Assembly Instructions for O-ring Face Seal (ORFS) Fittings

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

⚠ CAUTION

CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

3. Pre-lubricate the o-ring with Hydraulic Oil.
4. Place the tube assembly against the fitting body so that the flat face comes in contact with the o-ring. Hand thread the nut onto the fitting body.
5. Torque nut to value listed in Table 4-7, O-ring Face Seal (ORFS) - Steel or Table 4-8, O-ring Face Seal (ORFS) - Aluminum/Brass while using the Double Wrench Method. Refer to FFWR and TFFT Methods for procedure requirements if using the FFWR method.

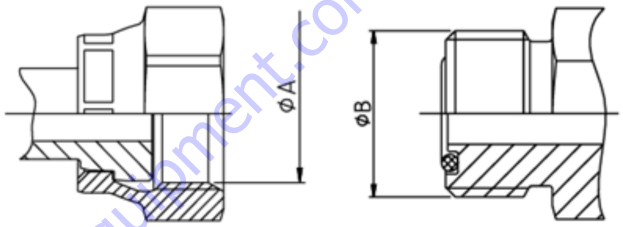
NOTE: *Torque values provided in Table 4-7, O-ring Face Seal (ORFS) - Steel and Table 4-8, O-ring Face Seal (ORFS) - Aluminum/Brass are segregated based on the material configuration of the connection.*

ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or

BRASS mating components

Table 4-7. O-ring Face Seal (ORFS) - Steel

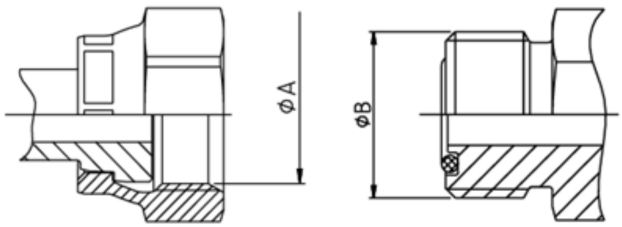


TYPE/FITTING IDENTIFICATION							Torque						Flats from Wrench Resistance (F.F.W.R)**	
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[ft. lb.]			[N-m]			Tube Nuts	Swivel & Hose Ends
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max		
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	4	9/16-18	0.51	13.00	0.56	14.20	18	19	20	25	26	27	1/4 to 1/2	1/2 to 3/4
	6	11/16-16	0.63	15.90	0.69	17.50	30	32	33	40	43	45	1/4 to 1/2	1/2 to 3/4
	8	13/16-16	0.75	19.10	0.81	20.60	40	42	44	55	57	60	1/4 to 1/2	1/2 to 3/4
	10	1-14	0.94	23.80	1.00	25.40	60	63	66	81	85	89	1/4 to 1/2	1/2 to 3/4
	12	13/16-12	1.11	28.20	1.19	30.10	85	90	94	115	122	127	1/4 to 1/2	1/2 to 3/4
	16	17/16-12	1.34	34.15	1.44	36.50	110	116	121	149	157	164	1/4 to 1/2	1/2 to 3/4
	20	111/16-12	1.59	40.50	1.69	42.90	150	158	165	203	214	224	1/4 to 1/2	1/2 to 3/4
	24	2-12	1.92	48.80	2.00	50.80	230	242	253	312	328	343	1/4 to 1/2	1/2 to 3/4
	32	21/2-12	2.43	61.67	2.50	63.50	375	394	413	508	534	560	1/4 to 1/2	1/2 to 3/4

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methods for FFWR procedure requirements.

Table 4-8. O-ring Face Seal (ORFS) - Aluminum/Brass



TYPE/FITTING IDENTIFICATION							Torque						Flats from Wrench Resistance (F.F.W.R)**	
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[ft. lb.]			[N-m]			Tube Nuts	Swivel & Hose Ends
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max		
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	4	9/16-18	0.51	13.00	0.56	14.20	12	13	13	16	18	18	1/4 to 1/2	1/2 to 3/4
	6	11/16-16	0.63	15.90	0.69	17.50	20	21	22	27	28	30	1/4 to 1/2	1/2 to 3/4
	8	13/16-16	0.75	19.10	0.81	20.60	26	28	29	35	38	39	1/4 to 1/2	1/2 to 3/4
	10	1-14	0.94	23.80	1.00	25.40	39	41	43	53	56	58	1/4 to 1/2	1/2 to 3/4
	12	13/16-12	1.11	28.20	1.19	30.10	55	58	61	75	79	83	1/4 to 1/2	1/2 to 3/4
	16	17/16-12	1.34	34.15	1.44	36.50	72	76	79	98	103	107	1/4 to 1/2	1/2 to 3/4
	20	111/16-12	1.59	40.50	1.69	42.90	98	103	108	133	140	146	1/4 to 1/2	1/2 to 3/4
	24	2-12	1.92	48.80	2.00	50.80	12	13	13	16	18	18	1/4 to 1/2	1/2 to 3/4
	32	21/2-12	2.43	61.67	2.50	63.50	20	21	22	27	28	30	1/4 to 1/2	1/2 to 3/4

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methods for FFWR procedure requirements.

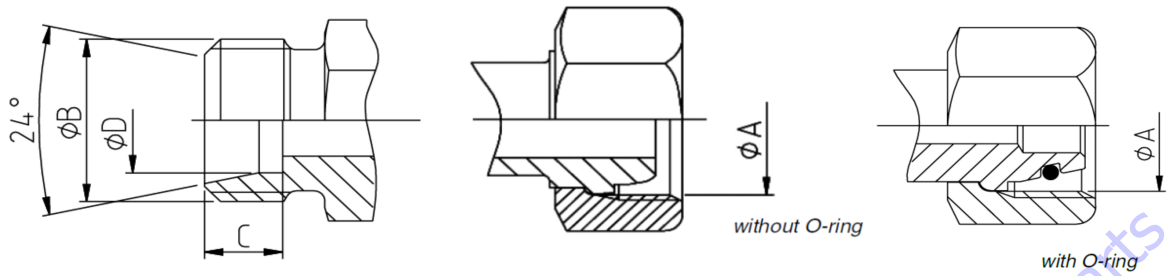
Assembly Instructions for DIN 24° Flare Bite Type Fittings (MBTL and MBTS)

⚠ CAUTION

A NON-SQUARE TUBE END CAN CAUSE IMPROPERLY SEATED FITTINGS AND LEAKAGE.

1. Inspect the components to ensure free of contamination, external damage, rust, splits, dirt, foreign matter, or burrs. Ensure tube end is visibly square. If necessary replace fitting or tube.
2. Lubricate thread and cone of fitting body or hardened pre-assembly tool, as well as the progressive ring and nut threads.
3. Slip nut and progressive ring over tube, assuring that they are in the proper orientation.
4. Push the tube end into the coupling body.
5. Slide collet into position and tighten until finger tight. Mark nut and tube in the finger-tight position. Tighten nut to the number of flats listed in Table 4-9, DIN 24°Cone (MBTL & MBTS) while using the Double Wrench Method. The tube must not turn with the nut.

Table 4-9. DIN 24°Cone (MBTL & MBTS)



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

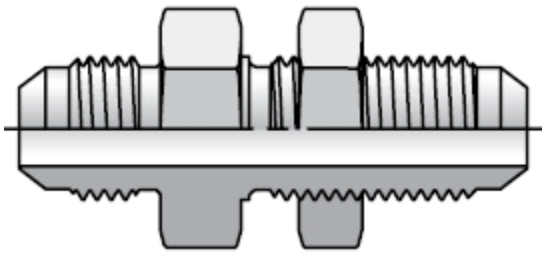
*ØA, ØB, C, & ØD thread dimensions for reference only.

** See Appendix B for FFWR procedure requirements.

Assembly Instructions for Bulkhead (BH) Fittings

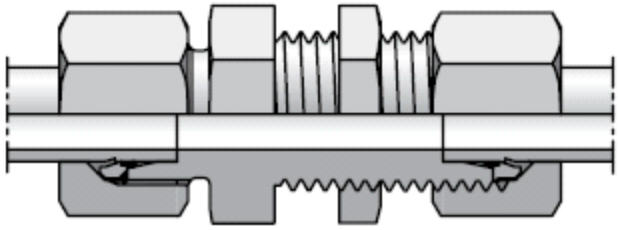
1. Ensure threads and surface are free of rust, weld and brazing splatter, splits, burrs or other foreign material. If necessary replace fitting or adapter.
2. Remove the locknut from the bulkhead assembly.
3. Insert the bulkhead side of the fitting into the panel or bulkhead bracket opening.
4. Hand thread the locknut onto the bulkhead end of the fitting body.
5. Torque nut onto fitting per Table 4-10 and Table 4-11 while using the Double Wrench Method.

Table 4-10. Bulkhead Fittings (BH) - INCH



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

Table 4-11. Bulkhead Fittings (BH) - METRIC



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

Assembly Instructions for O-ring Boss (ORB) Fittings

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

⚠ CAUTION

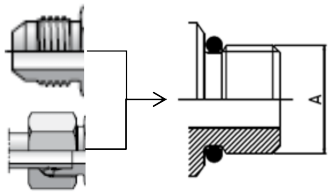
CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

3. Pre-lubricate the o-ring with Hydraulic Oil.
4. For Non-Adjustable and Plugs, thread the fitting by hand until contact.
5. For Adjustable fittings, refer to Adjustable Stud End Assembly for proper assembly.
6. Torque the fitting or nut to value listed in Table 4-12 through Table 4-17 while using the Double Wrench Method.
   a. The table headings identify the straight thread o-ring port and the type on the other side of the fitting. The torque will be applied to the straight thread o-ring port.
   b. Torque values provided in Table 4-12 through Table 4-17 are segregated based on the material configuration of the connection. 'ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

7. Inspect to ensure the o-ring is not pinched and the washer is seated flat on the counterbore of the port.

Table 4-12. O-ring Boss (ORB) - Table 1 of 6



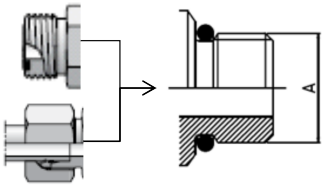
TYPE/FITTING IDENTIFICATION					HEX TYPE PLUGS & STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(85)	(90)	(94)	10	10	11
	3	3/8-24	0.37	9.52	(155)	(163)	(171)	18	18	19
	4	7/16-20	0.44	11.11	22	23	24	29	31	33
	5	1/2-20	0.50	12.70	23	25	26	32	34	35
	6	9/16-18	0.56	14.28	29	31	32	40	42	43
	8	3/4-16	0.75	19.10	52	55	57	70	75	77
	10	7/8-14	0.87	22.22	85	90	94	115	122	127
	12	1 1/16-12	1.06	27.00	135	142	149	185	193	202
	14	1 3/16-12	1.19	30.10	175	184	193	235	249	262
	16	1 5/16-12	1.31	33.30	200	210	220	270	285	298
	20	1 5/8-12	1.63	41.30	250	263	275	340	357	373
	24	1 7/8-12	1.87	47.60	305	321	336	415	435	456
	32	2 1/2-12	2.50	63.50	375	394	413	510	534	560

TYPE/FITTING IDENTIFICATION					HEX TYPE PLUGS & STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(55)	(58)	(61)	6	7	7
	3	3/8-24	0.37	9.52	(101)	(106)	(111)	11	12	13
	4	7/16-20	0.44	11.11	14	15	16	19	20	22
	5	1/2-20	0.50	12.70	15	16	17	20	22	23
	6	9/16-18	0.56	14.28	19	20	21	26	27	28
	8	3/4-16	0.75	19.10	34	36	37	46	49	50
	10	7/8-14	0.87	22.22	55	58	61	75	79	83
	12	1 1/16-12	1.06	27.00	88	93	97	119	126	132
	14	1 3/16-12	1.19	30.10	114	120	126	155	163	171
	16	1 5/16-12	1.31	33.30	130	137	143	176	186	194
	20	1 5/8-12	1.63	41.30	163	171	179	221	232	243
	24	1 7/8-12	1.87	47.60	198	208	218	268	282	296
	32	2 1/2-12	2.50	63.50	244	256	268	331	347	363

* ØA Thread OD dimension for reference only.

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

Table 4-13. O-ring Boss (ORB) - Table 2 of 6

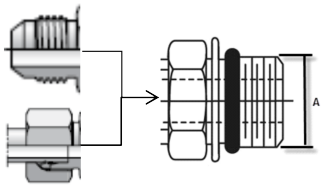


TYPE/FITTING IDENTIFICATION					STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	--	--	--	--	--	--
	3	3/8-24	0.37	9.52	--	--	--	--	--	--
	4	7/16-20	0.44	11.11	26	27	28	35	37	38
	5	1/2-20	0.50	12.70	30	32	33	40	43	45
	6	9/16-18	0.56	14.28	35	37	39	46	50	53
	8	3/4-16	0.75	19.10	60	63	66	80	85	89
	10	7/8-14	0.87	22.22	100	105	110	135	142	149
	12	1 1/16-12	1.06	27.00	135	142	149	185	193	202
	14	1 3/16-12	1.19	30.10	175	184	193	235	249	262
	16	1 5/16-12	1.31	33.30	200	210	220	270	285	298
	20	1 5/8-12	1.63	41.30	250	263	275	340	357	373
	24	1 7/8-12	1.87	47.60	305	321	336	415	435	456
	32	2 1/2-12	2.50	63.50	375	394	413	510	534	560
TYPE/FITTING IDENTIFICATION					STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	--	--	--	--	--	--
	3	3/8-24	0.37	9.52	--	--	--	--	--	--
	4	7/16-20	0.44	11.11	17	18	18	23	24	24
	5	1/2-20	0.50	12.70	20	21	21	27	28	28
	6	9/16-18	0.56	14.28	23	24	24	31	33	33
	8	3/4-16	0.75	19.10	39	41	43	53	56	58
	10	7/8-14	0.87	22.22	65	69	72	88	94	98
	12	1 1/16-12	1.06	27.00	88	93	97	119	126	132
	14	1 3/16-12	1.19	30.10	114	120	126	155	163	171
	16	1 5/16-12	1.31	33.30	130	137	143	176	186	194
	20	1 5/8-12	1.63	41.30	163	171	179	221	232	243
	24	1 7/8-12	1.87	47.60	198	208	218	268	282	296
	32	2 1/2-12	2.50	63.50	244	256	268	331	347	363

* ØA Thread OD dimension for reference only.

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

Table 4-14. O-ring Boss (ORB) - Table 3 of 6

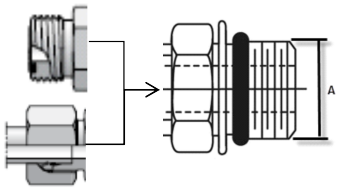


TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(60)	(63)	(66)	7	7	7
	3	3/8-24	0.37	9.52	(100)	(105)	(110)	11	12	12
	4	7/16-20	0.44	11.11	15	16	17	20	22	23
	5	1/2-20	0.50	12.70	21	22	23	28	30	31
	6	9/16-18	0.56	14.28	29	31	32	40	42	43
	8	3/4-16	0.75	19.10	52	55	57	70	75	77
	10	7/8-14	0.87	22.22	85	90	94	115	122	127
	12	1 1/16-12	1.06	27.00	135	142	149	185	193	202
	14	1 3/16-12	1.19	30.10	175	184	193	235	249	262
	16	1 5/16-12	1.31	33.30	200	210	220	270	285	298
	20	1 5/8-12	1.63	41.30	250	263	275	340	357	373
	24	1 7/8-12	1.87	47.60	305	321	336	415	435	456
	32	2 1/2-12	2.50	63.50	375	394	413	510	534	560
TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(39)	(41)	(43)	4	5	5
	3	3/8-24	0.37	9.52	(65)	(69)	(72)	7	8	8
	4	7/16-20	0.44	11.11	10	11	11	14	15	15
	5	1/2-20	0.50	12.70	14	15	15	19	20	20
	6	9/16-18	0.56	14.28	19	20	21	26	27	28
	8	3/4-16	0.75	19.10	34	36	37	46	49	50
	10	7/8-14	0.87	22.22	55	58	61	75	79	83
	12	1 1/16-12	1.06	27.00	88	93	97	119	126	132
	14	1 3/16-12	1.19	30.10	114	120	126	155	163	171
	16	1 5/16-12	1.31	33.30	130	137	143	176	186	194
	20	1 5/8-12	1.63	41.30	163	171	179	221	232	243
	24	1 7/8-12	1.87	47.60	198	208	218	268	282	296
	32	2 1/2-12	2.50	63.50	244	256	268	331	347	363

* ØA Thread OD dimension for reference only.

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

Table 4-15. O-ring Boss (ORB) - Table 4 of 6



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

*ØA Thread OD dimension for reference only.

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

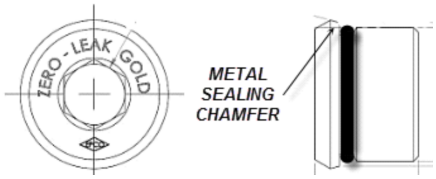
Table 4-16. O-ring Boss (ORB) - Table 5 of 6

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

* ØA Thread OD dimension for reference only.

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

Table 4-17. O-ring Boss (ORB) - Table 6 of 6



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

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

*ØA Thread OD dimension for reference only.

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

Assembly Instructions for Adjustable Port End Metric (MFF) Fittings

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

⚠ CAUTION

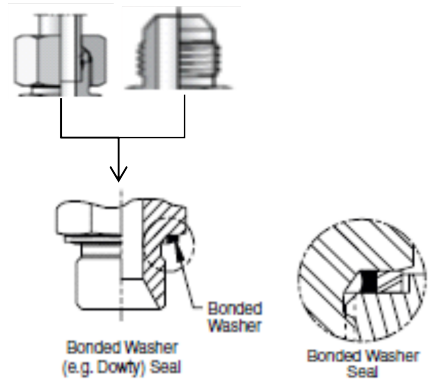
CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

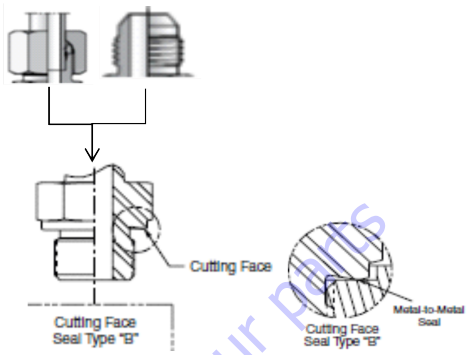
3. Pre-lubricate the o-ring with Hydraulic Oil.
4. For Non-Adjustable Fittings and Plugs, thread the fitting by hand until contact.
5. For Adjustable fittings, refer to Adjustable Stud End Assembly for proper assembly.
6. Torque the fitting or nut to value listed in Table 4-18, Table 4-19, Table 4-20, Table 4-21, Table 4-22, or Table 4-23 while using the Double Wrench Method.
   a. The table headings identify the Metric port and the type on the other side of the fitting. The torque will be applied to the Metric port.
   b. Torque values provided in Table 4-18, Table 4-19, Table 4-20, Table 4-21, Table 4-22, and Table 4-23 are segregated based on the material configuration of the connection. 'ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

7. Inspect to ensure the o-ring is not pinched and the washer is seated flat on the counterbore of the port.

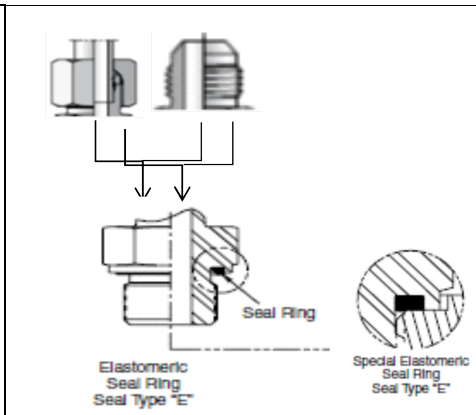
Table 4-18. Metric Flat Face Port (MFF) - L Series - Table 1 of 3

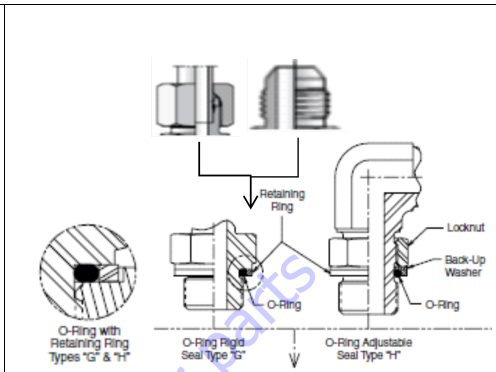




TYPE/FITTING IDENTIFICATION			FORM A (SEALING WASHER) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM B (CUTTING FACE) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[ft. lb.]			[N-m]			[ft.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

Table 4-19. Metric Flat Face Port (MFF) - L Series - Table 2 of 3





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

Table 4-20. Metric Flat Face Port (MFF) - L Series - Table 3 of 3

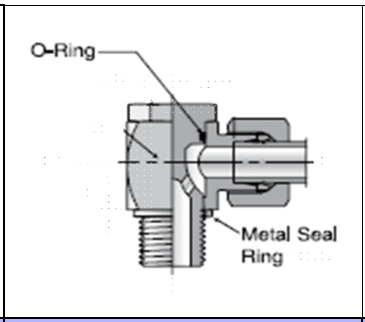
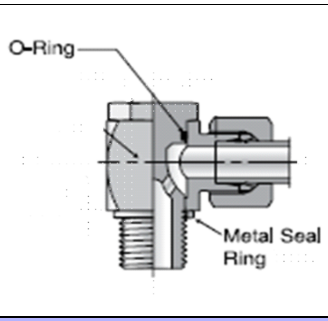
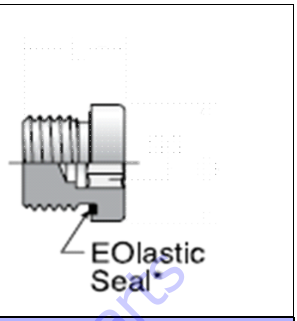
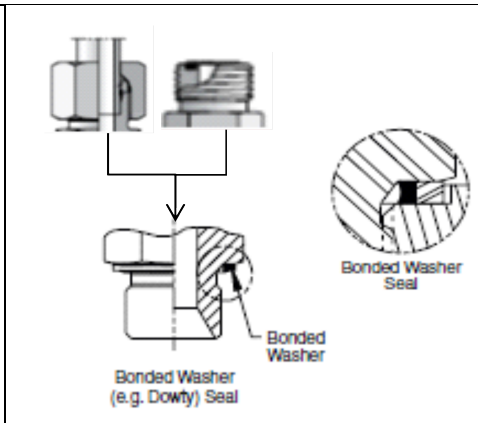
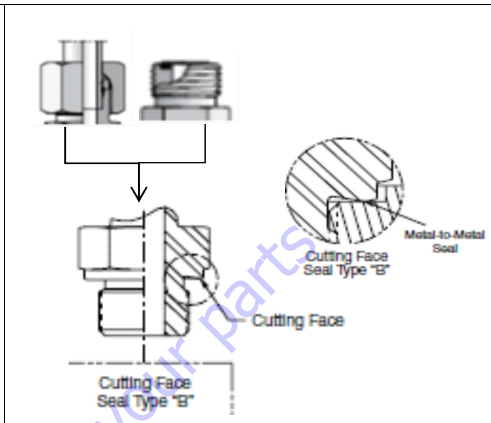
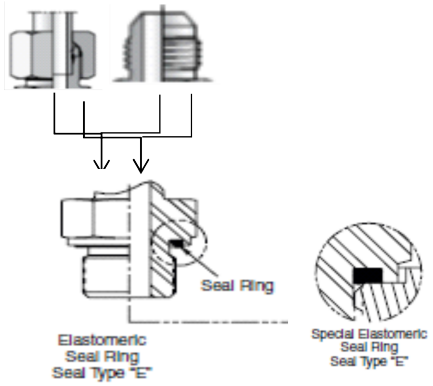
																				
TYPE/FITTING IDENTIFICATION			BANJO FITTINGS with L series DIN (MBTL) opposite end						HIGH PRESSURE BANJO FITTINGS with L series DIN (MBTL) opposite end						FORM E (EOLASTIC SEALING RING) HOLLOW HEX PLUGS					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[ft.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

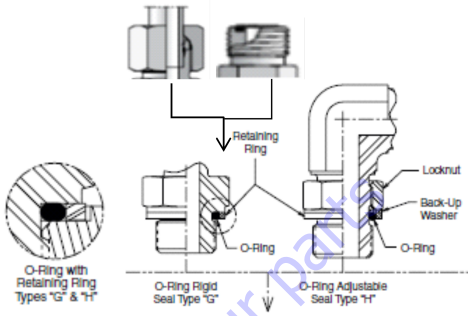
Table 4-21. Metric Flat Face Port (MFF) - S Series - Table 1 of 3

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

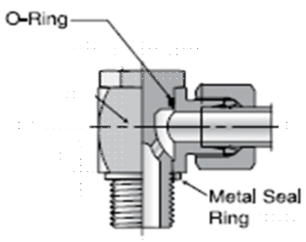
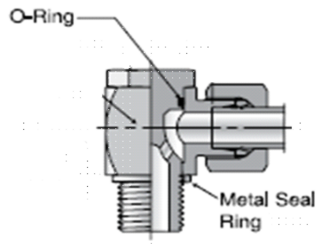
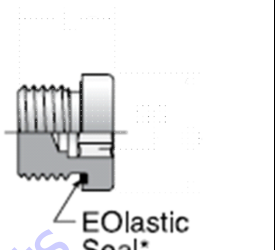
Table 4-22. Metric Flat Face Port (MFF) - S Series - Table 2 of 3





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

Table 4-23. Metric Flat Face Port (MFF) - L Series - Table 3 of 3

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

Assembly Instructions for Metric ISO 6149 (MPP) Port Assembly Stud Ends

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

⚠ CAUTION

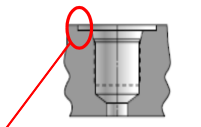
CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

3. Pre-lubricate the o-ring with Hydraulic Oil.
4. For Non-Adjustable Fittings and Plugs, thread the fitting by hand until contact.
5. For Adjustable fittings, refer to Adjustable Stud End Assembly for proper assembly.
6. Torque the fitting or nut to value listed in Table 4-24 while using the Double Wrench Method.
   a. The table headings identify the Metric port and the type on the other side of the fitting. The torque will be applied to the Metric port.
   b. Torque values provided in Table 4-24 are segregated based on the material configuration of the connection. 'ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

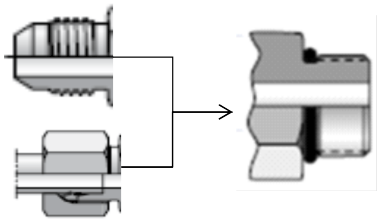
- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

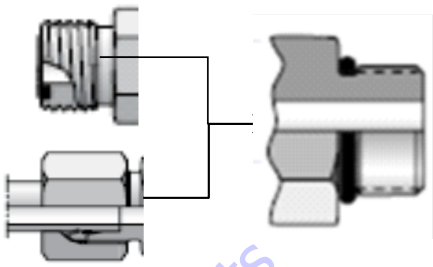
7. Inspect to ensure the o-ring is not pinched and the washer is seated flat on the counterbore of the port.

Table 4-24. Metric Pipe Parallel O-ring Boss (MPP)



Note: Metric O-ring only style (ISO 6149) requires o-ring chamfer in the port, similar to ISO 11926 (SAE ORB),**but is not interchangeable.**





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

Assembly instructions for Adjustable Port End (BSPP) Fittings

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

⚠ CAUTION

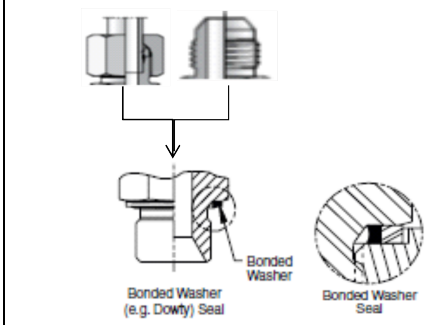
CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

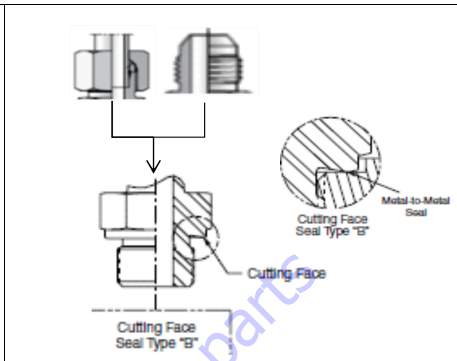
3. Pre-lubricate the o-ring with Hydraulic Oil.
4. For Non-Adjustable Fittings and Plugs, thread the fitting by hand until contact.
5. For Adjustable fittings, refer to Adjustable Stud End Assembly for proper assembly.
6. Torque the fitting or nut to value listed in Table 4-25, Table 4-26, Table 4-27, Table 4-28, Table 4-29, or Table 4-30 while using the Double Wrench Method.
   a. The table headings identify the BSPP port and the type on the other side of the fitting. The torque will be applied to the BSPP port.
   b. Torque values provided in Table 4-25, Table 4-26, Table 4-27, Table 4-28, Table 4-29, and Table 4-30 are segregated based on the material configuration of the connection. 'ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

7. Inspect to ensure the o-ring is not pinched and the washer is seated flat on the counterbore of the port.

Table 4-25. British Standard Parallel Pipe Port (BSPP) - L Series - Table 1 of 3





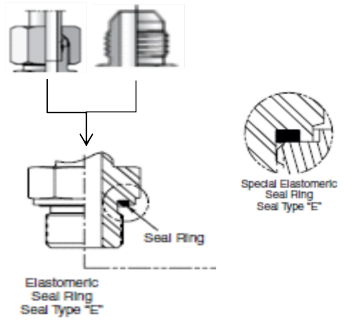
TYPE/FITTING IDENTIFICATION			FORM A**(SEALING WASHER) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM B** (CUTTING FACE) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[ft. lb.]			[N-m]			[ft. lb.]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	7	8	8	9	11	11	13	14	14	18	19	19
	G 1/4A	8	26	28	29	35	38	39	26	28	29	35	38	39
	G 1/4A	10	26	28	29	35	38	39	26	28	29	35	38	39
	G 3/8A	12	33	35	36	45	47	49	52	55	57	70	75	77
	G 1/2A	15	48	51	53	65	69	72	103	108	113	140	146	153
	G 1/2A	18	48	51	53	65	69	72	74	78	81	100	106	110
	G 3/4A	22	66	70	73	90	95	99	133	140	146	180	190	198
	G 1A	28	111	117	122	150	159	165	243	255	267	330	346	362
	G 1-1/4A	35	177	186	195	240	252	264	398	418	438	540	567	594
	G 1-1/2A	42	214	225	235	290	305	319	465	489	512	630	663	694
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[ft. lb.]			[N-m]			[ft. lb.]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	4	5	5	5	7	7	8	9	9	11	12	12
	G 1/4A	8	17	18	19	23	24	26	17	18	19	23	24	26
	G 1/4A	10	17	18	19	23	24	26	17	18	19	23	24	26
	G 3/8A	12	21	22	23	28	30	31	34	36	37	46	49	50
	G 1/2A	15	31	33	34	42	45	46	67	70	73	91	95	99
	G 1/2A	18	31	33	34	42	45	46	48	51	53	65	69	72
	G 3/4A	22	42	45	47	57	61	64	86	91	95	117	123	129
	G 1A	28	72	76	79	98	103	107	158	166	174	214	225	236
	G 1-1/4A	35	115	121	127	156	164	172	259	272	285	351	369	386
	G 1-1/2A	42	139	146	153	188	198	207	302	318	333	409	431	451

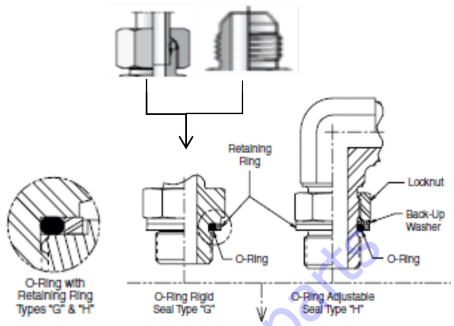
*Typical for JLG Straight Male Stud Fittings

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

***Typical for JLG Adjustable Fittings

Table 4-26. British Standard Parallel Pipe Port (BSPP) - L Series - Table 2 of 3





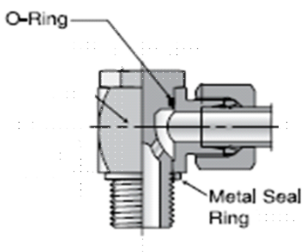
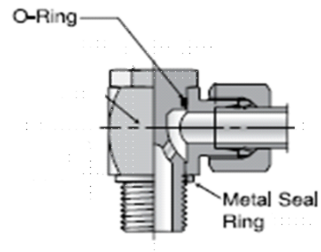
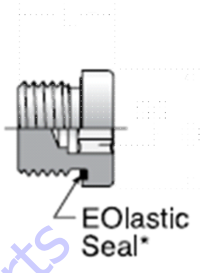
TYPE/FITTING IDENTIFICATION			FORM E* (EOLASTIC SEALING RING) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM G/H*** (O-RING W/ RETAINING RING) STUD ENDS & ADJUSTABLE STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[ft. lb.]			[N-m]			[ft. lb.]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	13	14	14	18	19	19	13	14	14	18	19	19
	G 1/4A	8	26	28	29	35	38	39	26	28	29	35	38	39
	G 1/4A	10	26	28	29	35	38	39	26	28	29	35	38	39
	G 3/8A	12	52	55	57	70	75	77	52	55	57	70	75	77
	G 1/2A	15	66	70	73	90	95	99	66	70	73	90	95	99
	G 1/2A	18	66	70	73	90	95	99	66	70	73	90	95	99
	G 3/4A	22	133	140	146	180	190	198	133	140	146	180	190	198
	G 1A	28	229	241	252	310	327	342	229	241	252	310	327	342
	G 1-1/4A	35	332	349	365	450	473	495	332	349	365	450	473	495
	G 1-1/2A	42	398	418	438	540	567	594	398	418	438	540	567	594
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[ft. lb.]			[N-m]			[ft. lb.]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	8	9	9	11	12	12	8	9	9	11	12	12
	G 1/4A	8	17	18	19	23	24	26	17	18	19	23	24	26
	G 1/4A	10	17	18	19	23	24	26	17	18	19	23	24	26
	G 3/8A	12	34	36	37	46	49	50	34	36	37	46	49	50
	G 1/2A	15	43	45	47	58	61	64	43	45	47	58	61	64
	G 1/2A	18	43	45	47	58	61	64	43	45	47	58	61	64
	G 3/4A	22	86	91	95	117	123	129	86	91	95	117	123	129
	G 1A	28	149	157	164	202	213	222	149	157	164	202	213	222
	G 1-1/4A	35	216	227	237	293	308	321	216	227	237	293	308	321
	G 1-1/2A	42	259	272	285	351	369	386	259	272	285	351	369	386

*Typical for JLG Straight Male Stud Fittings

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

***Typical for JLG Adjustable Fittings

Table 4-27. British Standard Parallel Pipe Port (BSPP) - L Series - Table 3 of 3

																				
TYPE/FITTING IDENTIFICATION			BANJO FITTINGS with L series DIN (MBTL) opposite end						HIGH PRESSURE BANJO FITTINGS with L series DIN (MBTL) opposite end						FORM E (EOLASTIC SEALING RING) HOLLOW HEX PLUGS					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[ft. lb.]			[N-m]			[ft. lb.]			[N-m]			[ft. lb.]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G1/8A	6	13	14	14	18	19	19	13	14	14	18	19	19	10	11	11	13	15	15
	G1/4A	8	30	32	33	40	43	45	33	35	36	45	47	49	22	23	24	30	31	33
	G1/4A	10	30	32	33	40	43	45	33	35	36	45	47	49	22	23	24	30	31	33
	G3/8A	12	48	51	53	65	69	72	52	55	57	70	75	77	44	46	48	60	62	65
	G1/2A	15	66	70	73	90	95	99	89	94	98	120	127	133	59	62	65	80	84	88
	G1/2A	18	66	70	73	90	95	99	89	94	98	120	127	133	59	62	65	80	84	88
	G3/4A	22	92	97	101	125	132	137	170	179	187	230	243	254	103	108	113	140	146	153
	G1A	28	--	--	--	--	--	--	236	248	260	320	336	353	148	156	163	200	212	221
	G1-1/4A	35	--	--	--	--	--	--	398	418	438	540	567	594	295	313.5	332	400	425	450
	G1-1/2A	42	--	--	--	--	--	--	516	542	568	700	735	770	332	349	365	450	473	495
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[ft. lb.]			[N-m]			[ft. lb.]			[N-m]			[ft. lb.]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G1/8A	6	8	9	9	11	12	12	8	9	9	11	12	12	6	7	7	8	9	9
	G1/4A	8	20	21	21	27	28	28	21	22	23	28	30	31	14	15	16	19	20	22
	G1/4A	10	20	21	21	27	28	28	21	22	23	28	30	31	14	15	16	19	20	22
	G3/8A	12	31	33	34	42	45	46	34	36	37	46	49	50	29	30	31	39	41	42
	G1/2A	15	43	45	47	58	61	64	58	61	64	79	83	87	38	40	42	52	54	57
	G1/2A	18	43	45	47	58	61	64	58	61	64	79	83	87	38	40	42	52	54	57
	G3/4A	22	60	63	66	81	85	89	111	117	122	150	159	165	67	70	73	91	95	99
	G1A	28	--	--	--	--	--	--	153	161	169	207	218	229	96	101	106	130	137	144
	G1-1/4A	35	--	--	--	--	--	--	259	272	285	351	369	386	216	227	237	293	308	321
	G1-1/2A	42	--	--	--	--	--	--	335	352	369	454	477	500	216	227	237	293	308	321

* Typical for JLG Straight Male Stud Fittings

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

*** Typical for JLG Adjustable Fittings

Table 4-28. British Standard Parallel Pipe Port (BSPP) - S Series - Table 1 of 3

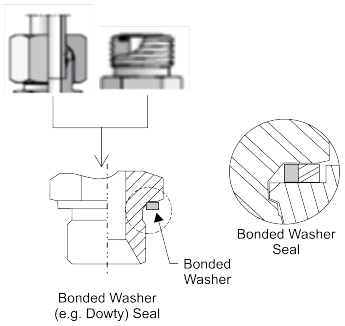
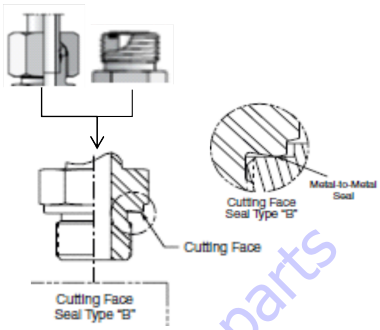
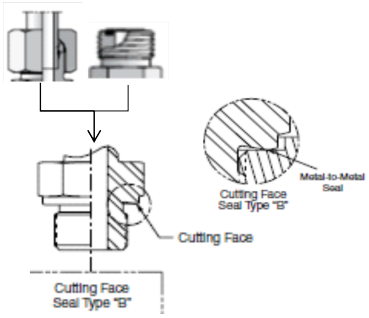
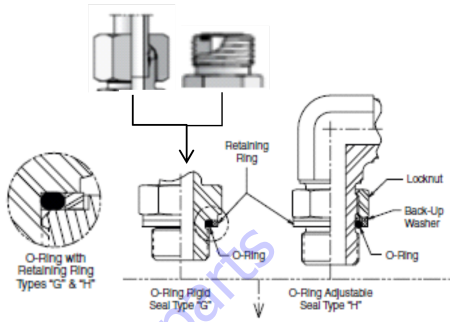
														
TYPE/FITTING IDENTIFICATION			FORM A** (SEALING WASHER) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end						FORM B** (CUTTING FACE) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[ft. lb.]			[N-m]	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

Table 4-29. British Standard Parallel Pipe Port (BSPP) - S Series - Table 2 of 3





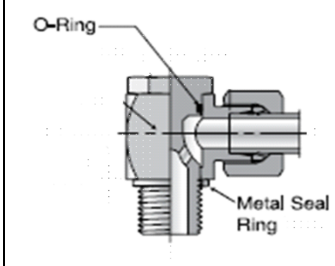
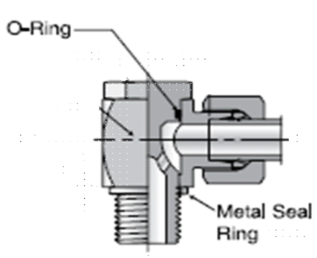
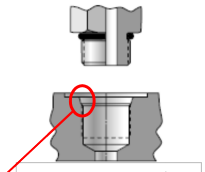
TYPE/FITTING IDENTIFICATION			FORM E* (EOLASTIC SEALING RING) STUD ENDS AND HEX TYPE PLUGS with (ORFS) or S series DIN (MBTS) opposite end						FORM G/H*** (O-RING W/ RETAINING RING) STUD ENDS & ADJUSTABLE STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	BSPP Thread G Size	Connecting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

*Typical for JLG Straight Male Stud Fittings

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

***Typical for JLG Adjustable Fittings

Table 4-30. British Standard Parallel Pipe Port (BSPP) - S Series - Table 3 of 3

			 **Note:** BSPP O-ring only style (ISO 228-1) requires o-ring chamfer in the port, similar to ISO 11926 (SAE ORB), **but is not interchangeable. Not typically used on JLG machines.**
TYPE/FITTING IDENTIFICATION	BANJO FITTINGS with S series DIN (MBTS) opposite end	HIGH PRESSURE BANJO FITTINGS with S series DIN (MBTS) opposite end	JIS/BSPP O-RING ONLY

MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque [ft. lb.]			Torque [N-m]			Torque [ft. lb.]			Torque [N-m]			Torque [ft. lb.]			Torque [N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	30	32	33	40	43	45	33	35	36	45	47	49	Fitting type not typically specified on JLG applications. Refer to the specific procedure in this Service Manual.					
	G 1/4A	8	30	32	33	40	43	45	33	35	36	45	47	49						
	G 3/8A	10	48	51	53	65	69	72	52	55	57	70	75	77						
	G 3/8A	12	48	51	53	65	69	72	52	55	57	70	75	77						
	G 1/2A	14	66	70	73	90	95	99	89	94	98	120	127	133						
	G 1/2A	16	66	70	73	90	95	99	89	94	98	120	127	133						
	G 3/4A	20	92	97	101	125	132	137	170	179	187	230	243	254						
	G 1A	25	--	--	--	--	--	--	236	248	260	320	336	353						
	G 1-1/4A	30	--	--	--	--	--	--	398	418	438	540	567	594						
	G 1-1/2A	38	--	--	--	--	--	--	516	542	568	700	735	770						

MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque [ft. lb.]			Torque [N-m]			Torque [ft. lb.]			Torque [N-m]			Torque [ft. lb.]			Torque [N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	20	21	21	27	28	28	22	22	23	30	30	31	Fitting type not typically specified on JLG applications. Refer to the specific procedure in this Service Manual.					
	G 1/4A	8	20	21	21	27	28	28	22	22	23	30	30	31						
	G 3/8A	10	31	33	34	42	45	46	34	36	37	46	49	50						
	G 3/8A	12	31	33	34	42	45	46	34	36	37	46	49	50						
	G 1/2A	14	43	45	47	58	61	64	58	61	64	79	83	87						
	G 1/2A	16	43	45	47	58	61	64	58	61	64	79	83	87						
	G 3/4A	20	60	63	66	81	85	89	111	117	122	150	159	165						
	G 1A	25	--	--	--	--	--	--	153	161	169	207	218	229						
	G 1-1/4A	30	--	--	--	--	--	--	259	272	285	351	369	386						
	G 1-1/2A	38	--	--	--	--	--	--	335	352	368	454	477	499						

* Typical for JLG Straight Male Stud Fittings

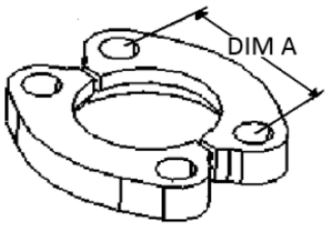
** Non typical for JLG Straight Male Stud Fittings, reference only.

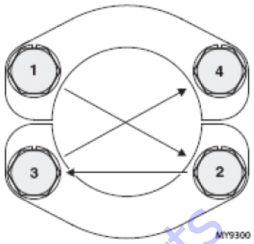
*** Typical for JLG Adjustable Fittings

Assembly Instructions for Flange Connections: (FL61 and FL62)

1. Make sure sealing surfaces are free of rust, splits, scratches, dirt, foreign matter or burrs.
2. Install o-ring as per “O-ring Installation (Replacement)” .
3. Pre-lubricate the o-ring with Hydraulic Oil.
4. Position flange and clamp halves.
5. Place lock washers on bolt and bolt through clamp halves.
6. Tighten all bolts by hand.
7. Torque bolts in diagonal sequence in two or more increments to the torque listed on Table 4-31and Table 4-32.

Table 4-31. Flange Code (FL61 & FL62) -Inch Fasteners

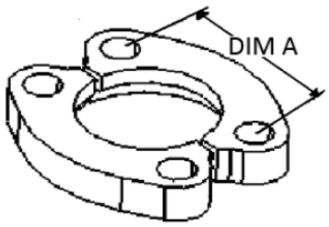


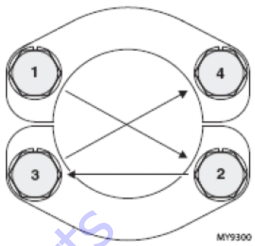


TYPE/FITTING IDENTIFICATION						STEEL 4-BOLT FLANGE SAE J518 (INCH FASTENERS)													
TYPE	Inch Flange SAE Dash Size	Flange Size		A*		Bolt Thread Size	Fastener Torque for Flanges Equipped with GRADE 5 Screws						Fastener Torque for Flanges Equipped with GRADE 8 Screws					
							[ft. lb.]			[N-m]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

* A dimension for reference only.

Table 4-32. Flange Code (FL61 & FL62) - Metric Fasteners





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

* A dimension for reference only.

Double Wrench Method

To prevent undesired hose or connector rotation, two wrenches must be used; one torque wrench and one backup wrench. If two wrenches are not used, inadvertent component rotation may occur which absorbs torque and causes improper joint load and leads to leaks. For hose connections, the 'layline' printed on the hose is a good indicator of proper hose installation. A twisted lay-line usually indicates the hose is twisted. See Figure 4-11. for double wrench method requirements.

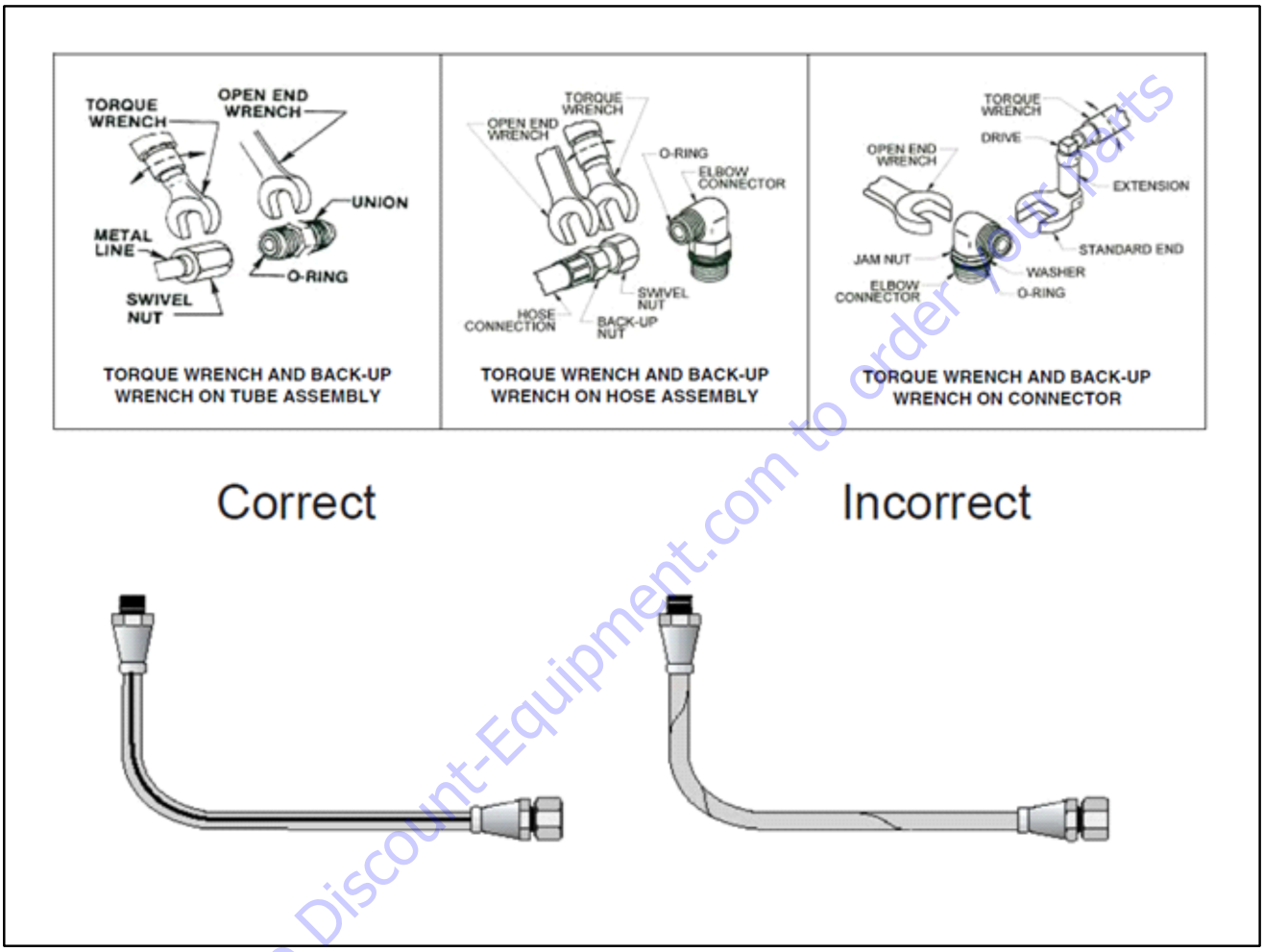


Figure 4-11. Double Wrench Method

FFWR and TFFT Methods

FFWR (FLATS FROM WRENCH RESISTANCE METHOD)

1. Tighten the swivel nut to the mating fitting until no lateral movement of the swivel nut can be detected; finger tight condition.
2. Mark a dot on one of the swivel hex nut flats and another dot in line on the connecting tube adapter. See Figure B.1.
3. Use the double wrench method per Appendix A, turn the swivel nut to tighten as shown in Figure 4-11. The nut is to be rotated clockwise the number of hex flats as defined by the applicable Table in Section 5.0.
4. After the connection has been properly tightened, mark a straight line across the connecting parts, not covering the dots, to indicate the connection has been properly tightened. See Figure 4-12.

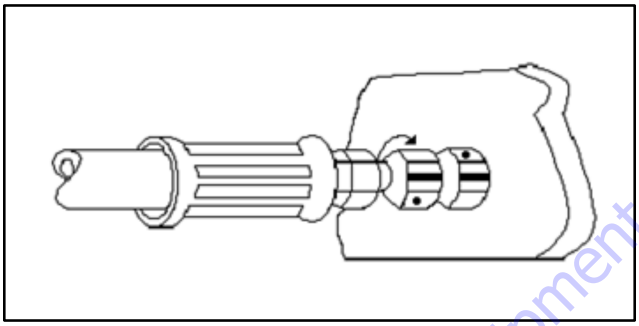


Figure 4-12. FFWR Method

TFFT (TURNS FROM FINGER TIGHT METHOD)

1. Tighten the swivel nut to the mating fitting until no lateral movement of the swivel nut can be detected; finger tight condition.
2. Mark a dot on one of the swivel hex nut flats and another dot in line on the connecting tube adapter.
3. Use the double wrench method per Appendix A, turn the swivel nut to tighten. The nut is to be rotated clockwise the number of turns as defined by the applicable Table in Section 5.0.
4. After the connection has been properly tightened, mark a straight line across the connecting parts, not covering the dots, to indicate the connection has been properly tightened.

Adjustable Stud End Assembly

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

1. Lubricate the o-ring with a light coat of hydraulic oil.
2. Position #1 – The o-ring should be located in the groove adjacent to the face of the backup washer. The washer and o-ring should be positioned at the extreme top end of the groove as shown.
3. Position #2 – Position the locknut to just touch the backup washer as shown. The locknut in this position will eliminate potential backup washer damage during the next step.
4. Position #3 – Install the connector into the straight thread box port until the metal backup washer contacts the face of the port as shown.
5. Position #4 – Adjust the connector to the proper position by turning out (counterclockwise) up to a maximum of one turn as shown to provide proper alignment with the mating connector, tube assembly, or hose assembly.
6. Position #5 – Using two wrenches, use the backup wrench to hold the connector in the desired position and then use the torque wrench to tighten the locknut to the appropriate torque.
7. Visually inspect, where possible, the joint to ensure the o-ring is not pinched or bulging out from under the washer and that the backup washer is properly seated flat against the face of the port.

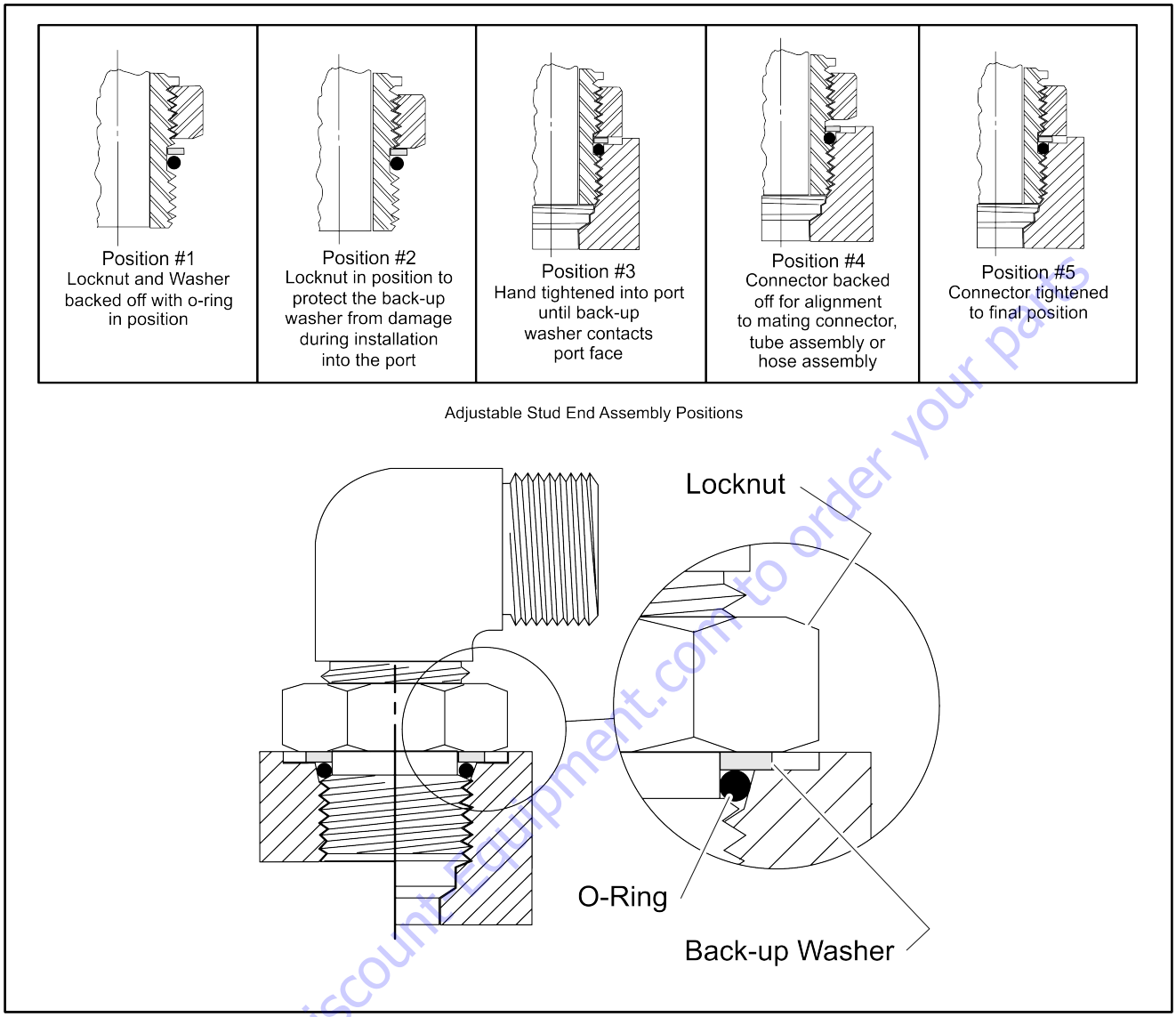


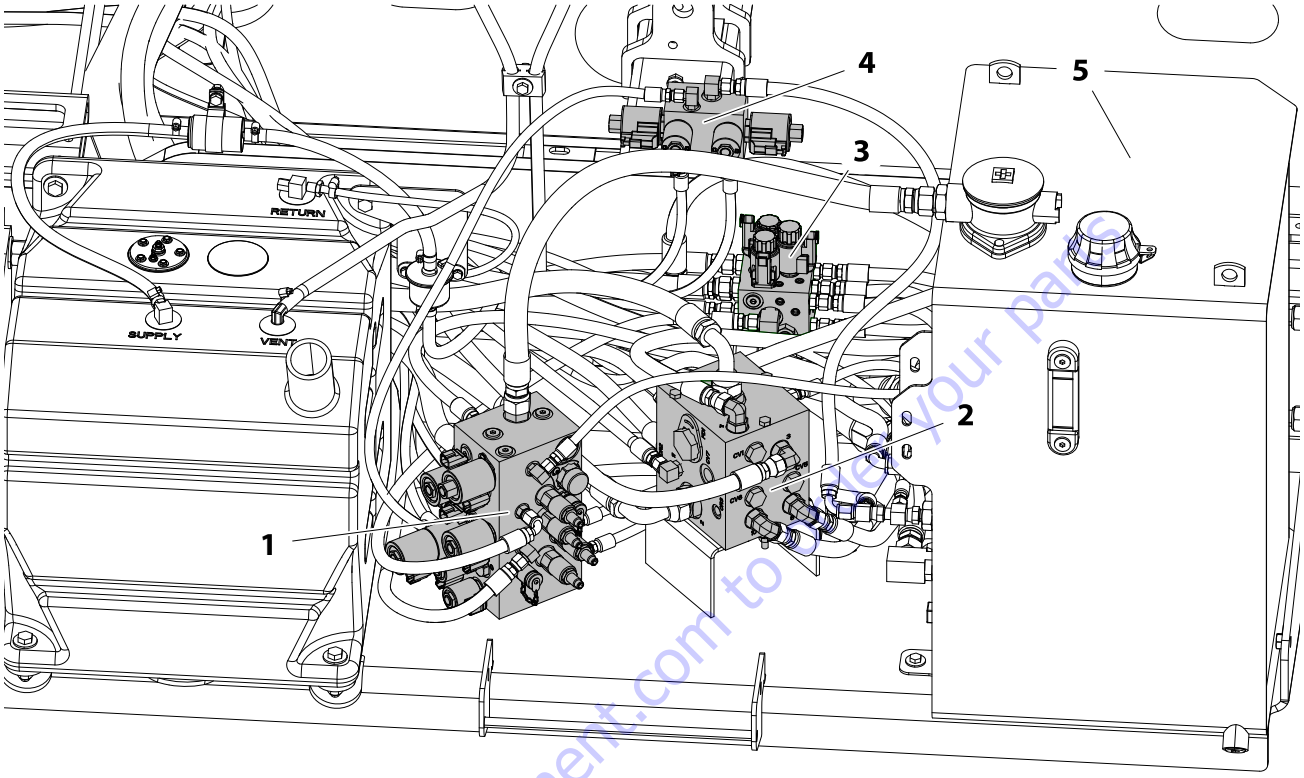
Figure 4-13. Adjustable Stud End Assembly

O-ring Installation (Replacement)

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

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

4.9 HYDRAULIC VALVES



1. Main Valve
2. Flow Divider Valve
3. Leveling Jack Valve
4. Oscillating Axle Lock-Out Valve (If Equipped)
5. Hydraulic Tank

Figure 4-14. Hydraulic Compartment Control Valves

REMOVAL

1. Disconnect, cap and label all hydraulic hoses and any electrical harness connected to valves.
2. Remove the valve blocks from the hydraulic tray by removing the attaching bolts.

INSTALLATION

1. Re-attach valve blocks to tray with bolts.
2. Re-connect all hydraulic lines and electrical harness.

Main Hydraulic Valve

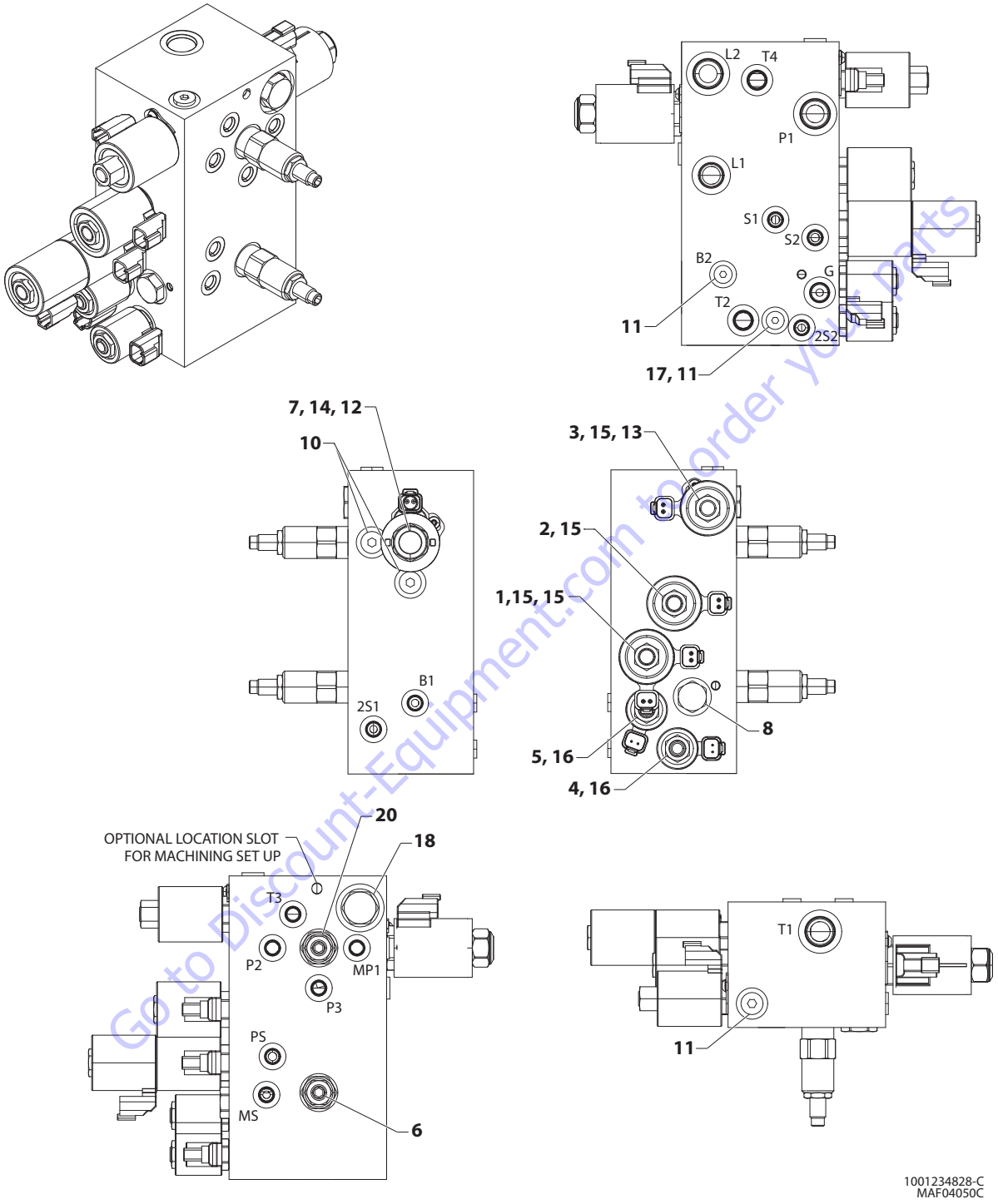


Figure 4-15. Main Valve Port Identification
See Table 4-34 on page 4-55

Table 4-33. Main Valve Port Identification
See Figure 4-15. on page 4-54

Port	Functionality	To Port
L1	To Lift Cylinder	Lift Cylinder
L2	To Lift Cylinder	Lift Cylinder
T4	Main RT Valve (Left Side)	T - Outrigger Valve
P1	Main RT Valve (Left Side)	Outlet - Tandem Gear Pump
S1	Main RT Valve (Left Side)	Steer Cylinder
S2	Main RT Valve (Left Side)	Steer Cylinder
G	Main RT Valve (Left Side) (Tee at Port)	P - Axle Lockout Valve M3 - Axial Pump
2S2	Main RT Valve (Left Side)	Union Tee
T2	Main RT Valve (Left Side)	Return to Tank
P2	Main RT Valve (Right Side)	LP - Leveling Jack Valve
PS	Main RT Valve (Right Side)	Outlet - Tandum Gear Pump
MS	Main RT Valve (Right Side)	Diagnostic Port
MP1	Main RT Valve (Right Side)	Diagnostic Port

Table 4-34. Main Valve Torque Specs
See Figure 4-15. on page 4-54

Component	Functionality	Torque
1	Steer Valve	25 ft. lb.
2	Lift Up Valve	24 - 26 ft. lb.
3	Lift Pump Unloader Valve (Dump)	35 - 40 ft. lb.
4	Motors 2 Speed Control	40 ft. lb.
5	Hydraulic Brakes	40 ft. lb.
6	Steer Cylinder Relief Valve	19 - 21 ft. lb.
7	Flow Control	35 - 40 ft. lb.
8	Steer Cylinder Shuttle Valve	19 - 21 ft. lb.
18	Lift Cylinders Tank Port Check Valve	40 - 45 ft. lb.
20	Manifold Relief Valve	40 - 45 ft. lb.

Table 4-35. Main Valve Porting Specs

Port	Size
L2, P1 & T1	SAE 10
L1	SAE 08
G, T4 & T2	SAE 06
All Others	SAE 04

NOTE: *For internal hydraulic circuits see Figure 4-45. on page 4-85.*

Flow Divider Valve

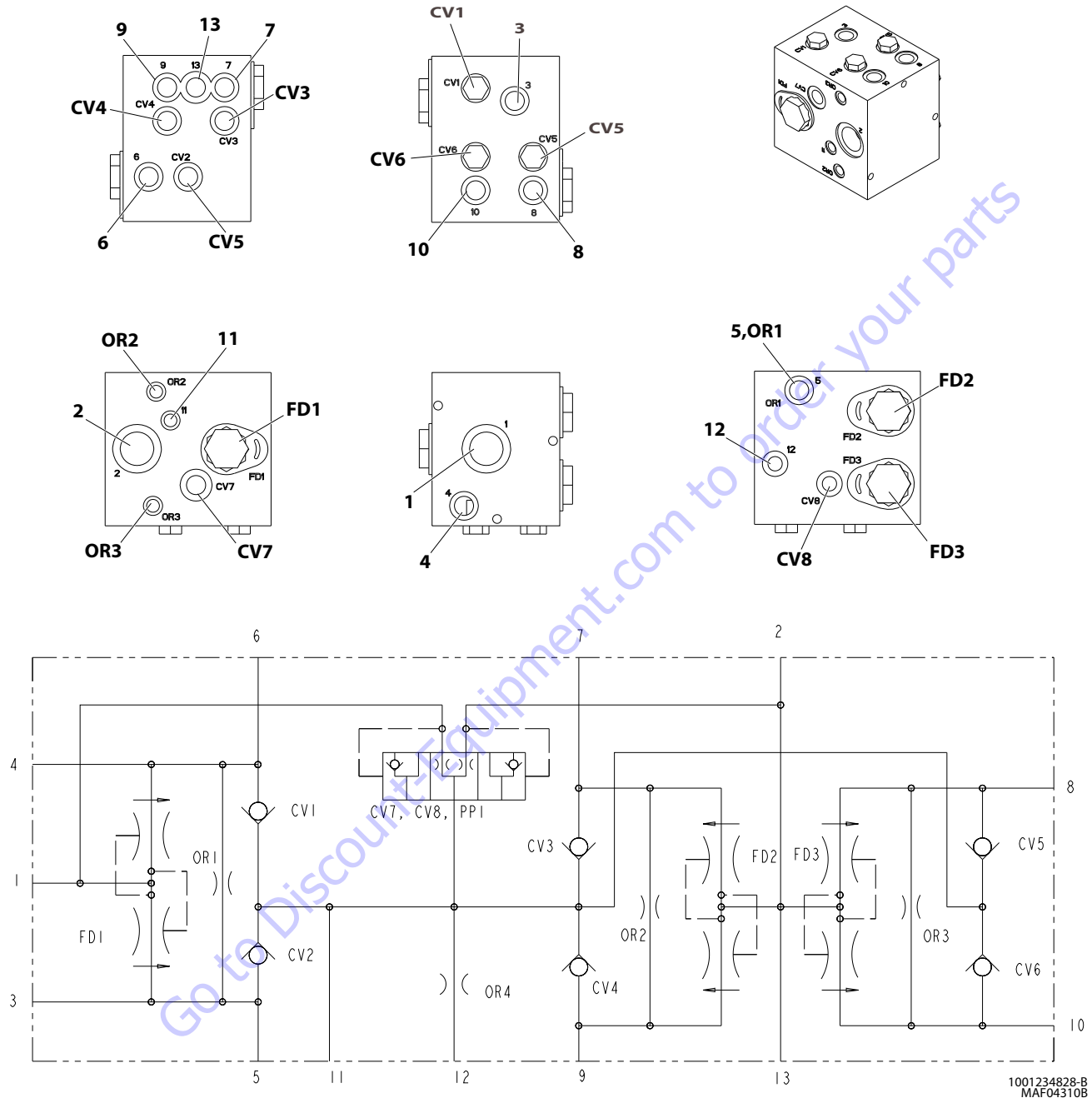


Figure 4-16. Flow Divider Valve

Leveling Jack Directional Valve

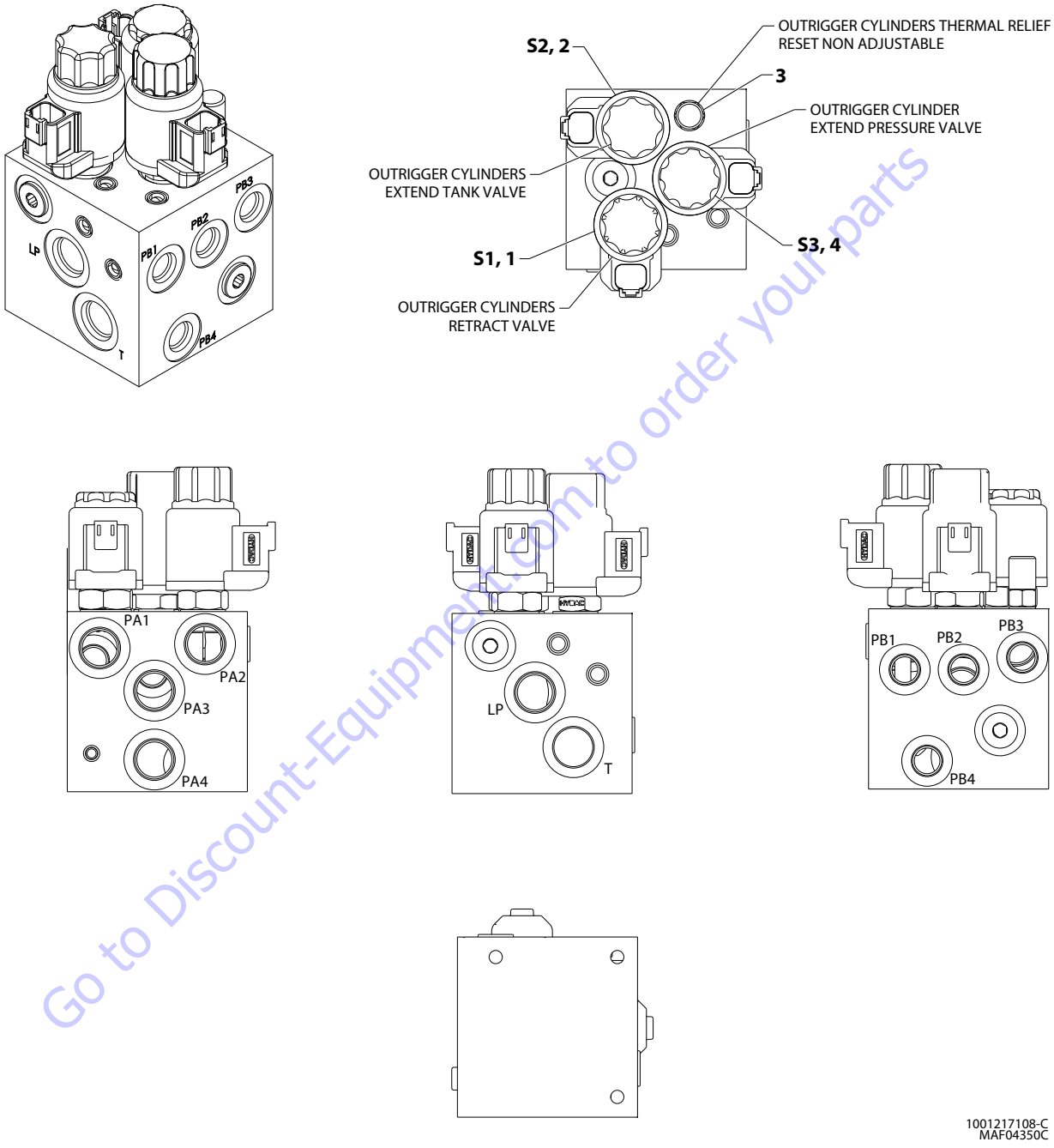


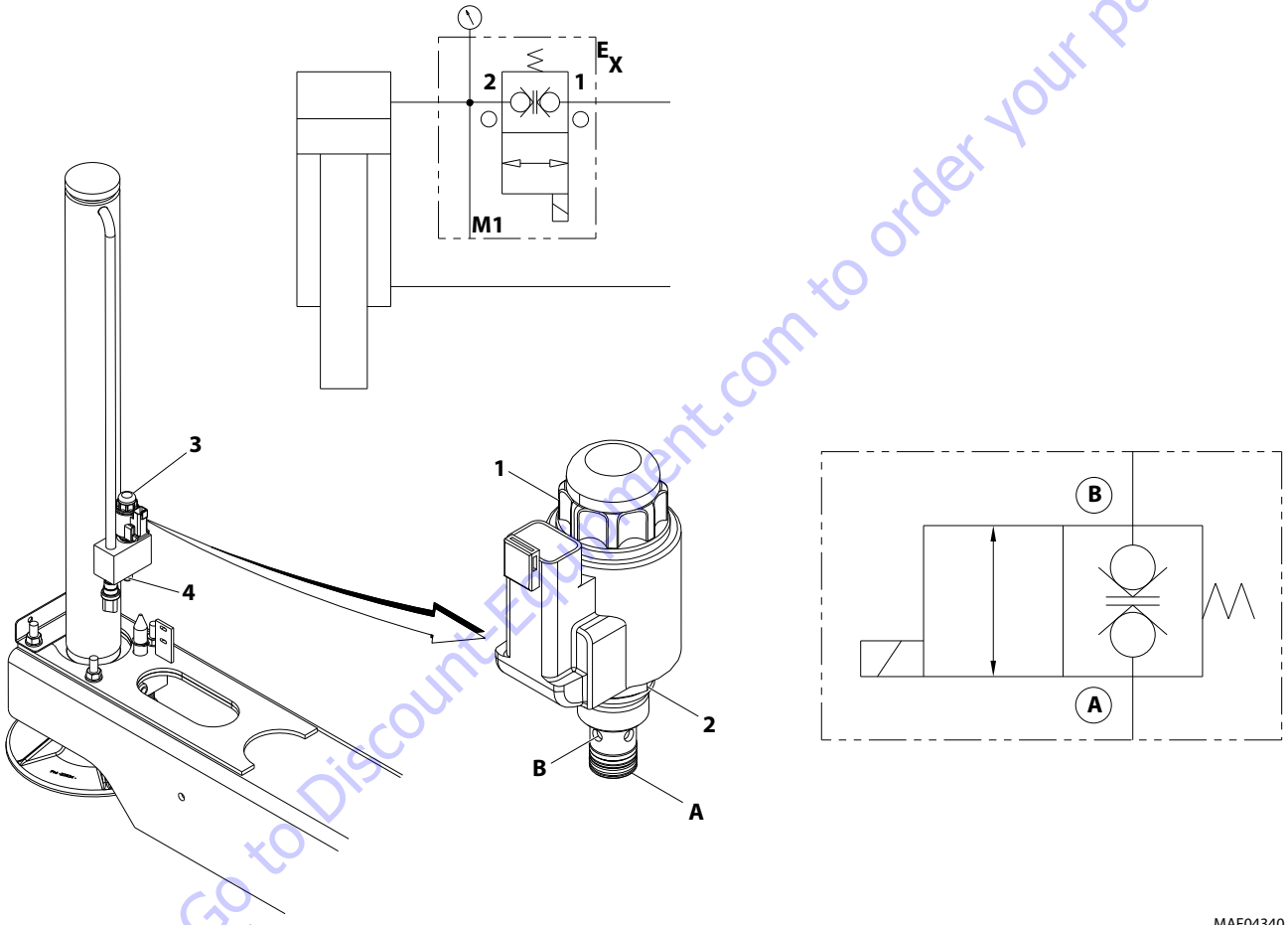
Figure 4-17. Leveling Jack Directional Valve

NOTE: *For valve torque specs see Table 4-36 on page 4-58.*
For internal hydraulic circuits see Figure 4-45. on page 4-85.

Table 4-36. Leveling Jack Directional Valve Torque Specs
See Figure 4-17. on page 4-57

Component	Functionality	Torque
S1	Leveling Jack Cylinders Retract Valve	18.5 - 22 ft. lb. (25-30 Nm)
S2	Leveling Jack Cylinders Extend Tank Valve	28 - 33 ft. lb. (38-45 Nm)
S3	Leveling Jack Cylinders Extend Pressure Valve	22 - 26 ft. lb. (30-35 Nm)
Coils S1-S3	Leveling Jack Cylinders Coils 12 VDC, 8.0 OHMS	3 - 4.5 ft. lb. (4 Nm)

Leveling Jack Valves



NOTE: *Applies to all four Leveling Jacks.*

Figure 4-18. Leveling Jack Valves

Table 4-37. Leveling Jack Valves Torque Specs

Item	Torque
1	3 to 4.5 ft. lb. (4.1 to 6.1 Nm)
2	18.5 to 22 ft. lb. (25.1 to 29.8 Nm)
3	18.4 to 22.1 ft. lb. (25-30 Nm)
4	16.2 ft. lb. (22 Nm)

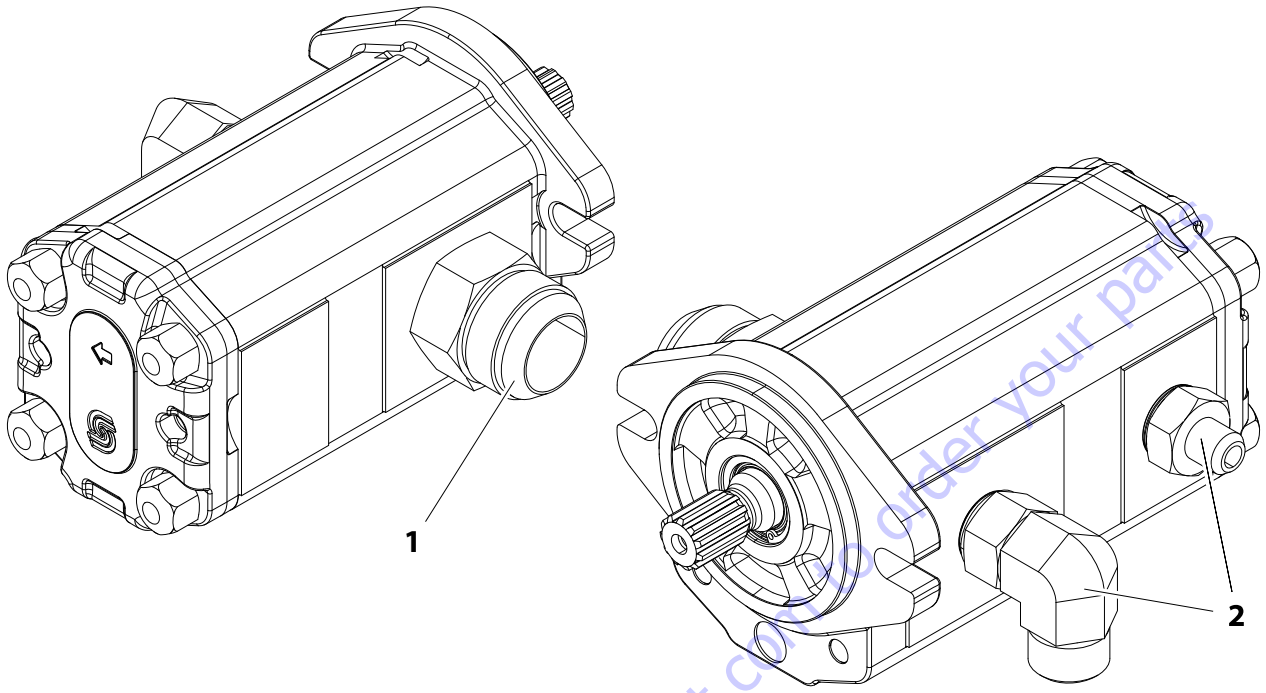
Pressure Relief Valve - Setting Procedures

Cold temperatures have a significant impact on pressure readings. JLG Industries Inc. recommends operating the machine until the hydraulic system has warmed to normal operating temperatures prior to checking pressures. JLG Industries Inc. also recommends the use of a calibrated gauge. Pressure readings are acceptable if they are within ± 5% of specified pressures.

(See Main Valve Port Identification - Figure 4-15. on page 4-54)

1. **Main Relief;**
   a. Locate the lift up solenoid valve (SV1). It is the middle solenoid on the main valve assembly.
   b. Remove the coil nut and coil from the cartridge. Do not remove the wire out of the coil plug.
   c. Install a pressure gauge, 3000 PSI or higher, at port MP1, located on the face 90 degrees towards right.
   d. Start the engine and activate lift up. The gauge should read 2700 PSI.
   e. The main relief (RV1/RV2) is located on the same face as solenoid valve, and is the top relief cartridge. Adjust clockwise to increase, counter-clockwise to decrease.
   f. Re-install the coil onto the lift up solenoid valve (SV1) and torque coil nut to 5 ft. lb.s.
2. **Steer Work Port Relief Valve;**
   a. Install a pressure gauge, 3000 PSI or higher, at port MS, located on the top face (opposite face to mounting hole).
   b. Start the engine and activate steer right or left. The gauge should read 2500 PSI.
   c. The steer work port relief (RV2/RV3) is located on the same face as port MP1, and is the lowest relief valve. Adjust clockwise to increase, counter-clockwise to decrease.
   This one relief valve takes care of both right and left.
3. **Outrigger Jack Retract Relief Valve;**
   a. Install a pressure gauge, 3000 PSI or higher, at port MP1 of the main control valve.
   b. Start the engine and activate the auto level function, then proceed to full extension by using the rocker switch “trim” function.
   c. Next, fully retract leveling jacks. Repeat this cycle four more times to bleed all air from circuit.
   d. The relief valve is fixed type and the relief is set at the vendor side. The relief valve is located on the outrigger valve, the same face as the solenoid valves.

4.10 GEAR PUMP



1. Inlet Port from Hydraulic Tank, 1-15/16-12 SAE STD THD - SAE #16 ORB
2. Outlet Ports, 7/8-14 SAE STD THD - SAE #10 ORB

Figure 4-19. Tandem Gear Pump

Table 4-38. Gear Pump Specs

Rotation (Viewing Drive End)		Clockwise
Displacement	Front: Rear:	14.4 cc/rev 175 GPM 3.9 cc/rev 47 GPM
Max Rated Speed		2800 rpm
Rated Pressure Continuous Intermittent Peak		 3045 psi (210 bar) 3336 psi (230 bar) 3336 psi (230 bar)
Minimum Speed at Rated Pressure Front Rear		 1000 rpm 1400 rpm

Table 4-39. Gear Pump - Dual Fuel - Gas/LPG

Rotation (Viewing Drive End)		Clockwise
Displacement	Front: Rear:	8.4 cc/rev 8.9 GPM 2.62 cc/rev 2.77 GPM
Max Rated Speed		4000 rpm
Rated Pressure Continuous Intermittent Peak		 3046 psi (210 bar) - 3336 psi (230 bar)
Minimum Speed at Rated Pressure		1000 rpm

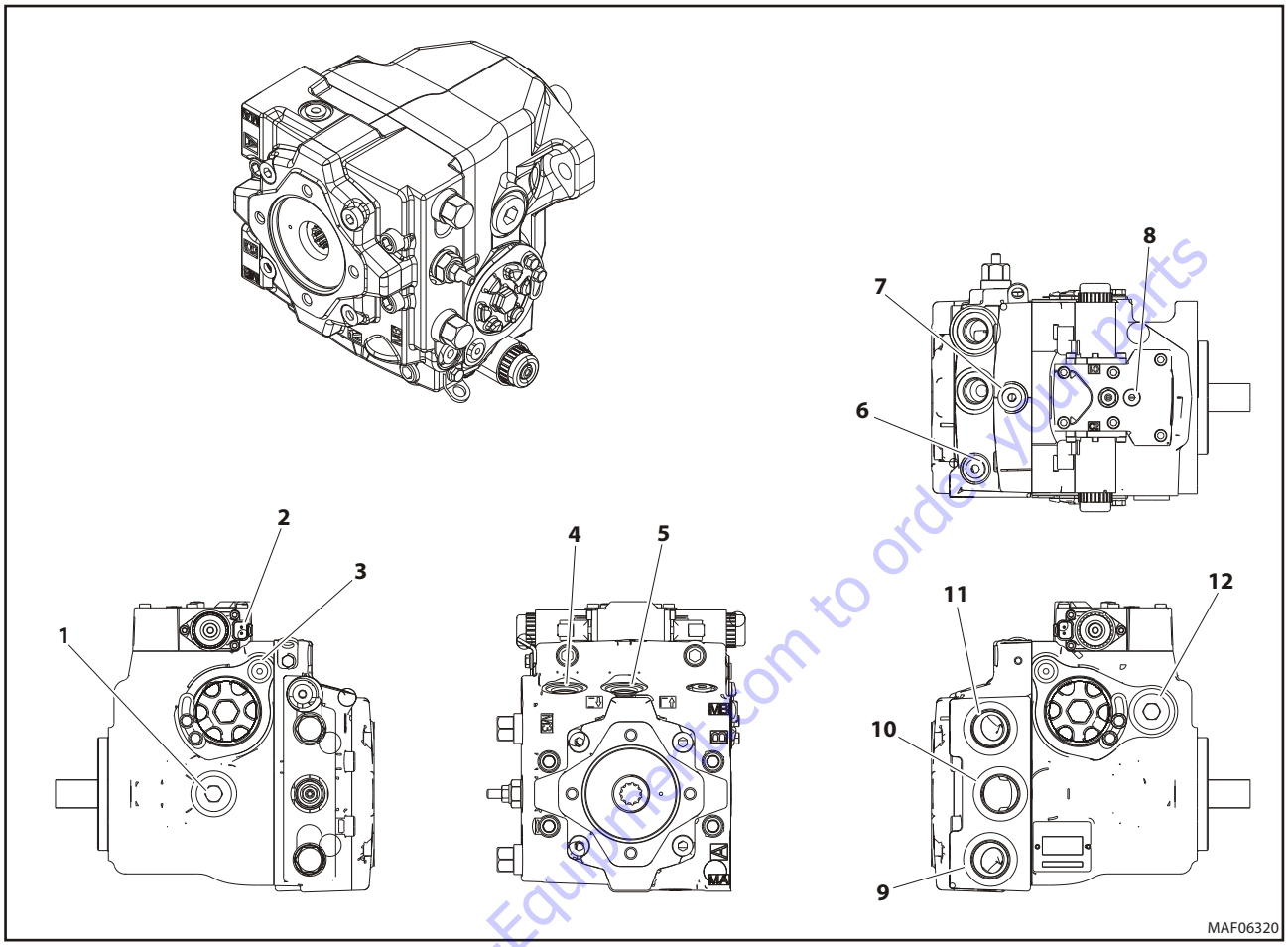
Gear Pump Priming

The gear pump is mounted with the suction hose up. Air trapped in this area can cause an air lock on start up. during this period, the pump is running dry, which can cause gear wear, which affects the volumetric efficiency of the pump.

To prime the pump:

1. Fill the hydraulic tank to the full mark.
2. Using a 2 in. wrench, loosen the suction hose fitting at the gear pump. The hose fitting does not need to be removed, just loosened enough to let the air escape.
3. When oil leaks at the hose end, re-torque the hose end to 115 ft. lb. (Nm). The pump is primed and the machine is ready to start.

4.11 AXIAL HI 45 PUMP



1. Case Drain Port L2 (SAE#12)
2. Deutsch DT04-2P Connector
3. M5 Servo Gage Port (SAE#4)
4. Charge Pressure Filtration Port (from outlet on filter)
5. Charge Pressure Filtration Port (to inlet on filter)
6. MB Gage Port (SAE#6)
7. M3 Charge Gage Port (SAE#6)
8. M14 Gage Port (SAE#4)
9. Port A (SAE#16)
10. Charge Pump Suction Port (SAE#16)
11. Port B (SAE#16)
12. Case Drain Port L1 (SAE#12)

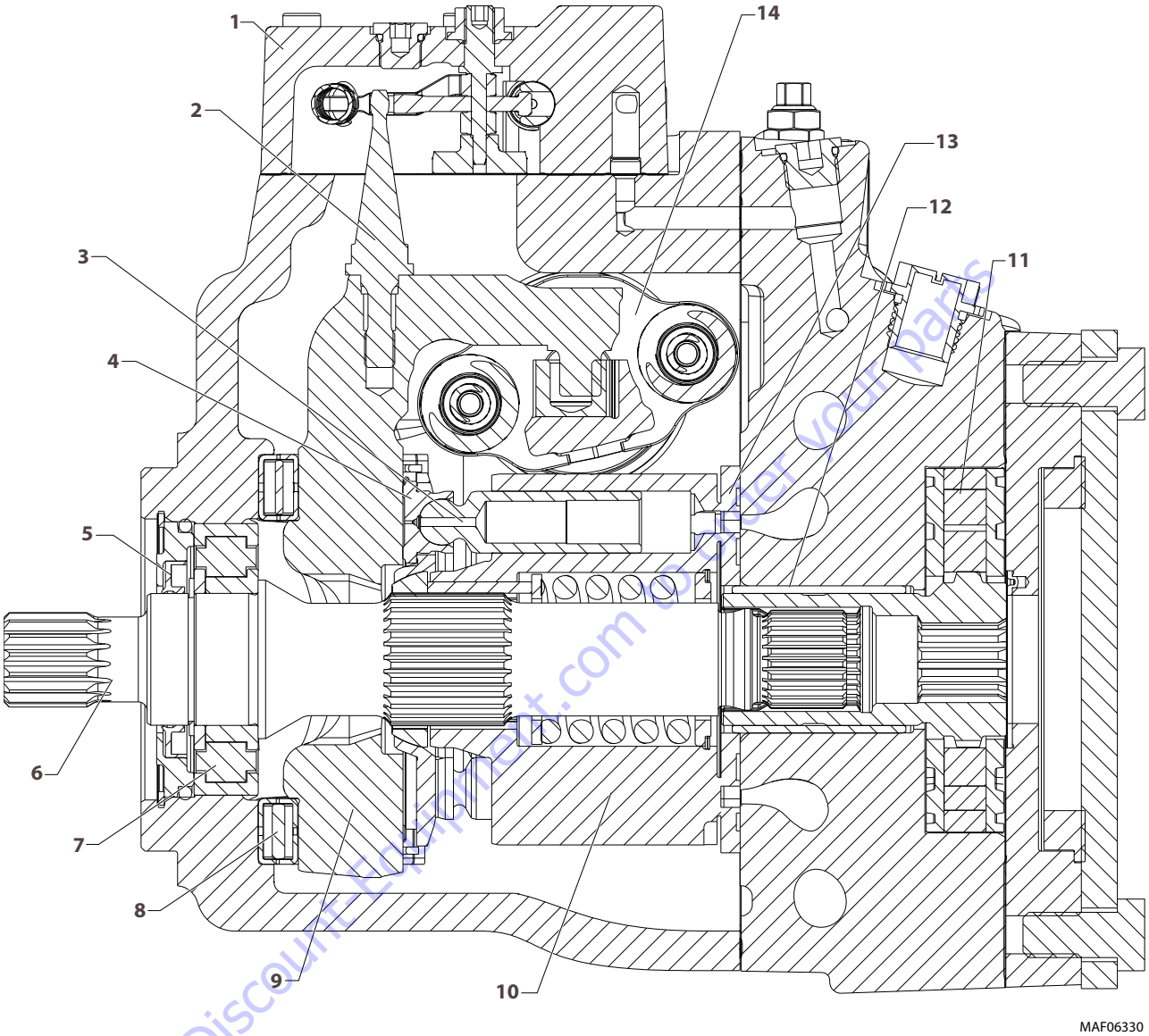
Figure 4-20. Axial HI 45 Pump

Table 4-40. Axial HI 45 Pump Specs

Rotation	Clockwise
Max Pressure	6525 psi (450 bar)
Displacement	2.75 in^3 (45 cm^3)
Control Current	755 mA Threshold 1640 mA Max Displacement

Table 4-40. Axial HI 45 Pump Specs

12 CC Charge Pump Pressure	348 psi (24 bar)
Max Operating Speed	3500 rpm



1. Electric Displacement Control
2. Swashplate Feedback Pin
3. Piston
4. Slipper
5. Shaft Seal
6. Shaft
7. Front Bearing
8. Swashplate Bearing
9. Swashplate
10. Cylinder Block
11. Charge Pump
12. Rear Bearing
13. Valve Plate
14. Servo Piston

Figure 4-21. Axial HI 45 Pump - Cross Section View

General Repair Instructions

REMOVAL

⚠ CAUTION

PRIOR TO PERFORMING REPAIRS, REMOVE THE UNIT FROM THE MACHINE. CHOCK WHEELS ON THE MACHINE TO INHIBIT MOVEMENT. BE AWARE THAT HYDRAULIC FLUID MAY BE UNDER HIGH PRESSURE AND/OR HOT. INSPECT THE OUTSIDE OF THE PUMP AND FITTINGS FOR DAMAGE. CAP HOSES AFTER REMOVAL TO PREVENT CONTAMINATION.

KEEP IT CLEAN

Clean the outside of the pump thoroughly before disassembly. Take care not to contaminate system ports. Clean parts using a clean solvent wash and air dry.

NOTICE

AS WITH ANY PRECISION EQUIPMENT, YOU MUST KEEP ALL PARTS FREE OF FOREIGN MATERIAL AND CHEMICALS. PROTECT ALL EXPOSED SEALING SURFACES AND CAVITIES FROM DAMAGE AND FOREIGN MATERIAL. IF LEFT UNATTENDED, COVER THE PUMP WITH A PROTECTIVE LAYER OF PLASTIC.

REPLACE ALL O-RINGS & GASKETS

Replace all o-rings and seals during service. Lightly lubricate o-rings with clean petroleum jelly prior to assembly.

SECURE THE UNIT

Place the unit in a stable position with the shaft pointing downward. It will be necessary to secure the pump while removing and torquing fasteners and components.

NOTICE

PERFORMING MINOR REPAIRS ACCORDING TO THIS SECTION WILL NOT AFFECT THE PUMP'S WARRANTY. MAJOR REPAIRS REQUIRING THE REMOVAL OF THE UNIT'S CENTER SECTION, SERVO SLEEVES, OR FRONT FLANGE VOIDS WARRANTY.

Start-Up Procedure

Follow this procedure when starting-up a new pump installation or when restarting an installation in which the pump has been removed and re-installed on the machine. Ensure pump has been thoroughly tested on a test stand before installing on a machine.

These pumps should never be dry started. The time it takes for the charge pump to create a vacuum to draw in the fluid, send it out through the charge pump filter and then back in to the pump may take 30-40 seconds. During this time the surface between the cylinder barel and valve plate are running dry. This can afec the volumetric efficiency of the pump and cause premature failure of the pump. Pre-filling the case also reduces the time it takes fro the pump to create a vacuum to draw fluid into the pump.

⚠ WARNING

TO PROTECT AGAINST UNINTENDED MOVEMENT, SECURE THE MACHINE OR DISABLE/DISCONNECT THE MECHANISM WHILE SERVICING.

NOTE: *Prior to installing the pump, inspect for damage that may have occurred during shipping.*

1. Ensure that the machine hydraulic oil and system components (reservoir, hoses, valves, fittings, and heat exchanger) are clean and free of any foreign material.
2. Install new system filter element(s) if necessary. Check that inlet line fittings are properly tightened and there are no air leaks.
3. Install the pump. Install a 1000 psi (50 bar) gauge in the charge pressure gauge port M3.
4. Fill the housing by adding filtered oil in the upper case drain port. If the control is installed on top, open the construction plug in the top of the control to assist in air bleed.
5. Fill the reservoir with hydraulic fluid of the recommended type and viscosity. Use a 10-micron filler filter. Fill inlet line from reservoir to pump. Ensure construction plug in control is closed after filling.
6. Disconnect the pump from all control input signals.
7. Close construction plug removed in step 4.

NOTICE

AFTER START-UP, THE FLUID LEVEL IN THE RESERVOIR MAY DROP DUE TO SYSTEM COMPONENTS FILLING. DAMAGE TO HYDRAULIC COMPONENTS MAY OCCUR IF THE FLUID SUPPLY RUNS OUT. ENSURE RESERVOIR REMAINS FULL OF FLUID DURING START-UP.
AIR ENTRAPMENT IN OIL UNDER HIGH PRESSURE MAY DAMAGE HYDRAULIC COMPONENTS. CHECK CAREFULLY FOR INLET LINE LEAKS. DO NOT RUN AT MAXIMUM PRESSURE UNTIL SYSTEM IS FREE OF AIR AND FLUID HAS BEEN THOROUGHLY FILTERED.

8. Disable the engine to prevent it from starting. Crank the starter for several seconds. Do not exceed the engine manufacturer's recommendation. Wait 30 seconds and then crank the engine a second time as stated above. This operation helps remove air from the system lines. Refill the reservoir to recommended full oil level.
9. When the gauge begins to register charge pressure, enable and start engine. Let the engine run for a minimum of 30 seconds at low idle to allow the air to work itself out of the system. Check for leaks at all line connections and listen for cavitation. Check for proper fluid level in reservoir.
10. When adequate charge pressure is established (as shown in model code), increase engine speed to normal operating rpm to further purge residual air from the system.
11. Shut off engine. Connect pump control signal. Start engine, checking to be certain pump remains in neutral. Run engine at normal operating speed and carefully check for forward and reverse control operation.
12. Continue to cycle between forward and reverse for at least five minutes to bleed all air and flush system contaminants out of loop.

NOTE: *Normal charge pressure fluctuation may occur during forward and reverse operation.*

13. Check that the reservoir is full. Remove charge pressure gauge. The pump is now ready for operation.

Removing the pump

NOTICE

CONTAMINATION CAN DAMAGE INTERNAL COMPONENTS AND VOID THE MANUFACTURER'S WARRANTY.
TAKE PRECAUTIONS TO ENSURE SYSTEM CLEANLINESS WHEN REMOVING AND INSTALLING SYSTEM LINES.

DISASSEMBLY

1. With the prime mover off, thoroughly clean all dirt and grime from the outside of the pump.
2. Tag, disconnect, and cap each hydraulic line connected to the pump. As hydraulic lines are disconnected, plug each open port, to ensure that dirt and contamination do not get into the pump.
3. Remove the pump and its auxiliary pump (if applicable) as a single unit.

NOTE: *Be careful, do not damage solenoids and electrical connections when using straps or chains to support the pump.*

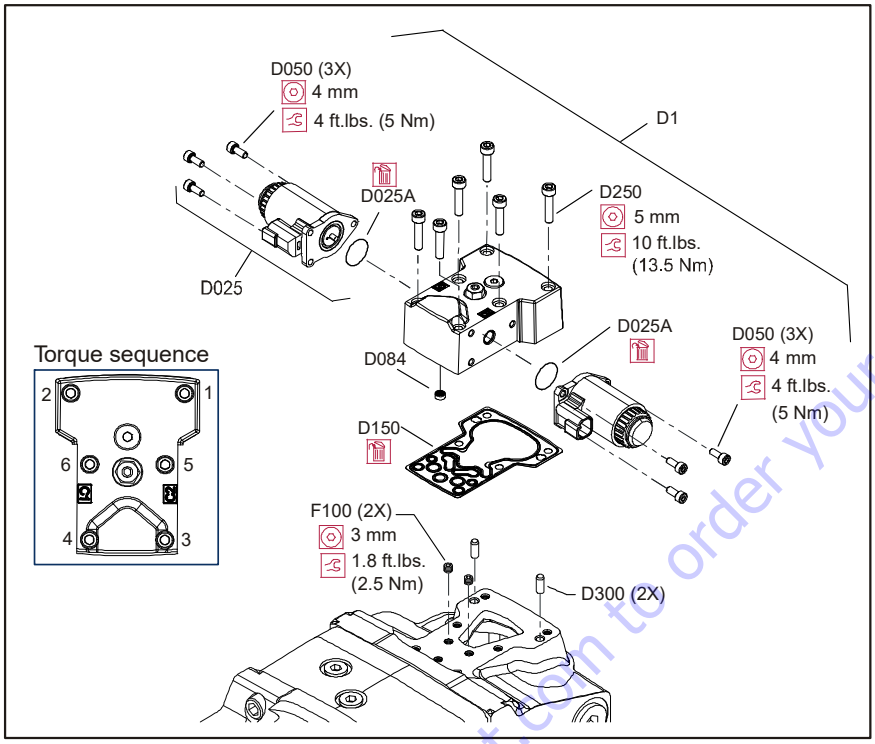
INSPECTION

1. Ensure the work surface and surrounding area are clean and free of contaminants such as dirt and grime.
2. Inspect the system for contamination.
3. Look at the hydraulic fluid for signs of system contamination, oil discoloration, foam in the oil, sludge, or metal particles.

REASSEMBLY

1. Before replacing the pump, replace all filters and drain the hydraulic system. Flush the system lines and fill the reservoir with the correct, filtered hydraulic fluid.
2. Fill the pump with clean, filtered hydraulic fluid.
3. Attach the pump to the prime mover. Torque mounting screws according to the manufacturers recommendation.
4. Replace all hydraulic lines. Ensure the charge inlet line is filled with fluid.

Electric Control Module



REMOVAL

1. Using a 5 mm internal hex wrench, remove the six cap screws (D250).
2. Remove the control module and gasket (D150). Discard the gasket.
3. If necessary, remove orifices (F100) using a 3 mm internal hex wrench. Tag and number them for reinstallation.

INSPECTION

1. Inspect the machined surfaces on the control and top of the pump. If you find any nicks or scratches, replace the component.

REASSEMBLY

NOTE: *Ensure you install dowel pins (D300) in housing before installing control.*

1. Install a new gasket (D150).
2. If you removed screen (D084), install a new one. Install with the mesh facing outward (see drawing).
3. If previously removed, install orifices (F100) using a 3 mm internal hex wrench. Torque to 1.8 ft. lb. (2.5 Nm).
4. Install the control module and six cap screws (D250).
5. Using a 5 mm internal hex wrench, torque the cap screws (D250) to 10 ft. lb. (13.5 Nm).

Control Solenoids

REMOVAL

1. Disconnect electrical connection and remove the three cap screws (D050) using a 4 mm internal hex wrench.
2. Remove the solenoid (D025) and O-ring (D025A). Discard the O-ring.
3. If necessary, remove the coil using a 12 point 26 mm socket.

INSPECTION

1. Inspect the machined surface on the control. If you find any nicks or scratches, replace the component.

REASSEMBLY

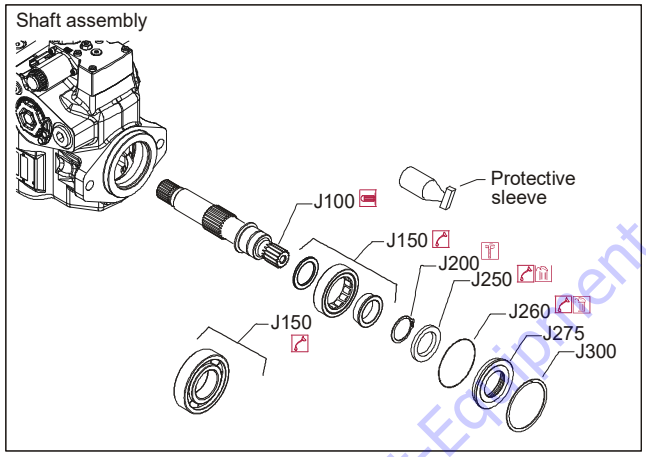
1. Lubricate new O-ring (D025A) using petroleum jelly and install.
2. Install solenoid with three cap screws (D050) using a 4 mm internal hex wrench. Torque screws to 5 Nm (4 ft. lb.).
3. Install coil using a 12 point 26 mm socket. Torque coil nut to 3.7 ft. lb. (5 Nm).
4. Reconnect electrical connections and test the pump for proper operation.

Shaft Seal, Roller Bearing & Shaft Replacement

NOTE: *The shaft assembly is serviceable without disassembling the pump. Orient the pump on the work surface so the shaft is pointing to the side.*

REMOVAL

1. Unwind the spiral ring (J300) from the housing to release the shaft/seal/bearing subassembly.
2. Pry on the lip of the seal carrier (J275) to dislodge it from the pump. Remove the seal carrier. Remove and discard O-ring (J260). Press the seal (J250) out of the carrier and discard.
3. Pull the shaft (J100) with bearing (J150) out of the pump. If necessary, tap lightly on the shaft to dislodge it from the cylinder block.
4. Remove the retaining ring (J200) using retaining ring pliers. Press the bearing off the shaft.

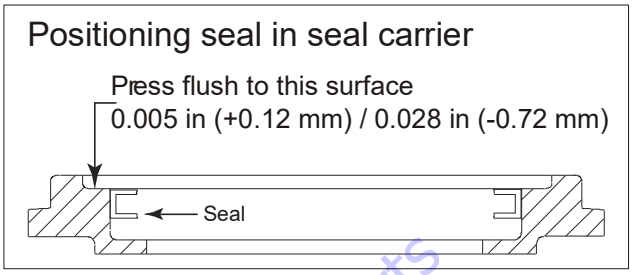


INSPECTION

1. Inspect the shaft journals for wear, scratching, and pits. Check the splines for fretting; replace if damaged. Rotate the bearing, if it does not rotate smoothly, replace it.

REASSEMBLY

1. Press the bearing (J150) onto the shaft (J100) and replace the retaining ring (J200). Ensure the retaining ring diameter is less than 1.53 in (38.84 mm) when installed on the shaft.
2. Install the shaft/bearing assembly into the pump.
3. Lubricate and install a new O-ring (J260) onto seal carrier (J275). Press a new seal (J250) into the seal carrier. Press the seal until it is flush within 0.005 in (+0.12mm) or 0.0028 in (-0.72 mm) of the inside lip of the carrier: see illustration.



4. Cover the shaft with a protective sleeve while installing the seal carrier. Hand press the seal carrier into the housing. Ensure the seal carrier clears the spiral ring groove in the housing. Remove the protective sleeve.
5. Wind the spiral ring into the housing. Ensure the inside diameter of the spiral ring is greater than 2.677 in (68 mm) after installation.

Charge Pump

If the pump has an auxiliary pump attached, remove the auxiliary pump and connecting shaft before removing the auxiliary pad.

REMOVAL

1. Position pump so end cover or auxiliary pad is on top.
2. If necessary, remove auxiliary pump (not shown), or shipping cover (K300) and pad seal (K250) as shown on following page.
3. Remove end cover/auxiliary pad screws (K400) using a 10 mm internal hex wrench.

NOTE: *Alignment pins (G450) are in end cover. They may dislodge during disassembly.*

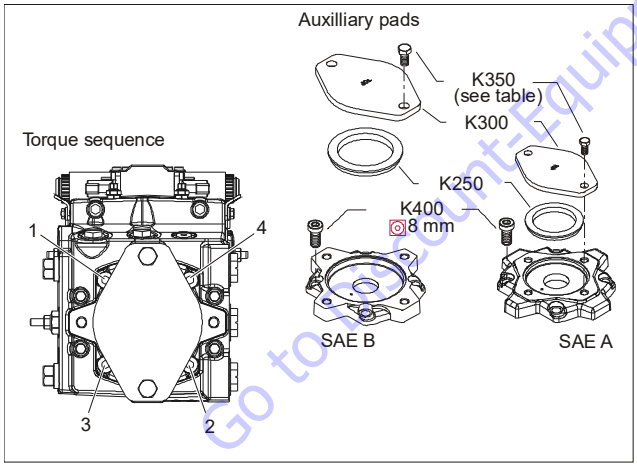
4. Remove and discard gasket (K150).
5. Remove thrust washer (K500). Note thrust washer orientation.
6. Use a small hook to remove pressure balance plate (S200) and seal (S300). Note plate orientation. Discard seal.
7. Remove coupling (K200). Use a small hook if necessary.
8. Remove the charge pump outer ring (S150), and gearset (S100).
9. Remove valve plate (S250) with seal (S300). Discard seal

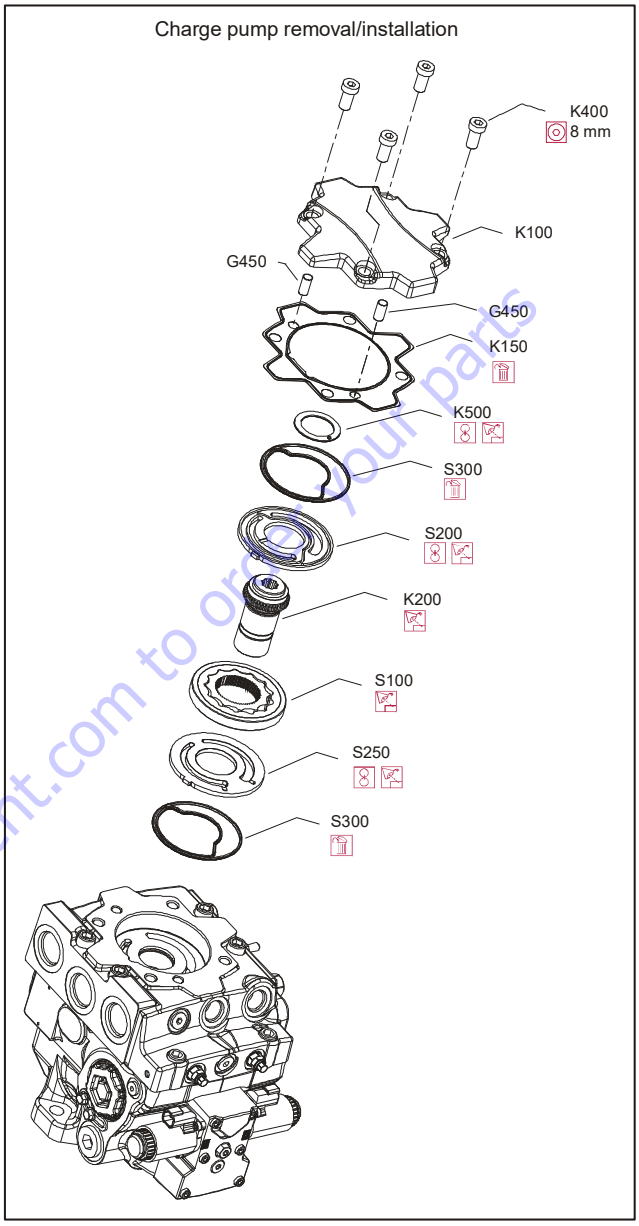
INSPECTION

1. Inspect the components for wear, scratches or pitting. Carefully inspect the valve and pressure-balance plates. Scratches on these components will cause a loss of charge pressure. If any component shows signs of wear, scratching or pitting, replace it.

REASSEMBLY

1. Install new seals (S300) in the valve (S250) and pressure-balance (S200) plates.
2. Install valve plate (S250) in the same orientation as removed.
3. Lubricate and install charge pump (S100) and outer ring (S150).
4. Install charge pump coupling (K200).
5. Install pressure balance plate (S200) in the same orientation as removed.
6. Install the thrust washer (K500). Coated side goes toward charge pump coupling (K200).
7. Install a new cover gasket. (K150). If removed, install guide pins (K450).
8. Install the auxiliary pad or charge pump cover and cap screws. Using a 10mm internal hex wrench, torque the cap screws (K400) to 68 ft. lb. (92 Nm). Torque in sequence below.
9. Reinstall auxiliary pump or pad seal (K250) and shipping cover (K300).





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Cover Screw K350

Cover Pad	Wrench Size; Torque
A	17 mm; 35 ft. lb. (48 Nm)
B, C	19 mm; 58 ft. lb. (77 Nm)

Charge Check/HPRV

REMOVAL

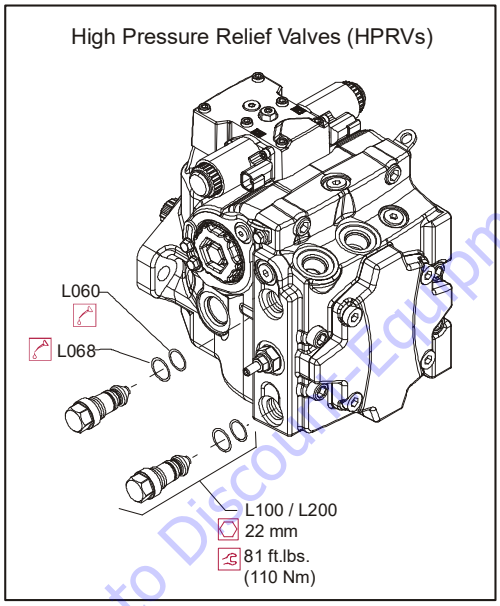
1. Using a 22 mm hex wrench, remove the HPRVs (L100/L200). Remove and discard the O-rings (L060) and backup rings (L068).

INSPECTION

1. Inspect the sealing surfaces in the pump for nicks or scratches. Check the valves for damage. Replace any damaged components.

REASSEMBLY

1. Lubricate and install new backup rings (L068) and O-rings (L060).
2. Install HPRVs. Torque to the value in the illustration below.
3. Operate the machine through full range of controls to ensure proper operation. Check for leaks.



Charge Pressure Relief Valve

Replace the charge pressure relief valve (V10) as a complete unit. Do not attempt to repair the internal components of the valve. Torque to 38 ft. lb. (52 Nm).

REMOVAL

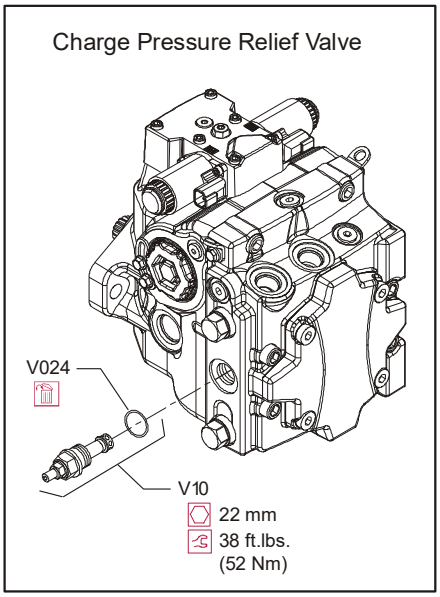
1. Using a 22 mm wrench, remove the charge pressure relief valve (V10). Discard seal (V024).

INSPECTION

1. Inspect the sealing surfaces of the pump for nicks or scratches.

REASSEMBLY

1. Lubricate and install new seal (V024).
2. Install the charge pressure relief valve. Torque to 38 ft. lb. (52 Nm).
3. Operate machine through full range of controls to ensure proper operation.



Pressure Limiter Valve Replacement

NOTE: *Replace the pressure limiter valve as a complete unit. Do not attempt to repair individual components.*

REMOVAL

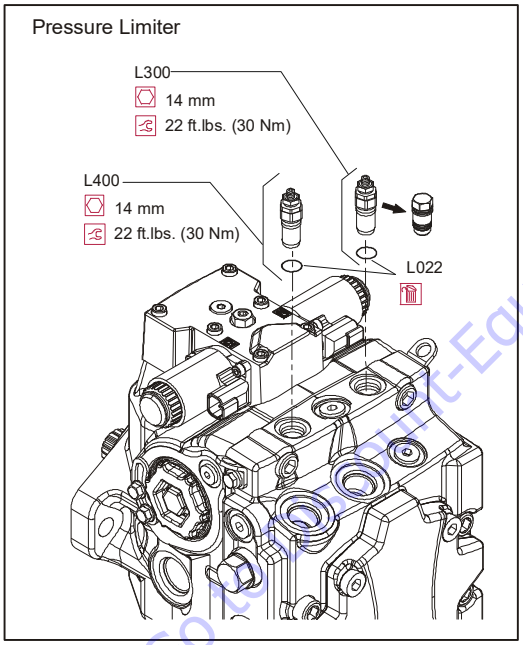
1. Using a 14 mm wrench, remove the pressure limiter valves (L300/L400). Discard O-rings.

INSPECTION

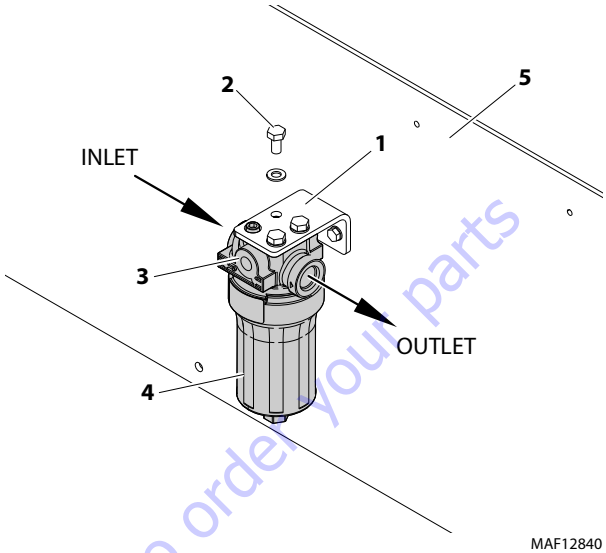
1. Inspect the sealing surfaces of the pump for nicks or scratches.

REASSEMBLY

1. Install new O-ring. Lubricate 0-ring with petroleum jelly.
2. Replace pressure limiter valves. Torque to 22 ft. lb. (30 Nm).
3. Operate pump at full range of controls to ensure proper machine operation.



4.12 CHARGE PUMP FILTER



1. Mounting Bracket
2. Filter to Bracket Bolts/Washers
3. Filter Assembly
4. Filter Bowl
5. Rear Wall of Engine Compartment

Figure 4-22. Charge Pump Filter

REMOVAL

1. Disconnect and cap the hydraulic lines on the filter assembly (3).
2. Remove the mounting bolts/washers (2) on top to remove the filter assembly from the bracket.

INSTALLATION

1. Attach filter assembly (3) to mounting bracket (1) using the mounting bolts/washers (2).

NOTE: *Torque mounting bolts to 35 ft. lb. (48 Nm).*

2. Uncap and reconnect the hydraulic lines (5 and 6) to the filter.

NOTE: *If removed and reinstalled, filter bowl torque is 30 ft. lb. (40 Nm).*

4.13 CYLINDER REPAIR

NOTE: *The following are general procedures that apply to all cylinders on this machine. Procedures that apply to a specific cylinder will be so noted.*

Disassembly

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.

⚠ WARNING

DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. If applicable, remove the cartridge-type holding valve and fittings from the cylinder port block. Discard o-rings.

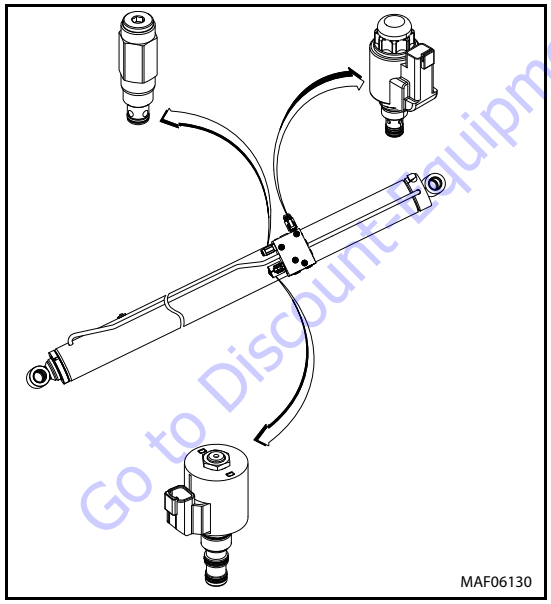


Figure 4-23. Lift Cylinder Holding Valve and Fitting Removal

4. Place the cylinder barrel into a suitable holding fixture.

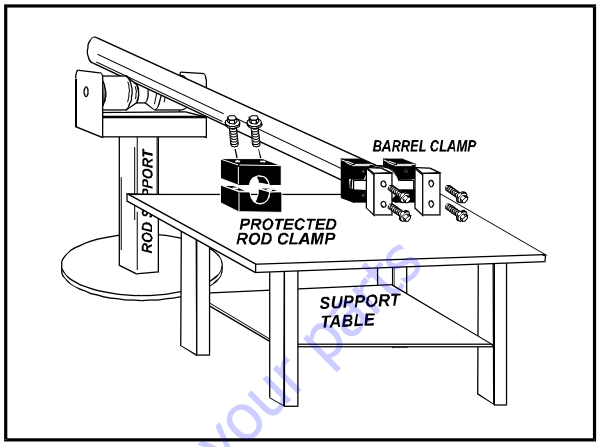


Figure 4-24. Cylinder Barrel Support

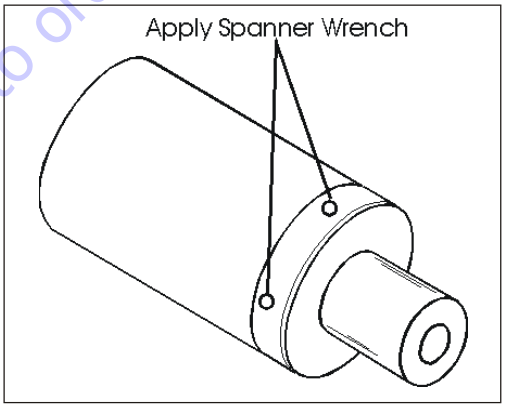
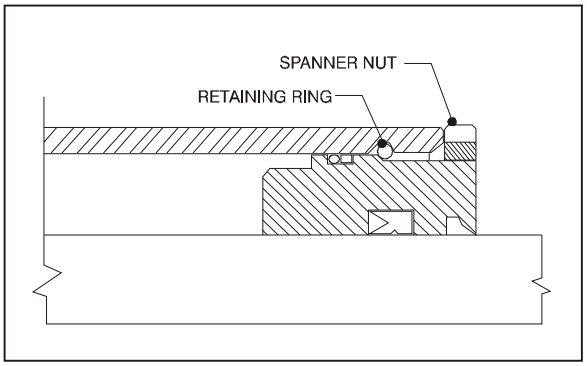


Figure 4-25. Lift Cylinder Cap Screw Removal

NOTE: *Steps 6 and 7 apply only to the steer cylinder.*

5. Using a spanner wrench, loosen the spanner nut retainer, and remove spanner nut from cylinder barrel.
6. Being careful not to mar the surface of the rod, use a punch or wooden dowel and hammer to drive the rod guide about one inch down into the cylinder bore. Using a screw driver, carefully push one end of the round retaining ring back towards the inside of the cylinder and then slip the screwdriver tip under that end. Pull the ring out of the groove toward the wall mouth. Once one end of the retaining ring is free from the groove, the remainder can be easily pried free using ones fingers or pliers.



7. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

8. With the barrel securely clamped, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

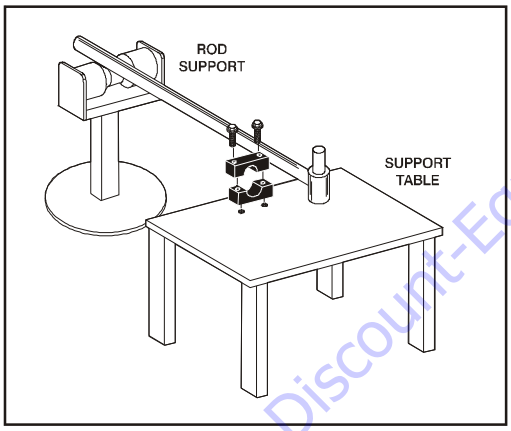


Figure 4-26. Cylinder Rod Support

9. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.

NOTE: *Step 11 applies only to the steer cylinder.*

10. Loosen and remove the nut which attaches the piston to the rod, and remove the piston.
11. Loosen and remove the cap screw(s), if applicable, which attach the tapered bushing to the piston.
12. Insert the cap screw(s) in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the cap screw(s) until the bushing is loose on the piston.
13. Remove the bushing from the piston.

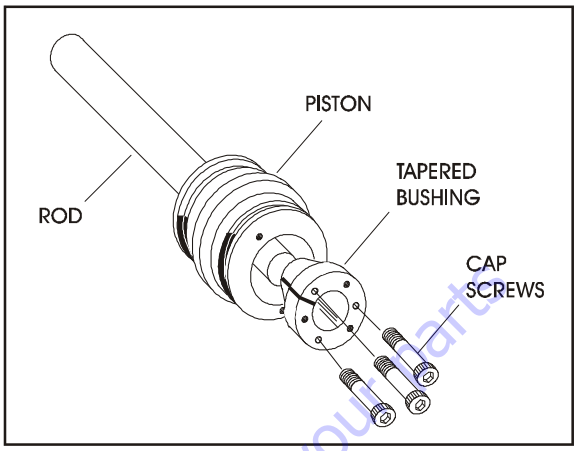


Figure 4-27. Tapered Bushing Removal

14. Screw the piston counter-clockwise, by hand, and remove the piston from cylinder rod.
15. Remove and discard the piston o-rings, seal rings, and backup rings.
16. Remove piston spacer, if applicable, from the rod.
17. Remove the rod from the holding fixture. Remove the cylinder head gland and retainer plate, if applicable. Discard the o-rings, backup rings, rod seals, and wiper seals.

Cleaning and Inspection

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovallity, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovallity. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage and for ovallity and tapering. Replace as necessary.

10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage and ovallity and tapering. Replace as necessary.
13. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of steel bushing with WD40 prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the Gar-Max bearing dry. Lubrication is not required with nickel plated pins and bearings.*

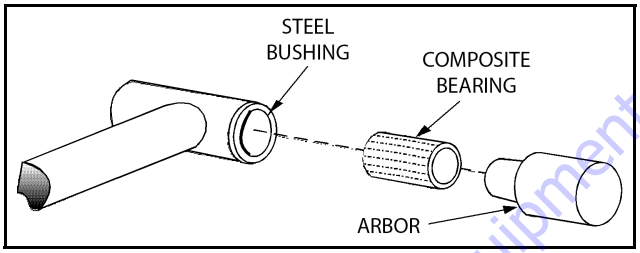


Figure 4-28. Bushing Installation

14. Inspect travel limiting collar or spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
15. If applicable, inspect port block fittings and holding valve. Replace as necessary.
16. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
17. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

Assembly

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

Apply a light film of hydraulic oil to all components prior to assembly.

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

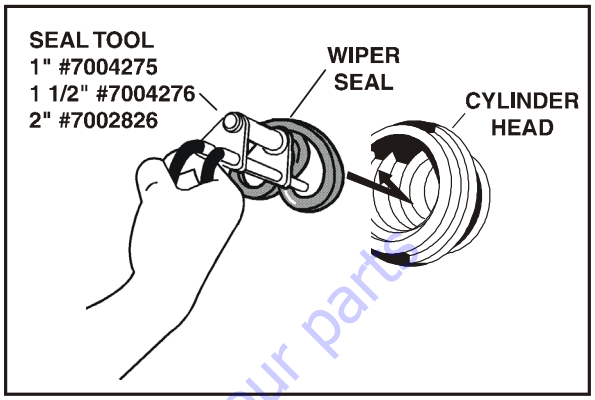


Figure 4-29. Rod Seal Installation

NOTICE

WHEN INSTALLING 'POLY-PAK' PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO WIPER SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

WHEN INSTALLING THE WIPER SEAL ON THE LOWER (TOWER) LIFT CYLINDER, APPLY HIGH STRENGTH THREADLOCKING COMPOUND ON THE WIPER SEAL IN THREE EVENLY SPACED PLACES TO AID IN RETENTION OF THE SEAL.

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland-groove.

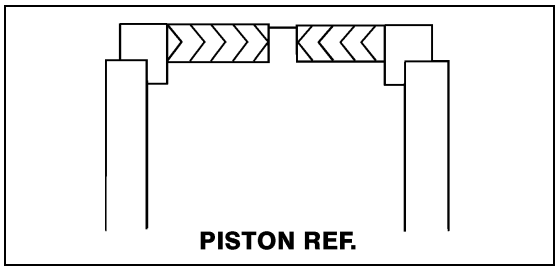


Figure 4-30. Poly-Pak Piston Seal Installation

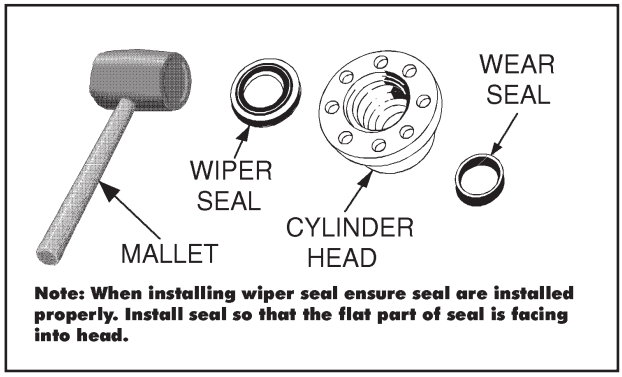


Figure 4-31. Wiper Seal Installation

3. Place a new o-ring and backup seal in the applicable outside diameter groove of the cylinder head.

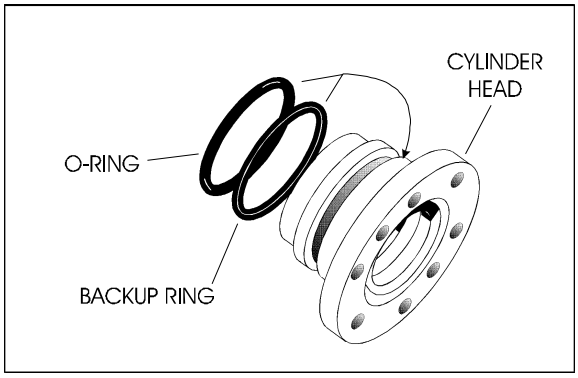


Figure 4-32. Installation of Head Seal Kit

4. Install washer ring onto rod. Carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.
5. Carefully slide the piston spacer on the rod.
6. If applicable, correctly place new o-ring in the inner piston diameter groove. (The backup ring side facing the o-ring is grooved.)
7. If applicable, correctly place new seals and guide lock rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal.)

NOTE: *The backup rings for the solid seal have a radius on one side. This side faces the solid seal. [See magnified insert in (See Figure 4-33.)] The split of seals and backup rings must be positioned so as not to be in alignment with each other.*

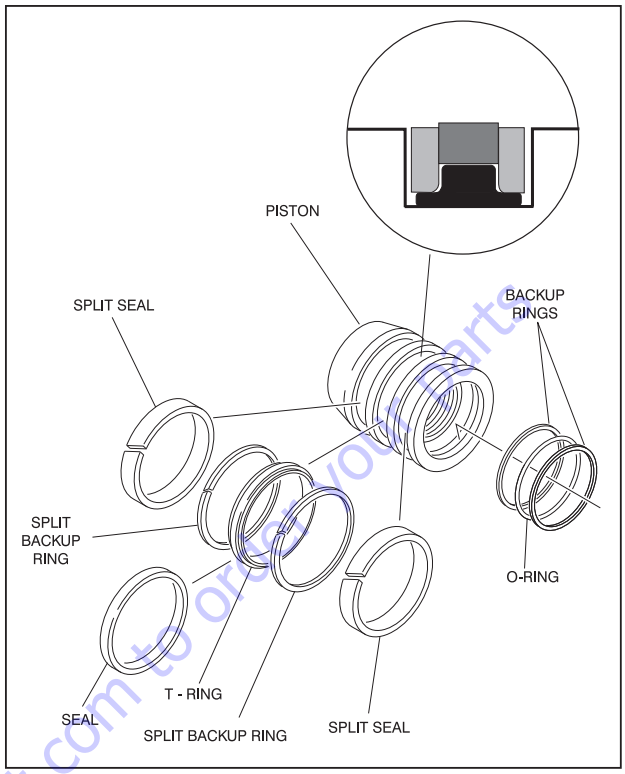


Figure 4-33. Piston Seal Kit Installation

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
9. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.
10. Thread piston onto rod until it abuts the spacer end and install the tapered bushing.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

11. Assemble the tapered bushing loosely into the piston and insert JLG capscrews (not vendor capscrews) through the drilled holes in the bushing and into the tapped holes in the piston.

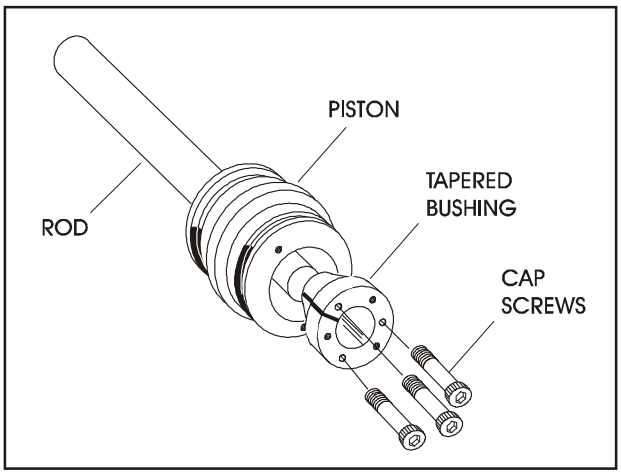


Figure 4-34. Tapered Bushing Installation

12. Tighten the capscrews evenly and progressively in rotation to the specified torque value.
13. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;
    a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.
    b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

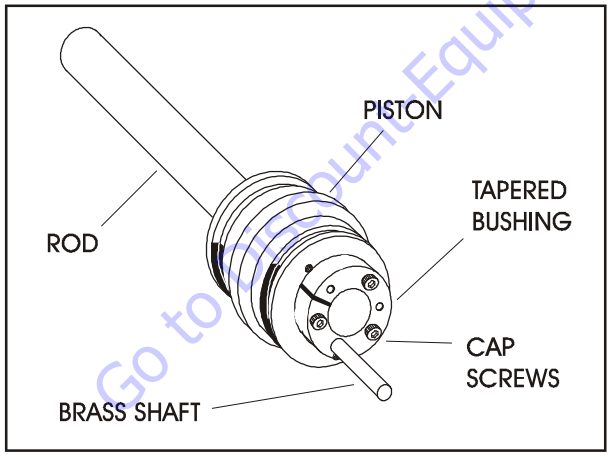


Figure 4-35. Seating the Tapered Bearing

14. Re-torque the capscrews evenly and progressively in rotation to the specified torque value.
15. Remove the cylinder rod from the holding fixture.
16. Place new guide locks and seals in the applicable outside diameter grooves of the cylinder piston. (See Figure 4-33.)
17. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

18. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
19. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
20. Secure the cylinder head gland using the washer ring and socket head bolts.

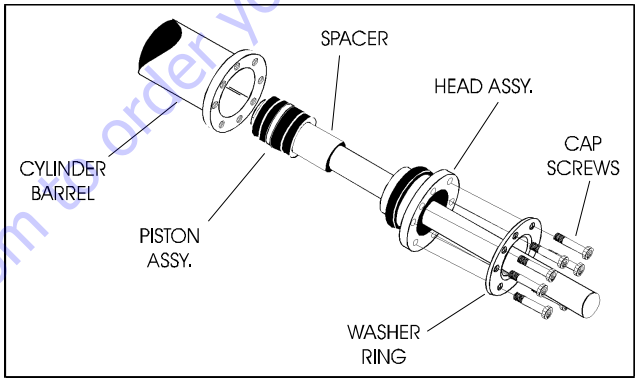


Figure 4-36. Rod Assembly Installation

21. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.
22. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable.
23. Push the piston onto the rod until it abuts the spacer end and install the attaching nut.

⚠ WARNING

WHEN REBUILDING THE CYLINDERS, APPLY MEDIUM STRENGTH THREADLOCKING COMPOUND TO PISTON NUT AND SETSCREW, THEN TORQUE PISTON NUT.

NOTE: *The Steer Cylinder uses snap rings to secure piston.*

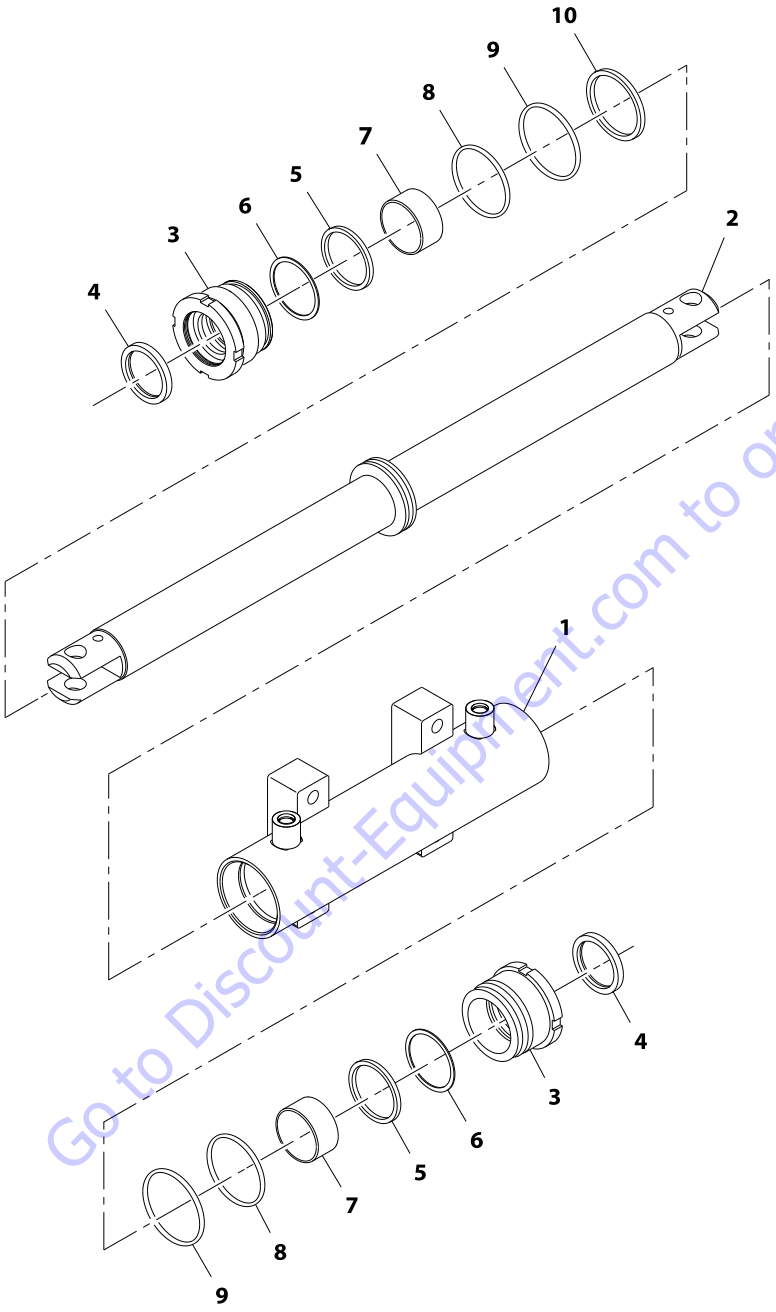
24. Prior to setscrew installation spot drill rod before installing the setscrew(s) which secure the piston attaching nut to the diameter groove.
25. Remove the cylinder rod from the holding fixture.
26. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

27. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
28. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
29. If applicable, secure the cylinder head retainer using a suitable chain wrench.
30. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.
31. If applicable, install the cartridge-type holding valve and fittings in the port block using new o-rings as applicable.

4.14 CYLINDER ASSEMBLIES

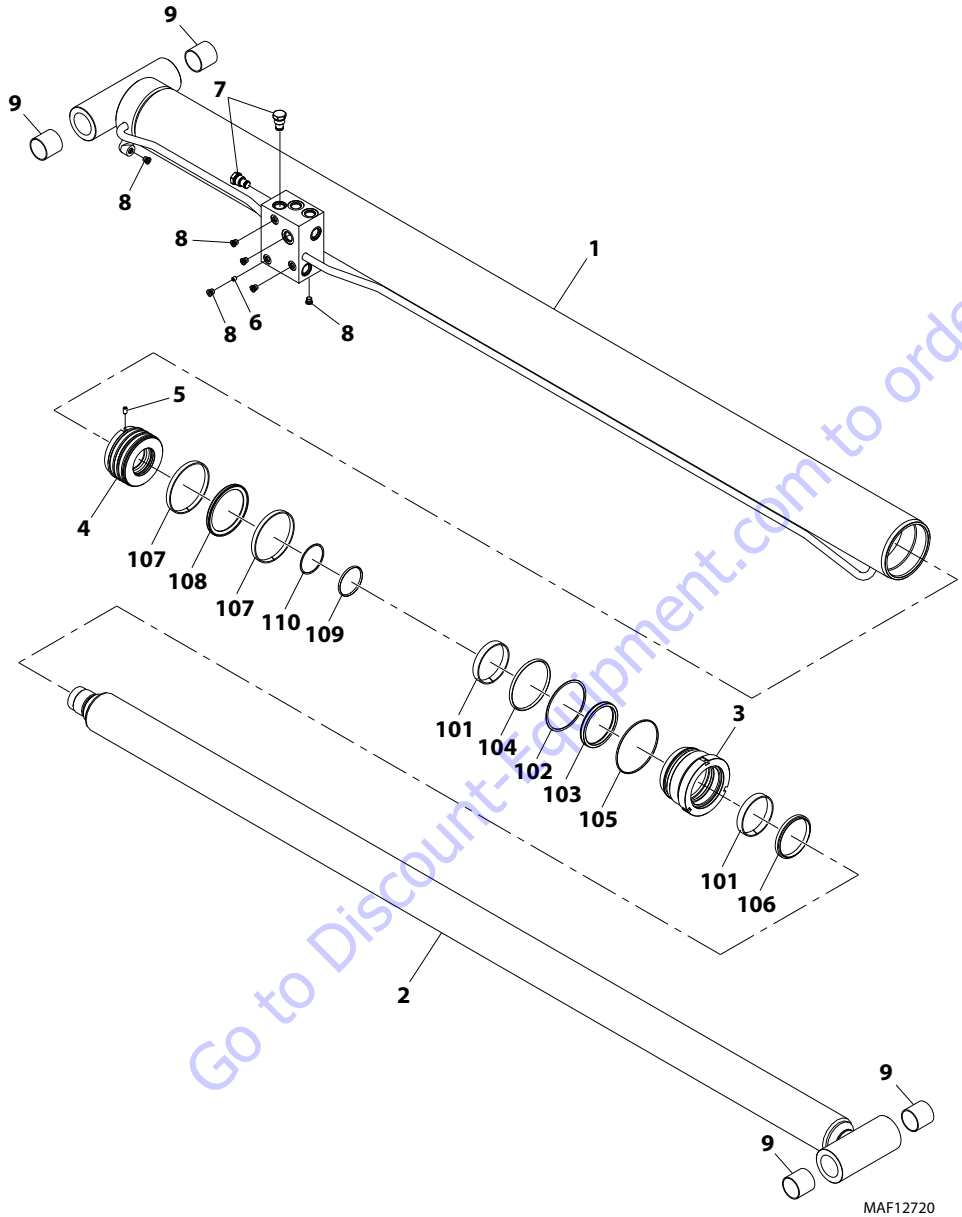


Steer Cylinder

1. Barrel
2. Rod
3. Head - Torque to 434 ft. lb. (588 Nm)
4. Wiper
5. Road Seal
6. Backup Ring
7. Dry Bearing
8. O-Ring
9. O-Ring
10. Piston Seal

Figure 4-37. Steer Cylinder

NOTE: SEE SCISSORS ARMS ASSEMBLY FOR CARTRIDGE VALVES LOCATED IN VALVE BLOCK. DO NOT PUT CYLINDER INTO SERVICE WITHOUT CARTRIDGE VALVE INSTALLED

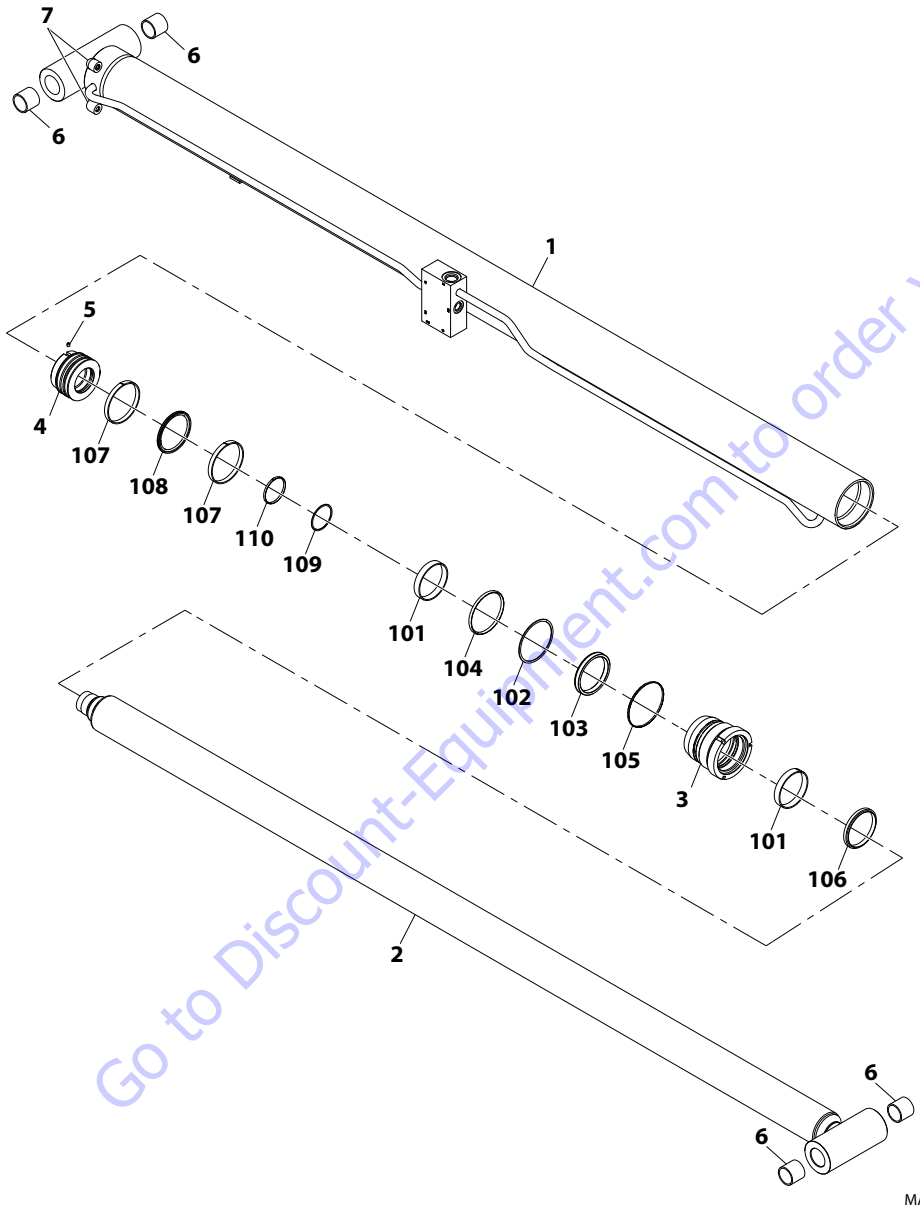


Lift Cylinder (Lower)

1. Barrel
2. Rod
3. Head - Torque to 332 ft. lb. (450 Nm)
4. Piston - Torque to 1003 ft. lb. (1360 Nm)
5. Screw - Torque to 7 ft. lb. (10 Nm)
6. Orifice
7. Check Valve
8. Plug
9. Bearing
101. Wear Ring
102. O-Ring
103. Backup Ring
104. Rod Seal
105. O-Ring
106. Wiper Ring
107. Wear Ring
108. Piston Seal
109. O-Ring
110. Backup Ring

Figure 4-38. Lift Cylinder (Lower)

NOTE: SEE SCISSORS ARMS ASSEMBLY FOR CARTRIDGE VALVES LOCATED IN VALVE BLOCK. DO NOT PUT CYLINDER INTO SERVICE WITHOUT CARTRIDGE VALVE INSTALLED

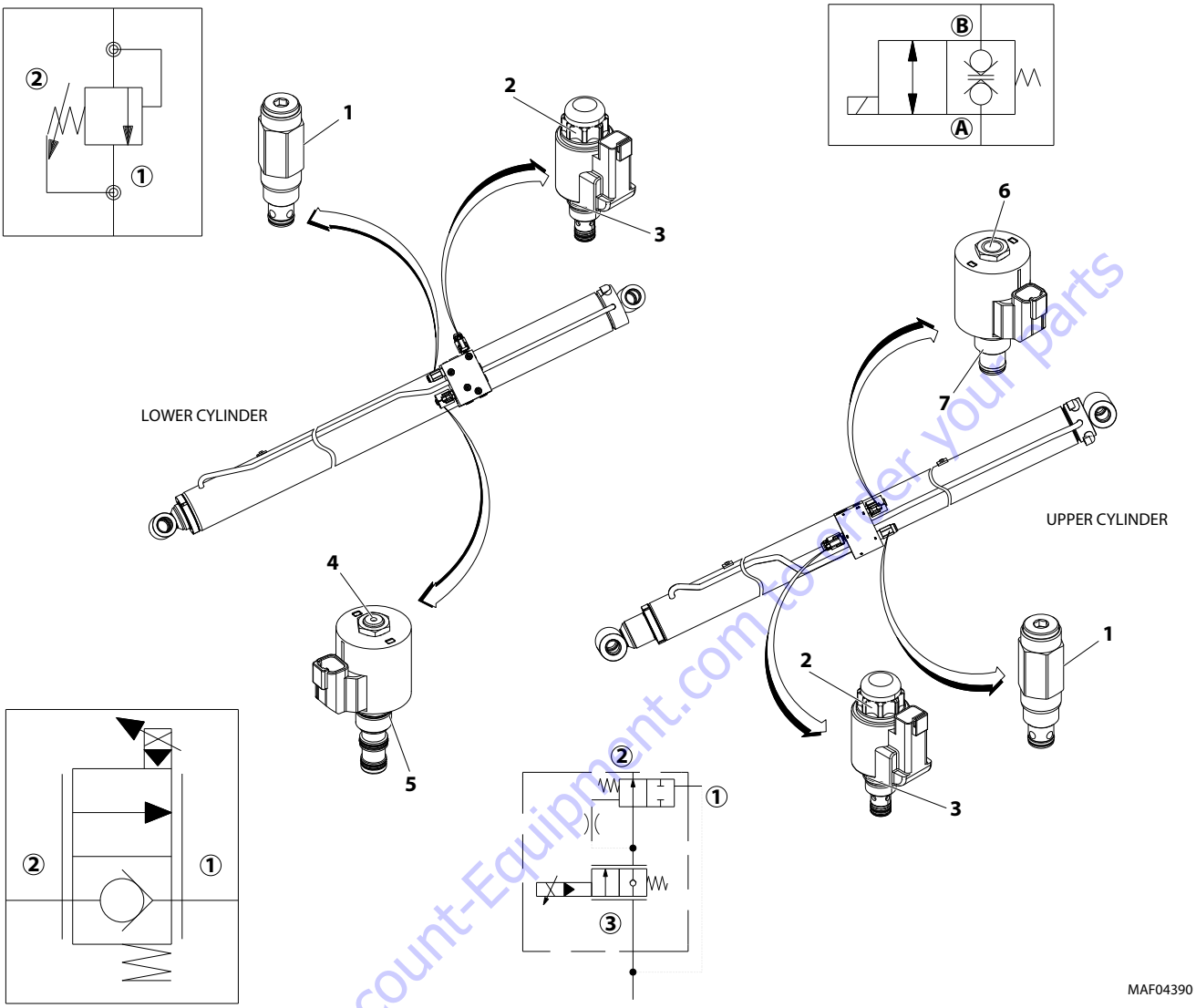


Lift Cylinder (Upper)

1. Barrel
2. Rod
3. Head - Torque to 332 ft. lb. (450 Nm)
4. Piston - Torque to 575 ft. lb. (780 Nm)
5. Screw - Torque to 4 ft. lb. (5 Nm)
6. Bearing
7. LSS Transducers (If Equipped)

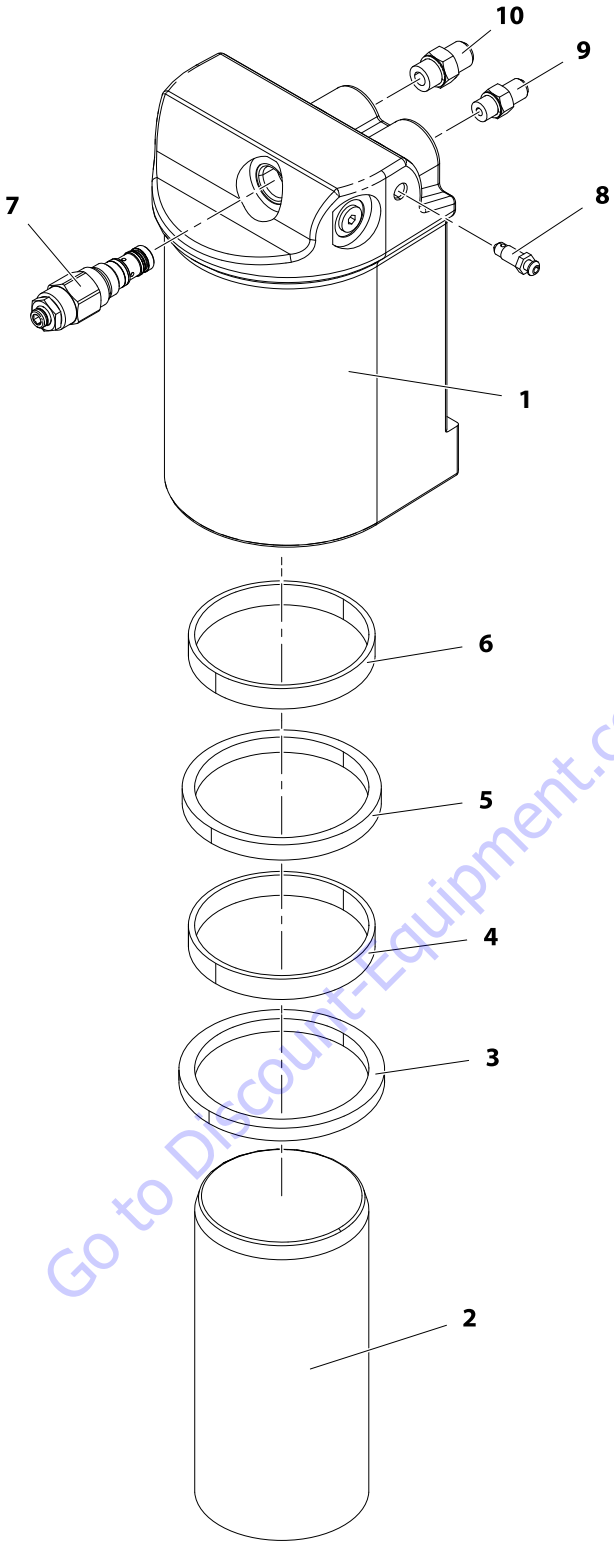
101. Wear Ring
102. O-Ring
103. Backup Ring
104. Rod Seal
105. O-Ring
106. Wiper Ring
107. Wear Ring
108. Piston Seal
109. O-Ring
110. Backup Ring

Figure 4-39. Lift Cylinder (Upper)



Item	Torque
1	33 - 37 ft. lb. (45 - 50 Nm)
2	3 - 4.5 ft. lb. (4 - 6 Nm)
3	18.5 - 22 ft. lb. (25 - 30 Nm)
4	5 - 7 ft. lb. (7 - 10 Nm)
5	75 - 85 ft. lb. (102 - 115 Nm)
6	4 - 5 ft. lb. (5.4 - 6.8 Nm)
7	33 - 37 ft. lb. (45 - 50 Nm)

Figure 4-40. Lift Cylinder Valve Cartridge Torque Values



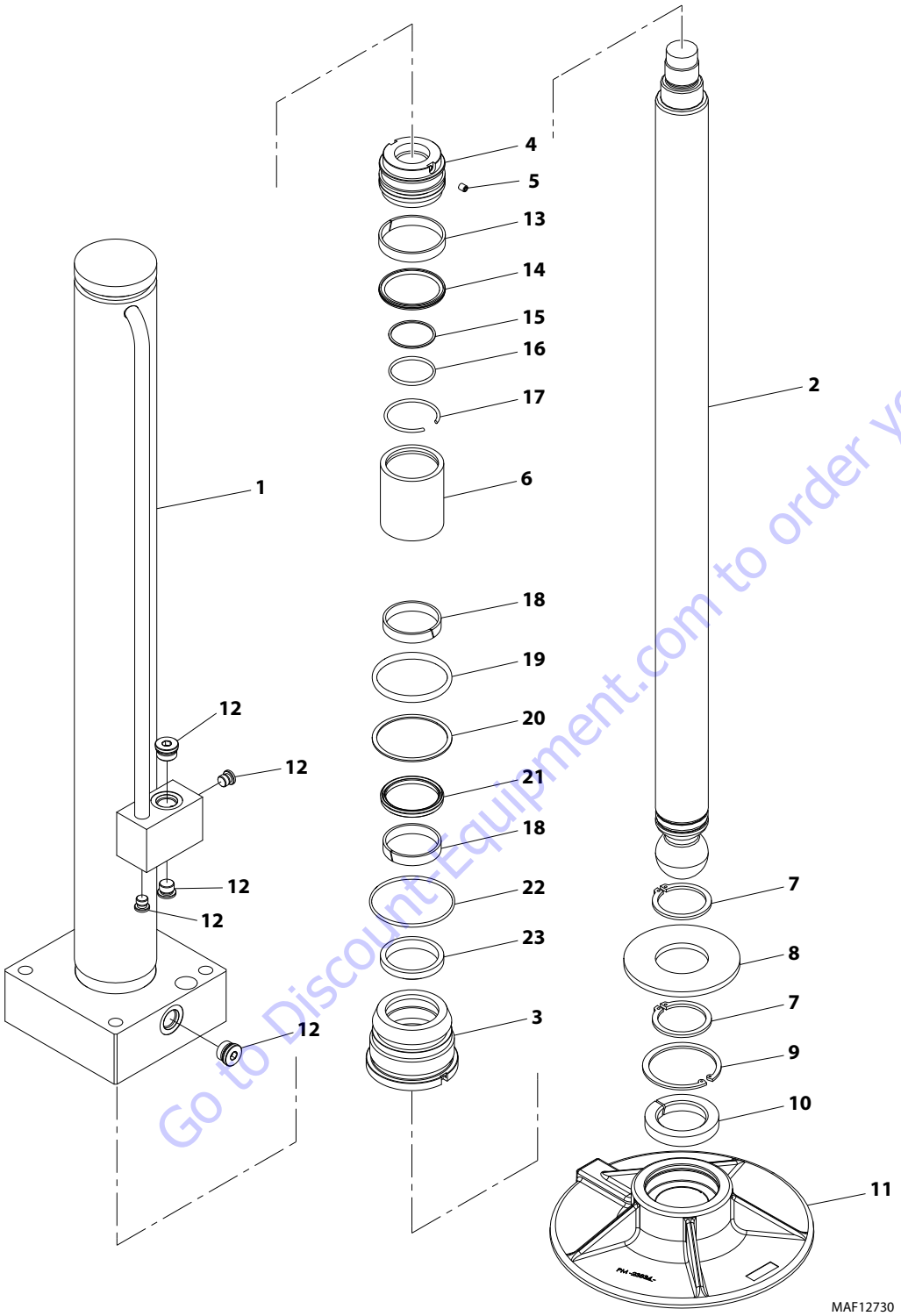
1. Barrel
2. Rod
3. Wiper Seal
4. Wear Ring
5. Rod Seal
6. Wear Ring
7. CounterBalance Valve
8. Bleeder Valve
9. Pilot Port
10. Valve Port

NOTE: *Torque item #7 to 22 ft. lb. (30 Nm)*

⚠ WARNING

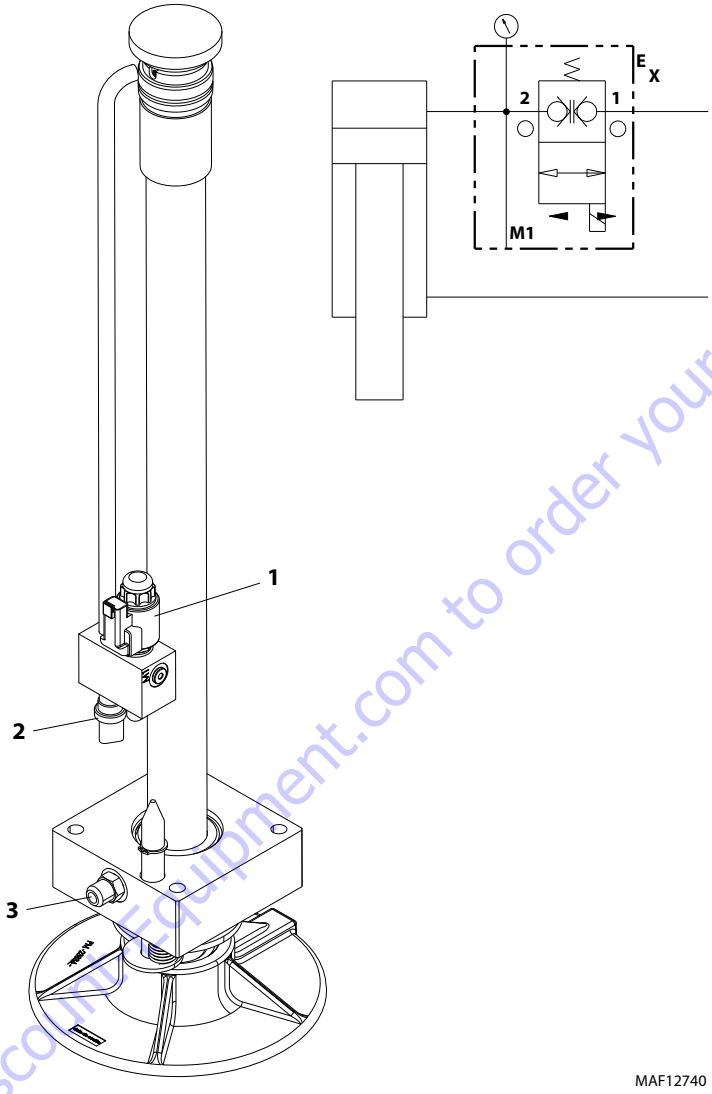
THE CYLINDER ROD CAN SLIDE OUT OF THE CYLINDER IF THE BLEEDER VALVE IS LOOSENED.

Figure 4-41. Oscillating Axle Cylinder



1. Barrel
2. Rod
3. Head
4. Piston
5. Screw
6. Spacer
7. Ring, Retaining
8. Jack Plate
9. Ring, Retaining
10. Wear Ring
11. Jack Pad
12. Plugs
13. Wear Rings
14. Seal
15. Backup Ring
16. O-Ring
17. Snap Ring
18. Wear Ring
19. O-Ring
20. Backup Ring
21. Seal
22. O-Ring
23. Wiper

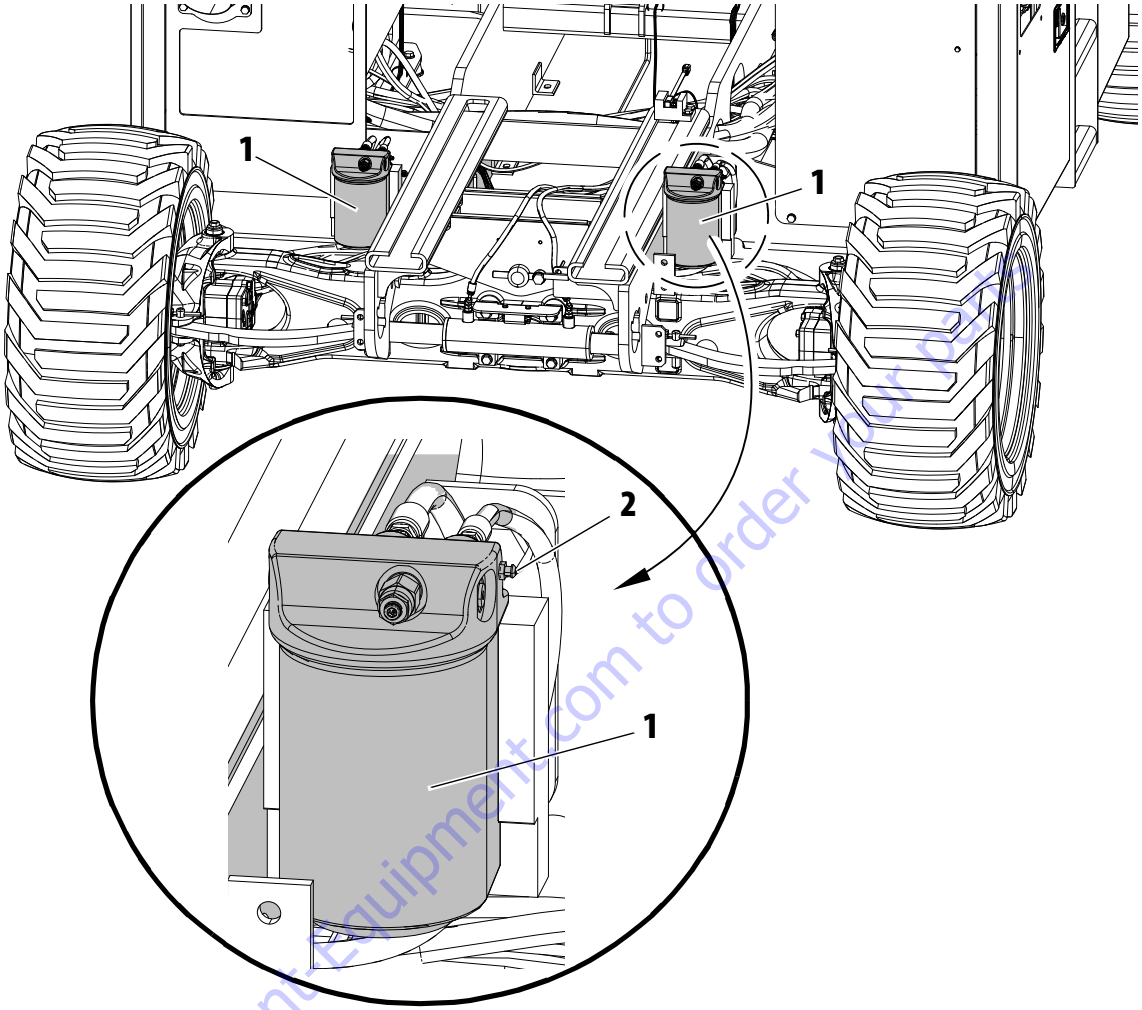
Figure 4-42. Leveling Jack Cylinder



Item	Description	Torque
1	Solenoid Directional Valve	18 to 22 ft. lb. (25-30 Nm)
2	Pressure Transducer	16 ft. lb. (22 Nm)
3	Straight Fitting	55 ft. lb. (75 Nm)

Figure 4-43. Leveling Jack Torques

Oscillating Axle Cylinder Bleeding Procedure



1. Oscillating Axle Cylinder
2. Bleeder Valve

Figure 4-44. Oscillating Axle Cylinder Bleeding

1. Start the engine.
2. Raise the arms high enough so that the left axle cylinder bleeder valve can be accessed.
3. Let engine run at idle.
4. Position a suitable container [approximately 0.5 gal (1.9 l)] over the bleeder valve.
5. Using a 3/8" wrench, slowly open bleeder valve.
6. Keep the container close enough to the bleeder valve to catch the aerated oil.
7. Open the bleeder valve enough to get a fast stream of oil.

NOTE: *A fast stream of oil will exhaust the air out of the hoses and cylinder better than a slow stream of oil.*

8. Every 3-4 seconds, close the bleeder valve so that a slower stream of oil is being purged. When only oil and no air is being purged, close the bleeder valve.
9. A new system can take 10-15 seconds per cylinder to bleed.

NOTICE

ANYTIME EITHER OF THE HOSES PLUMBING TO THE CYLINDERS ARE BROKEN INTO, AIR HAS BEEN INTRODUCED INTO THE SYSTEM. THE CYLINDERS MUST BE BLED.

4.15 HYDRAULIC SCHEMATICS

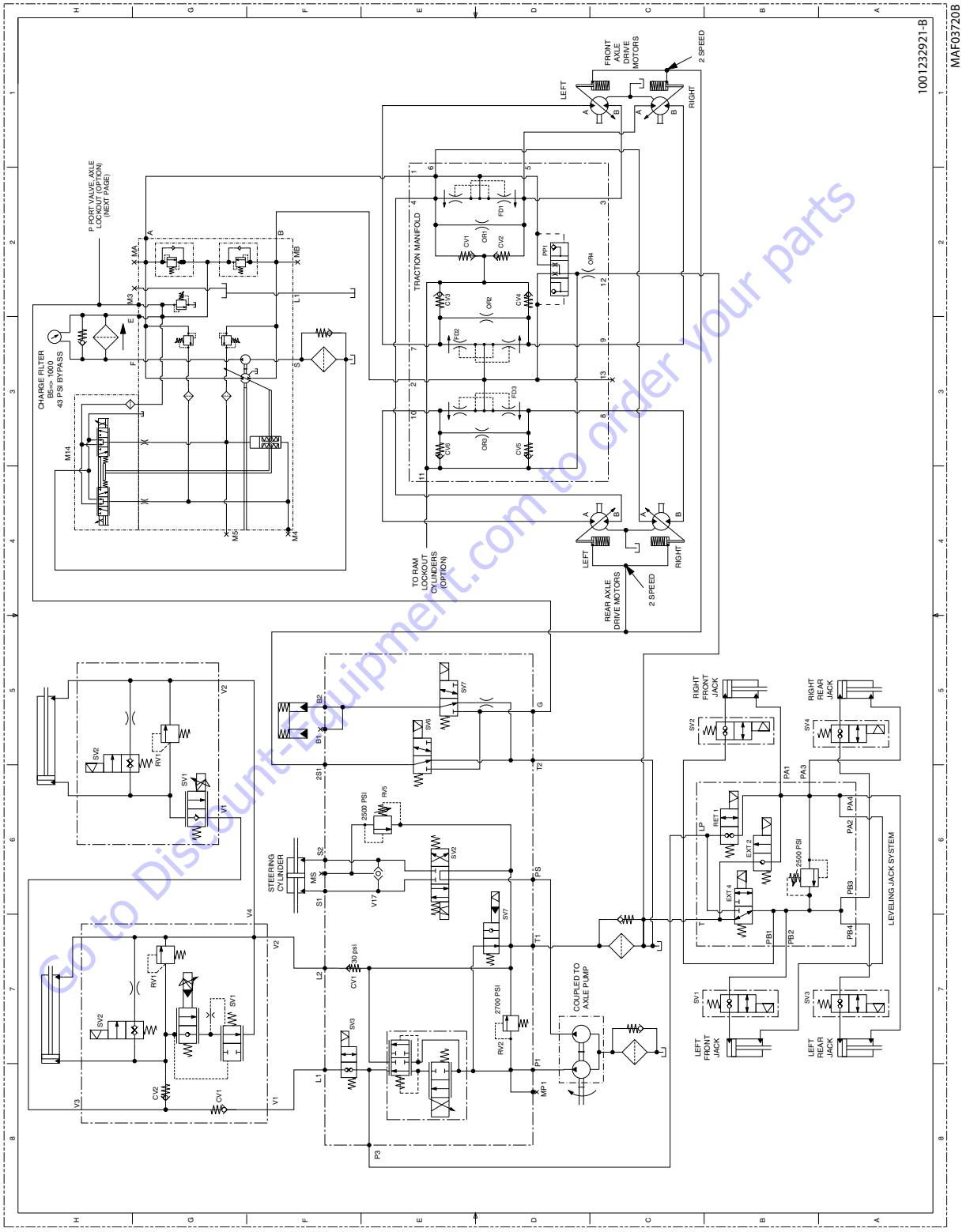


Figure 4-45. Hydraulic Schematic

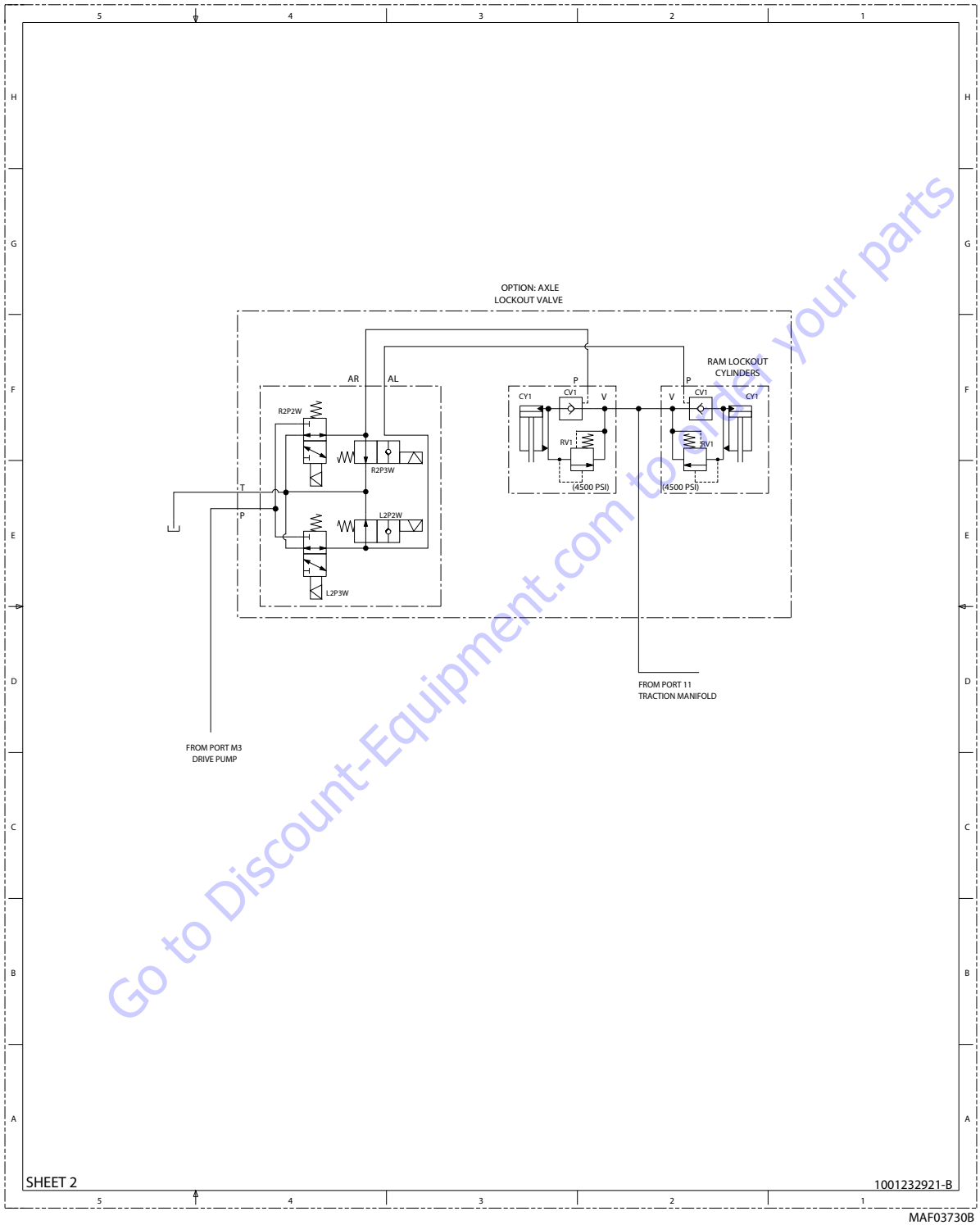
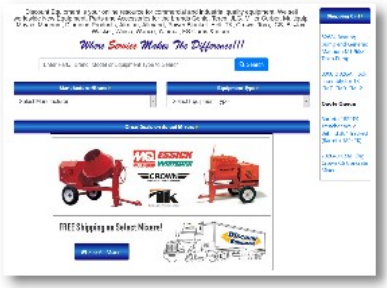


Figure 4-46. Hydraulic Schematic

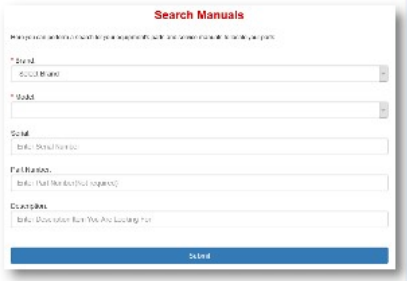
PARTS FINDER

Search Website by Part Number

Discount Equipment



Search Manual Library For Parts Manual & Lookup Part Numbers – Purchase or Request Quote



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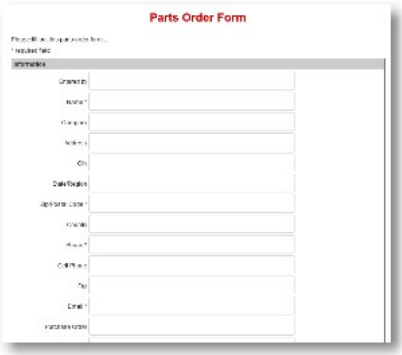

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SECTION 5. JLG CONTROL SYSTEM

5.1 HAND HELD ANALYZER

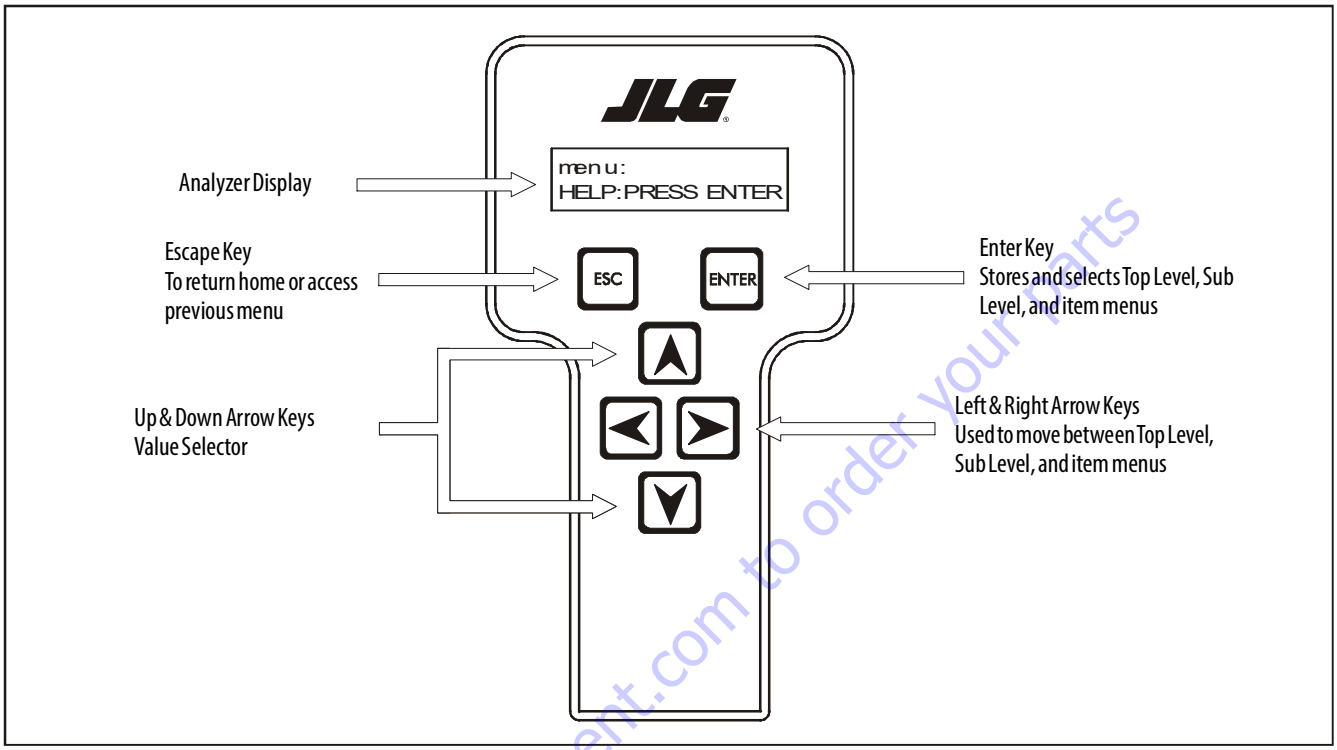
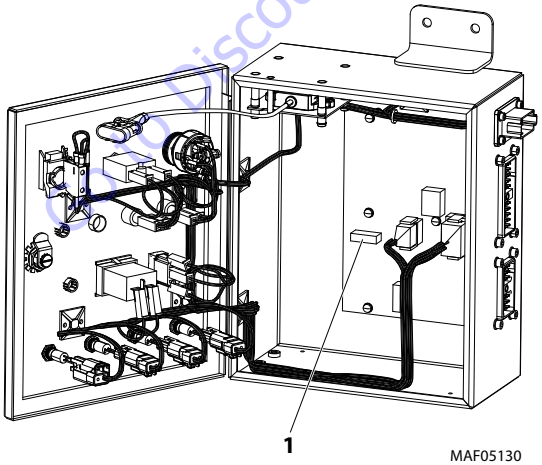
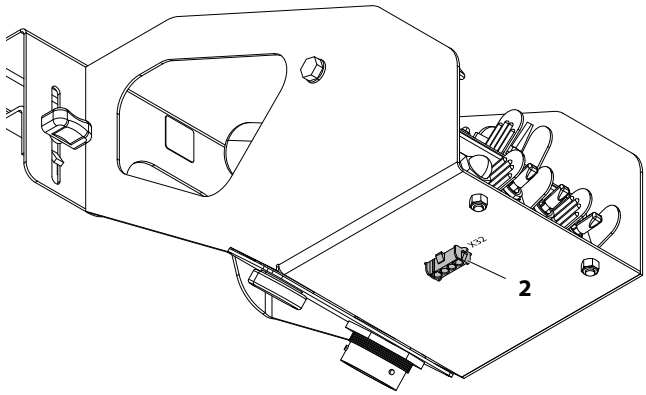


Figure 5-1. Hand Held Analyzer

To Connect the Hand Held Analyzer

1. Connect the four pin end of the cable supplied with the analyzer, to the four position connector (1) J6 on the PCB in the ground control station or at the platform control station connector (2) X32 as shown. Connect the remaining end of the cable to the analyzer.





1. Ground Control Box - Analyzer Connector
2. Platform Control Box - Analyzer Connector

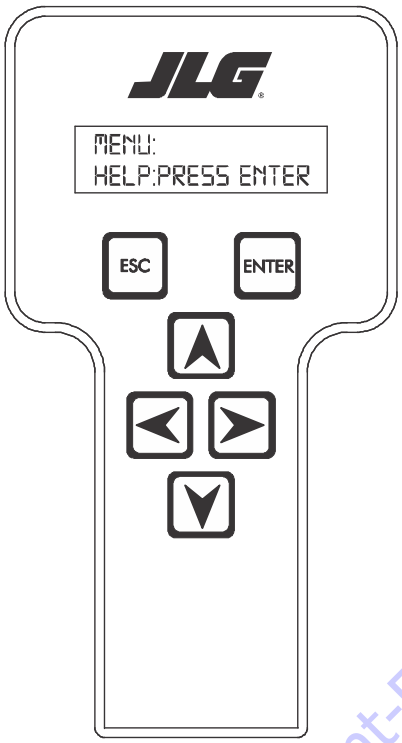
Figure 5-2. Hand-Held Analyzer Connections

NOTE: *The cable has a four pin connector at each end; the cable cannot be connected backwards.*

3. Power up the Control System by turning the lower key to the platform position and pulling out both emergency stop buttons.

Using the Analyzer

With the machine power on and the analyzer connected properly, the analyzer will display the following:



HELP:

PRESS ENTER

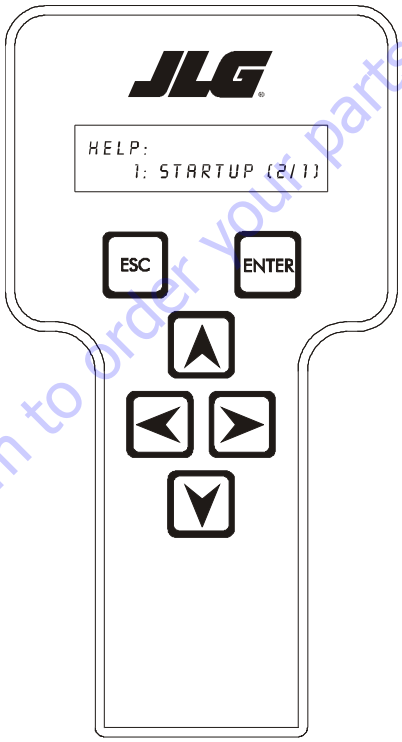
At this point, using the **RIGHT** and **LEFT** arrow keys, you can move between the top level menu items. To select a displayed menu item, press **ENTER.** To cancel a selected menu item, press **ESC**; then you will be able to scroll using the right and left arrow keys to select a different menu item.

The top level menus are as follows:

ACCESS LEVEL
PERSONALITIES
MACHINE SETUP
CALIBRATIONS
ACTIVATE TESTS
HELP
DIAGNOSTICS

If you press **ENTER**, at the HELP:PRESS ENTER display, and a fault is present during power up, the analyzer display will scroll the fault across the screen. If there was no fault detected during power up, the display will read:
In platform mode**, HELP: EVERYTHING OK,**
In ground mode**, GROUND MODE OK**

If **ENTER** is pressed again, the display moves to the following display:



LOGGED HELP

1: STARTUP (2/1): (Or last recorded fault)

At this point, the analyzer will display the current fault, if any are present. You may scroll through the fault logs to view what the last fifteen faults were. Use the right and left arrow keys to scroll through the fault logs. To return to the beginning, press **ESC** two times.

When a top level menu is selected, a new set of menu items may be offered; If for example you choose Personalities:

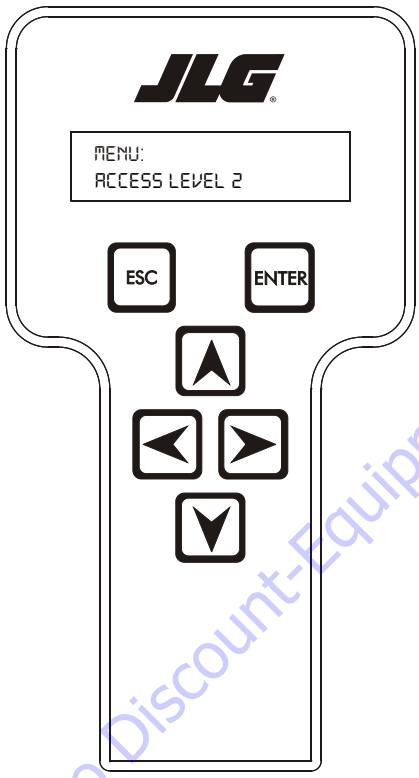
DRIVE
LIFT
GROUND MODE

Pressing **ENTER** with any of the above displayed menus will display additional sub-menus within the selected menu. In some cases the next level is the parameter or information to be changed. Refer to the flow chart for what menus are available within the top level menus. You may only view the personality settings for selected

menus while in access level 2. Remember, you may always cancel a selected menu item by pressing the **ESC** key.

Changing the Access Level of the Hand Held Analyzer

When the analyzer is first connected, you will be in access level 2 which enables you to only view most configuration settings which cannot be changed until you enter a password to advance to a lower level. This ensures that a setting cannot be accidentally altered. To change the access level, the correct password must be entered. To enter the password, scroll to the **ACCESS LEVEL** menu. For example:



MENU:

ACCESS LEVEL 2

Press **ENTER** to select the **ACCESS LEVEL** menu.

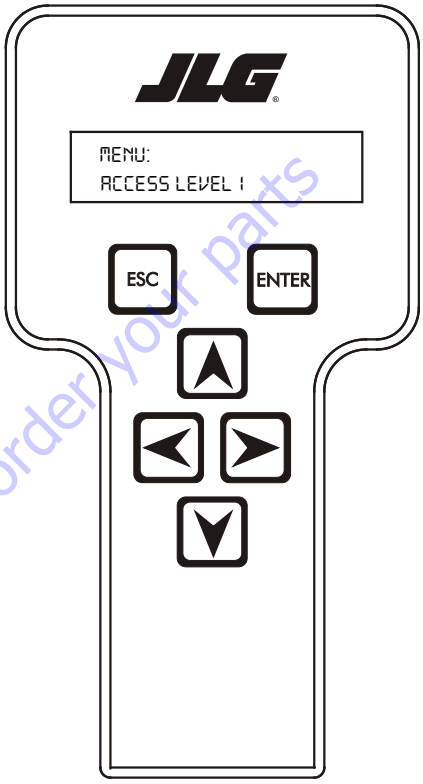
Using the **UP** or **DOWN** arrow keys, enter the first digit of the password, 3.

Then using the **RIGHT** arrow key, position the cursor to the right one space to enter the second digit of the password.

Use the **UP** or **DOWN** arrow key to enter the second digit of the password which is 3.

Repeat this process until you have entered all five digits of the password which is **33271**.

Once the correct password is displayed, press **ENTER**. The access level should display the following, if the password was entered correctly:



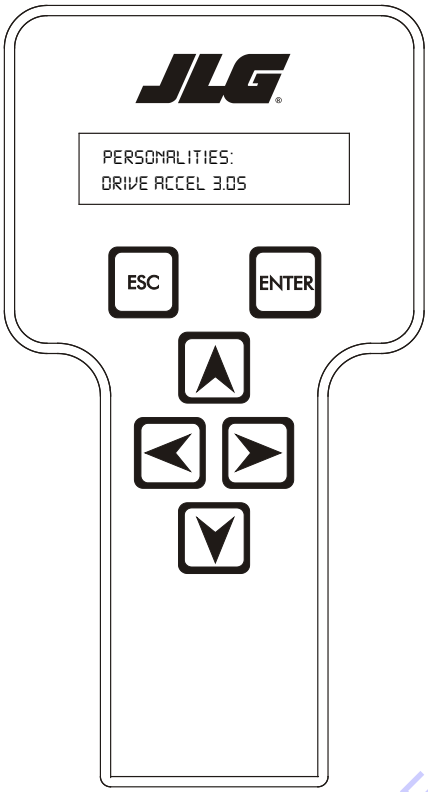
MENU:

ACCESS LEVEL 1

Repeat the above steps if the correct access level is not displayed or you can not adjust the personality settings.

Adjusting Parameters Using the Hand Held Analyzer

Once you have gained access to level 1, and a personality item is selected, press the UP or DOWN arrow keys to adjust its value, for example:



PERSONALITIES:

DRIVE ACCEL 3.0s

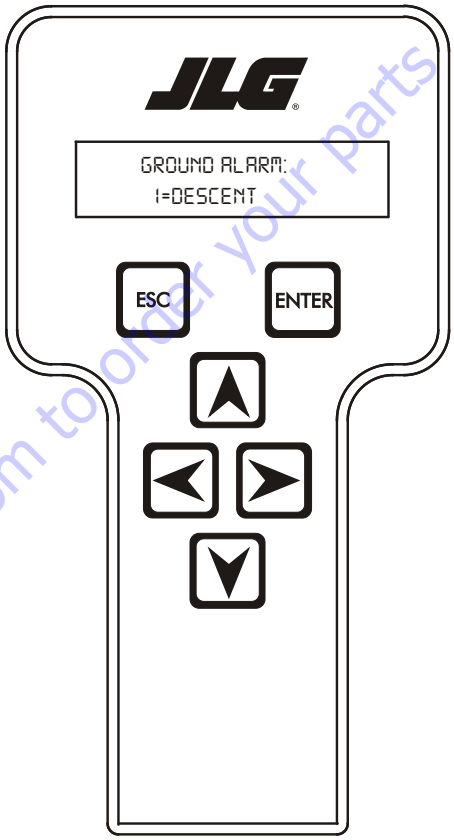
There will be a minimum and maximum for the value to ensure efficient operation. The value will not increase if the **UP** arrow is pressed when at the maximum value nor will the value decrease if the **DOWN** arrow is pressed and the value is at the minimum value for any particular personality. If the value does not change when pressing the up and down arrows, check the access level to ensure you are at access level 1.

Machine Setup

When a machine digit item is selected, press the **UP** or **DOWN** arrow keys to adjust its value, for example:

⚠ WARNING

FAILURE TO MAKE THE PROPER SETTINGS FOR THE PARTICULAR MACHINE CAN RESULT IN IMPROPER OPERATION.



GROUND ALARM:

1=DESCENT

The effect of the machine digit value is displayed along with its value. The above display would be selected if the machine was equipped with a ground alarm and you wanted it to sound when driving. There are certain settings allowed to install optional features or select the machine model.

When selecting the machine model to match the size of the machine, the personality settings will return to default settings.

NOTE: *Refer to Table 5-3, Machine Configuration Programming Information (Version P1.3) and Table 5-5, Machine Model Personality Adjustment for default settings.*

Password 33271 will give you access to level 1, which will permit you to change all machine personalities and/or machine setup settings.

⚠ WARNING

CHANGING THESE SETTINGS MAY ADVERSELY AFFECT THE PERFORMANCE OF YOUR MACHINE.

The flash code is indicated on the face of the platform control box as shown:

MAF06040

NOTE: *Flash codes are also displayed on the handheld analyzer. For descriptions see Table 5-1, DTC and Flash Code Descriptions.*

NOTICE

IT IS A GOOD PRACTICE TO AVOID PRESSURE-WASHING ELECTRICAL/ELECTRONIC COMPONENTS. SHOULD PRESSURE-WASHING BE UTILIZED TO WASH AREAS CONTAINING ELECTRICAL/ELECTRONIC COMPONENTS, JLG INDUSTRIES, INC. RECOMMENDS A MAXIMUM PRESSURE OF 750 PSI (52 BAR) AT A MINIMUM DISTANCE OF 12 INCHES (30.5 CM) AWAY FROM THESE COMPONENTS. IF ELECTRICAL/ELECTRONIC COMPONENTS ARE SPRAYED, SPRAYING MUST NOT BE DIRECT AND BE FOR BRIEF TIME PERIODS TO AVOID HEAVY SATURATION.

Analyzer Menu Flow Charts

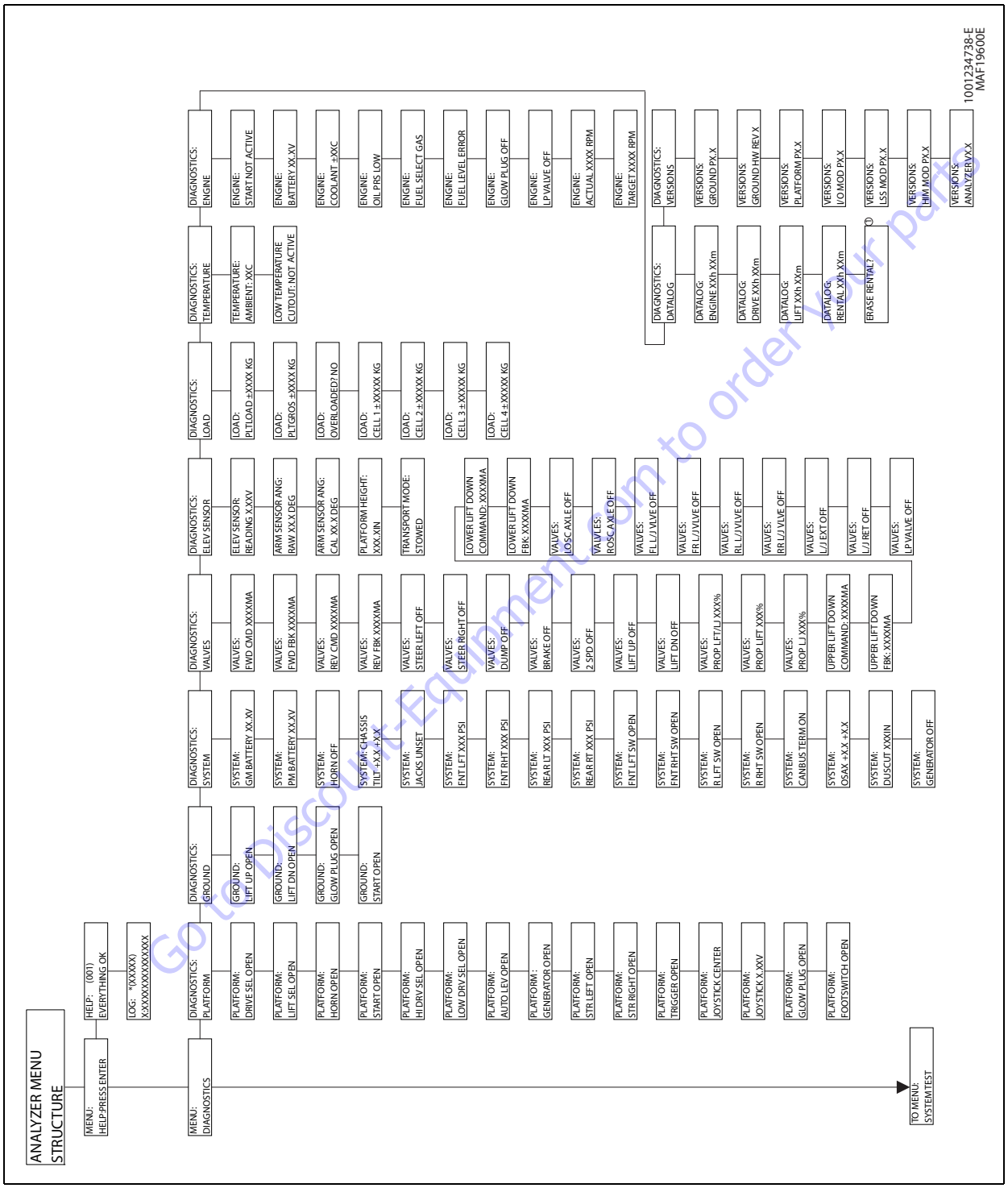


Figure 5-3. Analyzer Menu Flow Chart (Version P1.3) - Sheet 1 of 3

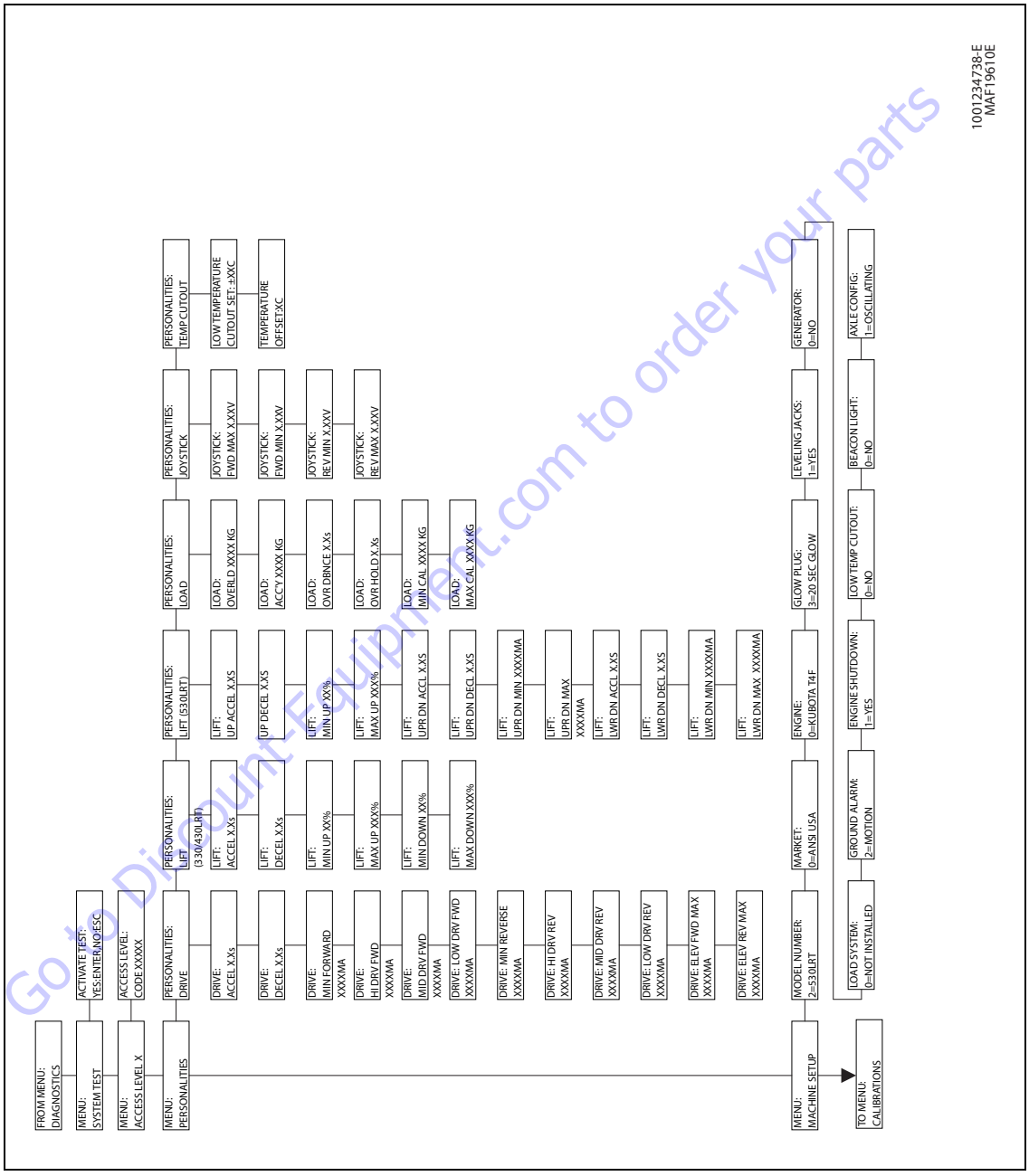


Figure 5-4. Analyzer Menu Flow Chart (Version P1.3) - Sheet 2 of 3

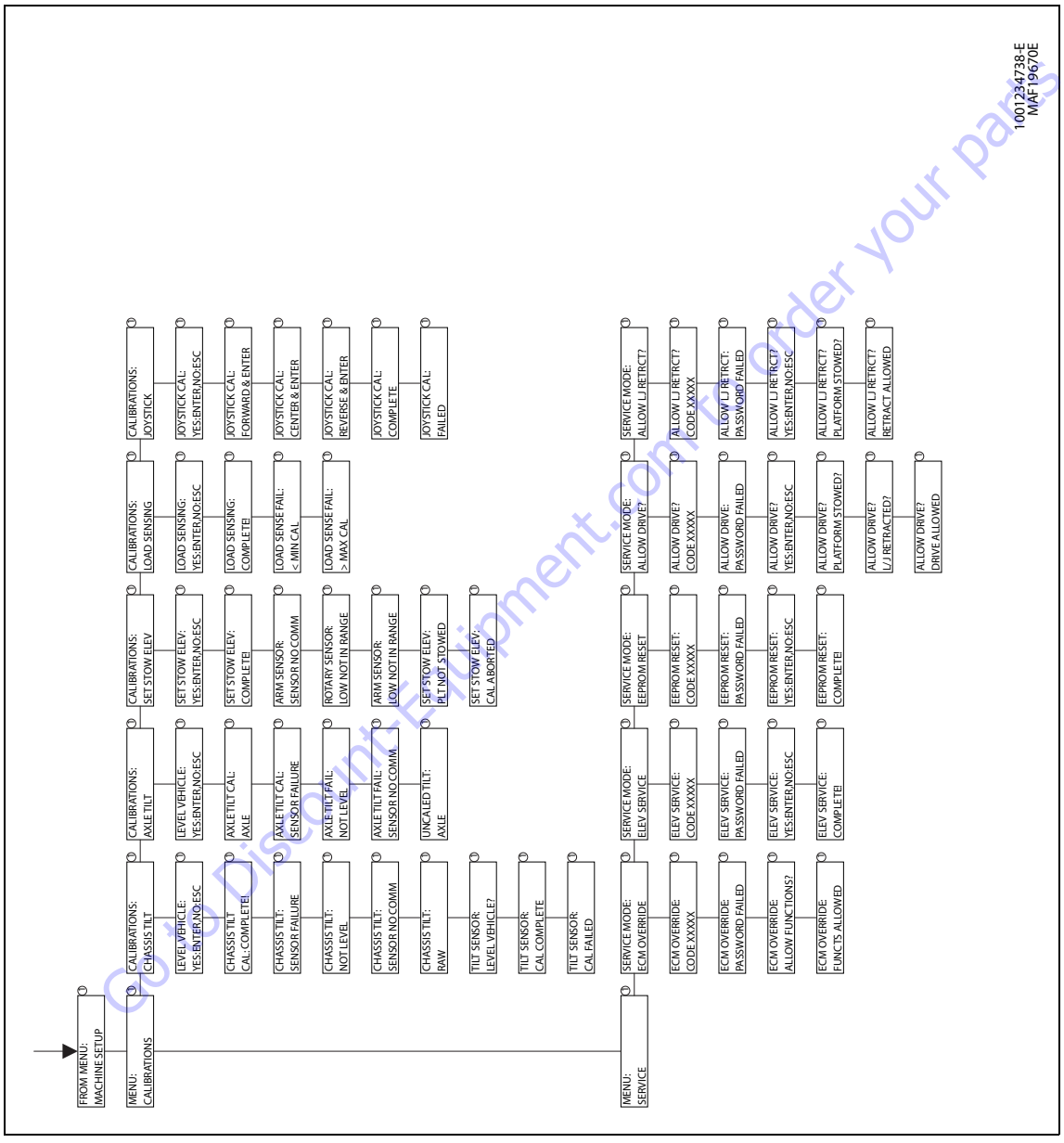


Figure 5-5. Analyzer Menu Flow Chart (Version P1.3) - Sheet 3 of 3

5.2 DIAGNOSTIC TROUBLESHOOTING CODES (DTC'S) AND FLASH CODES DESCRIPTION

Table 5-1. DTC and Flash Code Descriptions

DTC Code	Flash Code		Description	Item Check List
001	0	0	"Everything Ok"	• No issues detected
004	0	0	"Driving At Cutback - Above Elevation"	• The platform is determined to be elevated (Reference platform height calculation section).
005	0	0	"Drive & Lift Up Prevented - Tilted & Elevated"	• Platform is elevated, and machine tilt exceeds the model and market specific limits.
009	0	0	"Drive Prevented - Elevated Above Drive Cutout Height"	• Attempting to drive with the platform elevated to over 32 feet. The control system prevents driving. • Lower the platform to under 32 feet.
0041	0	0	"Front Left Leveling Jack At End Of Stroke"	• Front Left Leveling Jack cylinder has reached end of stroke. • Check if the cylinder is at end of stroke (normal operation). • Check the wiring to the Front Left Leveling Jack end of stroke switch.
0042	0	0	"Front Right Leveling Jack At End Of Stroke"	• Front Right Leveling Jack cylinder has reached end of stroke. • Check if the cylinder is at end of stroke (normal operation). • Check the wiring to the Front Right Leveling Jack end of stroke switch.
0043	0	0	"Rear Left Leveling Jack At End Of Stroke"	• Rear Left Leveling Jack cylinder has reached end of stroke. • Check if the cylinder is at end of stroke (normal operation). • Check the wiring to the Rear Left Leveling Jack end of stroke switch.
0044	0	0	"Rear Right Leveling Jack At End Of Stroke"	• Rear Right Leveling Jack cylinder has reached end of stroke. • Check if the cylinder is at end of stroke (normal operation). • Check the wiring to the Rear Right Leveling Jack end of stroke switch.
0045	0	0	"Engine Shutdown Commanded - Check Engine Sensors"	• The engine coolant temperature is high or the oil pressure is low. The control system shuts down the engine. • DIESEL - Check the engine oil pressure and engine coolant temperature sensors for damage. • Check the engine oil pressure input J2-17 (should be low when not overheating). • Check the engine coolant input J2-25 (resistive).
211	2	1	"Power Cycle"	• Power was cycled ON
212	2	1	"Keyswitch Faulty - Platform & Ground Active Together"	• The Platform and Ground mode switches are both high. • Check the Ground Module inputs for Ground Mode (J4-4) and Platform Mode (J1-2).
221	2	2	"Function Problem - Horn Permanently Selected"	• Horn switch input is closed during power up.
223	2	2	"Function Problem - Drive & Lift Active Together"	• Drive and Lift Digital Inputs on the Platform Control Module are HIGH simultaneously for 1000ms.
224	2	2	"Function Problem - Steer Left Permanently Selected"	• Left steer select switch input is closed during power up.
225	2	2	"Function Problem - Steer Right Permanently Selected"	• Right steer select switch input is closed during power up.
228	2	2	"Function Locked Out - Accelerator Not Centered"	• Joystick is not centered during start-up of the machine. Joystick signal must remain at neutral voltage for 1000 ms after start-up or fault will activate.
229	2	2	"Function Problem - Trigger Permanently Closed"	• The Trigger Switch CAN message and LRT Ground Module Trigger DI are conflicting with each one another.

Table 5-1. DTC and Flash Code Descriptions

DTC Code	Flash Code		Description	Item Check List
232	2	3	"Ground Lift Up/down Active Together"	• Ground lift up and lift down inputs both closed. The control system prevents lifting and lowering. • Check if the Ground lift switch is damaged, obstructed, or jammed. • Check Ground input J4-7 (should be low when lift up is not selected). • Check Ground input J4-8 (should be low when lift down is not selected).
241	2	4	"Ambient Temperature Sensor - Out Of Range Low"	• The temperature is below the allowed minimum value. The control system prevents lift up. The control system limits driving to turtle speed if elevated. • Check the wires to the Chassis Tilt Sensor. • Replace the Chassis Tilt Sensor (also sends temperature).
242	2	4	"Ambient Temperature Sensor - Out Of Range High"	• The temperature is above the allowed maximum value. The control system prevents lift up. The control system limits driving to turtle speed if elevated. • Check the wires to the Chassis Tilt Sensor. • Replace the Chassis Tilt Sensor (also sends temperature).
243	2	4	"Front Left Leveling Jack Pressure Transducer Failure"	• Front Left Leveling Jack pressure transducer reading is outside of the allowed range. • Check the wiring to the Front Left Leveling Jack pressure transducer.
244	2	4	"Front Right Leveling Jack Pressure Transducer Failure"	• Front Right Leveling Jack pressure transducer reading is outside of the allowed range. • Check the wiring to the Front Right Leveling Jack pressure transducer.
245	2	4	"Rear Left Leveling Jack Pressure Transducer Failure"	• Rear Left Leveling Jack pressure transducer reading is outside of the allowed range. • Check the wiring to the Rear Left Leveling Jack pressure transducer.
246	2	4	"Rear Right Leveling Jack Pressure Transducer Failure"	• Rear Right Leveling Jack pressure transducer reading is outside of the allowed range. • Check the wiring to the Rear Right Leveling Jack pressure transducer.
247	2	4	"Front Left Leveling Jack Stow Switch Faulty "	• Front Left Outrigger stow switch is closed (digital input is high) while all Leveling Jacks are set.
248	2	4	"Front Right Leveling Jack Stow Switch Faulty"	• Front Right Outrigger stow switch is closed (digital input is high) while all Leveling Jacks are set.
249	2	4	"Rear Left Leveling Jack Stow Switch Faulty"	• Rear Left Outrigger stow switch is closed (digital input is high) while all Leveling Jacks are set.
251	2	5	"Elev Angle Sensor Faulty - Not Mounted or Voltage Out Of Range"	• Elevation angle sensor's voltage is > 4.85V or < 0.30V.
252	2	5	"Elev Angle Sensors Have Not Been Calibrated"	• The EEPROM value for Arm Stack Arm Angle and Rotary Sensor values for Stowed are default EEPROM values.
2111	2	1	"Engine Start Prevented - Platform Start Switch High At Power Up"	• Start switch is closed during power up.
2210	2	2	"Trigger Closed Too Long While In Neutral"	• Trigger has been squeezed for 10 seconds while the joystick was in the center position. • Check the Platform Trigger input J1-1 (should be high when trigger is squeezed).
2232	2	2	"Function Locked Out - Drive & Lift Both Open"	• The Platform Drive and Lift inputs are both open. The control system prevents any function selects. • Check Platform inputs J1-3 (should be high in drive mode) and J1-4 (should be high in lift mode).
2237	2	2	"Joystick Faulty - Steer Switches Active Together"	• Steer switch inputs are both closed at the same time.

Table 5-1. DTC and Flash Code Descriptions

DTC Code	Flash Code		Description	Item Check List
2239	2	2	"Function Locked Out - Joystick Calibration Faulty"	• Joystick calibration is not valid. The control system prevents any function selects. • Calibrate the Platform Joystick.
2267	2	2	"Joystick Faulty - Wiper Out Of Range"	• Joystick Wiper is outside the acceptable voltage range. • Check the wires to the joystick.
2269	2	2	"Function Problem - High Speed & Creep Active Together"	• The High Speed and Low Speed Drive Inputs are active Simultaneously for 1000ms.
2282	2	2	"Function Problem - Generator Permanently Selected"	• Generator select switch input is closed during power up.
2284	2	2	"Function Problem - Trigger Switch Wiring Short to Ground"	• CAN messages and DI on ground board are conflicting with one another
22101	2	2	"Function Problem - Drive & Level Active Together"	• Machine Setup Leveling Jacks is set to 1=YES Drive and Level Digital Inputs on the Platform Control Module are HIGH simultaneously for 1000ms
2299	2	2	"Function Problem - Lift and Level Active Together"	• Machine Setup Leveling Jacks is set to 1=YES Lift and Level Digital Inputs on the Platform Control Module are HIGH simultaneously for 1000ms
22100	2	2	"Function Problem - Drive & Lift & Level All Open"	• Machine Setup Leveling Jacks is set to 1=YES The Lift/Level/Drive Mode Digital Inputs are LOW simultaneously for 1000ms.
22102	2	2	"Trigger Faulty"	• Disagreement between the trigger input at the platform and the ground. Trigger reads low at the platform module • Trigger reads high at the ground module
23245	2	3	"Elevation Sensors - Disagreement"	• DTC 252 - ELEVATION ANGLE SENSORS NOT CALIBRATED is NOT Active AND Rotary Sensor Voltage > 1.5V (indicating elevated) and Adjusted Arm Angle > -4 deg (indicating stowed) for 1000ms OR Rotary Sensor Voltage > 3V (indicating close to full height) and Adjusted Arm Angle > -30 deg (indicating not close to full height) for 1000ms
2410	2	4	"Rear Right Leveling Jack Stow Switch Faulty"	• Rear Right Outrigger stow switch is closed (digital input is high) while all Leveling Jacks are set

Table 5-1. DTC and Flash Code Descriptions

DTC Code	Flash Code		Description	Item Check List
2512	2	5	"Elev Angle Sensor Not Detecting Change"	• DTC 6661, 8114, 8117 Not Active ANDThe Platform Calculated Height is . . . > 100 inches AND < 350 inches AND Model = 330LRT OR > 120 inches AND < 450 inches AND Model = 430LRT OR > 140 inches AND < 600 inches AND Model = 530LRT AND Lift Up/LJ Flow Control (530LRT) or Lift Flow Control (330/430LRT) Command > LIFT UP MIN + 15% AND RDGFilteredAdjustedArmTiltAngle does not change more than 0.50 degrees for 5000mS
2555	2	5	"Function Prevented - Selected Before FSW"	• Machine Setup Market == Korea AND Machine Setup Footswitch is 1=YES AND Footswitch is open while the joystick is not in the neutral/center position
2568	2	5	"Temperature Cutout Active - Ambient Temperature Too Low"	• The temperature is too low. The control system may prevent lift up, drive, steer. • Check the wires to the Chassis Tilt Sensor. • Replace the Chassis Tilt Sensor (also sends temperature).
2580	2	5	"Lift Up Prevented - Leveling Jacks Not Set"	• Attempting to lift up with the platform elevated too high with out the leveling jacks set. The control system prevents lifting. • Lower the platform to stowed. Set the leveling jacks.
2588	2	5	"Function Prevented - Leveling Jacks State Unknown"	• One or more of the leveling jack's switches are not in the stowed position and the jacks are not in the set position.
2590	2	5	"Functions Locked Out - ECM Lost"	• MACHINE SETUP -> ENGINE = KUBOTA D/F ECM and CANbus communication is lost for 250mS
23107	2	3	"Function Problem - Lift Up Permanently Selected"	• Ground lift up switch is closed during a power up.
23108	2	3	"Function Problem - Lift Down Permanently Selected"	• Ground lift down switch is closed during a power up.
23153	2	3	"Function Problem - Engine Start Permanently Selected"	• Ground start switch is closed during power up.
3517	3	5	"Front Left Leveling Jack Short To Ground"	• The Front Left Leveling Jack is shorted to ground. • Check the wiring to the Front Left Leveling Jack.
3518	3	5	"Front Left Leveling Jack Short To Battery"	• The Front Left Leveling Jack is shorted to battery. • Check the wiring to the Front Left Leveling Jack.
3519	3	5	"Front Left Leveling Jack Open Circuit"	• The Front Left Leveling Jack is open circuit. • Check the wiring to the Front Left Leveling Jack.
3520	3	5	"Front Right Leveling Jack Short To Ground"	• The Front Right Leveling Jack is shorted to ground. • Check the wiring to the Front Right Leveling Jack.
3521	3	5	"Front Right Leveling Jack Short To Battery"	• The Front Right Leveling Jack is shorted to battery. • Check the wiring to the Front Right Leveling Jack.
3522	3	5	"Front Right Leveling Jack Open Circuit"	• The Front Right Leveling Jack is open circuit. • Check the wiring to the Front Right Leveling Jack.
3523	3	5	"Rear Left Leveling Jack Short To Ground"	• The Rear Left Leveling Jack is shorted to ground. • Check the wiring to the Front Left Leveling Jack.

Table 5-1. DTC and Flash Code Descriptions

DTC Code	Flash Code		Description	Item Check List
3524	3	5	"Rear Left Leveling Jack Short To Battery"	• The Rear Left Leveling Jack is shorted to battery. • Check the wiring to the Front Left Leveling Jack.
3525	3	5	"Rear Left Leveling Jack Open Circuit"	• The Rear Left Leveling Jack is open circuit. • Check the wiring to the Front Left Leveling Jack.
3526	3	5	"Rear Right Leveling Jack Short To Ground"	• The Rear Right Leveling Jack is shorted to ground. • Check the wiring to the Rear Right Leveling Jack.
3527	3	5	"Rear Right Leveling Jack Short To Battery"	• The Rear Right Leveling Jack is shorted to battery. • Check the wiring to the Rear Right Leveling Jack.
3528	3	5	"Rear Right Leveling Jack Open Circuit"	• The Rear Right Leveling Jack is open circuit. • Check the wiring to the Rear Right Leveling Jack.
3529	3	5	"Leveling Jack Extend Valve Short To Ground"	• The Leveling Jack extend valve is shorted to ground. • Check the wiring to the Leveling Jack extend valve.
3530	3	5	"Leveling Jack Extend Valve Short To Battery"	• The Leveling Jack extend valve is shorted to battery. • Check the wiring to the Leveling Jack extend valve.
3531	3	5	"Leveling Jack Extend Valve Open Circuit"	• The Leveling Jack extend valve is open circuit. • Check the wiring to the Leveling Jack extend valve.
3532	3	5	"Leveling Jack Retract Valve Short To Ground"	• The Leveling Jack retract valve is shorted to ground. • Check the wiring to the Leveling Jack retract valve.
3533	3	5	"Leveling Jack Retract Valve Short To Battery"	• The Leveling Jack retract valve is shorted to battery. • Check the wiring to the Leveling Jack retract valve.
3534	3	5	"Leveling Jack Retract Valve Open Circuit"	• The Leveling Jack retract valve is open circuit. • Check the wiring to the Leveling Jack retract valve.
33132	3	3	"Throttle Actuator - Short to Battery"	• The Engine RPM is not commanded to high idle however the control system detects high idle.
33280	3	3	"Glowplug - Short to Battery"	• The platform or ground glow plug input is detected high at power up.
33318	3	3	"Drive Forward Valve - Short to Battery"	• The HIM has detected a STB on the Drive Forward Valve output and communicated it to the LRT Ground Module via CAN
33319	3	3	"Drive Forward Valve - Short to Ground"	• The HIM has detected a STG on the Drive Forward Valve output and communicated it to the LRT Ground Module via CAN
33317	3	3	"Drive Forward Valve - Open Circuit"	• The HIM has detected a OC on the Drive Forward Valve output and communicated it to the LRT Ground Module via CAN Only detectable when a function is active
33321	3	3	"Drive Reverse Valve - Short to Battery"	• The HIM has detected a STB on the Drive Reverse Valve output and communicated it to the LRT Ground Module via CAN
33322	3	3	"Drive Reverse Valve - Short to Ground"	• The HIM has detected a STG on the Drive Reverse Valve output and communicated it to the LRT Ground Module via CAN
33320	3	3	"Drive Reverse Valve - Open Circuit"	• The HIM has detected a OC on the Drive Reverse Valve output and communicated it to the LRT Ground Module via CAN Only detectable when a function is active
33750	3	3	"Upper Lift Down Valve - Short to Battery"	• The HIM has detected a STB on the Upper Lift Down Valve output and communicated it to the LRT Ground Module via CAN AND Machine Setup Model - 530LRT

Table 5-1. DTC and Flash Code Descriptions

DTC Code	Flash Code		Description	Item Check List
33751	3	3	"Upper Lift Down Valve - Short to Ground"	• The HIM has detected a STG on the Upper Lift Down Valve output and communicated it to the LRT Ground Module via CAN AND Machine Setup Model - 530LRT
33752	3	3	"Upper Lift Down Valve - Open Circuit"	• The HIM has detected a OC on the Upper Lift Down Valve output and communicated it to the LRT Ground Module via CAN Only detectable when a function is active AND Machine Setup Model - 530LRT
33753	3	3	"Lower Lift Down Valve - Short to Battery"	• The HIM has detected a STB on the Lower Lift Down Valve output and communicated it to the LRT Ground Module via CAN AND Machine Setup Model - 530LRT
33754	3	3	"Lower Lift Down Valve - Short to Ground"	• The HIM has detected a STG on the Lower Lift Down Valve output and communicated it to the LRT Ground Module via CAN AND Machine Setup Model - 530LRT
33755	7	8	"Lower Lift Down Valve - Open Circuit"	• The HIM has detected a OC on the Lower Lift Down Valve output and communicated it to the LRT Ground Module via CAN Only detectable when a function is active AND Machine Setup Model - 530LRT
4381	4	3	"Fuel Sensor - Short to Battery"	• The control system measures Fuel Sensor A2D value > 1023 counts
432	4	3	"Fuel Sensor Short To Ground"	• The fuel sensor value is under the minimum allowed value. • Check the fuel sensor input J2-34 (resistive).
4382	4	3	"Fuel Sensor - Open Circuity"	• The control system measures Fuel Sensor A2D value > 768 counts
433	4	3	"Oil Pressure Short To Battery"	• Engine oil pressure is high while the engine is not running for 30 seconds. • Check the engine oil pressure input J2-17 (should be low when not overheating). • Check the speed sensor wiring.
434	4	3	"Oil Pressure Short To Ground"	
435	4	3	"Coolant Temperature Short To Ground"	
437	4	3	"Engine Trouble Code "	• Fault was reported by the engine controller. • Check the engine.
438	4	3	"Engine Temperature High"	• Engine temperature is over 110 degrees C.
441	4	4	"Battery Too Low - System Shut Down"	• Battery voltage is under 9 Volts. • Check the battery charge and cables.
442	4	4	"Battery Too High - System Shut Down"	• Battery voltage is over 16 Volts. • Check the battery charge and cables.
4310	4	3	"No Alternator Output"	• The Alternator input is high after 15 seconds of engine running. • Check alternator input J2-21 (should be low if engine is running).
4311	4	3	"Oil Pressure Low"	• Engine oil pressure low after 10 seconds of running. • Check engine oil pressure input J2-17 (should be high if engine is running).
4322	4	3	"Loss of Engine Speed Sensor"	• Oil Pressure is present, Diesel Rpm is equal to zero and Speed Sensor Loss Counter has timed out.

Table 5-1. DTC and Flash Code Descriptions

DTC Code	Flash Code		Description	Item Check List
4323	4	3	"Speed Sensor Reading Invalid Speed"	• The speed sensor reading is over the maximum allowed value. • Check the speed sensor wiring.
4352	4	3	"Coolant Temp Sensor Out Of Range High"	• Engine coolant temp value is over the maximum allowed value. • Check the engine coolant input J2-25 (resistive).
4353	4	3	"Coolant Temp Sensor Out Of Range Low"	• Engine coolant temp value is under the minimum allowed value. • Check the engine coolant input J2-25 (resistive).
4430	4	4	"Battery Low"	• Battery voltage is under 11 Volts. • Check the battery charge and cables.
662	6	6	"Canbus Failure - Platform Module"	• The control system failed to receive messages from the Platform Module. All data from Platform Module is marked invalid. • Check wiring to the Platform Module.
666	6	6	"Canbus Failure - Engine Controller"	• MACHINE SETUP -> ENGINE = KUBOTA D/F ECM and CANbus communication is lost for 250mS.
663	6	6	"LSS Not Sending Can Messages"	• LSS Module CANbus messages not received for 250mS AND LOAD CFG = LOAD PINS AND LOAD != NO
664	6	6	"Canbus Failure - Accessory Module"	• Canbus communication with the accessory module port has been lost for 1000ms
6649	6	6	"Canbus Failure - Temp/Tilt Sensor"	• Ground module has lost communication with the tilt/temperature (0xC1) sensor via Canbus for greater than or equal to 250ms AND Low Temperature Cutout is configured
671	6	7	"Accessory Fault"	• CAN faults reported by the Accessory Module.
6635	6	6	"Canbus Failure - Chassis Tilt Sensor"	• The control system failed to receive messages from the Chassis Tilt Sensor. The control system behaves tilted. • The Chassis Tilt Sensor is located inside the left chassis cover. Check wiring to the Chassis Tilt Sensor.
6650	6	6	"Canbus Failure - Oscillating Axle Tilt Sensor"	• MACHINE SETUP ->AXLE = OSCILLATING AND MODEL = 330/430LRT and MARKET = CE OR MACHINE SETUP MODEL = 530LRT and AXLE = OSCILLATING AND Ground module has lost communication with the oscillating axle tilt sensor (0xC3) via CANbus for greater than or equal to 250ms .
6660	6	6	"Canbus Failure - Leveling Jacks Module"	• CAN communication is lost with the leveling jacks module for 250ms.
6661	6	6	"Canbus Failure - Arm Stack Tilt Sensor"	• Arm Stack Tilt Sensor CANbus messages not received for 250mS.
6671			"Canbus Failure - Hydraulics Improvement Module"	• The LRT Ground Module has not received HIM messages for 250ms
813	8	1	"Chassis Tilt Sensor Not Calibrated"	• The chassis tilt sensor has never been calibrated so the control system assumes the vehicle is tilted. Control system determines that the chassis tilt sensor EEPROM values have never been calibrated.
814	8	1	"Chassis Tilt Sensor Out Of Range"	• The Chassis Tilt Sensor Raw X or Raw Y axis reads > +35 deg or < -35 deg.

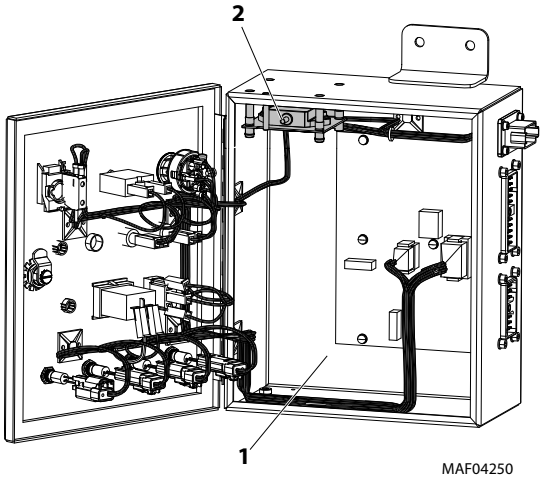
Table 5-1. DTC and Flash Code Descriptions

DTC Code	Flash Code		Description	Item Check List
818	8	1	"Tilt Sensor Stagnant"	• If DTC's 6635, 813, 814 Not Active AND Commanded Drive Fwd or Rev > Max Low Drive Forward or Max Low Drive Reverse Personalities AND RDGChassisTilt(X) does not change by 0.01 deg within 5000ms OR RDGChassisTilt(Y) does not change by 0.01 deg within 5000ms
825	8	2	"LSS Has Not Been Calibrated"	• Machine Setup LOAD != NO AND the control system detects that LSS has not been calibrated.
829	8	2	"Functions Cutout - Platform Overloaded"	• Machine Setup -> LOAD != NO • AND • The platform load exceeds the "overload weight" value.
821	8	2	"LSS Cell #1 Error"	• LOAD CFG = LOAD PINS and LOAD != NO AND LSS Module Reports Cell #1 DTC
822	8	2	"LSS Cell #2 Error"	• LOAD CFG = LOAD PINS and LOAD != NO AND LSS Module Reports Cell #2 DTC
823	8	2	"LSS Cell #3 Error"	• LOAD CFG = LOAD PINS and LOAD != NO AND LSS Module Reports Cell #3 DTC
824	8	2	"LSS Cell #4 Error"	• LOAD CFG = LOAD PINS and LOAD != NO AND LSS Module Reports Cell #4 DTC
837	8	3	"Platform LSS Sensor 1 - Short To Battery"	• Pressure Transducer Number 1 is reading higher then 3360PSI. • Check Sensor wiring.
838	8	3	"Platform LSS Sensor 1 - Short To Ground Or Open Circuit"	• Pressure Transducer Number 1 is reading lower then 0 PSI. • Check Sensor wiring.
873	8	7	"Machine Safety System Override Occurred"	• The Platform was moved while overloaded using the MSSO button. • Can be reset only with an Analyzer, via the CALIBRATIONS > MSSO RESET > MSSO RESET menu.
8113	8	1	"Axle Tilt Sensor Has Not Been Calibrated"	• Ground module is indicating that the EEPROM which stores the axle tilt sensor calibration is blank. MACHINE SETUP ->AXLE = OSCILLATING AND MODEL = 330/430LRT and MARKET = CE OR MACHINE SETUP MODEL = 530LRT and AXLE = OSCILLATING.
8114	8	1	"Arm Stack Tilt Sensor Out Of Range"	• The Arm Stack Tilt Sensor Raw Arm Angle reading is < -90 degrees (factors in max arm angle plus 40% grade) OR greater than 40 degrees (conservatively assumes a minimum arm angle of 0 degrees plus a downhill grade of 40%) DTC 813 CHASSIS TILT SENSOR NOT CALIBRATED is not Active.
8115	8	1	"Axle Tilt Sensor Out Of Range"	• The Axle Tilt Sensor Raw X or Raw Y axis reads: 530 LRT: > +25 deg or < -25 deg 330/430 LRT > +30 deg or < -30 deg
8118	8	1	"Axle Tilt Sensor Stagnant"	• If DTC's 6650, 8113, 8115 Not Active AND Commanded Drive Fwd or Rev > Max Low Drive Forward or Max Low Drive Reverse Personalities AND RDGAxleXTilt_SideSide does not change by 0.01 deg within 5000ms OR RDGAxleYTilt_FrontBack does not change by 0.01 deg within 5000ms

Table 5-1. DTC and Flash Code Descriptions

DTC Code	Flash Code		Description	Item Check List
991	9	9	"LSS Watchdog Reset"	• LOAD CFG = LOAD PINS and LOAD != NO LSS Module reports watchdog reset fault 0x40
992	9	9	"LSS EEPROM Error"	• LOAD CFG = LOAD PINS and LOAD != NO LSS Module reports EEPROM fault 0x40
993	9	9	"LSS Internal Error - Pin Excitation"	• LOAD CFG = LOAD PINS and LOAD != NO LSS Module reports excitation fault 0x01
994	9	9	"LSS Internal Error - DRDY Missing From A/D"	• LOAD CFG = LOAD PINS and LOAD != NO LSS Module reports DRDY fault 0x10
998	9	9	"EEPROM Failure - Check All Settings"	• EEPROM checksum did not match saved checksum for a memory bank. Bank (personalities, machine configuration, calibrations, or fault log) reset to defaults. • Replace controller.
9910	9	9	"Functions Locked Out - Platform Module Software Version Improper"	• DTC 662 does not exist AND The LRT Ground Module software major version number does not match the major version number of the platform module software
9979	9	9	"Functions Locked Out - Ground Module Software Version Improper"	• Digital Input J4-10 = FALSE (indicating S299 control module has been placed on a pre S299 machine)
99333	9	9	"Functions Locked Out - Him Module Software Version Improper"	• DTC 6671 does not exist AND The LRT Ground Module software major version number does not match the major version number of the HIM module software
99187	9	9	"LSS Internal Error - Driver Failure"	• LOAD CFG = LOAD PINS and LOAD != NO LSS Module reports driver fault 0x04

5.3 CHASSIS TILT SENSOR INSTALLATION



1. Ground Control Box
2. Chassis Tilt Sensor Assembly

Figure 5-6. Chassis Tilt Sensor Location

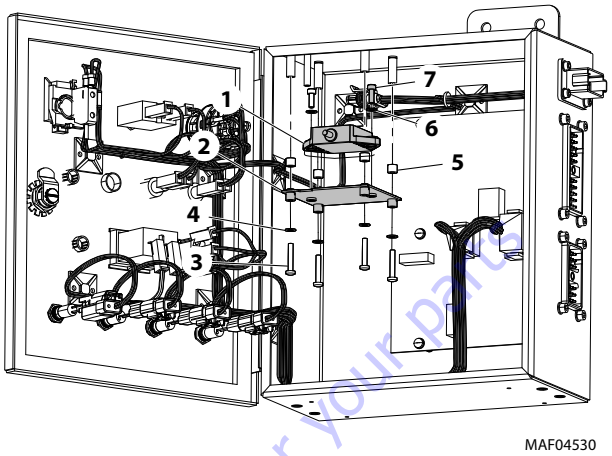
NOTE: *Refer to Figure 5-7., Chassis Tilt Sensor Removal for numbers in parenthesis.*

1. Disconnect the batteries.
2. Open the ground control box to gain access to the chassis tilt sensor assembly.
3. Disconnect the chassis tilt sensor wiring connector (SN3) from the (X03) harness connector on the side of the box.
4. Remove the four screws (3), lock washers (4), standoff insulators (5) to remove the chassis tilt sensor (1) and sensor mount (2) from the ground control box.
5. The chassis tilt sensor (1) can be removed from the sensor mount (2) by removing the two screws (7) and washers (6).

NOTE: *Follow the above procedures in reverse order when installing the chassis tilt sensor assembly. Torque screws (7) to 106 in. lbs (12 Nm).*

NOTE: *After installing, make sure to calibrate the chassis tilt sensor (refer to Section 5.4, Location Of Additional Sensors and Section 5.5, Calibration Procedures).*

Chassis Tilt Sensor - If this sensor is not wired correctly or if you have the wrong part number you will get CAN-BUS FAILURE - CHASSIS TILT SENSOR

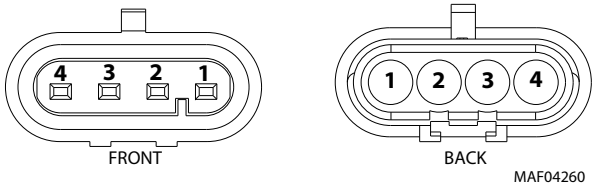


1. Chassis Tilt Sensor
2. Sensor Mount
3. Screws
4. Washers
5. Stand-off Insulators
6. Washers
7. Screws
8. Harness Connector

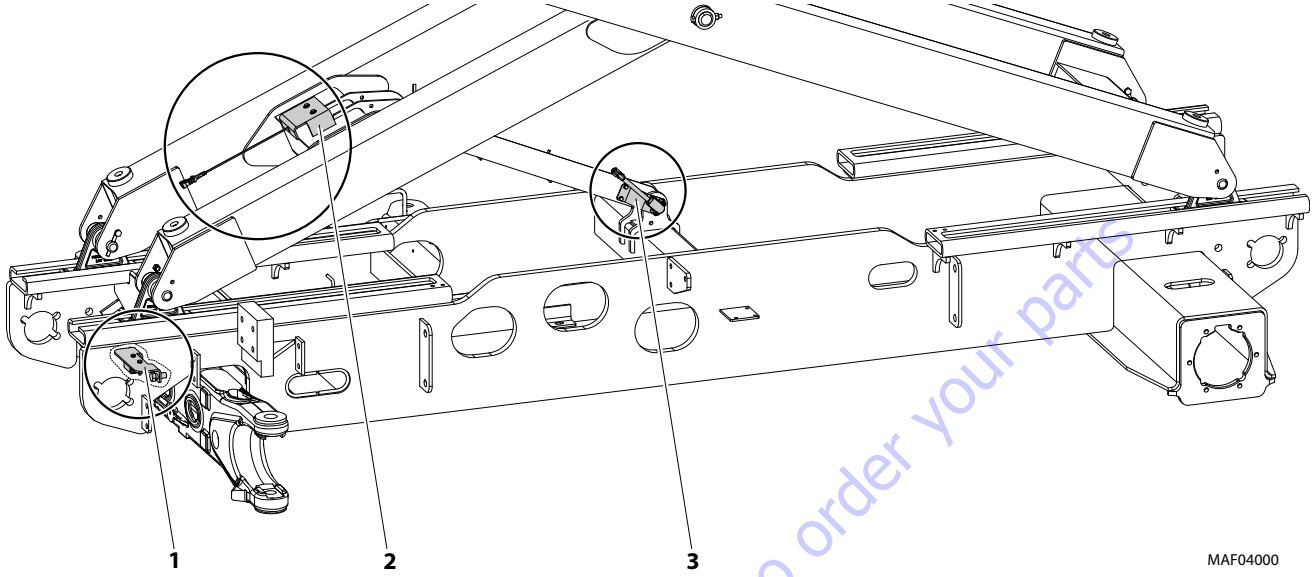
Figure 5-7. Chassis Tilt Sensor Removal

Table 5-2. Chassis Tilt Sensor Harness (SN3)

Wire Color	Function	Connector Pin
White	VCC	1
Yellow	Ground	2
Green	CANH	3
Brown	CANL	4



5.4 LOCATION OF ADDITIONAL SENSORS



1. Oscillating Axle Tilt Sensor
2. Arm Stack Tilt Sensor
3. Rotary Angle (Elevation) Sensor

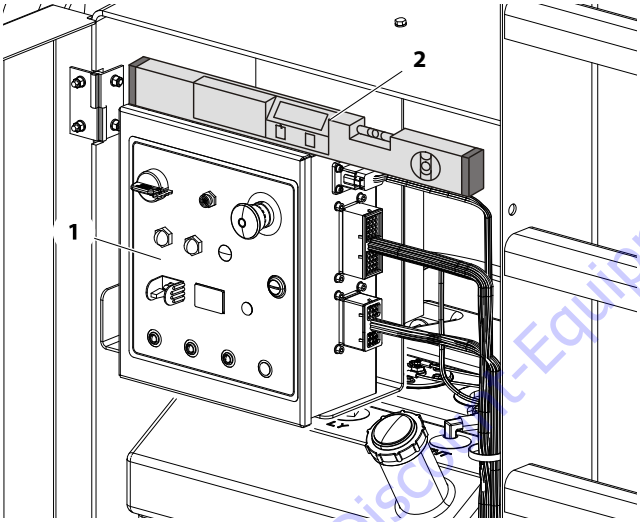
Figure 5-8. Chassis Sensor Locations

5.5 CALIBRATION PROCEDURES

Chassis Tilt Sensor Calibration

(Item 1, Figure 5-7.)

1. Drive the machine onto a measured level surface (±0.5° for both x and y axis).
2. Using the Analyzer, go to MENU: CALIBRATION; TILT SENSOR. Press Enter. LEVEL VEHICLE will display. Press Enter again to calibrate.
3. Both axis' raw angles need to be within ±5.0°, otherwise the machine is not level and the software will prohibit calibration. Should this occur, check for the following:
   a. Machine mounting and/or grade:
   With a digital level, measure the top of the Ground Control box for levelness. If unable to get a good reading, check the box's mounting surface for levelness.



1. Ground Control Box 2. Digital or Bubble Level

   b. Tilt sensor mounting on machine or wedged crooked in control box:
   If the machine mounting/grade appears acceptable, open the Ground Control box carefully. Observe whether the tilt sensor is properly seated.
   c. Tilt sensor has developed an offset shift:
   Remove the tilt sensor from the Ground Control box, but keep both the tilt sensor and Ground Control box electrically connected. Level one axis of the tilt sensor and observe the raw reading (should be within ±2.0°). Do the same for the other axis. If either axis is greater than ±2.0°, replace the tilt sensor.

Some possible reasons that the tilt sensor will not calibrate are:

   a. The surface the machine is sitting on is off level by a few degrees (flat doesn't imply level; parking lots are often not level).
   b. The tilt sensor has failed one or both of the channels (X axis and Y axis).
   c. Tilt sensor has moisture intrusion that has shifted its output.
   d. Water and/or corrosion in the box has corrupted electrical connections or caused a tilt sensor or ground control board failure (observe any cracks in the box).
   e. The Ground Control Box, as mounted on the machine, does not allow the tilt sensor to be level.

For the following troubleshooting steps, a bubble level (smaller is better) will be needed and the machine must be on a level surface:

1. On the Analyzer, go to Diagnostics/System and read the tilt angle. If either angle reports +20.0°, there is an electrical/electronic failure (tilt sensor, control board, electrical connections).
   a. Open the Ground Control Box.
   b. Disconnect the sensor and clean any corrosion off of the tilt sensor and control board connections.
   c. Reassemble and test. If fault persists, replace tilt sensor.
2. If the Analyzer displays angles other than +20.0°, attempt to calibrate. If machine will not calibrate, note the reason displayed on Analyzer:
   a. SENSOR FAILURE – tilt sensor internal frequency is out of range (replace sensor).
   b. NOT LEVEL - tilt sensor has either developed an offset or it is too unlevel as mounted on the machine.

Oscillating Axle Tilt Sensor

(Item 4, Figure 5-8.)

1. Place machine on level surface
2. Start with machine in the stow position
3. Go to CALIBRATIONS > AXLE TILT
4. Select Enter
5. Analyzer says "Level Vehicle"
6. Select Enter
7. Analyzer will display the Axle Tilt Calibration Values
8. Hit Escape to leave menu.

Set Stow Elevation

1. Place machine on level surface
2. Start with machine in the stow position
3. Go to CALIBRATIONS > SET STOW ELEV
4. Select Enter
5. Analyzer says "Calibrate Stow Elev Sensor?"
6. Select Enter
7. Analyzer will display "Complete"
8. Hit Escape to leave menu.

5.6 SERVICE MODE PROCEDURES

ECM Override (Dual Fuel Only)

This service menu may be utilized when ECM CAN communication is lost on a machine equipped with Dual Fuel, but Elevated Drive, Auto-Level, or Generator function is needed. This service mode will bypass the ECM CAN loss DTCs and allow the machine to function as normal.

1. Using the Analyzer, navigate to SERVICE MODE > ECM OVERRIDE.
2. Input the pass code **22954** and select Enter.
3. The Analyzer will display ALLOW FUNCTIONS?
4. Select Enter.
5. Analyzer will display FUNCTS ALLOWED.
6. Select Escape to leave menu.

Elevation Service

This procedure allows a service technician to elevate the platform when an active DTC is preventing elevation by bypassing the DTC and allowing the platform to lift up. This mode remains active until a power cycle occurs. Once power is cycled, the DTC will become active again, and Elevation Service mode must be reactivated to lift.

1. Using the Analyzer, navigate to SERVICE MODE > ELEV SERVICE.
2. Input the pass code **87189** and select Enter.
3. Select Enter to activate the Elevation Service Mode.
4. Analyzer will display COMPLETE!
5. Elevation Service is now active. Select Escape to leave menu.

EEPROM Reset

This procedure clears all the machine's calibrations and returns the machine personalities and set-up to default settings. After Reset EEPROM, all calibration procedures will need to be completed. Use this service mode when: a machine is having multiple issues and clearing the EEPROM may help to fix the problem; a service technician wants to clear all machine calibrations and return the machine to default settings; or a module is moved from one machine to another and must be cleared and returned to default.

1. Using the Analyzer, navigate to SERVICE MODE > EEPROM RESET.
2. Input the pass code **35470** and select Enter.
3. Select Enter to activate EEPROM Reset.
4. Analyzer will display COMPLETE.
5. All settings will be reset. Select Escape to leave menu.

Allow Drive

This mode allows a service technician to drive the machine when an active DTC prevents normal drive functionality. Before initiating this service mode, the service technician must verify the platform is stowed and the leveling jacks are retracted before drive function will be enabled. Drive speed will only be allowed at elevated speed.

1. Using the Analyzer, navigate to SERVICE MODE > ALLOW DRIVE.
2. Input the pass code **82221** and select Enter.
3. The Analyzer will display ALLOW DRIVE? Select Enter for YES.
4. The Analyzer will display PLATFORM STOWED? Select Enter.
5. The Analyzer will display L/J RETRACTED? Select Enter.
6. The analyzer will display RETRCT ALLOWED. Select Escape to leave menu.

Allow Leveling Jack Retract

This mode allows a service technician to retract the leveling jacks when an active DTC prevents normal leveling jack functionality. Before initiating this service mode, the service technician must verify the platform is stowed before the leveling jacks can be retracted.

1. Using the Analyzer, navigate to SERVICE MODE > ALLOW LJ RETRCT.
2. Input the pass code **54749** and select Enter.
3. The Analyzer will display ALLOW LJ RETRCT? Select Enter.
4. The Analyzer will display PLATFORM STOWED? Select Enter.
5. The analyzer will display RETRCT ALLOWED. Select Escape to leave menu.

5.7 MACHINE CONFIGURATION AND PROGRAMMING SETTINGS

The Machine Configuration Programming must be completed before any Personality settings *(Table 5-5)* can be changed. Changing the Personality settings first and then changing the Model of the Machine Configuration will cause the Personality settings to return to default values.

Table 5-3. Machine Configuration Programming Information (Version P1.3)

Configuration Digit	Setting	Description	Default Number
MODEL NUMBER:	0	330 LRT	
1	1	430 LRT	
	2	**530 LRT**	**2**
MARKET:	**0**	**ANSI USA**	**0**
2	1	ANSI EXPORT	
	2	CSA	
	3	CE	
	4	AUSTRALIA	
	5	KOREA	
ENGINE:	0	**KUBOTA T4F**	**0**
3	1	KUBOTA T4I	
	2	KUBOTA D/F	
GLOW PLUGS:	0	NO GLOW PLUGS	
4	1	5 SEC GLOW	
	2	10 SEC GLOW	
	3	**20 SEC GLOW**	**3**
LEVELING JACKS:	0	No - Leveling Jacks not installed on vehicle.	
5	**1**	**YES - Leveling Jacks are installed on vehicle.**	**1**
GENERATOR:	**0**	**NO - Generator is not installed on vehicle.**	**0**
6	1	YES - Generator is installed on vehicle.	
LOAD SYSTEM:	0	NOT INSTALLED – No overload detection.	
7*	**1**	**CUTOUT PLT – Platform controls are disabled when overloaded.**	**1**
	2	CUTOUT ALL – Platform and Ground controls are disabled when overloaded.	
		NOTE: ** Different Defaults by market: CE = 2*	
GROUND ALARM:	0	NOT INSTALLED – Vehicle alarm will function for Overload (if LOAD enabled).	
8*	1	DESCENT – Vehicle alarm will function for Overload (if LOAD enabled) and during Lift Down motion.	
	2	**MOTION – Vehicle alarm will function for Overload (if LOAD enabled), during Drive motion, and during Lift motion.**	**2**
		NOTE: ** Different Defaults by market: CE = 0*	
ENGINE SHUTDOWN:	0	NO - The engine will not be automatically shutdown.	
9	**1**	**SHUTDOWN - The engine will automatically shutdown in the event of high engine coolant temperature, low oil pressure, or a temperature sensor or oil pressure sensor fault.**	**1**
LOW TEMP CUTOUT:	**0**	**NO - The machine will not have low temperature cutout functionality.**	**0**
10	1	YES - The machine is equipped with low temperature cutout capability for the CE and ANSI EXPORT markets.	
BEACON LIGHT:	**0**	**NO - The beacon light will never flash except for when being used by Electronic Arm Guards (CE market). See footnote.**	**0**
11*	1	YES - The beacon light will flash at 1 Hertz all the time the machine is powered and not being used by Electronic Arm Guards (CE market). See footnote.	
		NOTE: ** The beacon light will ALWAYS be used for unique visual indication (flash at 1 Hertz for 2 seconds, then off for 1 second) for the Electronic Arm Guards feature (only equipped on CE market) regardless of the BEACON LIGHT setting.*	

Table 5-3. Machine Configuration Programming Information (Version P1.3)

Configuration Digit	Setting	Description	Default Number
AXLE CONFIG: 12	**0** 1	**FIXED - The machine is not equipped with an oscillating axle.** OSCILLATING - The machine is equipped with an oscillating axle.	**0**
			1001241348_C

NOTE: *Bold Numbers indicate the default setting for that market. Plain text indicates another available selection. SHADED CELLS indicates hidden menu or selection in that market.*

CONFIG. DIGIT	1	2	3			4				5		6			7			8			9		10		11		12	
530LRT	MODEL NUMBER	MARKET	ENGINE			GLOW PLUG				LEVELING JACKS		GENERATOR			LOAD SYSTEM			GROUND ALARM			ENGINE SHUTDOWN		LOW TEMP CUTOUT		BEACON LIGHT		AXLE CONFIG.	
ANSI USA	**2**	**0**	**0**	1	2	0	1	2	**3**	0	**1**	**0**	1	2	0	**1**	X	0	1	**2**	0	**1**	**0**	X	**0**	1	**0**	1
ANSI EXPORT	**2**	**1**	**0**	1	2	0	1	2	**3**	0	**1**	**0**	1	2	0	**1**	X	0	1	**2**	0	**1**	**0**	1	**0**	1	**0**	1
CSA	**2**	**2**	**0**	1	2	0	1	2	**3**	0	**1**	**0**	1	2	0	**1**	X	0	1	**2**	0	**1**	**0**	X	**0**	1	**0**	1
CE	**2**	**3**	**0**	1	2	0	1	2	**3**	0	**1**	**0**	1	2	0	X	**2**	**0**	1	2	0	**1**	**0**	1	**0**	1	**0**	1
AUSTRALIA	**2**	**4**	**0**	1	2	0	1	2	**3**	0	**1**	**0**	1	2	0	**1**	X	X	X	**2**	0	**1**	**0**	X	**0**	1	**0**	1
KOREA	**0**	**5**	**0**	1	2	0	1	2	**3**	0	**1**	**0**	1	2	0	**1**	X	0	1	**2**	0	**1**	**0**	1	**0**	1	**0**	1
																											1001241348_C	

Table 5-4. Machine Tilt Configuration (Version P1.3)

Model	Market	Lift Up and Drive prevented when Elevated and Tilted Front to Back beyond the following limits:	Lift Up and Drive prevented when Elevated and Tilted Side to Side beyond the following limits:	Drive prevented when Elevated beyond the following heights (regardless of tilt):	Lift Up prevented when Elevated beyond the following heights without outriggers deployed (regardless of tilt):
530LRT	ANSI USA	±5° to 32 Feet ±1.3° to 45 Feet, Jacks Not Set ±1.5° to 53 Feet, Jacks Set	±3° to 32 Feet ±1.3° to 45 Feet, Jacks Not Set ±1.5° to 53 Feet, Jacks Set	32 Feet	45 Feet
	ANSI EXPORT	±5° to 32 Feet ±1.3° to 45 Feet, Jacks Not Set ±1.5° to 53 Feet, Jacks Set	±3° to 32 Feet ±1.3° to 45 Feet, Jacks Not Set ±1.5° to 53 Feet, Jacks Set	32 Feet	45 Feet
	CSA	±3° to 32 Feet ±1.5° to 53 Feet	±3° to 32 Feet ±1.5° to 53 Feet	32 Feet	32 Feet
	CE	±5° to 32 Feet ±1.3° to 45 Feet, Jacks Not Set ±1.5° to 53 Feet, Jacks Set	±3° to 32 Feet ±1.3° to 45 Feet, Jacks Not Set ±1.5° to 53 Feet, Jacks Set	32 Feet	45 Feet
	AUSTRALIA	±5° to 32 Feet ±1.3° to 45 Feet, Jacks Not Set ±1.5° to 53 Feet, Jacks Set	±3° to 32 Feet ±1.3° to 45 Feet, Jacks Not Set ±1.5° to 53 Feet, Jacks Set	32 Feet	45 Feet
	KOREA	±5° to 32 Feet ±1.3° to 45 Feet, Jacks Not Set ±1.5° to 53 Feet, Jacks Set	±3° to 32 Feet ±1.3° to 45 Feet, Jacks Not Set ±1.5° to 53 Feet, Jacks Set	32 Feet	45 Feet
					1001241348_C

Table 5-5. Machine Model Personality Adjustment

Adjustment	Adjustment Range	Model Default Values
		530LRT
DRIVE		
Accel	0.1 - 5.0 (sec)	2.0
Decel	0.1 - 3.0 (sec)	2.0
Min Forward	500 - 800 mA	660
Hi Drv Fwd	1000 - 1800 mA	1400
Mid Drv Fwd	1100 - 1500 mA	1300
Low Drv Fwd	900 - 1100 mA	950
Min Reverse	500 - 800 mA	660
Hi Drv Rev	1000 - 1800 mA	1400
Mid Drv Rev	1100 - 1500 mA	1300
Low Drv Rev	900 - 1100 mA	950
Elev Fwd Max	700 - 1000 mA	860
Elev Rev Max	700 - 1000 mA	860
LIFT		
Accel	0.1 - 5.0 (sec)	NA
Decel	0.1 - 3.0 (sec)	NA
Up Accel	0.1 - 5.0 (sec)	1.5
Up Decel	0.1 - 3.0 (sec)	0.5
Min Up	0 - 35%	17
Max Up	0 - 75%	55
Min Down	0 - 35%	NA
Max Down	0 - 75%	NA
Upr Dn Accel	0.1 - 5.0 (sec)	0.5
Upr Dn Decl	0.1 - 1.5 (sec)	0.1
Upr Dn Min	200 - 700 mA	450
Upr Dn Max	500 - 1600 mA	1550
Lwr Dn Accl	0.1 - 5.0 (sec)	1.5
Lwr DN Decl	0.1 - 1.5 (sec)	1
Lwr Dn Min	200 - 700 mA	450
Lwr Dn Max	500 - 1600 mA	1550
LOAD		
Overload	450 - 1225 kg	710
Accy	0 - 680 kg	0.0
Overload Dbnce	0 - 10.0 (sec)	3.0
Overload Hold	0.5 - 10.0 (sec)	5.0

Table 5-5. Machine Model Personality Adjustment

Adjustment	Adjustment Range	Model Default Values
		530LRT
JOYSTICK		
Fwd Max	0.00 - 5.00V	1.1
Fwd Min	0.00 - 5.00V	2.25
Rev Min	0.00 - 5.00V	2.75
Rev Max	0.00 - 5.00V	3.9
TEMP CUTOUT		
Cutout Set	-30 - 0 (C)	-27
		1001241349_B
NOTE: *These settings may be changed in order to achieve optimal performance.*		

SECTION 6. LSS SETUP/CALIBRATION/SERVICE

6.1 CONNECTING THE JLG CONTROL SYSTEM ANALYZER

1. Connect the cable supplied with the Analyzer to the host control system located at the ground controlstation. There is also an alternate connection on the under side of the platform control station. Connect the remaining end of the cable to the analyzer.

NOTE: *The cable has a four-pin connector at each end of the cable; The cable cannot be connected backwards.*

2. Power-up the Control System by turning the key to the Platform or Ground position and pulling both emergency stop buttons.

6.2 HELP MENU & FAULT CODES

The Help Menu is a troubleshooting tool to communicate detected System Faults to the technician. The following table documents the Faults for the Load Sensing System. To access the Help Menu, use the LEFT and RIGHT arrow keys to select HELP: PRESS ENTER from the Top Level Menu. Press the ENTER key to view the menu.

When accessing the Help Menu, the JLG Analyzer will display EVERYTHING OK if the platform is not overloaded and no difficulties are detected. Otherwise, the JLG Analyzer will display OVERLOADED.

In the event of difficulty, the user can press ENTER again to display Logged Help, which is a record of the last 16 Fault Messages. The following table lists each Help/Logged Message, the Flash Code (for each Fault, the module will flash the two-digit code on its LED) triggered by the Fault, and a Description of the Situation (cause).

Table 6-1. LSS Fault Codes

HELP/LOGGED MESSAGE	FLASH CODE	DESCRIPTION OF SITUATION
PLATFORM OVERLOADED	2-5	The platform load measured at the Load Sensing System is excessive. Functions from the platform control are prevented, and functions from the ground control may be prevented, depending on machine.
BATTERY TOO HIGH	4-4	Incoming Supply Voltage >34.0 Vdc. The control system's battery voltage is too high. This may be due to over-charging or improper charger operation.
BATT TOO LOW	4-4	Incoming Supply Voltage <9.0 Vdc. The control system's battery voltage is too low due to excessive electrical load or discharge. This may compromise ability to predict weight. Recharge batteries or check for damaged batteries.
CANBUS FAILURE: LSS MODULE	6-6	The control system failed to receive messages from the LSS Module. Check wiring at the LSS Module and along scissor arms leading up to platform.
CELL #1 ERROR	8-1	Cell #1's Bridge <2V, >3V, or could not read Cell #1's Internal Memory. This situation indicates damage to the sensor or its wiring.
CELL #2 ERROR	8-2	Cell #2's Bridge <2V, >3V, or could not read Cell #2's Internal Memory. This situation indicates damage to the sensor or its wiring.
CELL #3 ERROR	8-3	Cell #3's Bridge <2V, >3V, or could not read Cell #3's Internal Memory. This situation indicates damage to the sensor or its wiring.
CELL #4 ERROR	8-4	Cell #4's Bridge <2V, >3V, or could not read Cell #4's Internal Memory. This situation indicates damage to the sensor or its wiring.
WATCHDOG RST	9-1	Microprocessor's Watchdog Timer Triggered. This is an indication that the LSS Module has been exposed to excessive electrical noise, or has experienced a hardware difficulty.
EEPROM ERROR	9-2	Memory used to retain Personality/Machine Setup/Calibration has been corrupted and must be reset by verifying all entries and re-calibrating. After resolution, re-cycle power to clear difficulty.
LSS NOT CALIBRATED	9-3	Calibration has not been successfully completed. A new LSS Module will display this message until properly calibrated.
LSS INTERNAL ERROR - PIN EXCITATION	9-9	Pin excitation <4.25 V. The sensors may be excessively loading the excitation supply, or the LSS Module may have hardware difficulty.
LSS INTERNAL ERROR - DRDY MISSING FROM A/D	9-9	DRDY Interrupt from LSS Module's A/D converter missing. This may indicate an LSS Module hardware difficulty.

6.3 DIAGNOSTIC MENU

NOTE: *If necessary refer to Section 5 - Analyzer Menu Flow Charts.*

The Diagnostic Load Menu is another troubleshooting tool for the Load Sensing System. Sensor and status information is presented in real-time for the technician.

To access the Diagnostic Menu, use the LEFT and RIGHT Arrow keys to select DIAGNOSTICS from the Top Level Menu. Press the ENTER key to select the menu.

NOTE: *The Diagnostic, Load menu is not available when the LSS is not enabled. (Machine Setup, Load is set to 0=Not Installed*

Press the LEFT and RIGHT Arrow keys to view the load sub-menus and press the enter key. Once in the load sub-menu, press the LEFT and RIGHT arrow keys to view the various displays.

The table below details the structure of the Diagnostic, Load Menu, and describes the meaning of each piece of information presented.

Table 6-2. Diagnostic Menu Descriptions

DIAGNOSTICS MENU (DISPLAYED ON ANALYZER 1ST LINE)	PARAMETER (DISPLAYED ON ANALYZER 2ND LINE)	PARAMETER VALUE (DISPLAYED ON ANALYZER 2ND LINE)	DESCRIPTION
LOAD:			
	PLTLOAD	±XXXX Kg	Displays (Total Measured Force – Empty Platform Calibration), in kilograms
	PLTGROS	±XXXX Kg	Displays Total Measured Force (Sum of Pins 1 thru 4 LOAD) in kilograms
	OVERLOADED?	Yes / No	Displays Current LSS Module Overload Status
	CELL 1	±XXXX Kg	Displays Calibrated Cell Reading in kilograms
	CELL 2	±XXXX Kg	Displays Calibrated Cell Reading in kilograms
	CELL 3	±XXXX Kg	Displays Calibrated Cell Reading in kilograms
	CELL 4	±XXXX Kg	Displays Calibrated Cell Reading in kilograms
	ANALYZER	VX.XXXX	Displays Analyzer Software Version

6.4 PERSONALITIES

The following parameter in the PERSONALITIES, LOAD menu adjust performance of the LSS. All adjustments must be made in Access Level 1 (33271).

Table 6-3. Personalities

SUBMENU (DISPLAYED ON ANALYZER1ST LINE)	PARAMETER (DISPLAYED ON ANALYZER 2ND LINE)	DESCRIPTION
LOAD:	ACC'Y XXXX KG	Displays/adjusts a derating for accessories.
	OVR DBNCE 3 S	Displays/ adjusts the debounce delay before an overload.
	OVR HOLD 5 S	Displays/adjusts the minimum delay before an overload can be released.

6.5 MACHINE SETUP MENU

The LOAD submenu within the machine setup menu is used to configure the LSS. To access the Machine Setup, Load menu, use the Left and Right arrow keys to select MACHINE SETUP from the Top Level Menu. Press the ENTER key to select the menu. Press the Left and Right arrow keys to select LOAD from the MACHINE SETUP menu. Press the Enter key to view the submenu.

The following table details the structure of the load submenu and describes the meaning of the parameter.

Table 6-4. Machine Setup

SUBMENU (DISPLAYED ON ANALYZER 1ST LINE)	PARAMETER (DISPLAYED ON ANALYZER 2ND LINE)	DESCRIPTION
LOAD:	0=NOT INSTALLED	Displays/adjusts the LSS Module
	1=CUTOUT PLT	
	2=CUTOUT ALL	

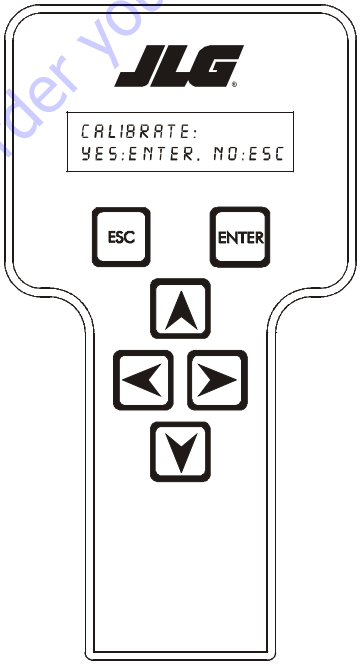
6.6 CALIBRATION MENU

The Load submenu within the Calibration Menu is used to zero the Empty Platform weight.

To access the Calibration Load Menu, use the LEFT and RIGHT Arrow keys to select CALIBRATION from the Top Level Menu. Press the ENTER key to select the menu. Press the LEFT and RIGHT arrow keys to select LOAD from the CALIBRATION menu. Press the ENTER key to view the submenu.

NOTE: *The Calibration Menu is not available in Access Level 2.*

Upon entry to the Calibration, Load Menu, the analyzer will display the following:

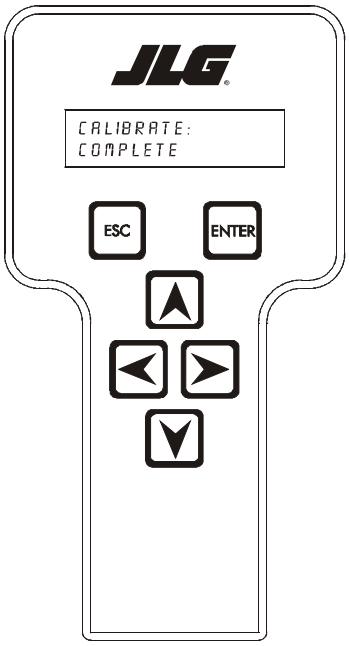


CALIBRATE:

YES:ENTER, NO:ESC

Pressing the ESC key will return the user to the top level menu and not disturb the prior calibration information.

Pressing the ENTER key will confirm that the platform is empty (except for factory-installed options outside the Rated Load). The LSS Module will calculate the total of all load cell readings and ensure that the total is greater than minimum calibration value, but less than maximum calibration value. If successful, the Analyzer will show the following:



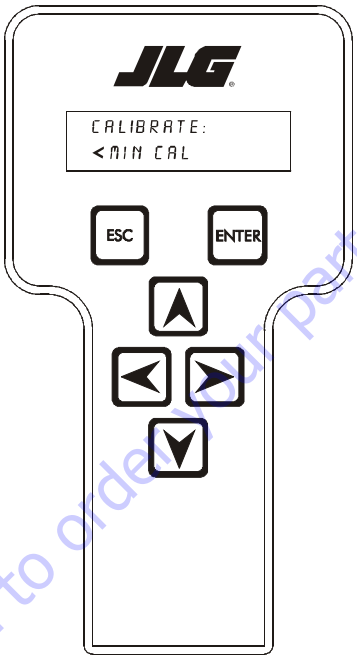
CALIBRATE:

COMPLETE

Calibration values are as follows:

- Minimum Calibration: 485 lb (220 kg)
- Maximum Calibration: 2205 lb (1000 kg)

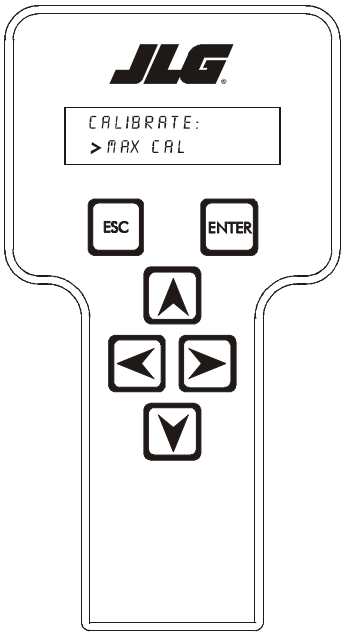
If the empty platform weight is less than minimum calibration value, the calibration attempt will be unsuccessful and the Analyzer will show the following:



CALIBRATE:

< MIN CAL

If the empty platform weight is greater than maximum calibration value, the calibration attempt will be unsuccessful and the Analyzer will show the following:



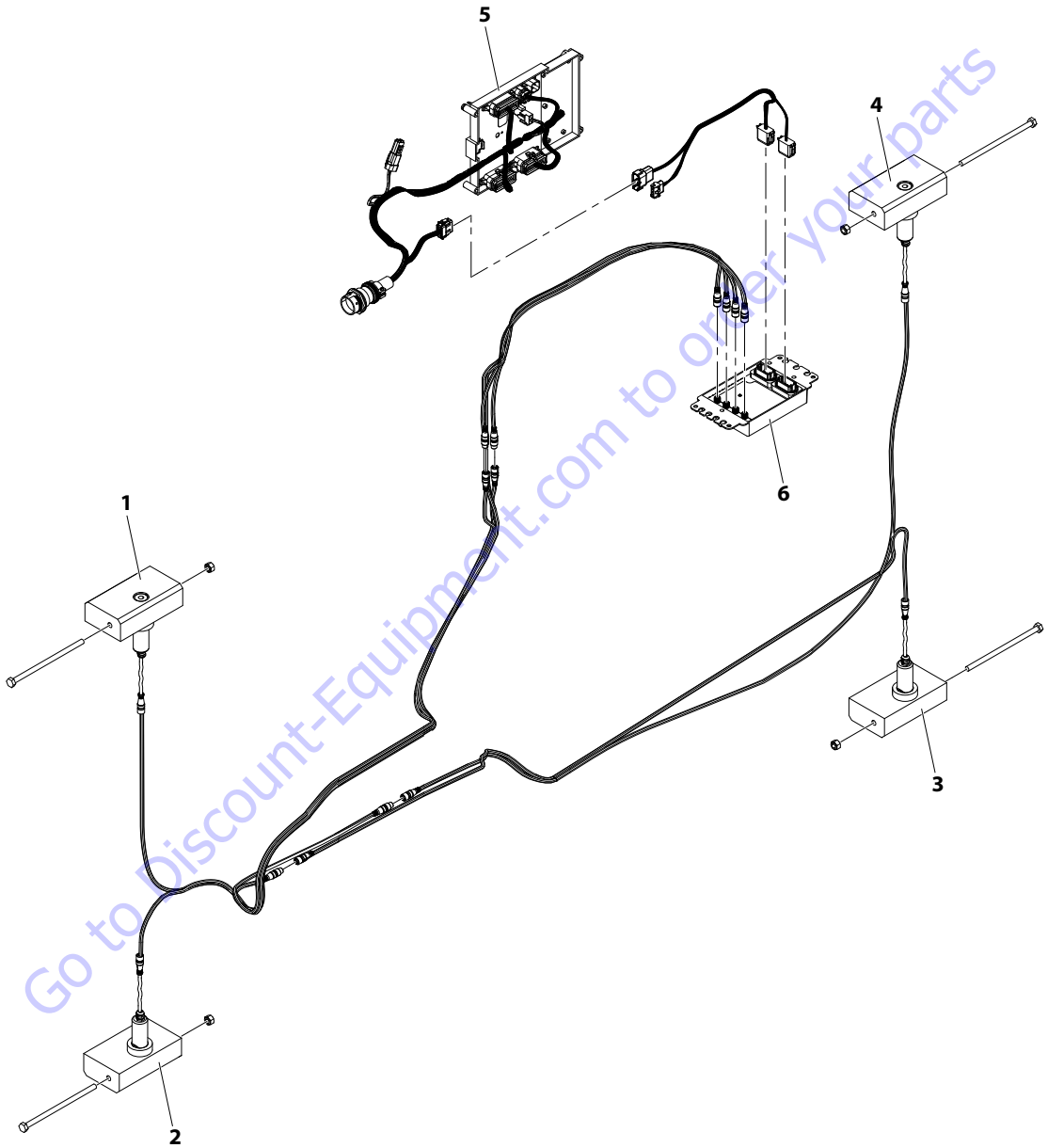
CALIBRATE:

> MAX CAL

6.7 SERVICE

Description

The system consists of the LSS Module, four Shear Pin Load Cells (sensors), Wire Harness, and various brackets and fasteners. The LSS Module is mounted beneath the platform on a bracket. The Shear Pin Load Cells mount between the platform and the arm structure in such a way that all support force for the platform is applied through them (for measurement). The four Shear Pin Load Cells plug directly into the LSS Module. The Wire Harness connects the LSS Module to the Host Control System.



1. Slide Block/Load Cell (Left Front)
2. Slide Block/Load Cell (Right Front)
3. Slide Block/Load Cell (Left Rear)
4. Slide Block/Load Cell (Right Rear)
5. Platform Interface Module
6. LSS System Module

Figure 6-1. Load Sensing System Components

6.8 CALIBRATION

Procedure

1. Plug the JLG Analyzer into the LSS Module on the Host Control System and enter the Access Level 1 Password. Do not confuse the Host Control System and LSS Module's Analyzer Connections. Proceed to the ACCESS LEVEL menu and enter the Access Level 1 Password (33271).
2. Park the vehicle on a level surface. The platform should be fully stowed and level within ± 5° (both directions).
3. Configure the LSS Module for the proper model and Desired Units. Proceed to the LSS Module's MACHINE SETUP, MODEL sub-menu and select the applicable model. Press the RIGHT ARROW to view the Units Selection. Select "UNITS=LBS" for platform load measurement in Pounds, and "UNITS=KG" for measurement in Kilograms.

NOTICE

EARLY RT'S REQUIRE A CONFIGURATION TO THE LSS MODULE. PLUG THE JLG ANALYZER INTO THE MODULE'S CONNECTION BENEATH THE DECKAND ENTER THE ACCESS LEVEL 1 PASSWORD (33271). UNDER MACHINE SETUP ENSURE THAT MODEL=260MRT.

4. Remove everything except JLG Accessories from the Platform. Empty the platform to allow the Load Sensing System to record its weight during calibration. All tools, debris, and customer-installed devices shall be removed. Permanently-fixed JLG Accessories shall remain and their contribution toward Rated Load will be accounted for in the next step.
5. Configure the LSS Module for JLG Accessories. The contribution of each permanently-fixed JLG Accessory toward Rated Load must be determined. JLG Accessories are decaled with their effective contribution toward Rated Load. If this decal is missing, reference the appropriate manual for the JLG Accessory. Once determined, the contributions of all permanently-fixed JLG Accessories mounted in the platform of the vehicle shall be added together and entered in the Analyzer's PERSONALITIES, ACC'Y display (using the proper units).
6. Execute a Calibration via the JLG Analyzer. Proceed to the Analyzer's CALIBRATION top level menu and press ENTER. Press ESC to abort a calibration or ENTER to calibrate (tare). If successful, the Analyzer will display "COMPLETE". If unsuccessful, a message will be displayed that will help lead to a resolution (reference the Troubleshooting section of this manual). Press ESC to return to the top level menu.

Testing & Evaluation

Refer to the Troubleshooting section of this manual if the Load Sensing System fails to meet these guidelines.

1. Plug the JLG Analyzer into the Host Control System.
2. Park the vehicle on a level surface. The platform should be fully stowed and level within ± 5° (both directions).
3. Observe the Empty Platform Weight. Proceed to the DIAGNOSTICS, PLTLOAD sub-menu and observe the measured platform load. All tools, debris, and customer-installed devices shall be removed during evaluation. Ideally, the PLTLOAD should be zero but can vary ±15lb (± 7kg). Further, the reading should be stable and should not vary by more than ±2lb (±1kg) (unless there is heavy influence from wind or vibration).
4. Use the Technician's Weight to Evaluate. The technician should enter the platform and record the PLTLOAD reading while standing in the center of the platform, and then each corner. The average of the readings should be the estimated weight of the technician. The range of the readings should be no more than 40lb (18kg) (max PLTLOAD reading – min PLTLOAD reading).
5. Confirm Host Control System Warnings and Interlocks. Using the vehicle's key switch, select Platform Mode and power-up. Start the vehicle's engine (If equipped) and ensure that all controls are functional and the Load Sensing System's Overload Visual and Audible Warnings are not active. Simulate an Overload by unplugging the Shear Pin Load Cell connected to J5 on the LSS Module.The Overload Visual Warning should flash, and the Audible Warning (at Platform and Ground) should sound for 5 seconds On, and 2 seconds Off. With the engine running (If equipped), all platform control should be prevented. Cycle the Platform EMS to stop the engine and then power-up again. The Overload Visual and Audible Warning should continue. Install the disconnected Shear Pin Load Cell back in J5 on the LSS Module. The Overload Visual and Audible Warnings should cease and normal control function should return. Switch the vehicle's key switch to Ground Mode and repeat the above procedure. The Overload Visual Warning at the Ground Controls should flash, and the Audible Warning (at Platform and Ground) should sound for 5 seconds On, 2 seconds Off. However, the controls should remain functional when using the engine (if the Host Controls System's MACHINE SETUP, LOAD is set to "2=CUTOUT PLT". If set to "3=CUTOUT ALL", then Ground Controls will be prevented when using the platform). Re-fit the Shear Pin Load Cell connector to J5 on the LSS Module and carefully tighten by hand, and then with a small pair of locking pliers to seat the O-ring seal.

6. Confirm Load Sensing System Performance with Calibrated Weights. Operate the vehicle from Ground Control and place the platform in the fully stowed position for safety. Place 120% of the machines rated load in the center of the platform and ensure that the overload visual and audible warnings are active. Reduce the platform load to 100% rated load and ensure that the warnings are not active. For vehicles with multiple capacities, evaluate each operating mode with the proper rated load.

6.9 TROUBLESHOOTING

The following tables are furnished to provide possible resolutions for common difficulties. Difficulties are classified as General, Calibration, Measurement Performance, and Host System Functionality.
Also refer to Electrical Schematic in Section 7 for wiring circuit diagnostics.

Table 6-5. LSS Troubleshooting Chart - General

DIFFICULTY	POSSIBLE RESOLUTION
JLG Analyzer does not display "HELP: PRESS ENTER" when connected to LSS Module's connection, but the module's LED is lit or flashing.	The JLG Analyzer is failing to communicate with the LSS Module, but the LSS Module is powered (indicated by module's LED). Investigate JLG Analyzer serial communication and power supply connections. 1. If the Analyzer displays "CONNECTING…" or "CONNECTION ERROR" after a short interval, examine the Analyzer harness on J2. J2-2 should connect to Pin 3 on the Analyzer, and J2-11 should connect to Pin 2. 2. If the Analyzer does not display anything (and there is no backlighting), examine the Analyzer's power supply. Remove the harness connection from J2 and ensure that J2-1 has approximately 12V, and J2-12 is 0V. The harness should connect J2-1 to Pin 1 on the Analyzer, and J2-12 to Pin 4 on the Analyzer. 3. The JLG Analyzer is suspect. Substitute to determine cause of failure. 4. The LSS Module is suspect. Substitute to determine cause of failure.
LED on LSS Module does not light.	The LSS Module is un-powered, a short exists, or the device is damaged. 1. LSS Module's power supply is improper. Check for the presence of approximately 12V on J1-1, and 0V on J1-2. The module's power supply comes from the Platform Console Box. Use to the Wiring Diagram to trace the conductors to their source. 2. There is a short circuit on the reference voltage present on J5-J8. Unplug the connectors one at a time and observe if the module begins to function after a particular connection is removed. If so, carefully inspect the wiring between the module and that sensor. 3. There is a short circuit on the pre-regulated supply for the JLG Analyzer present on J2-1. Unplug J2's connector and observe whether the module begins to function. If so, examine the Analyzer harness for defect. 4. The LSS Module is suspect. Substitute to determine cause of failure.

Table 6-6. LSS Troubleshooting Chart - Calibration

Difficulty	Possible Resolution
JLG Analyzer displays "<MIN CAL" after attempt is made to Calibrate.	The LSS Module expected the empty platform to weight more for calibration. 1. The platform is being supported by something other than the four Shear Pin Load Cells. This includes binding between the slide block/spacer bushing/arm tube assembly (bushing should be free enough to rotate by hand). For proper operation, the platform's entire weight must be transferred through the Shear Pin Load Cells and into the arm support structure for an accurate calibration. 2. The wrong Model Selection was made under the LSS Module's MACHINE SETUP, MODEL. This should be set to the proper MODEL. Improper selection may lead the LSS Module to expect different empty platform weights. 3. The calibration difficulty may be a result of a Measurement Performance issue. Review the Possible Resolutions under that category.
JLG Analyzer displays ">MAX CAL" after attempt is made to Calibrate.	The LSS Module expects the empty platform to weigh less for calibration. 1. Tools, debris, or customer-installed accessories have not been removed before calibration. The LSS Module must tare an empty platform and its optional JLG Accessories. 2. The wrong Model Selection was made under the LSS Module's MACHINE SETUP, MODEL. This should be set to MODEL. Improper selection may lead the LSS Module to expect different empty platform weights. 3. The calibration difficulty may be a result of a Measurement Performance issue. Review the Possible Resolutions under that category.

Table 6-7. LSS Troubleshooting Chart - Measurement Performance

DIFFICULTY	POSSIBLE RESOLUTION
Empty Platform Weight (DIAGNOSTICS, PLTLOAD) is not within ±15lb (±7kg) of zero. **or** Platform Load readings (DIAGNOTICS, PLTLOAD) are unstable by more than ±2lb (±1kg) (without the influence of vibration or wind). **or** There are large variations in Platform Load (DIAGNOSTICS, PLTLOAD) based on the location of the load. Tolerance to variations is 40lb (18kg) for an evaluation using the technician's weight, and ±5% of Rated Load when using calibrated weights.	The LSS Module is unable to properly measure the platform weight. 1. One of the Shear Pin Load Cells is not properly plugged into the LSS Module. Since the connectors seal with an O-ring and are located in a crowded area, it is possible that the connectors are threaded together, but poor electrical contact is made. Attempt to wiggle the molded portion of each connector on J5-J8. If properly tightened, the molded portion should not move. Also, examined each Shear Pin Load Cell's readings via the JLG Analyzer. Proceed to the DIAGNOSTICS, CELL 1-4, LOAD displays and determine if the readings are reasonable. Note that it is possible to have only two sensors carrying all of the platform load due to fit between the platform and support structure (this is normal). 2. Wiring leading to one of the Shear Pin Load Cells is damaged. Examine each sensor's reading using the JLG Analyzer. Proceed to the DIAGNOSTICS, CELL 1-4, LOAD displays and determine if the readings are reasonable and responsive to slight downward pressure above the sensor being viewed. Carefully inspect sensor wiring where it passes through cable clamps for signs of damage. Inspect wiring where damage to the channel is apparent. If damage to the sensor's cordset is found, replace the appropriate Shear Pin Load Cell since the cordset is not serviceable (connector is molded for moisture resistance; cordset is soldered into sensor beneath welded stainless steel cover). If damage to the sensors extension cordset is found, unplug both ends and fit a replacement. 3. One of the Shear Pin Load Cells was not assembled properly during installation. Examine each sensor's reading using the JLG Analyzer. Proceed to the DIAGNOSTICS, CELL 1-4, LOAD displays and determine if the readings are reasonable. It is often helpful to apply slight downward pressure above the sensor being examined and observe that its output increases (increasing force measurement; decreasing means the sensor is mounted upside-down). Compare the order of assembly to the detail on the Installation Drawing and ensure that the only contact between the platform and the support is through the sensor bodies (nothing else touches except wires). Re-assemble according to print if necessary. 4. Damage to the platform or arm structure has occurred or one of the components is out-of-tolerance.Twists in the platform, for instance, will cause huge off-axis forces to be applied to the Shear Pin Load Cells, disturbing their primary measurement axis readings. If Lift Up / Down is noisy or not smooth, examine this issue thoroughly. Resolution is to replace the damaged or faulty component. Watch for Shear Pin Load Cell damage (yield) as a result of this difficulty. 5. One of the Shear Pin Load Cells is contaminated by debris or moisture. Examine each sensor's reading using the JLG Analyzer. Proceed to the DIAGNOSTICS, CELL 1-4, LOAD displays and determine if the readings are reasonable and stable (not changing by more than ±2lb (±1kg) (without the influence of vibration or wind). Lack of measurement stability is a key indication of contamination. Unplug the appropriate connector (J5 is CELL 1, J6 is CELL 2, J7 is CELL 3, and J8 is CELL 4) and inspect for dirt or moisture. Look carefully into the female connector on the sensor's cordset for evidence of contamination. Debris should be brushed away with a soft bristle brush (do not introduce any cleaners as they will leave conductive residue). Moisture should be allowed to evaporate or accelerated with a heat-gun (use low heat and be carefully to not melt connector materials). Moisture intrusion into the molded portion of the connector (capillary action into the wire bundle) or the Shear Pin Load Cell itself will require replacement of the sensor. 6. One of the Shear Pin Load Cells has been mechanically damaged (yielded). Any Shear Pin Load Cell that is physically deformed or has damage to one of the stainless steel covers should be replaced immediately. It is also possible to have invisible mechanical damage resulting from an extreme overload (>4200lb [>1900kg] for 1.25 in diam.; >5700 lb or 2600 KG for 2 inch diam.). This can be detected by supporting the platform with an overhead crane and by removing the suspect sensor (no weight resting on the Shear Pin Load Cell). Examine the sensor's reading using the JLG Analyzer. Proceed to the DIAGNOSTICS, CELL 1-4, LOAD displays and observe whether the unloaded sensors read with ±15lb (±7kg) of zero (individually). Replace sensors that read excessive force when physically unloaded. 7. The LSS Module is suspect. Interchange the Shear Pin Load Cell connections (J5-J8) and observe the results via the JLG Analyzer. Proceed to the DIAGNOSTICS, CELL 1-4, LOAD displays and observe the readings. If the problem seems to remain with a particular sensor, carefully re-examine the issues above. If the problems seems to remain with a particular LSS Module channel, substitute another module.

Table 6-8. LSS Troubleshooting Chart - Host System Functionality

Difficulty	Possible Resolution
The Visual and Audible Overload Warnings fail to sound when platform is loaded beyond Rated Load, or when simulated by unplugging a Shear Pin Load Cell from the LSS Module. Controls remain functional at Platform and Ground Control positions.	The Host Control System is failing to regard the overload signal from the LSS Module, or the signal is shorted. 1. The Load Sensing System must be enabled within the Host Control System. Plug the JLG Analyzer into the Host Control System, enter the Access Level 1 password (33271), and examine the MACHINE SETUP, LOAD sub-menu. The selection "CUTOUT PLT" should be displayed for European Community compliance (platform controls prevented during overload, ground controls remain operational). In country- or customer-specific circumstance, the selection "3=CUTOUT ALL" is used (platform and ground controls prevented during overload). 2. The signal between the LSS Module and the Host Control System is shorted. The Platform Module's J1-20 is an input, and it connected to the J1-5 output on the LSS Module To examine the status of this signal, plug the JLG Analyzer into the Host Control System, enter the Access Level 1 password (33271), and examine the DIAGNOSTICS, SYSTEM, LOAD display. The display will indicate "OK" when the Platform Module's input is energized (approximately 12V), and "OVERLOADED" when it is de-energized (0V). Refer to the Wiring Diagram for Load Sensing System for details. 3. Observe the LSS Module's assessment of overload using the JLG Analyzer plugged into the LSS Module's connection. Proceed to the DIAGNOSTICS, OVERLOADED? display. The display should indicate "OVERLOADED? N" when the platform is empty, and "OVERLOADED? Y" when the platform is overloaded. If the assessment is improper, the difficulty may be a result of a General or Measurement Performance issue. Review the Possible Resolutions under those categories. 4. If the LSS Module's J1-5 Output does not appears to coincide with the DIAGNOSTICS, OVERLOADED? display, then the LSS Module is suspect. Substitute to determine cause of failure.
The Visual and Audible Overload Warnings sound even when the platform is empty. Controls are prevented in the same manner as when overloaded.	The LSS Module is un-powered, un-calibrated, or is experiencing a Measurement Performance difficulty. Alternately, the Host Control System is not receiving the proper signal from the LSS Module. 1. Ensure that the LSS Module is powered. The LSS Module's LED will be lit or flash if the module is powered. If not, ensure that approximately 12V is present between J1-1 and J1-2 on the LSS Module (J1-1 is positive). Trace the Ignition and Ground supply wires into the Host Control System's wiring harness using the wiring diagram to locate the difficulty. 2. Plug a JLG Analyzer into the LSS Module's connection and ensure that the Host Control System is powered-up. When HELP:PRESS ENTER is displayed, press the ENTER key on the Analyzer. If "EVERYTHING OK" is displayed, it is probable that the Overload Signal from the LSS Module is not reaching the Host Control System. This signal is present on LSS Module's J1-5 and is approximately 12V normally, and 0V during an overload. This signal eventually reaches the Main Terminal Box to provide the overload signal. Refer to the Wiring Diagram for wire color, number, and terminal information. 3. If the Analyzer displayed "OVERLOADED" in the previous step, press the ENTER key again. If "NO CAL" is displayed, the Load Sensing System has not been properly calibrated. Refer to the Calibration portion of this manual. 4. If another fault is displayed, refer to the portion of this manual that describes Fault Messages and their causes. 5. The difficulty may be a result of a Measurement Performance issue. Review the Possible Resolutions under those categories.
Controls remain functional at the Ground Control position during an overload, or when simulated by unplugging a Shear Pin from the LSS Module. The Control at the Platform Control position are prevented.	The Host Control System is configured to prevent platform controls only in the event of overload. Alternately, the Host Control System can be configured to prevent ground and platform controls for country- or customer-specific circumstances. Plug the JLG Analyzer into the LSS Module's connection and enter the Access Level 1 password (33271). Proceed to the MACHINE SETUP, LOAD sub-menu. Set this parameter to "CUTOUT PLT" to prevent platform controls in the event of overload. Set this parameter to "CUTOUT ALL" to prevent platform and ground controls in the event of overload.

Table 6-9. LSS Module System Interface Connector - Power & Digital (J1 - Grey)

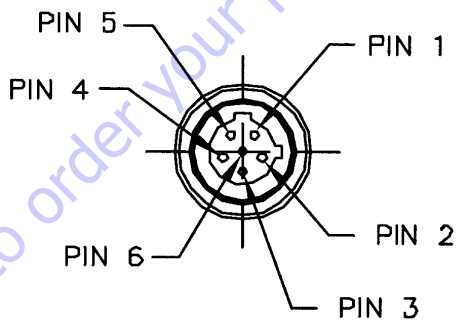
PIN	SIGNAL	DESCRIPTION
1	VBAT	Positive Power Supply from Host Control System (12-24V)
2	GND	Negative Power Supply from Host Control System (0V)
3	GND-2	Connects to GND
4	N/C	Unused
5	DO1	Overload Indicator Output (Normal=VBAT / Overload=0V)
6	DO2	Warning Indicator Output (Normal=0V / Overloaded=VBAT for 5 Sec, 0V for 2 Sec)
7	DI3	Unused
8	DI2	Select OVERLD3 Personality Rating (No=0V / Yes=VBAT)
9	DI1	Select OVERLD2 Personality Rating (No=0V / Yes=VBAT)
10	GND-2	Connects to GND
11	VBAT-2	Connects to VBAT
12	VBAT-2	Connects to VBAT

Table 6-10. LSS Module System Interface Connector – Communication (J1 - Black)

PIN	SIGNAL	DESCRIPTION
1	APWR	Pre-Regulated Supply for JLG Analyzer (Analyzer Pin 1; approx. 12V)
2	TX	RS-232 for JLG Analyzer (Analyzer Pin 3)
3	TRP1	120 Ohm CANbus Terminator
4	CANH-1	CANbus Interface High
5	CANS-1	CANbus Shield Termination (Not same as GND)
6	CANH-2	Connects to CANH-1
7	CANL-2	Connects to CANL-1
8	CANS-2	Connects to CANS-1
9	CANL-1	CANbus Interface Low
10	TRP2	120 Ohm CANbus Terminator
11	RX	RS-232 for JLG Analyzer (Analyzer Pin 2)
12	GND	Ground for JLG Analyzer (Analyzer Pin 4)

Table 6-11. LSS Module Load Cell Connector Pinout (J5, J6, J7, J8)

PIN	SIGNAL	DESCRIPTION
1	+ Signal	Positive Sensor Output (approx. 2.5V)
2	Cal Clock	Serial Clock to Sensor's Integrated Memory
3	- Excitation	Negative Sensor Supply Voltage (approx. 0V)
4	+Excitation	Positive Sensor Supply Voltage (approx. 5V)
5	- Signal	Negative Sensor Output (approx. 2.5V)
6	Cal Data	Serial Data from Sensor's Integral Memory



NOTE: *Physical connector as viewed looking into the cable end*

Figure 6-2. LSS Module Load Cell Connector Pinout (J5, J6, J7, J8)

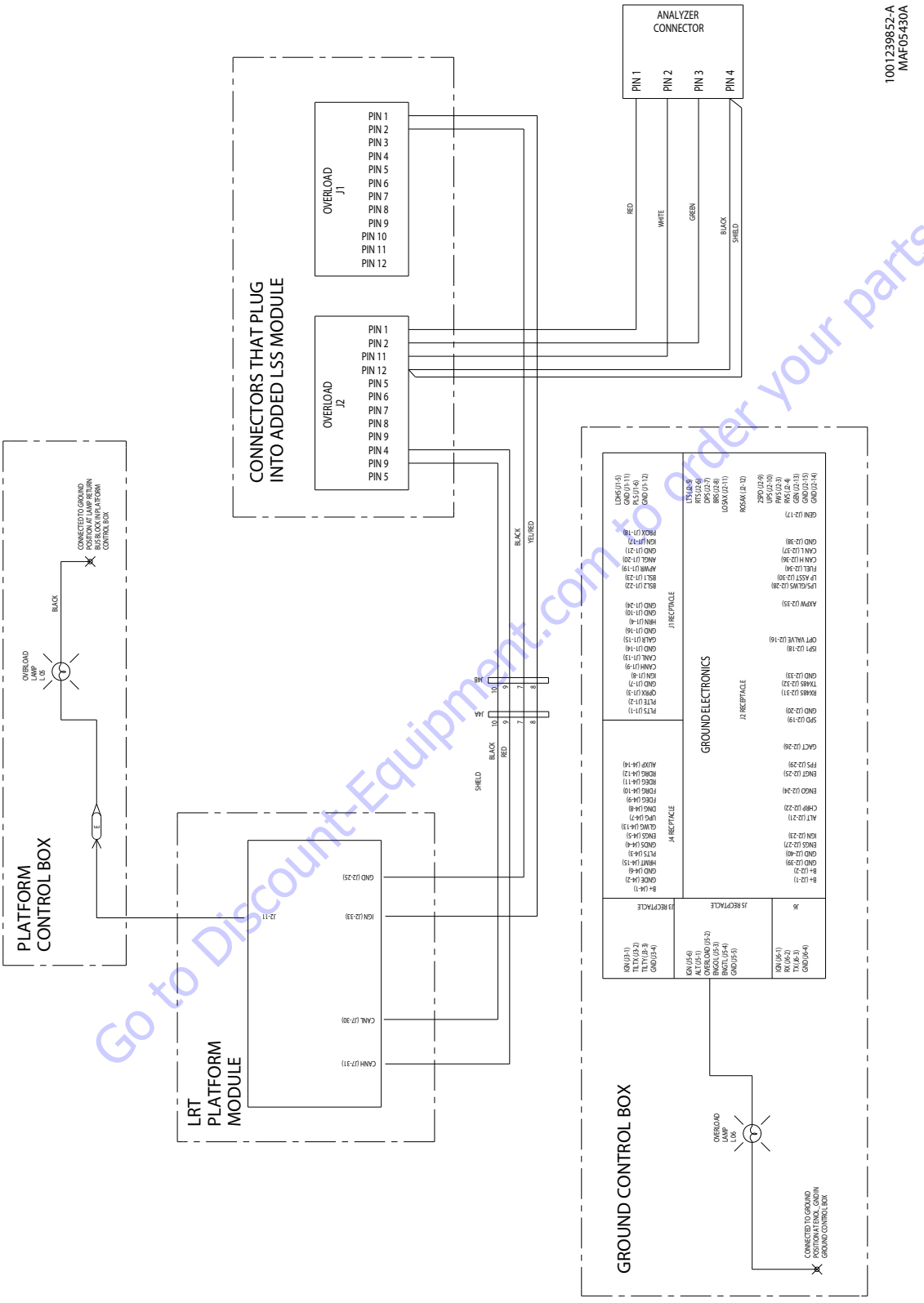


Figure 6-3. LRT Wiring Diagram

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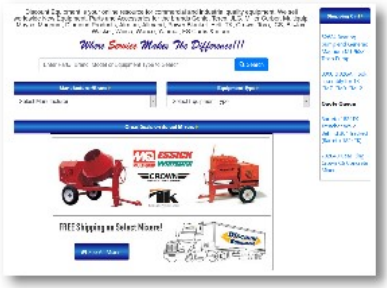

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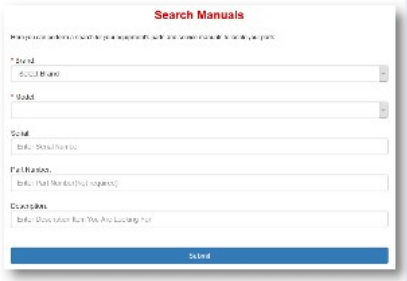

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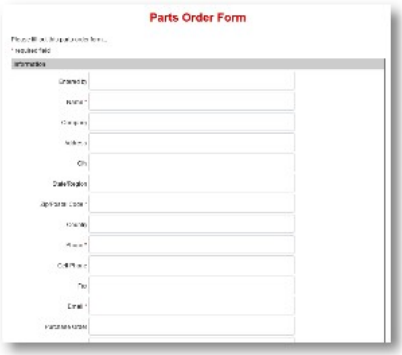

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We sell worldwide for the brands: Genie, Terex, JLG, MultiQuip, Mikasa, Essick, Whiteman, Mayco, Toro Stone, Diamond Products, Generac Magnum, Airman, Haulotte, Barreto, Power Blanket, Nifty Lift, Atlas Copco, Chicago Pneumatic, Allmand, Miller Curber, Skyjack, Lull, Skytrak, Tsurumi, Husquvarna Target, , Stow, Wacker, Sakai, Mi-T- M, Sullair, Basic, Dynapac, MBW, Weber, Bartell, Bennar Newman, Haulotte, Ditch Runner, Menegotti, Morrison, Contec, Buddy, Crown, Edco, Wyco, Bomag, Laymor, Barreto, EZ Trench, Bil-Jax, F.S. Curtis, Gehl Pavers, Heli, Honda, ICS/PowerGrit, IHI, Partner, Imer, Clipper, MMD, Koshin, Rice, CH&E, General Equipment, ,AMida, Coleman, NAC, Gradall, Square Shooter, Kent, Stanley, Tamco, Toku, Hatz, Kohler, Robin, Wisconsin, Northrock, Oztec, Toker TK, Rol-Air, Small Line, Wanco, Yanmar

SECTION 7. GENERAL ELECTRICAL INFORMATION & SCHEMATICS

7.1 GENERAL

This section contains schematics to be used for locating and correcting most of the operating problems which may develop. If a problem should develop which is not presented in this section or which is not corrected by listed corrective actions, technically qualified guidance should be obtained before proceeding with any maintenance.

NOTICE

IT IS A GOOD PRACTICE TO AVOID PRESSURE-WASHING ELECTRICAL/ELECTRONIC COMPONENTS. SHOULD PRESSURE-WASHING BE UTILIZED TO WASH AREAS CONTAINING ELECTRICAL/ELECTRONIC COMPONENTS, JLG INDUSTRIES, INC. RECOMMENDS A MAXIMUM PRESSURE OF 750 PSI (52 BAR) AT A MINIMUM DISTANCE OF 12 INCHES (30.5 CM) AWAY FROM THESE COMPONENTS. IF ELECTRICAL/ELECTRONIC COMPONENTS ARE SPRAYED, SPRAYING MUST NOT BE DIRECT AND BE FOR BRIEF TIME PERIODS TO AVOID HEAVY SATURATION.

7.2 MULTIMETER BASICS

A wide variety of multimeters or Volt Ohm Meters (VOM) can be used for troubleshooting your equipment. A digital meter with reasonable accuracy (within 7%) is recommended for the measurements in these procedures. This section shows diagrams of a common, digital VOM configured for several different circuit measurements. Instructions for your VOM may vary. Please consult the meter operator's manual for more information.

Grounding

"Grounding the meter" means to take the black lead (which is connected to the COM (common) or negative port) and touch it to a good path to the negative side of the voltage source.

Backprobing

To "backprobe" means to take the measurement by accessing a connector's contact on the same side as the wires, the back of the connector. Readings can be done while maintaining circuit continuity this way. If the connector is the sealed type, great care must be taken to avoid damaging the seal around the wire. It is best to use probes or probe tips specifically designed for this technique, especially on sealed connectors. Whenever possible insert probes into the side of the connector such that the test also checks both terminals of the connection. It is possible to inspect a connection within a closed connector by backprobing both sides of a connector terminal and measuring resistance. Do this after giving each wire a gentle pull to ensure the wires are still attached to the contact and contacts are seated in the connector.

Min/Max

Use of the "Min/Max" recording feature of some meters can help when taking measurements of intermittent conditions while alone. For example, you can read the voltage applied to a solenoid when it is only operational while a switch, far from the solenoid and meter, is held down.

Polarity

Finding a negative voltage or current reading when expecting a positive reading frequently means the leads are reversed. Check what reading is expected, the location of the signal and that the leads are connected to the device under test correctly. Also check that the lead on the "COM" port goes to the ground or negative side of the signal and the lead on the other port goes to the positive side of the signal.

Scale

M = Mega = 1,000,000 * (Displayed Number)

k = kilo = 1,000 * (Displayed Number)

m = milli = (Displayed Number) / 1,000

µ = micro = (Displayed Number) / 1,000,000

Example: 1.2 kΩ = 1200 Ω

Example: 50 mA = 0.05 A

Voltage Measurement

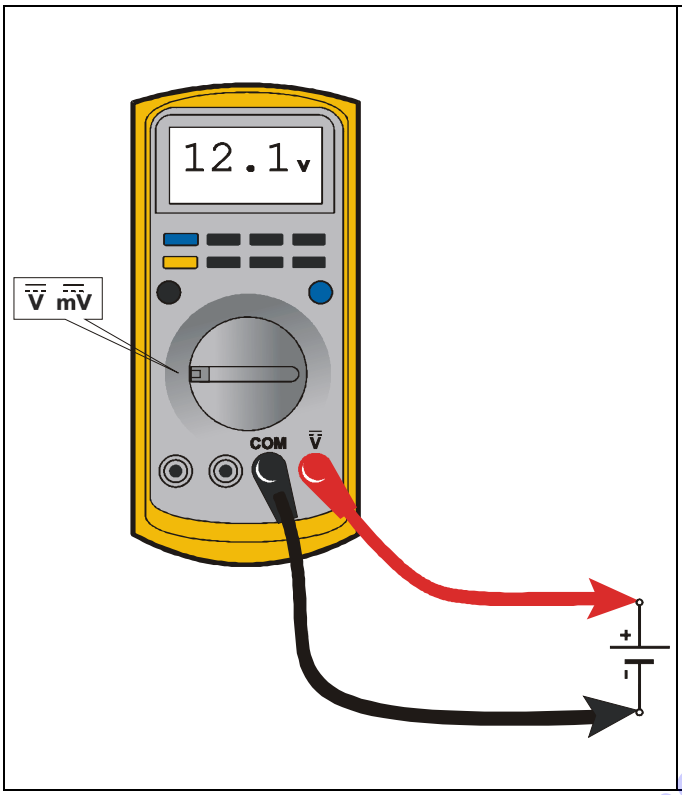


Figure 7-1. Voltage Measurement (DC)

- If meter is not auto ranging, set it to the correct range (See multimeter's operation manual)
- Use firm contact with meter leads

Resistance Measurement

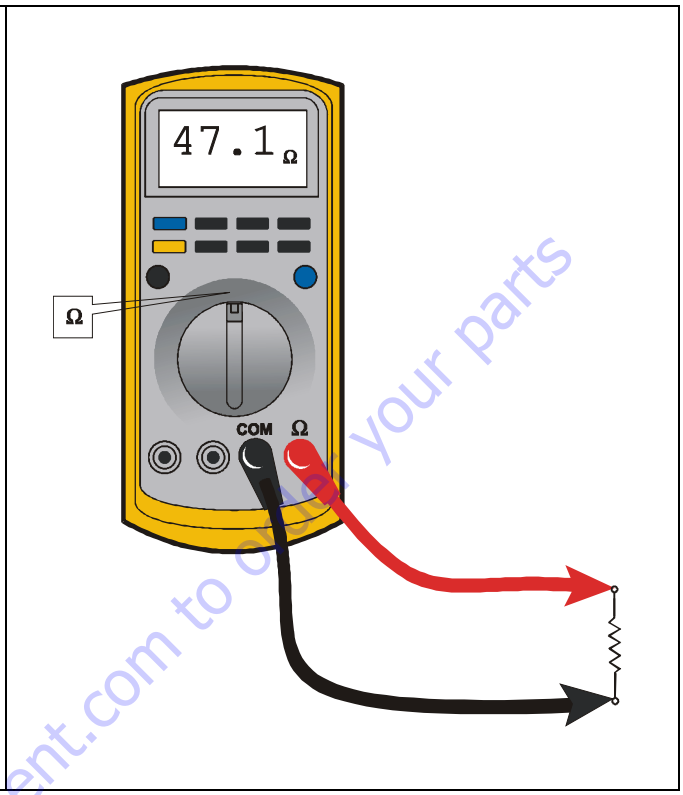


Figure 7-2. Resistance Measurement

- First test meter and leads by touching leads together. Resistance should read a short circuit (very low resistance)
- Circuit power must be turned OFF before testing resistance
- Disconnect component from circuit before testing
- If meter is not auto ranging, set it to the correct range (See multimeter's operation manual)
- Use firm contact with meter leads

Continuity Measurement

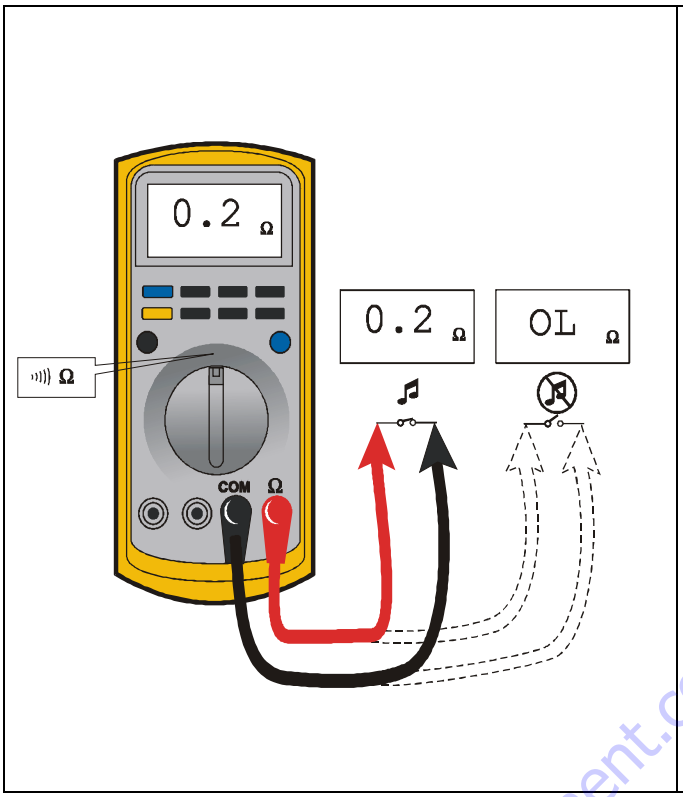


Figure 7-3. Continuity Measurement

- Some meters require a separate button press to enable audible continuity testing
- Circuit power must be turned OFF before testing continuity
- Disconnect component from circuit before testing
- Use firm contact with meter leads
- First test meter and leads by touching leads together. Meter should produce an audible alarm, indicating continuity

Current Measurement

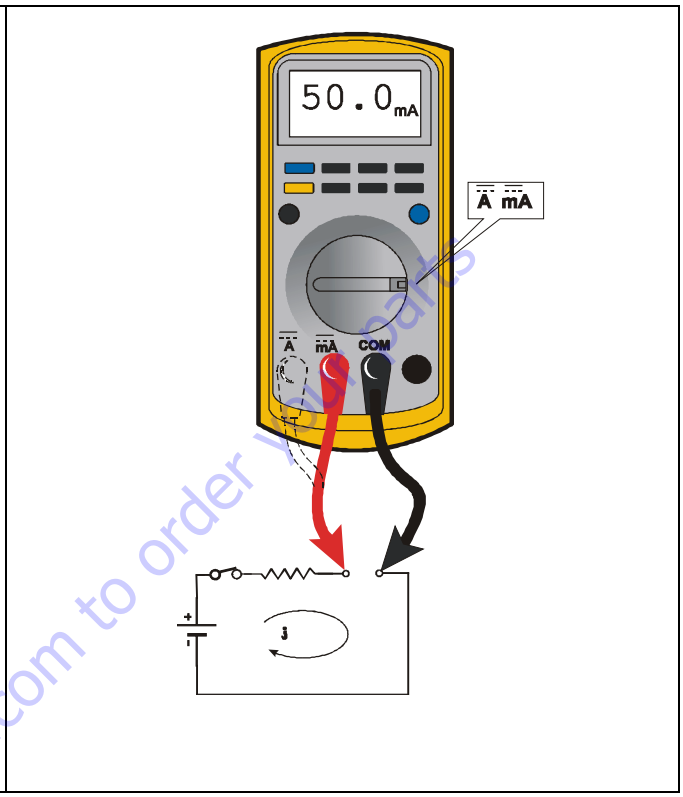


Figure 7-4. Current Measurement (DC)

- Set up the meter for the expected current range
- Be sure to connect the meter leads to the correct jacks for the current range you have selected
- If meter is not auto ranging, set it to the correct range (See multi meter's operation manual)
- Use firm contact with meter leads

Continuity Measurement Over Long Distances

When trying to determine continuity of a harness or wire, longer than the reach of standard instrument leads, is possible to perform the check without excessively long leads. Using the other wires in the harness one can determine the condition of a particular wire in the harness.

Requirements

- Harness with at least three separate wires including the wire under test.
- These wires must be able to be isolated from other wires, etc.
- Jumper or method to connect contacts on one side of harness.
- Meter that can measure resistance or continuity.

Procedure

Test multimeter leads resistance. Subtract this value from the measured resistance of the wires to get a more accurate measurement.

Consult the circuit schematic to determine which wires to use in addition to wire under test, here called wire #1 and wire #2, and how to isolate these wires. These wires should appear in the same connectors as the wire under test or are within reach of the jumper.

1. Disconnect all connections associated with the wire under test and the two additional wires. If harness is not completely isolated disconnect battery terminals also, as a precaution.
2. Measure continuity between all three wires, the wire under test, wire #1 and wire #2. These should be open. If not, repair the shorted wires or replace the harness.
3. On one side, jumper from contact of wire #1 and wire #2.
4. Measure continuity between wire #1 and wire #2. If there is continuity, both wires are good and can be used for this test. If there is not continuity, either wire could be bad. Check connections and measurement setup. Redo measurement. If still no continuity, repair wires or consult schematic for other wires to use for test.
5. Jumper from wire under test to wire #1.
6. Measure continuity. If there is continuity, the wire under test is good. Resistance of a wire increases as the length increases and as the diameter decreases.

One can find the continuity of two wires, here #1 and #2, at once by following steps 1 through 4. If there is a problem the third wire is used to troubleshoot the other wires. To find the problem, start at step 1 and use the entire procedure.

7.3 APPLYING SILICONE DIELECTRIC COMPOUND TO ELECTRICAL CONNECTIONS

NOTE: *This section is not applicable for battery terminals.*

JLG P/N 0100048 DIELECTRIC GREASE (NOVAGARD G661) IS THE ONLY MATERIAL APPROVED FOR USE AS A DIELECTRIC GREASE.

NOTE: *Do NOT apply dielectric grease to the following connections:*

- Main Boom Rotary sensor connections (on Celesco Sensor),
- LSS Modules connections,
- Deutz EMR 2 ECM connection.

Silicone Dielectric Compound must be used on all electrical connections except for those mentioned above for the following reasons:

- To prevent oxidation at the mechanical joint between male and female pins.
- To prevent electrical malfunction caused by low level conductivity between pins when wet.

Use the following procedure to apply Silicone Dielectric Compound to the electrical connectors. This procedure applies to all plug connections not enclosed in a box. Silicone grease should not be applied to connectors with external seals.

1. To prevent oxidation, silicone grease must be packed completely around male and female pins on the inside of the connector prior to assembly. This is most easily achieved by using a syringe.

NOTE: *Over a period of time, oxidation increases electrical resistance at the connection, eventually causing circuit failure.*

2. To prevent shorting, silicone grease must be packed around each wire where they enter the outside of the connector housing. Also, silicone grease must be applied at the joint where the male and female connectors come together. Any other joints (around strain reliefs, etc.) where water could enter the connector should also be sealed.

NOTE: *This condition is especially common when machines are pressure washed since the washing solution is much more conductive than water.*

3. Anderson connectors for the battery boxes and battery chargers should have silicone grease applied to the contacts only.

NOTE: *Curing-type sealants might also be used to prevent shorting and would be less messy, but would make future pin removal more difficult.*

When applied to electrical connections, dielectric grease helps to prevent corrosion of electrical contacts and improper conductivity between contacts from moisture intrusion. Open and sealed connectors benefit from the application of dielectric grease.

Dielectric grease shall be applied to all electrical connectors at the time of connection (except those noted under Exclusions).

7.4 DIELECTRIC GREASE APPLICATION

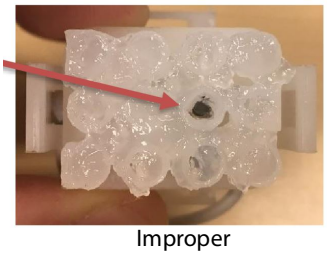
The following is general guidance for the installation of dielectric grease in a connector system.

1. Use dielectric grease in a tube for larger connection points or apply with a syringe for small connectors.
2. Apply dielectric grease to plug/male connector housing which typically contains sockets contact/female terminals.
3. Leave a layer of dielectric grease on the mating face of the connector, completely covering each connector terminal hole. Refer the pictures shown below.
4. Assemble the connector system immediately to prevent moisture ingress or dust contamination.

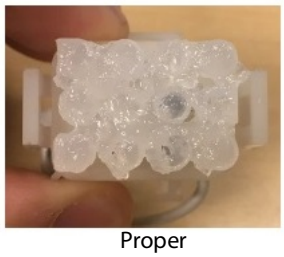
The following connector systems are specifically addressed because of their widespread use at JLG. However, this guidance may be applied to similar devices.

AMP Mate-N-Lok

This connector system is widely used inside enclosures for general-purpose interconnect. Follow the general guidance for installation.



Improper



Proper

AMP Faston

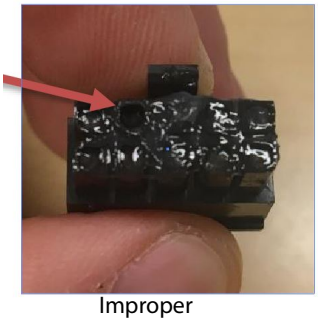
This connector system is typically used on operator switches at JLG. Follow the general guidance for installation.


Improper


Proper

AMP Micro-Fit

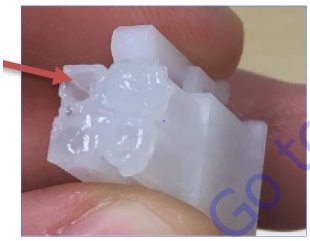
This connector system is typically used on control modules at JLG. Follow the general guidance for installation.


Improper


Proper

AMP Mini Fit Jr

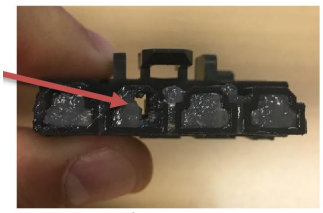
This connector system is typically used on control modules at JLG. Follow the general guidance for installation.

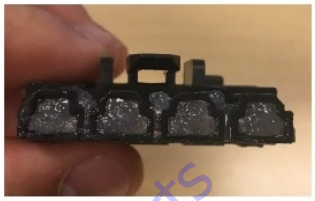

Improper


Proper

Mini Fit Sr

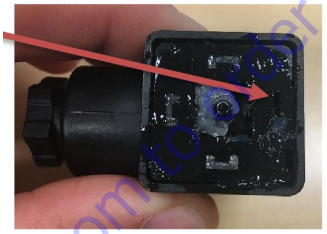
This connector system is typically used on control modules at JLG. Follow the general guidance for installation.


Improper


Proper

DIN Connectors

This connector is typically used on hydraulic valves. Follow the installation instructions.


Improper


Proper

Exceptions

Some waterproof connector applications do benefit from dielectric grease, and some non waterproof connectors do not benefit from dielectric grease.

In the exceptions below, we have found dielectric grease is not needed for some applications, and in some cases can interfere with the intended connection. Dielectric grease shall be used as an exception in other applications.

Enclosures

Application of dielectric grease is not required in properly sealed enclosures. To meet criteria, the enclosure must be rated to at least IP56 (dust protected; protected from powerful jets of water).

Carling Switch Connectors

Carling switches may experience high impedance, or discontinuity, due to silicone dielectric grease ingress when switching inductive loads. Therefore, dielectric grease shall not be applied to Carling switch mating connectors unless specifically noted.

Scissor Platform Cable at the Platform Control

Some waterproof connectors are exposed to the elements when disconnected by the customer benefit from having protection using dielectric grease.

7.5 APPLYING SILICONE DIELECTRIC COMPOUND TO AMP CONNECTORS

Silicone Dielectric Compound must be used on the AMP connections for the following reasons:

- To prevent oxidation at the mechanical joint between male and female pins.
- To prevent electrical malfunction caused by low level conductivity between pins when wet.

Use the following procedure to apply Silicone Dielectric Compound to the electrical connectors.

1. To prevent oxidation and low level conductivity, silicone dielectric grease must be packed completely around male and female pins on the inside of the connector after the mating of the housing to the header. This is easily achieved by using a syringe to fill the header with silicone dielectric compound, to a point just above the top of the male pins inside the header. When assembling the housing to the header, it is possible that the housing will become air locked, thus preventing the housing latch from engaging.
2. Pierce one of the unused wire seals to allow the trapped air inside the housing to escape.
3. Install a hole plug into this and/or any unused wire seal that has silicone dielectric compound escaping from it.

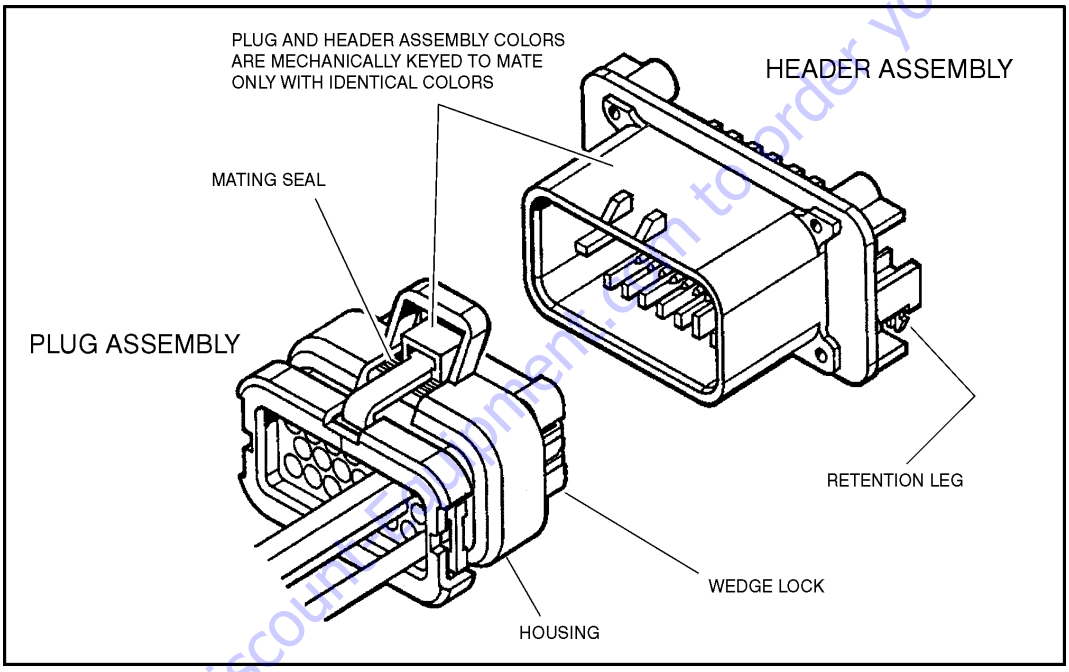


Figure 7-5. AMP Connector

Assembly

Check to be sure the wedge lock is in the open, or as-shipped, position (See Figure 7-6. Connector Assembly (1 of 4)). Proceed as follows:

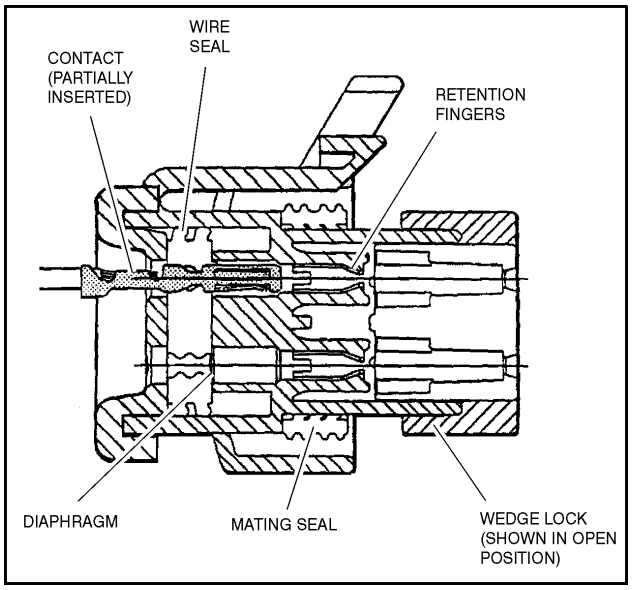


Figure 7-6. Connector Assembly (1 of 4)

1. To insert a contact, push it straight into the appropriate circuit cavity as far as it will go (See Figure 7-7. Connector Assembly (2 of 4)).
2. Pull back on the contact wire with a force of 1 or 2 lb to be sure the retention fingers are holding the contact (See Figure 7-7. Connector Assembly (2 of 4)).
3. After all required contacts have been inserted, the wedge lock must be closed to its locked position. Release the locking latches by squeezing them inward (See Figure 7-8. Connector Assembly (3 of 4)).
4. Slide the wedge lock into the housing until it is flush with the housing (See Figure 7-9. Connector Assembly (4 of 4)).

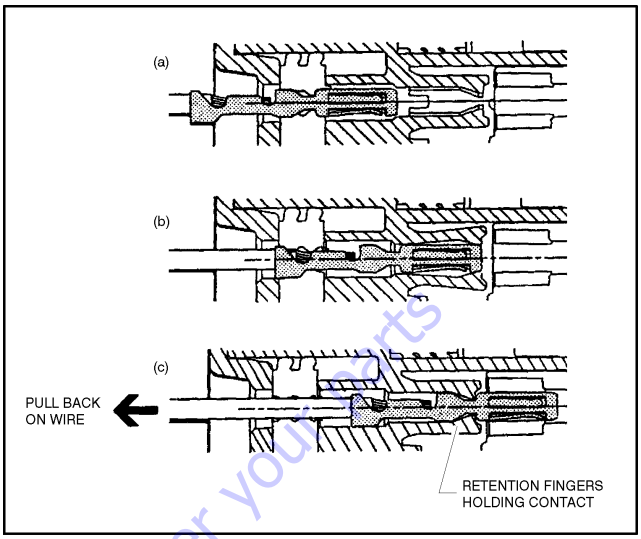


Figure 7-7. Connector Assembly (2 of 4)

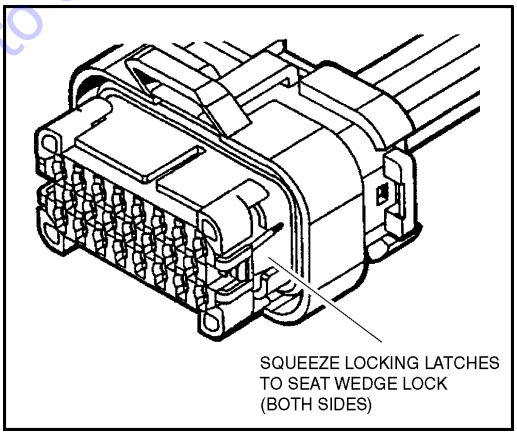


Figure 7-8. Connector Assembly (3 of 4)

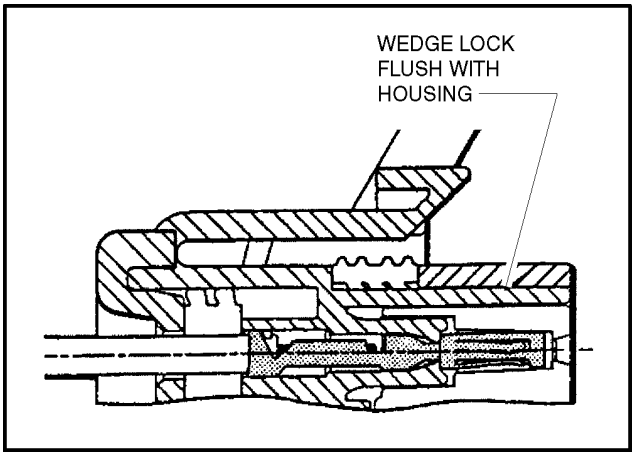


Figure 7-9. Connector Assembly (4 of 4)

Disassembly

1. Insert a 4.8 mm (3/16") wide screwdriver blade between the mating seal and one of the red wedge lock tabs.
2. Pry open the wedge lock to the open position.
3. While rotating the wire back and forth over a half turn (1/4 turn in each direction), gently pull the wire until the contact is removed.

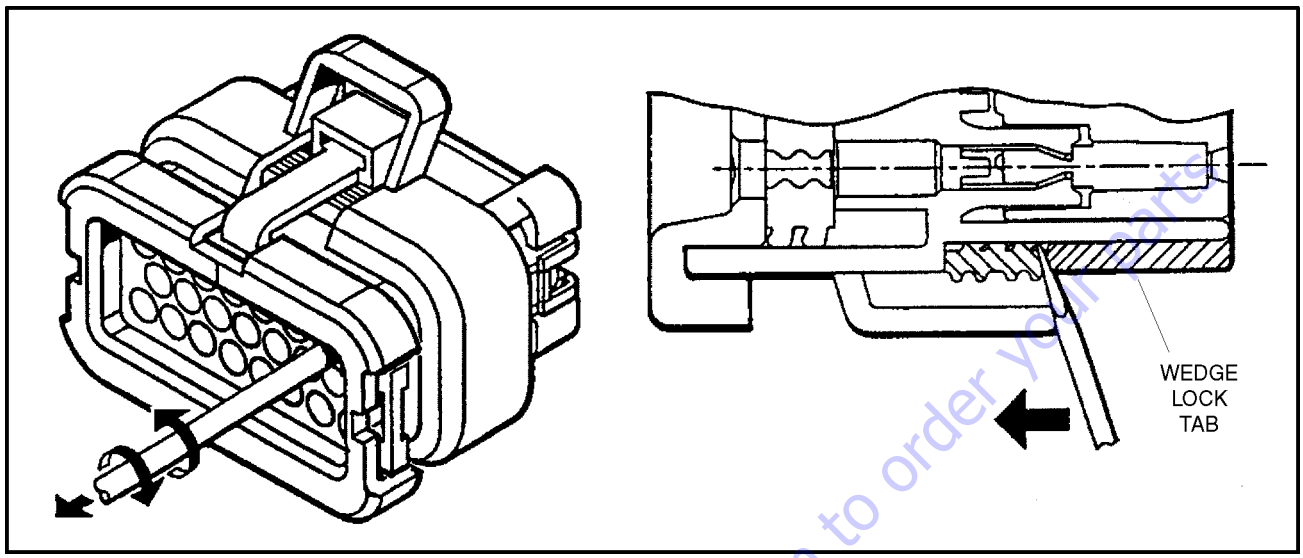


Figure 7-10. Connector Disassembly

NOTE: *The wedge lock should never be removed from the housing for insertion or removal of the contacts.*

Wedge Lock

The wedge lock has slotted openings in the forward, or mating end. These slots accommodate circuit testing in the field, by using a flat probe such as a pocket knife. DO NOT use a sharp point such as an ice pick.

Service - Voltage Reading

⚠ CAUTION

DO NOT PIERCE WIRE INSULATION TO TAKE VOLTAGE READINGS.

It has been common practice in electrical troubleshooting to probe wires by piercing the insulation with a sharp point. This practice should be discouraged when dealing with the AMPSEAL plug assembly, or any other sealed connector system. The resulting pinholes in the insulation will allow moisture to invade the system by traveling along the wire strands. This nullifies the effectiveness of the connector seals and could result in system failure.

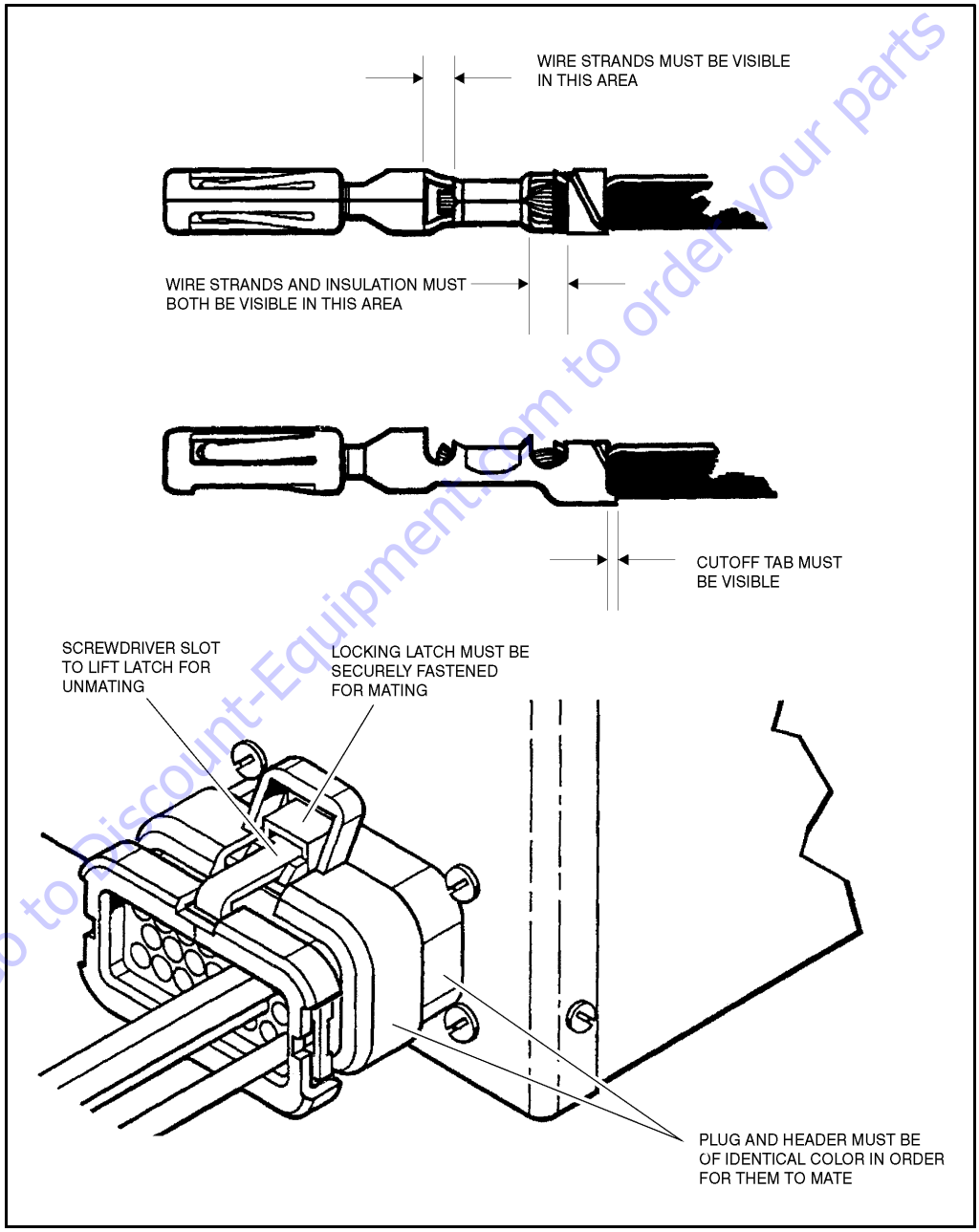


Figure 7-11. Connector Installation

7.6 WORKING WITH DEUTSCH CONNECTORS

DT/DTP Series Assembly

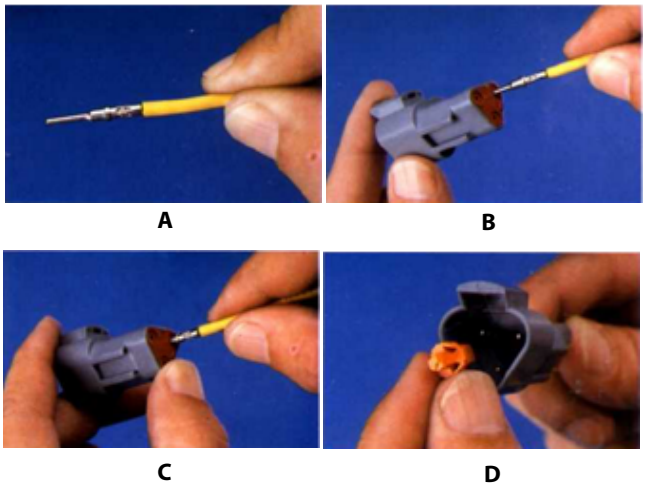


Figure 7-12. DT/DTP Contact Installation

1. Grasp crimped contact about 25mm behind the contact barrel.
2. Hold connector with rear grommet facing you.
3. Push contact straight into connector grommet until a click is felt. A slight tug will confirm that it is properly locked in place.
4. Once all contacts are in place, insert wedgelock with arrow pointing toward exterior locking mechanism. The wedgelock will snap into place. Rectangular wedges are not oriented. They may go in either way.

NOTE: *The receptacle is shown - use the same procedure for plug.*

DT/DTP Series Disassembly

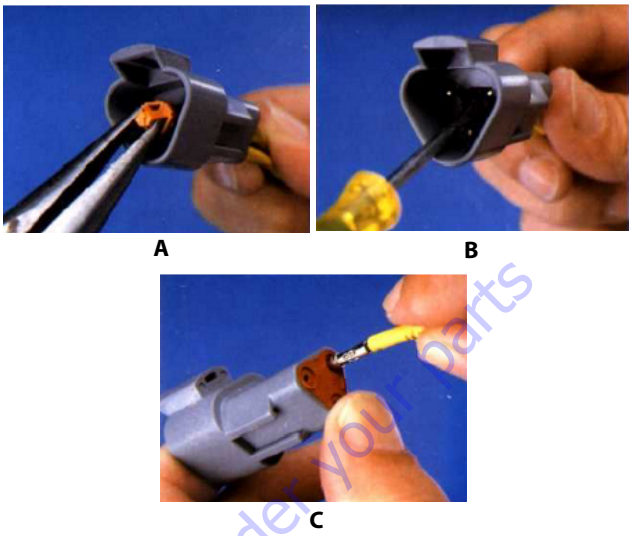


Figure 7-13. DT/DTP Contact Removal

1. Remove wedgelock using needle nose pliers or a hook shaped wire to pull wedge straight out.
2. To remove the contacts, gently pull wire backwards, while at the same time releasing the locking finger by moving it away from the contact with a screw-driver.
3. Hold the rear seal in place, as removing the contact may displace the seal.

HD30/HDP20 Series Assembly

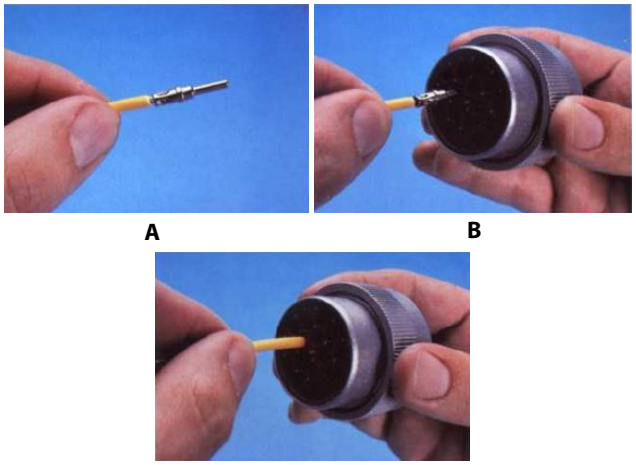


Figure 7-14. HD/HDP Contact Installation

1. Grasp contact about 25mm behind the contact crimp barrel.
2. Hold connector with rear grommet facing you.
3. Push contact straight into connector grommet until a positive stop is felt. A slight tug will confirm that it is properly locked in place.

Figure 7-15. HD/HDP Locking Contacts Into Position

NOTE: *For unused wire cavities, insert sealing plugs for full environmental sealing.*

HD30/HDP20 Series Disassembly

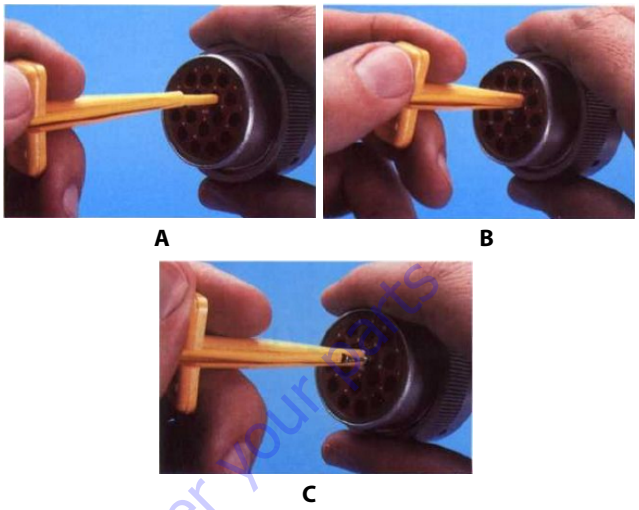


Figure 7-16. HD/HDP Contact Removal

1. With rear insert toward you, snap appropriate size extractor tool over the wire of contact to be removed.
2. Slide tool along into the insert cavity until it engages contact and resistance is felt.
3. Pull contact-wire assembly out of connector.

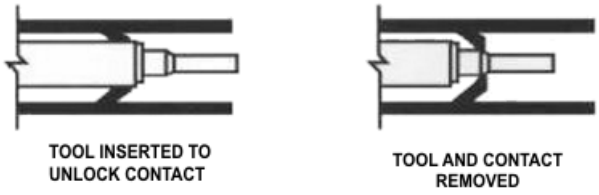


Figure 7-17. HD/HDP Unlocking Contacts

NOTE: *Do Not twist or insert tool at an angle.*

7.7 SWITCHES

Basic check

The following check determines if the switch is functioning properly, not the circuit in which the switch is placed. A switch is functioning properly when there is continuity between the correct terminals or contacts only when selected.

1. De-energize the circuit.
2. Isolate the switch from the rest of the circuit if possible. If not possible, keep in mind it may affect readings.
3. Access the terminals to the switch.
4. If the switch has two terminals:
    a. Measure resistance across the terminals.
    b. Change the switch position.
    c. Measure resistance again with the leads in the same positions. If the meter was reading short, it should read an open. If the meter was reading open it should read short.
5. If the switch has more than two terminals, consult the schematic or switch diagram to determine what terminals will be connected. The test is similar to testing a switch with two terminals.
    a. Place one meter lead on the common contact and the other on a different contact in the same circuit.
    b. Cycle through all positions of the switch. The meter should read short only when the switch connects the two terminals and open otherwise.
    c. If the switch has more than one common contact repeat the process for that circuit.

Leveling Jacks Limit Switch

Limit switches are used to control movement or indicate position. Mechanical limit switches are just like manually operated switches except that the moving object operates the switch. These switches can be tested the same way as a standard switch by manually operating the sensing arm.

Another type of limit switch used by JLG is the inductive proximity switch, also referred to as a “prox switch”. Inductive proximity switches are actuated only by ferrous metal (metal that contains Iron, such as steel) near the switch. They do not require contact, and must be energized to actuate. These types of switches can be used to detect boom or platform position, for example. These switches have a sensing face where the switch can detect ferrous metal close to it. To find the sensing face, take note how the switch is mounted and how the mechanisms meet the switch. Test this type of switch as follows:

1. Remove prox switch from its mount.
2. Reconnect harness if it was disconnected for step a, and turn on machine.
3. Hold switch away from metal and observe switch state in the control system diagnostics using the Analyzer. See vehicle or control system documentation on how to do this.
4. Place sensing face of switch on the object to be sensed by the switch. If that is not available, use a piece of ferrous metal physically similar to it. The switch state in the control system diagnostics should change.
5. When reinstalling or replacing switch be sure to follow mounting instructions and properly set the gap between the switch and object sensed.

Automatic Switches

If the switch is actuated automatically, by temperature or pressure for example, find a way to manually actuate the switch to test it. Do this either by applying heat or pressure, for example, to the switch. These switches may need to be energized to actuate.

1. Connect instrumentation to monitor and/or control the parameter the switch is measuring.
2. Observe switch state in control system with the Analyzer. See vehicle or control system documentation on how to do this.
3. Operate system such that the switch actuates. This could be going over a certain pressure or temperature, for example. The state indicated in the control system should change.

Switch Wiring - Low Side, High Side

When controlling a load, a switch can be wired between the positive side of the power source and the load. This switch is called a “high side” switch. The switch supplies the power to the load. When a switch is wired between the negative side of the power source and the load, it is a “low side” switch. The switch provides the ground to the load.

A low side switch will allow voltage to be present on the load. No power is applied because the switch is stopping current flow. This voltage can be seen if the measurement is taken with one test lead on the load and the other on the battery negative side or grounded to the vehicle. What is actually being measured is the voltage drop across the switch. This could mislead a technician into thinking the load is receiving power but not operating. To produce an accurate picture of power or voltage applied to the load, measure voltage across the load’s power terminals. Also, the technician can measure the voltage at both power terminals with respect to battery ground. The difference between those two measurements is the voltage applied to the load.

7.8 ELECTRICAL SCHEMATICS

SHEET 2: GROUND CONTROL
- HARNESS,GROUND MODULE
- HARNESS,GROUND CONTROL BOX

SHEET 3: CHASSIS, ARM STACK & OPTIONS
- HARNESS,CHASSIS WIRING
- CABLE,ARM STACK
- CABLE,ARM STACK
- CABLE,ARM STACK
- HARNESS,CHASSIS WIRING
- CABLE,ARM STACK,UPR AUX
- CABLE,ARM STACK,LWR AUX
- CABLE,ARMS LSS
- HARNESS,OSCILLATING AXLE OPTION
- HARNESS,ARM STACK TILT SENSOR
- WIRE,LEVELING JACK HARNESS
- OIL COOLER HARNESS OPTION

SHEET 4: PLATFORM CONTROL
- HARNESS,PLATFORM I/O MODULE

SHEET 5: PLATFORM CONTROL BOX
- HARNESS,PLATFORM BOX

SHEET 6: DIESEL ENGINE
- HARNESS,ENGINE KUBOTA,DIESEL
- CABLE,BATTERY KIT
- WIRE,10 GA FUSIBLE LINK

SHEET 7: GAS ENGINE CHASSIS
- HARNESS,HYDRUALIC COMPARTMENT

SHEET 8: GAS ENGINE
- HARNESS,ENGINE KUBOTA,DUAL FUEL

SHEET 9: GENERATOR & LIGHT OPTIONS
- HARNESS,4000W GEN CONTROL
- HARNESS,4000W GEN CONTROL
- CABLE,4000W GEN POWER
- HARNESS,7500W GEN CONTROL
- HARNESS,7500W GEN CONTROL
- CABLE,7500W GEN POWER
- HARNESS,BOX SWITCH
- HARNESS,HEAD/TAIL LIGHTS
- HARNESS,WORK LIGHTS
- HARNESS,FLOOD LIGHT SWITCH

SHEET 10: LOAD SENSE
- HARNESS,LOAD SENSE

1001236134-B

Figure 7-18. Electrical Schematic

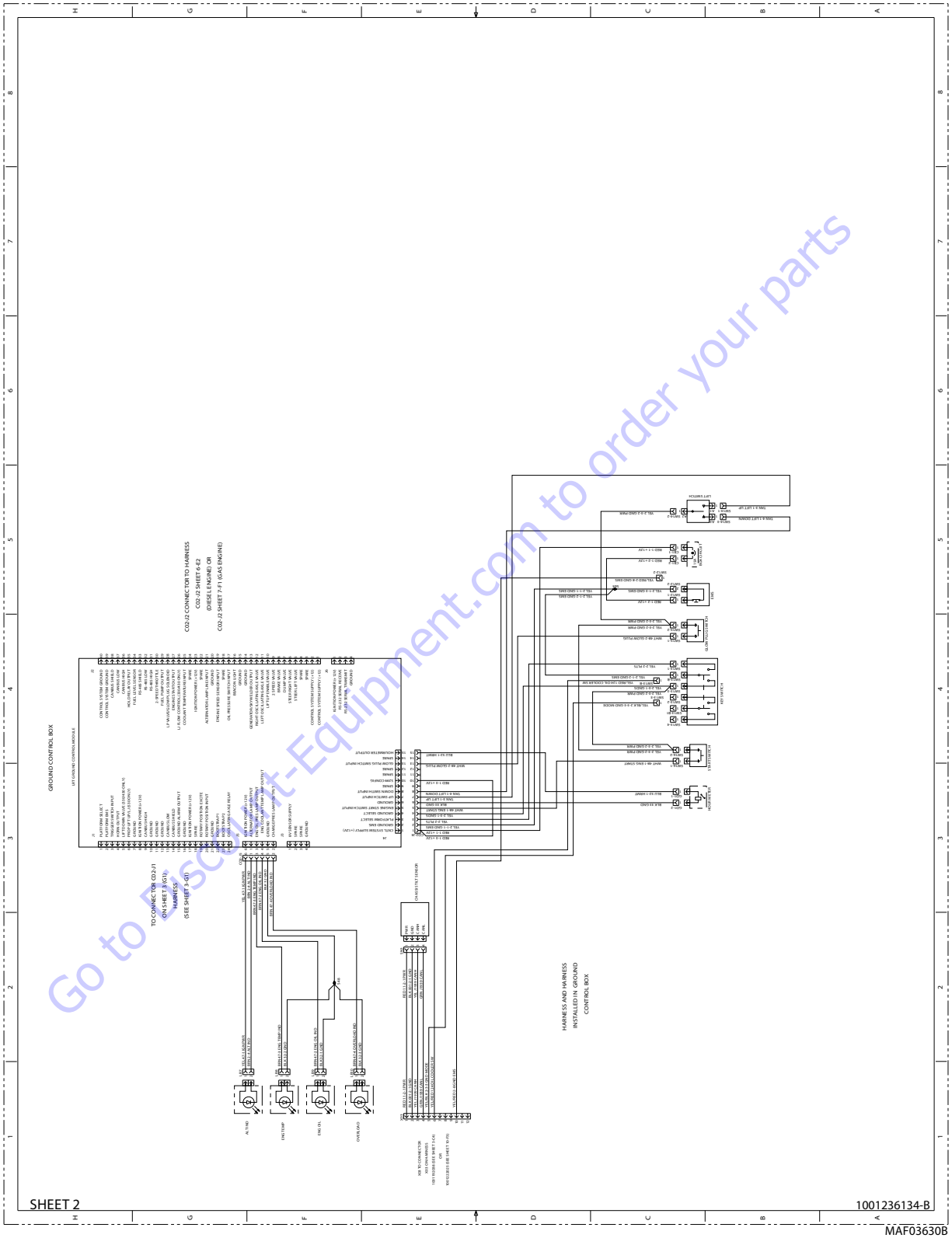


Figure 7-18. Electrical Schematic

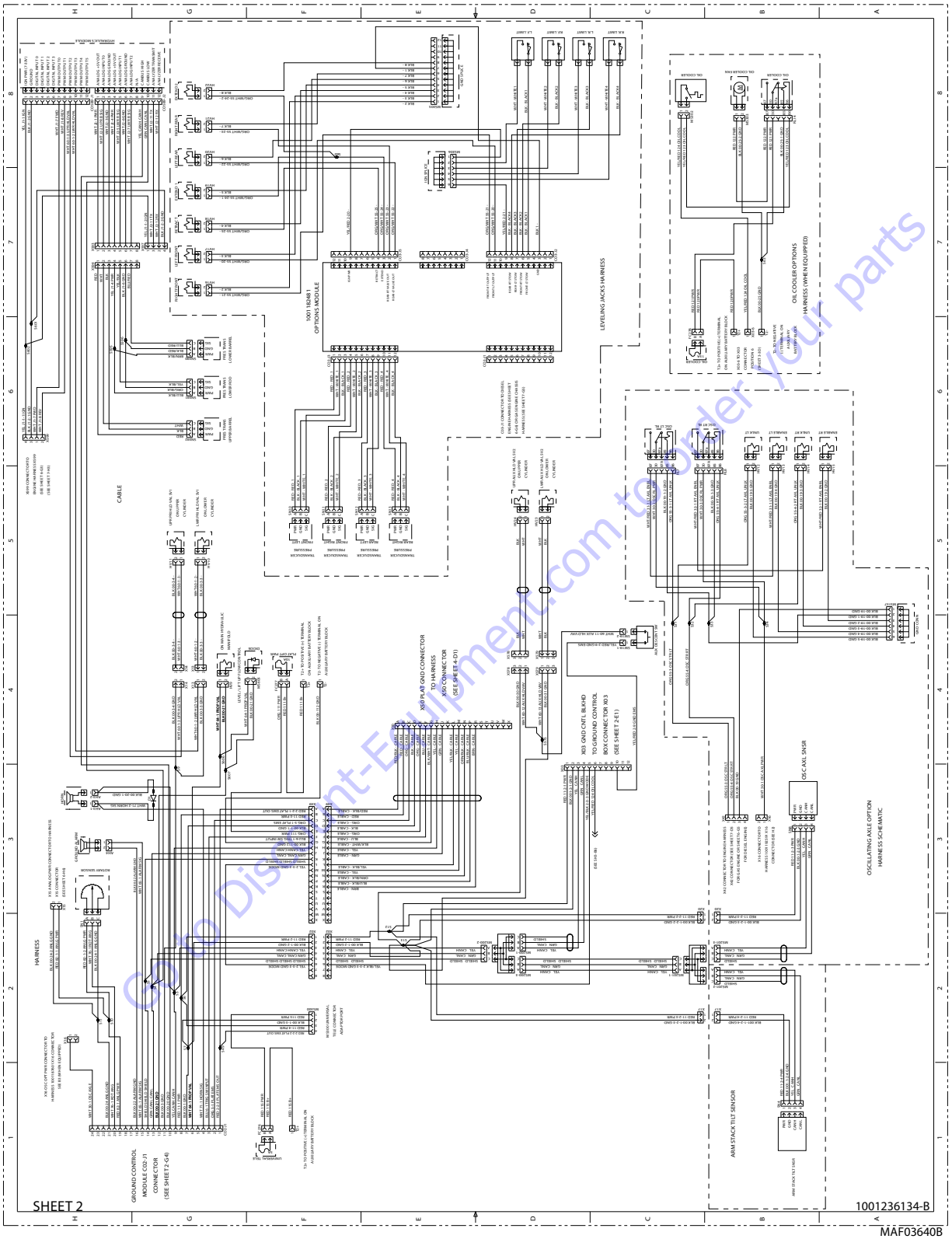


Figure 7-18. Electrical Schematic

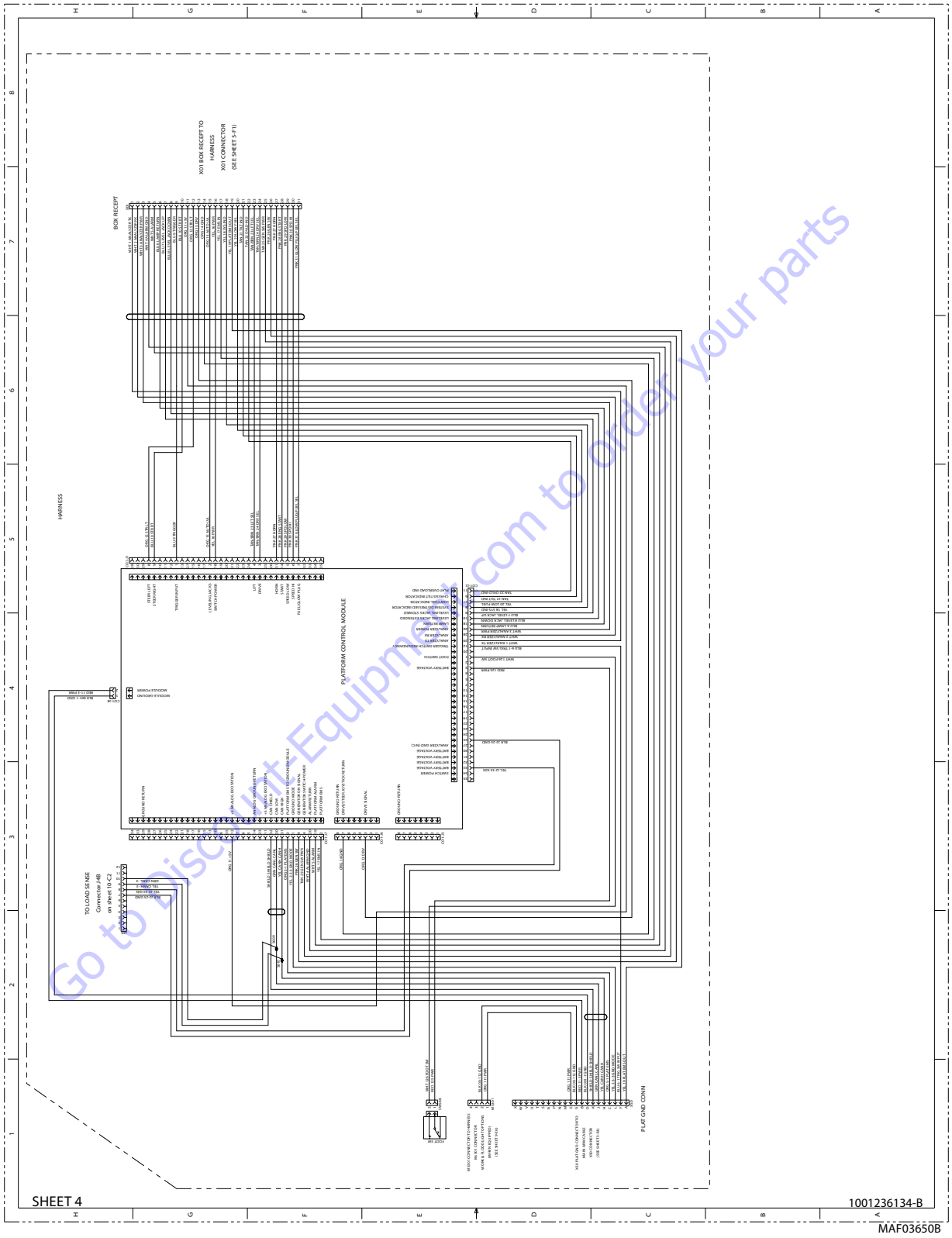


Figure 7-18. Electrical Schematic

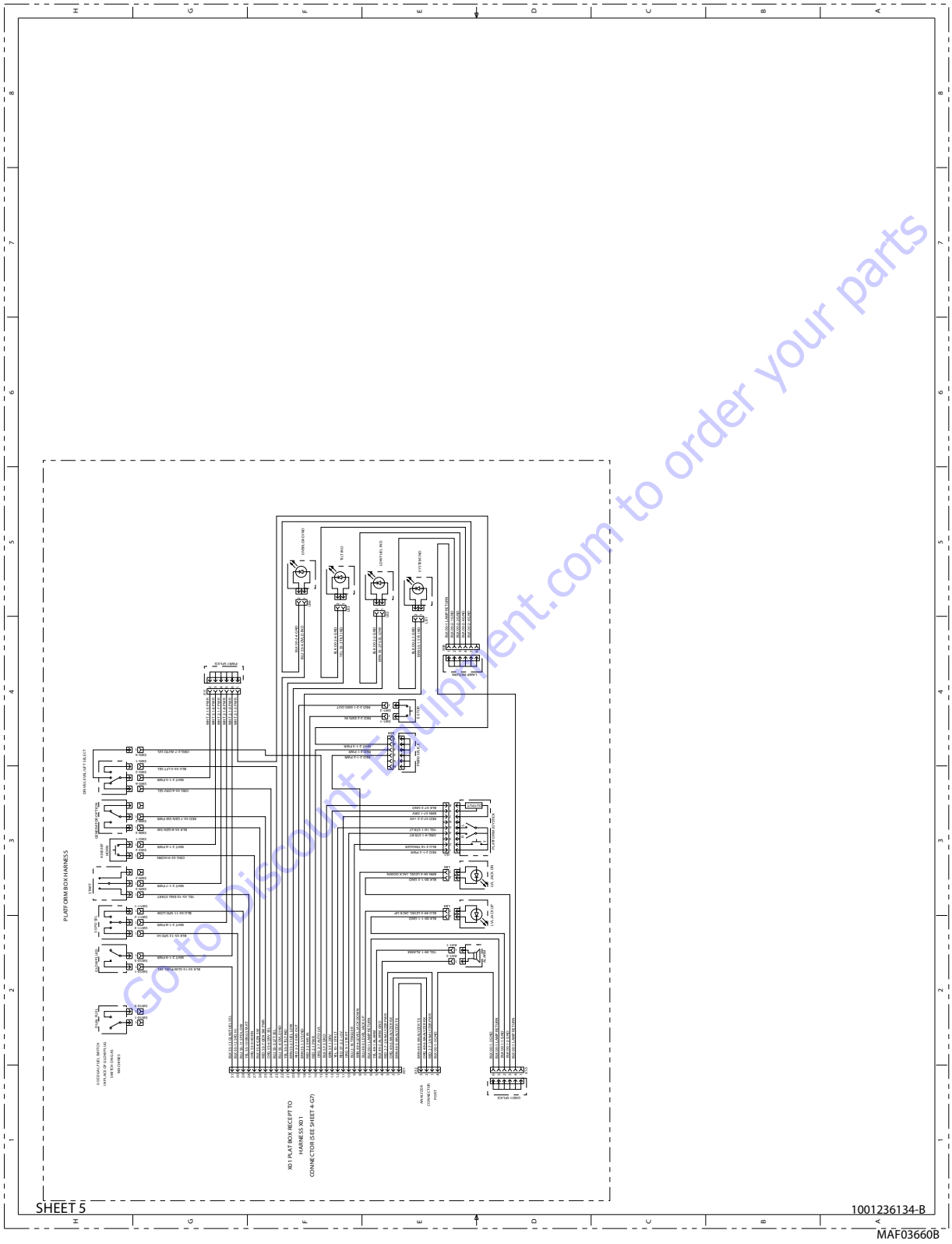


Figure 7-18. Electrical Schematic

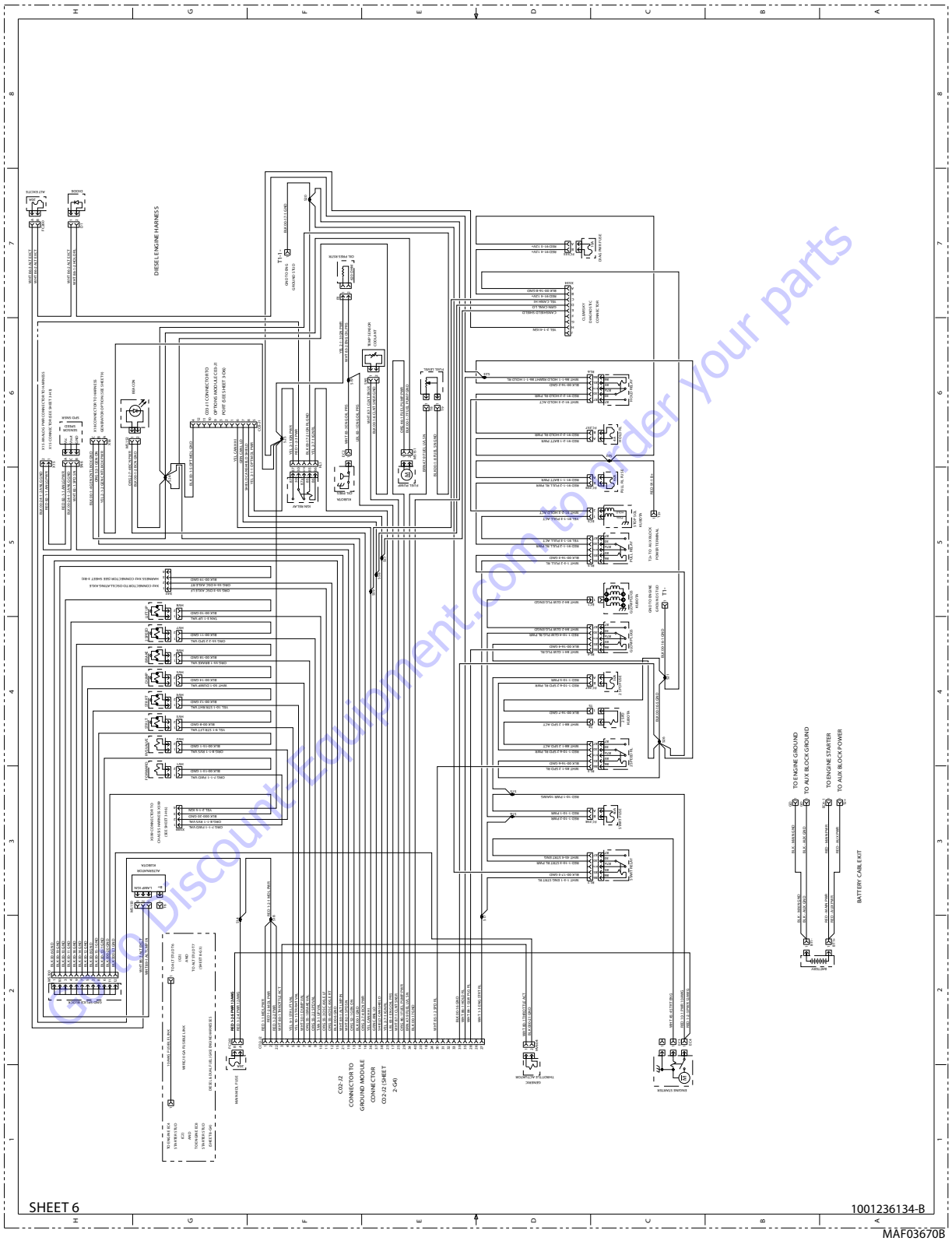


Figure 7-18. Electrical Schematic

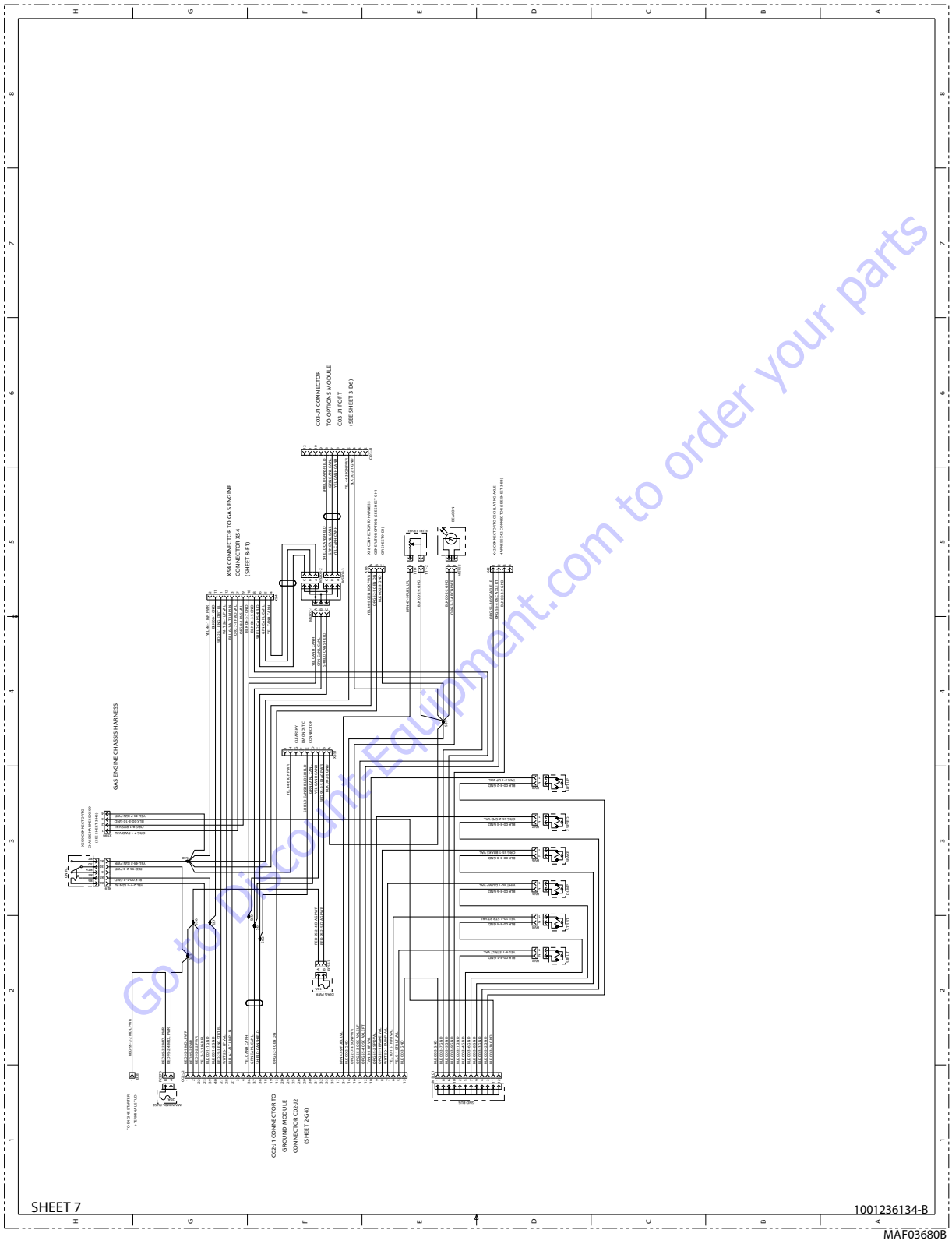


Figure 7-18. Electrical Schematic

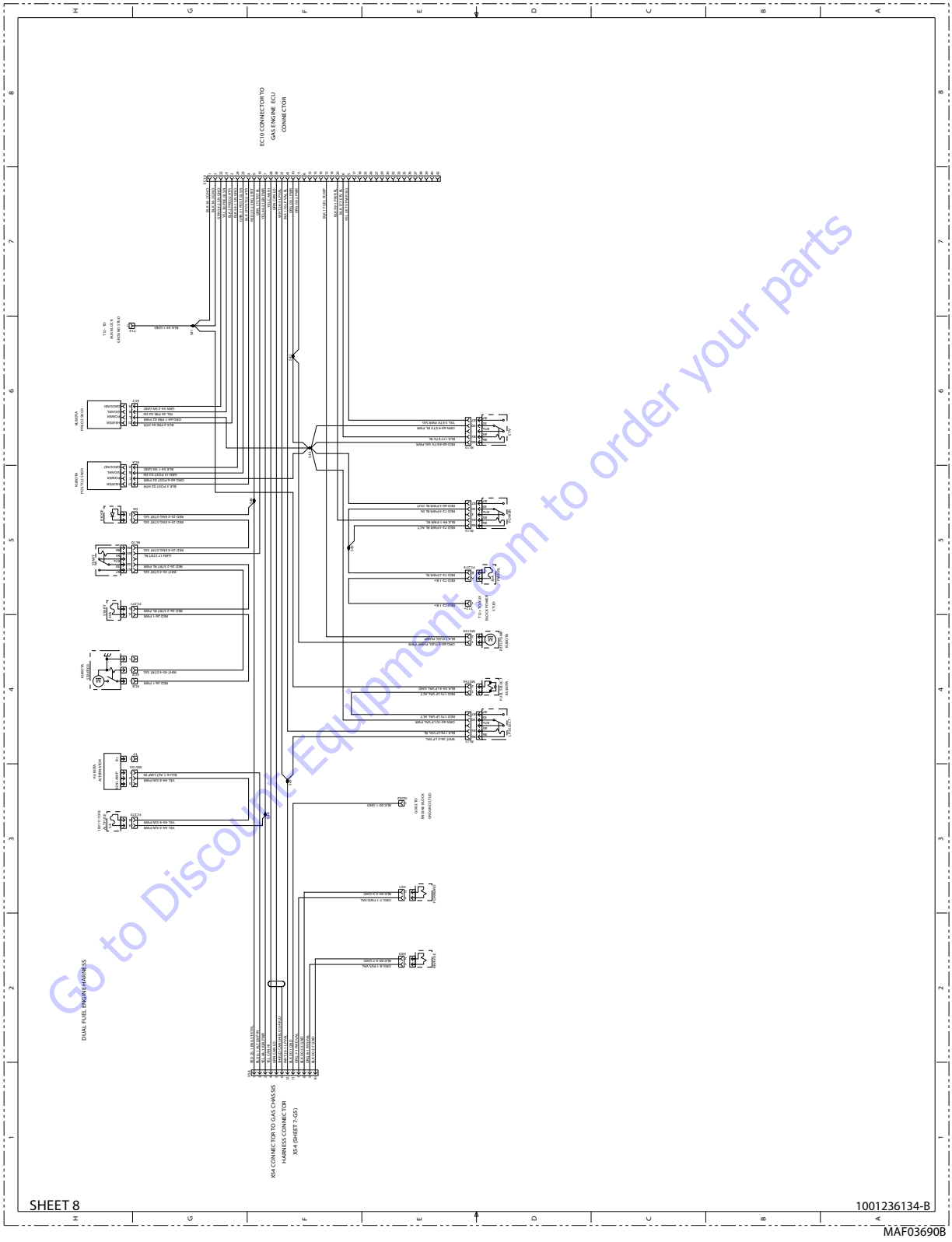


Figure 7-18. Electrical Schematic

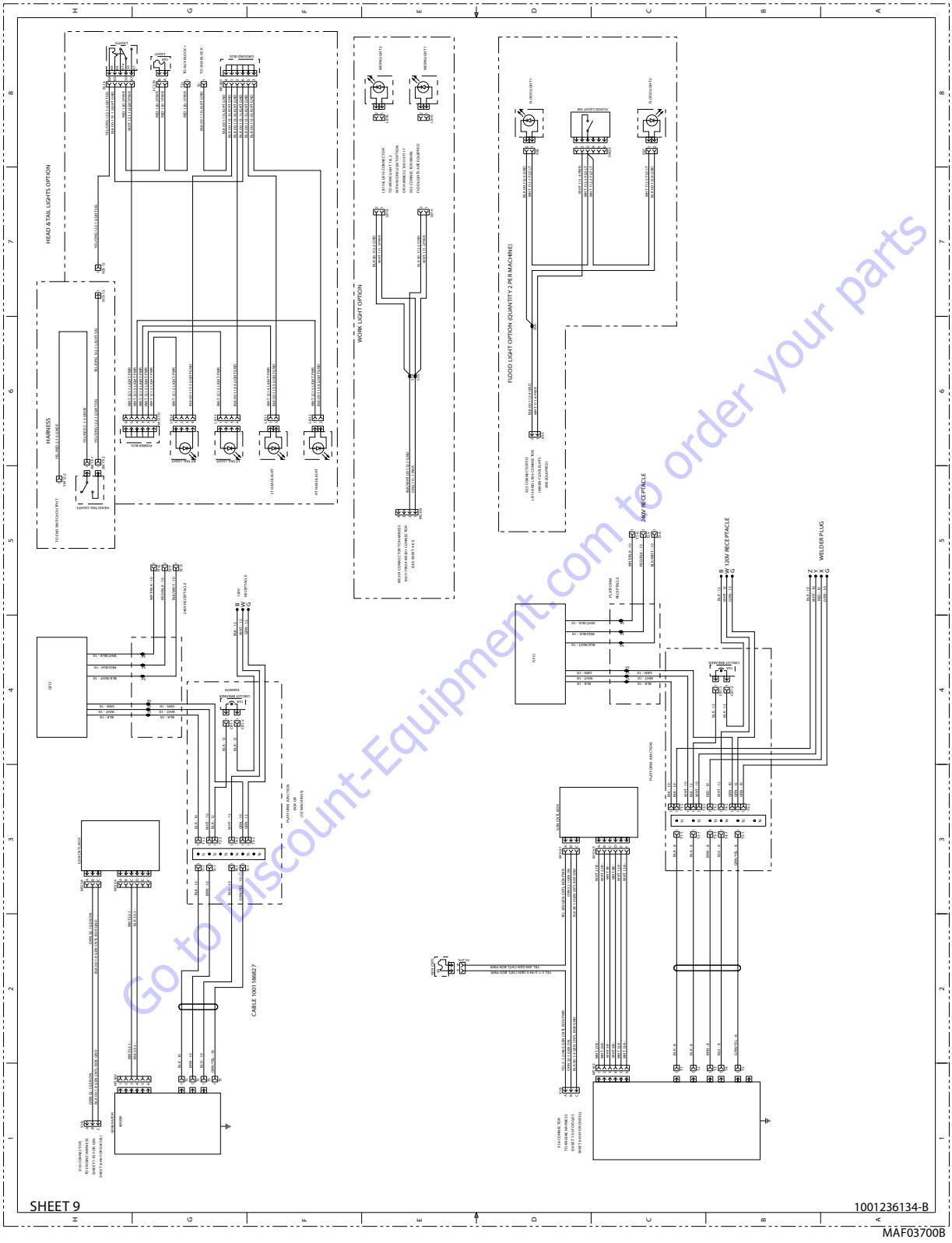


Figure 7-18. Electrical Schematic

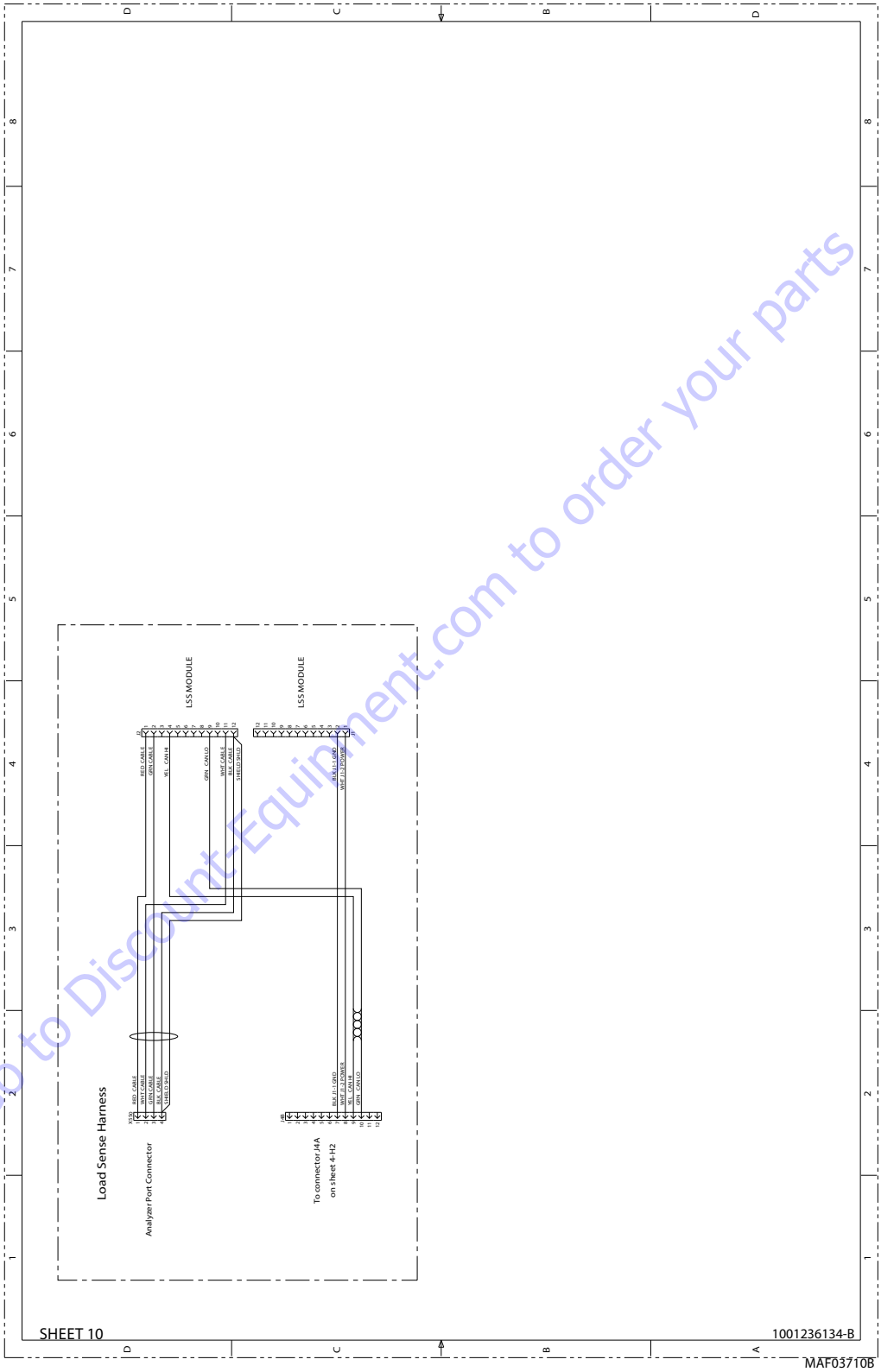


Figure 7-19. Electrical Schematic

PARTS FINDER

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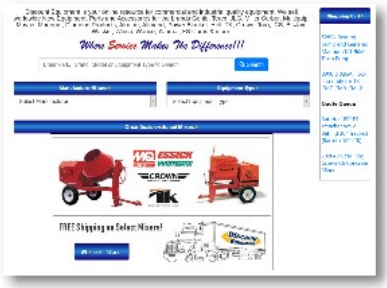

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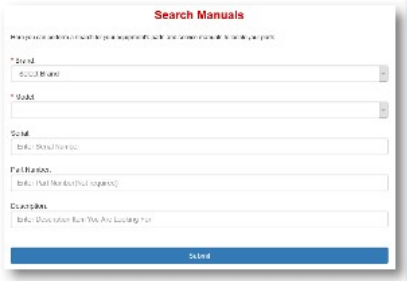

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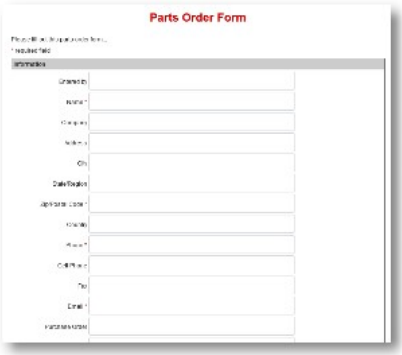

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