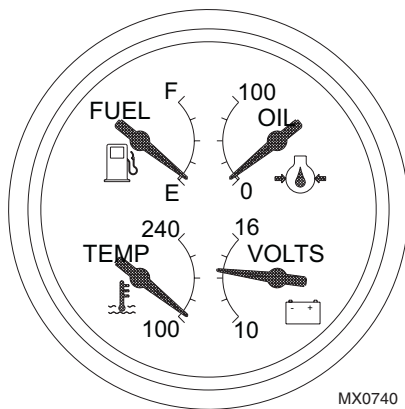


3. If the fuel level indicator needle does not move after the ignition key switch is turned to the RUN position, use a test lamp to determine whether current is flowing from the ignition switch to the fuel level sender.
4. If the fuel level indicator does not move and a faulty or defective fuel level 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.

9.11 GAUGES

9.11.1 Analog Gauges

The machine is equipped with an analog fuel level, oil pressure, water temperature and battery voltage gauge.



a. Removal

1. Remove the battery negative (-) cable at the negative battery (-) terminal.
2. Remove the four bolts holding the gauge panel, unplug connectors from the harness on the backside of the gauge panel and remove the panel from the dash.

b. Disassembly

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

c. Installation and Testing

1. Install the gauge in the dash. Install the gauge bracket, lock washers and nuts. Connect the wire connections.
2. Connect the battery negative (-) cable at the negative battery (-) terminal.
3. Turn the ignition to the ON position to check the fuel level. If gauge is not reading properly refer to Section 9.10.4, "Fuel Level Sender."
4. Start the machine and allow the engine to warm to check the engine water temperature.

9.12 DASH SWITCHES

Note: For information on the front windshield wiper, rear window wiper and washer systems, refer to Section 9.8.1, "Windshield Washer Reservoir and Pump."

9.12.1 Ignition Key Switch

a. Ignition Switch Removal

1. Remove the battery negative (-) cable at the negative battery (-) terminal.
2. Remove lower access panel.
3. Remove the hex nut securing the ignition key switch to the dash.
4. Reach up and under the dash to work the ignition switch and wiring out of the mounting hole.
5. Disconnect the ignition switch connectors from the cab harness connectors, and remove the switch from the machine.

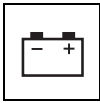
b. Disassembly

DO NOT disassemble the ignition switch. Replace a defective switch with a new part.

c. Inspection and Replacement

To determine the proper operation of the ignition key switch, using the following charts, test the wires on the back of the switch for continuity with an ohmmeter.

Test the ignition key switch for continuity, by checking from the ignition (Red - Battery) wire to each of the following wires in each switch position. Continuity (X) should be present as indicated in the following chart:



Electrical System

Switch Position			
Test from Red (Battery) wire to:	OFF	RUN	START
Orange/Gray Wire			
Orange/Dark Green Wire		X	X
Violet/Brown Wire			X

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

d. Ignition Switch Installation

1. Connect the ignition key switch to the cab harness connectors.
2. Reach up and under the dash to work the ignition switch into the ignition switch-mounting hole on the lower right side of the dash.
3. Align the ignition switch 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.
4. Install the lower access panel.
5. Connect the battery negative (-) cable at the negative battery (-) terminal.

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

9.12.2 Dash Switches

a. Switch Removal

1. Remove the battery negative (-) cable at the negative battery (-) terminal.
2. There are three standard switches in the gauge panel (park brake, 4x4/4x2 and shutdown override). The machine could be equipped with one or more of these optional switches (heater on/off, beacon, work lights, and wiper/washer switch).

3. Pull the panel out of the dash, disconnect the harness connector to the switch in question and remove the switch out of the panel.

b. Disassembly

DO NOT disassemble the dash switch. Replace a defective switch with a new part.

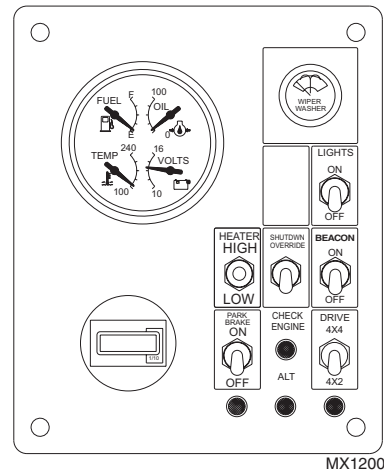
c. Inspection and Replacement

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.

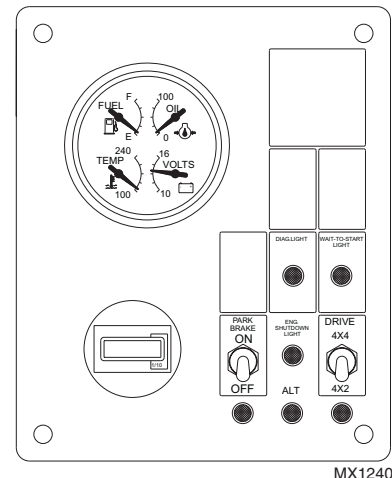
d. Switch Installation

1. Connect the switch to the cab harness connector.
2. Position the switch into the rectangular switch bezel and snap into position.

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3. Connect the battery negative (-) cable at the negative battery (-) terminal.
4. Start the machine and check the replaced switch for proper function.

9.12.3 Warning or Activated Lights

1. Park Brake - Activated
2. Check Engine - Warning
3. Alternator - Warning
4. 4x4/4x2 - Activated

a. Bulb Removal

1. Remove the battery negative (-) cable at the negative battery (-) terminal.
2. Pull the panel out of the dash, disconnect the wire connector to the bulb in question and remove the bulb from the panel.

b. Inspection and Replacement

Inspect the bulb terminals for continuity and/or shorting. Replace a defective or faulty bulb with a new bulb.

1. Replace bulb in panel, connect wire and secure dash panel.
2. Connect the battery negative (-) cable at the negative battery (-) terminal.

9.13 Transmission Lever

9.13.1 Transmission Lever Replacement

a. Lever Removal

1. Remove the battery negative (-) cable at the negative battery (-) terminal.
2. Loosen and remove the two allenhead screws holding the lever together. Disconnect the wiring harness connector from the lever base and remove.

b. Disassembly

DO NOT disassemble the shifter or wiper lever. Replace a defective lever with a new part.

c. Inspection and Replacement

Inspect the switch terminals for continuity and shorting. Replace a defective or faulty lever with a new lever.

d. Lever Installation

1. Connect the wire harness connector to the lever base.
2. Install both allenhead screws into the transmission shift lever base and tighten the two screws into the wiper lever base.
3. Connect the battery negative (-) cable at the negative battery (-) terminal.
4. Start the machine and check the functions of the replaced lever.

e. Neutral Lock Lever

The red lever on the side of the transmission shift lever base is the neutral lock. With the travel lever in neutral, switch the neutral lock lever to the "N" position. This will lock the travel select lever. Switch the neutral lock lever to "D" to unlock the travel select lever.

9.14 Traction Lock Pedal

9.14.1 Traction Lock Pedal Replacement

a. Pedal Removal

1. Remove the battery negative (-) cable at the negative battery (-) terminal.
2. Disconnect the wiring harness connector from the pedal base.
3. Remove the two bolts holding the pedal and remove.

b. Disassembly

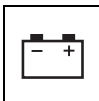
DO NOT disassemble the pedal. Replace a defective pedal with a new part.

c. Inspection and Replacement

Inspect the switch terminals for continuity and shorting. Replace a defective or faulty pedal with a new pedal.

d. Pedal Installation

1. Connect the wire harness connector to the pedal base.
2. Install both bolts and tighten base.
3. Connect the battery negative (-) cable at the negative battery (-) terminal.
4. Start the machine and check the function of the replaced pedal.



9.15 TROUBLESHOOTING - CUMMINS

9.15.1 Fault Detection

Faults are detected while the key switch is in the RUN position, during operation of the machine itself. If a fault becomes active (currently detected) at this time, a fault is logged in memory and a snapshot of the engine parameters is logged. In addition, certain faults may illuminate the warning lamp (amber) or the stop lamp (red) depending upon the severity of the active fault.

For more information, contact your local authorized Cummins service distributor.

9.15.2 Flash-Out of Fault Codes

Fault flash-out mode can be entered through the use of a diagnostic switch or the accelerator pedal. To enter the fault flash-out mode, the key switch must be in the RUN position with the engine not running.

When a diagnostic switch is used to enter the fault flash-out code mode, the ECM will automatically flash the first fault code after the switch is turned to the RUN position.

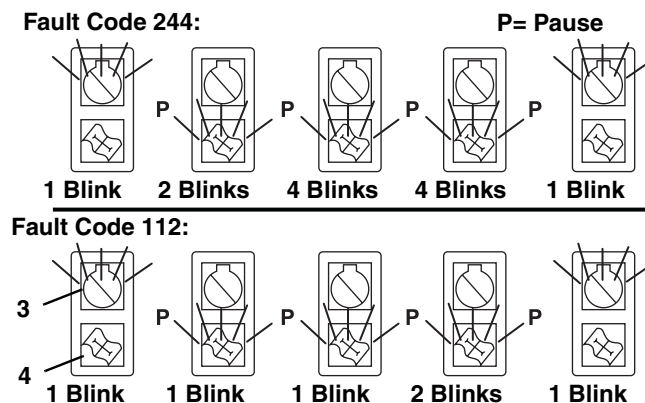
The diagnostic increment/decrement is used to sequence forward or backwards through the active faults.

To enter fault flash-out mode using the accelerator pedal, fully depress and release the pedal 3 times. Once in diagnostic mode, cycling the accelerator pedal will sequence forward through the active faults. The following graphic depicts the pattern of the fault code flash-out scheme as indicated by the stop lamp.

Stop Lamp (3) - The stop lamp provides critical operator messages. These messages require immediate and decisive operator response. The stop lamp is also used to diagnose flash-out fault codes.

Warning Lamp (4) - The warning lamp provides important operator messages. These messages require timely operator attention. The warning lamp is also used to delineate diagnostic fault codes.

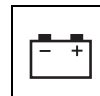
Example Fault Code Sequences



MU5441

9.15.3 Offboard Diagnostics

INSITE™, is the Windows®-based PC service/programming/diagnostic tool for the Cummins engine. It is used to help troubleshoot and repair the engine with extended fault diagnostics and processing power. INSITE™ allows the user to view active and inactive faults and clear the inactive faults. It provides a monitor function that allows the service technician to monitor measured parameters, actuator status and some calculated values. It also provides the technician with the capability to turn on certain drivers such as the grid heaters and lift pump as well as running diagnostic tests such as single cylinder cutout.



9.15.4 Engine Fault Codes Chart

Fault Code	SPN Code	FMI Code	Description
0001			Exhaust Gas Pressure Sensor Number 1 Circuit - High
0002			Exhaust Gas Pressure Sensor Number 1 Circuit - Low
0003			Exhaust Gas Pressure Sensor Number 1 Circuit - Erratic
0004			Exhaust Gas Temperature Sensor Number 1 Circuit - Erratic
0005			Exhaust Gas Temperature Sensor Number 1 Circuit - Low
0006			Exhaust Gas Temperature Sensor Number 1 Circuit - High
111	629	12/12	Engine Control Module
115	612	2	Engine Magnetic Crankshaft Speed/Position
122	102	3/3	Intake Manifold Pressure Sensor Circuit - High
123	102	4/4	Intake Manifold Pressure Sensor Circuit - Low
124		0/16	Intake Manifold 1 Pressure Sensor Circuit
131	91	3/3	Accelerator Pedal or Lever Position Sensor Circuit - High
132	91	4/4	Accelerator Pedal or Lever Position Sensor Circuit - Low
133	974	3/3	Remote Accelerator Pedal or Lever Position Sensor Circuit - High
134	974	4/4	Remote Accelerator Pedal or Lever Position Sensor Circuit - Low
135	100	3	Oil Pressure Sensor Circuit - High
141	100	4/4	Oil Pressure Sensor Circuit - Low
143	100	1/18	Engine Oil Rifle Pressure
144	110	3/3	Engine Coolant Temperature 1 Sensor Circuit - High
145	110	4/4	Engine Coolant Temperature 1 Sensor Circuit - Low
146	110	0/16	Engine Coolant Temperature - High - Warning
147		1	Accelerator Pedal or Lever Position 1 Sensor Circuit - Low
148		0	Accelerator Pedal or Lever Position 1 Sensor Circuit - High
151	110	0/0	Engine Coolant Temperature - High - Critical
153	105	3/3	Intake Manifold Air Temperature Sensor Circuit - High
154	105	4/4	Intake Manifold Air Temperature Sensor Circuit - Low
155	105	0/0	Intake Manifold 1 Temperature
187	1080	4/4	Sensor Supply Voltage Number 2 Circuit - Low
195	111	3/3	Coolant Level Sensor Circuit - High
196	111	4/4	Coolant Level Sensor Circuit - Low
197	111	1/18	Coolant Level - Low
221	108	3/3	Barometric Pressure Sensor Circuit - High
222	108	4/4	Barometric Pressure Sensor Circuit - Low
227	1080	3/3	Sensor Supply 2 Circuit - High
234	190	0/0	Engine Crankshaft Speed/Position
235	111	1	Coolant Level - Low
237	644	2	External Speed Command Input (Multiple Unit Synchronization)
238	611	4/4	Sensor Supply 3 Circuit - Low
241	84	2/2	Vehicle Speed Sensor Circuit
242	84	10/10	Vehicle Speed Sensor Circuit Tampering Has Been Detected



Electrical System

Fault Code	SPN Code	FMI Code	Description
245	647	4/4	Fan Control Circuit - Low
253	98	1	Engine Oil Level
268	94	2	Injector Metering Rail 1 Pressure
269	1195	2	Antitheft Password Valid Indicator
271	1347	4	High Fuel Pressure Solenoid Valve Circuit - Low
272	1347	3	High Fuel Pressure Solenoid Valve Circuit - High
275	1347	7	Fuel Pumping Element Number 1 (Front)
281	1347	7	Fuel Pump Pressurizing Assembly 1
284	1043	4/4	Engine Speed/Position Sensor (Crankshaft) Supply Voltage Circuit
285	639	9	SAE J1939 Multiplexing PGN Timeout Error
286	639	13	SAE J1939 Multiplexing Configuration Error
287	91	19	SAE J1939 Multiplexing Accelerator Pedal or Lever Sensor System Error
288	974	19	SAE J1939 Multiplexing Remote Accelerator Pedal or Lever Data
291	625	9	Proprietary Datalink Error
292	441	14	Auxiliary Temperature Sensor Input 1 - Special Instructions
293	441	3	Auxiliary Temperature Sensor Input 1 - High
294	441	4	Auxiliary Temperature Sensor Input 1 - Low
295	108	2	Barometric Pressure - Erratic
296	1388	14	Auxiliary Pressure Sensor Input 1 - Special Instructions
297	1388	3	Auxiliary Pressure Sensor Input 1 Circuit - High
298	1388	4	Auxiliary Pressure Sensor Input 1 Circuit - Low
319	251	2/2	Real-Time Clock Power Interrupt
322	651	5	Injector Solenoid Driver Cylinder 1 Circuit - Low
323	651	5	Injector Solenoid Driver Cylinder 5 Circuit - Low
324	653	5	Injector Solenoid Driver Cylinder 3 Circuit - Low
325	656	5	Injector Solenoid Driver Cylinder 6 Circuit - Low
331	652	5	Injector Solenoid Driver Cylinder 2 Circuit - Low
332	654	5	Injector Solenoid Driver Cylinder 4 Circuit - Low
334	110	2	Engine Coolant Temperature
341	630	2/2	Engine Control Module Data Lost
342	630	13	Electronic Calibration Code Incompatibility
343	629	12/12	Engine Control Module Warning Internal Hardware Failure
351	627	12	Injector Power Supply
352	1079	4/4	Sensor Supply Voltage Number 1 Circuit - Low
386	1079	3/3	Sensor Supply Voltage Number 1 Circuit - High
387	1043	3/3	Accelerator Pedal or Lever Position Sensor Supply Voltage Circuit - High
412	608	2	SAE J1587/J1922 Data Link - Can not Transmit
415	100	1/1	Engine Oil Rifle Pressure - Low
418	97	0/15	Water-In-Fuel Indicator - High
426	639	2	SAE J1939 Data Link - Can not Transmit
427	639	9	J1939 Datalink - Abnormal Update Rate
428	97	3/3	Water-In-Fuel Indicator Sensor Circuit - High



Fault Code	SPN Code	FMI Code	Description
429	97	4/4	Water-In-Fuel Indicator Sensor Circuit - Low
431	558	2/2	Accelerator Pedal or Lever Idle Validation Circuit - Erratic
432	558	13/13	Accelerator Pedal or Lever Idle Validation Circuit - Out of Calibration
433	102	2	Intake Manifold Pressure Sensor Circuit - Data incorrect
434	627	2/2	Power Supply Lost with Ignition On - Erratic
435	100	2/2	Oil Pressure Switch Sensor Circuit - Erratic
436	105	2	Intake Manifold 1 Temperature - Erratic
441	138	1/18	Battery 1 Voltage - Low
442	138	0/16	Battery 1 Voltage - High
443	1043	4/4	Accelerator Pedal or Lever Position Sensor Supply Voltage Circuit - Low
449	157	0	Injector Metering Rail Number 1 Pressure - High
451	157	3	Injector Metering Rail Number 1 Pressure Circuit - High
452	157	4	Injector Metering Rail Number 1 Pressure Circuit - Low
471	98	1/17	Engine Oil Level - Low
488	105	0/16	Intake Manifold 1 Temperature - High
497	1137	2	Multiple Unit Synchronization Switch - Erratic
498	98	3	Engine Oil Level Sensor Circuit - High
499	98	4	Engine Oil Level Sensor Circuit - Low
523	611	2	Auxiliary Intermediate (PTO) Speed Switch Validation - Erratic
527	702	3	Auxiliary Input/Output 2 Circuit - High
528	093	2	Auxiliary Alternate Torque Validation Switch - Erratic
529	703	3	Auxiliary Input/Output 3 Circuit - High
545	1188	7	Turbocharger 1 Wastegate Control - Not Responding
551	558	4/4	Accelerator Pedal or Lever Idle Validation Circuit - Low
553	157	0/16	Injector Metering Rail 1 Pressure - High
554	157	2	Injector Metering Rail 1 Pressure - Erratic
559	157	1/18	Fuel Pump Delivery Pressure Low
584	677	3/3	Starter Relay Circuit - High
585	677	4/4	Starter Relay Circuit - Low
595	103	0	Turbocharger Number 1 Speed High
596	167	0/16	Electrical Charging System Voltage High
597	167	1/18	Electrical Charging System Voltage Low - Moderately Severe
598	167	1/1	Electrical Charging System Voltage Low - Most Severe
599	640	14	Auxiliary Commanded Dual Output Shutdown - Special Instructions
649	1378	11/31	Change Lubricating Oil and Filter
687	103	18	Turbocharger Number 1 Speed Low
688	98	0	Engine Oil Level - High
689	190	2/2	Engine Crankshaft Speed/Position - Erratic
691	1172	3/3	Turbocharger Number 1 Compressor Inlet Temperature Sensor - High
692	1172	4/4	Turbocharger Number 1 Compressor Inlet Temperature Sensor - Low
731	723	7/7	Engine Speed Sensor/Position Camshaft and Crankshaft Misalignment
757	611	11/31	Engine Control Module Data Lost



Electrical System

Fault Code	SPN Code	FMI Code	Description
778	723	2	Engine Speed Sensor (Camshaft) Error - Erratic
779	703	11	Auxiliary Equipment Sensor Input #3 (OEM Switch)
784	1590	2	Loss of Communication with Adaptive Cruise Control
951	166	2	Cylinder Power Imbalance Between Cylinders
957	27	2	EGR Valve Position - Erratic
958	2795	2	VGT Position Sensor - Erratic
1117	627	2/2	Power Lost Without Ignition Off - Erratic
1139	651	7	Injector Solenoid Driver Cylinder 1 - Not Responding
1141	652	7	Injector Solenoid Driver Cylinder 2 - Not Responding
1142	653	7	Injector Solenoid Driver Cylinder 3 - Not Responding
1143	654	7	Injector Solenoid Driver Cylinder 4 - Not Responding
1144	655	7	Injector Solenoid Driver Cylinder 5 - Not Responding
1145	656	7	Injector Solenoid Driver Cylinder 6 - Not Responding
1228	27	2/2	EGR Valve Position - Erratic
1229	2795	2/2	VGT Position Sensor - Erratic
1239	2623	3/3	Accelerator Pedal or Lever Position Sensor 2 Circuit - High
1241	2623	4/4	Accelerator Pedal or Lever Position Sensor 2 Circuit - Low
1242	091	2/2	Accelerator Pedal or Lever Position Sensor Number 1 and 2 - Erratic
1633	625	2	Komnet Datalink Cannot Transmit
1639	703	11	Auxiliary Equipment Sensor Input Number 3 (OEM Switch)
1654	1323	11/31	Engine Misfire Cylinder 1
1655	1324	11/31	Engine Misfire Cylinder 2
1656	1325	11/31	Engine Misfire Cylinder 3
1657	1326	11/31	Engine Misfire Cylinder 4
1658	1327	11/31	Engine Misfire Cylinder 5
1659	1328	11/31	Engine Misfire Cylinder 6
1663	3241	11/31	Catalyst Inlet Temperature Sensor Swapped with Outlet
1664	3050	11/31	Catalyst Missing
1665	3241	4	Exhaust Gas Temperature 1 Circuit - Low
1666	3241	3	Exhaust Gas Temperature 1 Circuit - High
1667	3241	2	Exhaust Gas Temperature 1 - Erratic
1668	1761	4/4	Catalyst Tank Level Sensor Circuit - Low
1669	1761	3	Catalyst Tank Level Sensor Circuit - High
1671	1761	1/18	Catalyst Tank Level - Low - Moderately Severe
1673	1761	1	Catalyst Tank Level - Low - Most Severe
1674	3249	4	Exhaust Gas Temperature 2 Circuit - Low
1675	3249	3	Exhaust Gas Temperature 2 Circuit - High
1676	3249	2	Exhaust Gas Temperature 2 Circuit - Erratic
1677	3031	4	Catalyst Tank Temperature - Low
1678	3031	3	Catalyst Tank Temperature - High
1679	3031	2	Catalyst Tank Temperature - Erratic
1681	3361	12	Catalyst Dosing Control Unit



Fault Code	SPN Code	FMI Code	Description
1682	3362	11/31	Catalyst Reagent Dosing Unit Input Lines
1683	3449	3	Catalyst Tank Heater Circuit - High
1684	3363	4	Catalyst Tank Heater Circuit - Low
1687	3050	0	Catalyst Over Temperature
1689	251	12/2	Real-Time Clock Power Interrupt - Erratic
1692	3234	4	Aftertreatment NOx Sensor - Low
1694	3234	2	Aftertreatment NOx Sensor - Erratic
1697	3489	3	Aftertreatment #1 Air Enable Actuator - High
1698	3489	4	Aftertreatment #1 Air Enable Actuator - Low
1699	1761	2	Catalyst Tank Level Sensor - Erratic
1711	3361	9	Dosing Control Unit Datalink - Abnormal Update Rate
1712	3363	1/18	Catalyst Tank Heater Circuit - Low
1713	3363	0/16	Catalyst Tank Heater Circuit - High
1716	411	11	Auxiliary Temperature Sensor Input 1 Circuit
1717	3241	0/15	Exhaust Gas Temperature 1 - High
1718	1322	11/31	Engine Misfire for Multiple Cylinders
1848	105	10	Intake Manifold 1 Temperature - Abnormal Rate of Change
1849	3241	10	Exhaust Gas Temperature 1 - Abnormal Rate of Change
1851	3249	10	Exhaust Gas Temperature 2 - Abnormal Rate of Change
1892	84	1/18	Wheel-Based Vehicle Speed - Low
1911	157	0	Injector Metering Rail Number 1 Pressure - High
2183	1072	4	Engine Brake Actuator Driver 1 Circuit - Low
2185		3/3	Sensor Supply Voltage 4 Circuit - High
2186		4/4	Sensor Supply Voltage 4 Circuit - Low
2215	94	1	Fuel Pump Delivery Pressure - Low
2216	94	0	Fuel Pump Delivery Pressure - High
2217	630	11/31	Engine Control Module Calibration Program Memory (RAM) - Corruption
2249	157	1	Injector Metering Rail 1 Pressure - Low
2265	1075	3	Electric Lift Pump for Engine Fuel Supply Circuit - High
2266	1075	4	Electric Lift Pump for Engine Fuel Supply Circuit - Low
2271	27	3/3	Exhaust Gas Recirculation (EGR) Valve Position Sensor Circuit - High
2272	027	4/4	Exhaust Gas Recirculation (EGR) Valve Position Circuit - Low
2273	411	3/3	EGR Valve Differential Pressure Sensor Circuit - Shorted High
2274	411	4/4	EGR Valve Differential Pressure Sensor Circuit - Shorted Low
2292		16	Fuel Inlet Meter Device - High
2293		18	Fuel Inlet Meter Device Flow Demand Low
2311	633	11/31	Fueling Actuator Number 1 Circuit Error
2321	190	2	Engine Crankshaft Speed/Position - Erratic
2322	723	2	Backup Engine Speed/Position Sensor Number 2 - Erratic
2345	103	10/10	Turbocharger Speed - Invalid Rate of Change Detected
2346	2789	1/15	Exhaust Gas Temperature - High
2347	611	0/15	Turbocharger Compressor Outlet Temperature - High



Electrical System

Fault Code	SPN Code	FMI Code	Description
2348	27	13/13	EGR Valve Failed Automatic Calibration Procedure
2349	2791	5/5	EGR Valve Control Circuit - Low
2351	2791	4/4	EGR Valve Control Circuit - Low
2352	2791	3/3	EGR Valve Control Circuit - High
2353	2971	6/6	Exhaust Gas Recirculation (EGR) Valve Control Circuit - High
2357	2791	7/7	Exhaust Gas Recirculation (EGR) Valve Control - Not Responding
2359	411	0/16	Exhaust Gas Recirculation (EGR) Differential Pressure Sensor - High
2362	1072	4	Engine Brake Actuator Circuit #1 - Low
2363	1073	4	Engine Brake Actuator Circuit #2 - Low
2366	1072	3	Engine Brake Actuator Circuit #1 - High
2367	1073	3	Engine Brake Actuator Circuit #2 - High
2373	1209	3/3	Exhaust Gas Pressure Sensor Circuit - Shorted High
2374	1209	4/4	Exhaust Gas Pressure Sensor Circuit - Shorted Low
2375	412	3	EGR Temperature Sensor Circuit - High
2376	412	4/4	Recirculation Exhaust Gas (EGR) Temperature Sensor Circuit - Low
2377	647	3	Fan Control Circuit - High
2381	2795	4/4	Turbocharger Position Sensor Circuit - Shorted High
2382	2795	4/4	Turbocharger Position Sensor Circuit - Shorted Low
2383	641	5/5	Variable Geometry Turbocharger Actuator Circuit - Low
2384	641	4/4	VGT Actuator Driver Circuit - Low
2385	641	3/3	VGT Actuator Driver Circuit - High
2386	2975	6/6	Turbocharger Actuator Motor Circuit - High
2387	2975	7/7	Turbocharger Actuator Motor - Not Responding
2388	2795	13/13	Variable Geometry Turbocharger Actuator Position Failed Calibration
2554	1209	2/2	Exhaust Pressure Sensor Circuit - Erratic
2555	729	4	Intake Air Heater #1 Circuit - Low
2557	697	3	Auxiliary PWM Driver #1 - High
2558	697	4	Auxiliary PWM Driver #1 - Low
2771	3234	9	Aftertreatment Outlet NOx Sensor - Abnormal Update Rate
2772	3226	0/15	Aftertreatment Outlet NOx Sensor - High - Least Severe
2773	3226	0	Aftertreatment Outlet NOx Sensor - High - Most Severe
2961	412	0/15	Exhaust Gas Recirculation (EGR) Temperature - High - Least Severe
2962	412	0/16	Exhaust Gas Recirculation (EGR) Temperature - High - More Severe
2963	110	0/15	Engine Coolant Temperature High - Least Severe
2964	105	0/15	Intake Manifold Temperature High - Least Severe
2973	102	2/2	Intake Manifold Pressure Sensor Circuit - Erratic
2976	3361	2	Dosing Control Unit Temperature - Erratic
9121	2791	0/15	Exhaust Gas Recirculation (EGR) Valve Actuator Over Temperature
9122	641	0/15	Variable Geometry Turbocharger Actuator Over Temperature



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