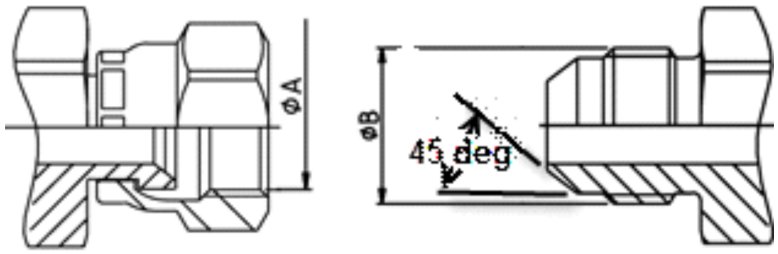
Table 5-5. 45° Flare (SAE) - Steel

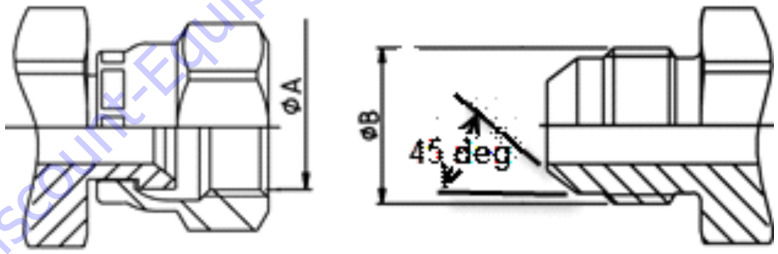


TYPE/FITTING IDENTIFICATION							Torque					
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]		
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	4	7/16-20	0.39	9.90	0.44	11.10	13	14	14	18	19	19
	6	5/8-18	0.56	14.30	0.63	15.90	22	23	24	30	31	33
	8	3/4-16	0.69	17.50	0.75	19.10	42	44	46	57	60	62
	10	7/8-14	0.81	20.60	0.87	22.20	60	63	66	81	85	89
	12	11/16-14	0.98	25.00	1.06	27.00	84	88	92	114	119	125

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methodsfor FFWR procedure requirements.

Table 5-6. 45° Flare (SAE) - Aluminum/Brass



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

* ØA and ØB thread dimensions for reference only.

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

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.

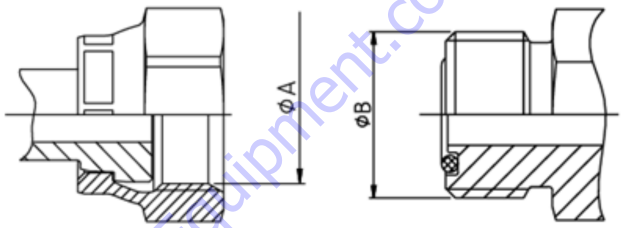
3. Pre-lubricate the O-ring with Hydraulic Oil.
4. Place the tube assembly against the fitting body so that the flat face comes in contact with the O-ring. Hand thread the nut onto the fitting body.
5. Torque nut to value listed in Table 5-7, O-ring Face Seal (ORFS) - Steel or Table 5-8, O-ring Face 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 5-7, O-ring Face Seal (ORFS) - Steel and Table 5-8, 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:

a. STEEL fittings with ALUMINUM or BRASS mating components
b. ALUMINUM or BRASS fittings with STEEL mating components
c. ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

Table 5-7. O-ring Face Seal (ORFS) - Steel

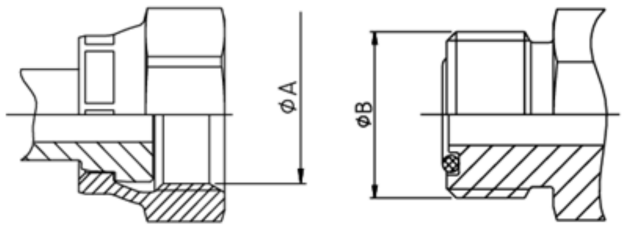


TYPE/FITTING IDENTIFICATION							Torque						Flats from Wrench Resistance (F.F.W.R)**	
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]			Tube Nuts	Swivel & Hose Ends
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max		
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	4	9/16-18	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	1 11/16-12	1.59	40.50	1.69	42.90	150	158	165	203	214	224	1/4 to 1/2	1/2 to 3/4
	24	2-12	1.92	48.80	2.00	50.80	230	242	253	312	328	343	1/4 to 1/2	1/2 to 3/4
	32	2 1/2-12	2.43	61.67	2.50	63.50	375	394	413	508	534	560	1/4 to 1/2	1/2 to 3/4

* ØA and ØB thread dimensions for reference only.

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

Table 5-8. 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	1 3/16-12	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	1 7/16-12	1.34	34.15	1.44	36.50	72	76	79	98	103	107	1/4 to 1/2	1/2 to 3/4
	20	1 11/16-12	1.59	40.50	1.69	42.90	98	103	108	133	140	146	1/4 to 1/2	1/2 to 3/4
	24	2-12	1.92	48.80	2.00	50.80	12	13	13	16	18	18	1/4 to 1/2	1/2 to 3/4
	32	2 1/2-12	2.43	61.67	2.50	63.50	20	21	22	27	28	30	1/4 to 1/2	1/2 to 3/4

* ØA and ØB thread dimensions for reference only.

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

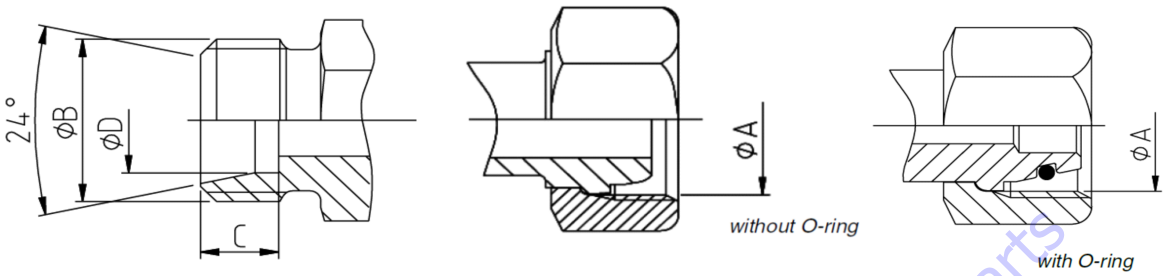
Assembly Instructions for DIN 24° Flare Bite Type Fittings (MBTL and MBTS)

⚠ 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 5-9, DIN 24° Cone (MBTL & MBTS) while using the Double Wrench Method. The tube must not turn with the nut.

Table 5-9. 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	Nom	Max	Torque [N-m] Min	Nom	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	Nom	Max	Torque [N-m] Min	Nom	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

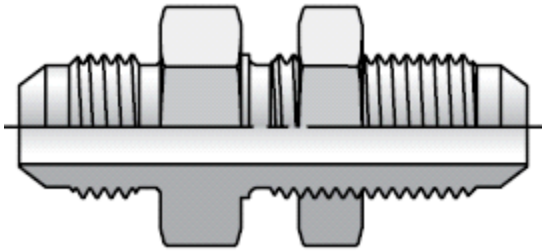
*ØA, ØB, C, & ØD thread dimensions for reference only.

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

Assembly Instructions for Bulkhead (BH) Fittings

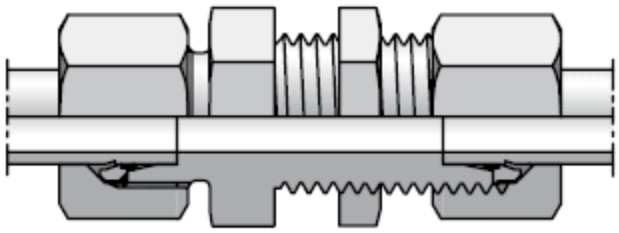
1. Ensure threads and surface are free of rust, weld and brazing splatter, splits, burrs or other foreign material. If necessary replace fitting or adapter.
2. Remove the locknut from the bulkhead assembly.
3. Insert the bulkhead side of the fitting into the panel or bulkhead bracket opening.
4. Hand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

Table 5-10. 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	13/16-12	135	142	149	183	193	202
		14	15/16-12	170	179	187	230	243	254
		16	17/16-12	200	210	220	271	285	298
		20	111/16-12	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	11/16-12	135	142	149	183	193	202
		14	13/16-12	170	179	187	230	243	254
		16	15/16-12	200	210	220	271	285	298
		20	15/8-12	245	258	270	332	350	366
		24	17/8-12	270	284	297	366	385	403
		32	21/2-12	310	326	341	420	442	462

Table 5-11. 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 5-12 thru Table 5-17 while using the Double Wrench Method.

NOTE: *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.*

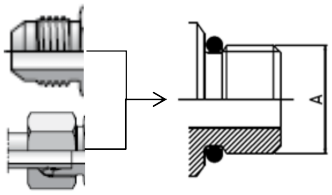
NOTE: *Torque values provided in Table 5-12 thru Table 5-17 are segregated based on the material configuration of the connection.*

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

- **a.** STEEL fittings with ALUMINUM or BRASS mating components.
- **b.** ALUMINUM or BRASS fittings with STEEL mating components.
- **c.** ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

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

Table 5-12. O-ring Boss (ORB) - Table 1 of 6



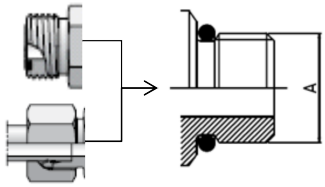
TYPE/FITTING IDENTIFICATION					HEX TYPE PLUGS & STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
					[Ft-Lb]			[N-m]		
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	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	11/16-12	1.06	27.00	135	142	149	185	193	202
	14	13/16-12	1.19	30.10	175	184	193	235	249	262
	16	15/16-12	1.31	33.30	200	210	220	270	285	298
	20	15/8-12	1.63	41.30	250	263	275	340	357	373
	24	17/8-12	1.87	47.60	305	321	336	415	435	456
	32	21/2-12	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					
					[Ft-Lb]			[N-m]		
		(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	11/16-12	1.06	27.00	88	93	97	119	126	132
	14	13/16-12	1.19	30.10	114	120	126	155	163	171
	16	15/16-12	1.31	33.30	130	137	143	176	186	194
	20	15/8-12	1.63	41.30	163	171	179	221	232	243
	24	17/8-12	1.87	47.60	198	208	218	268	282	296
	32	21/2-12	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 5-13. O-ring Boss (ORB) - Table 2 of 6



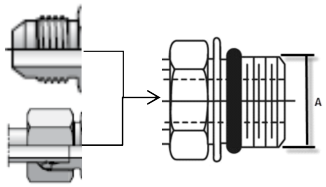
TYPE/FITTING IDENTIFICATION					STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
					[Ft-Lbs]			[N-m]		
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	--	--	--	--	--	--
	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					
					[Ft-Lb]			[N-m]		
		(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 5-14. O-ring Boss (ORB) - Table 3 of 6



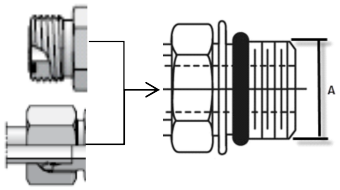
TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
					[Ft-Lb]			[N-m]		
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	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	11/16-12	1.06	27.00	135	142	149	185	193	202
	14	13/16-12	1.19	30.10	175	184	193	235	249	262
	16	15/16-12	1.31	33.30	200	210	220	270	285	298
	20	15/8-12	1.63	41.30	250	263	275	340	357	373
	24	17/8-12	1.87	47.60	305	321	336	415	435	456
	32	21/2-12	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					
					[Ft-Lb]			[N-m]		
		(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	11/16-12	1.06	27.00	88	93	97	119	126	132
	14	13/16-12	1.19	30.10	114	120	126	155	163	171
	16	15/16-12	1.31	33.30	130	137	143	176	186	194
	20	15/8-12	1.63	41.30	163	171	179	221	232	243
	24	17/8-12	1.87	47.60	198	208	218	268	282	296
	32	21/2-12	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 5-15. 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					
					[Ft-Lb]			[N-m]		
		(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					
					[Ft-Lb]			[N-m]		
		(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.

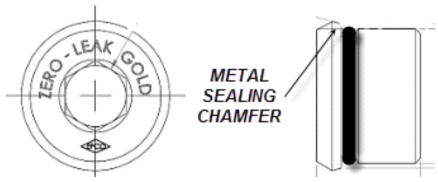
Table 5-16. O-ring Boss (ORB) - Table 5 of 6

TYPE/FITTING IDENTIFICATION					HOLLOW HEX PLUGS					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
					[Ft-Lb]			[N-m]		
		(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					
					[Ft-Lb]			[N-m]		
		(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 5-17. O-ring Boss (ORB) - Table 6 of 6



TYPE/FITTING IDENTIFICATION					ZERO LEAK GOLD® HOLLOW HEX PLUGS					
					Torque**					
					[Ft-Lb]			[N-m]		
MATERIAL	Dash Size	Thread Size	ØA*							
		(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					
					Torque**					
					[Ft-Lb]			[N-m]		
MATERIAL	Dash Size	Thread Size	ØA*							
		(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.

NOTICE

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

3. Pre-lubricate the O-ring with Hydraulic Oil.
4. For Non-Adjustable Fittings and Plugs, thread the fitting by hand until contact.
5. For Adjustable fittings, refer to Adjustable Stud End Assembly for proper assembly.
6. Torque the fitting or nut to value listed in Table 5-18, Table 5-19, Table 5-20, Table 5-21, Table 5-22, or Table 5-23 while using the Double Wrench Method.

NOTE: *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.*

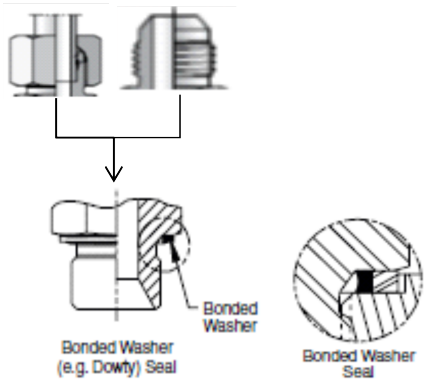
NOTE: *Torque values provided in Table 5-18, Table 5-19, Table 5-20, Table 5-21, Table 5-22, and Table 5-23 are segregated based on the material configuration of the connection.*

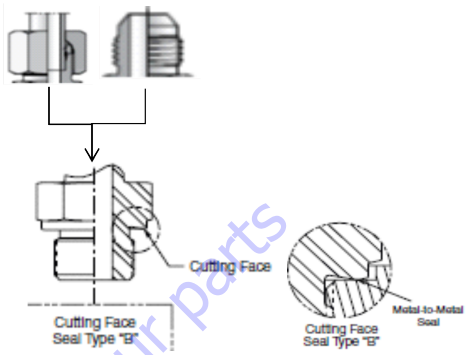
'ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- **a.** STEEL fittings with ALUMINUM or BRASS mating components.
- **b.** ALUMINUM or BRASS fittings with STEEL mating components.
- **c.** ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

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

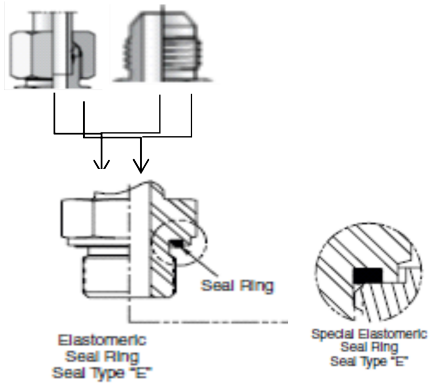
Table 5-18. Metric Flat Face Port (MFF) - L Series - Table 1 of 3

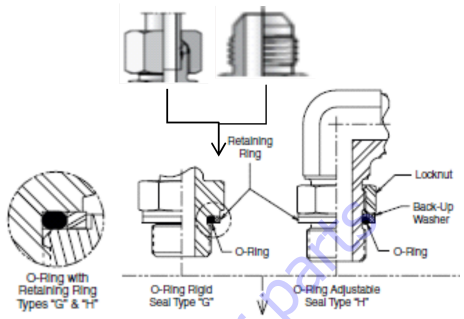




TYPE/FITTING IDENTIFICATION			FORM A (SEALING WASHER) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM B (CUTTING FACE) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[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 5-19. 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 5-20. Metric Flat Face Port (MFF) - L Series - Table 3 of 3

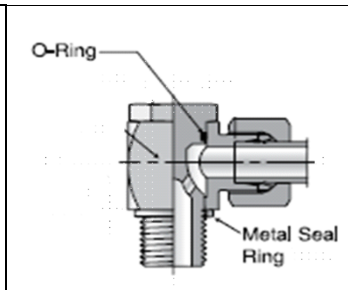
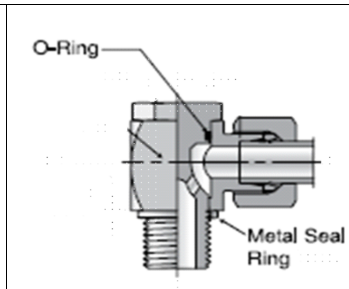
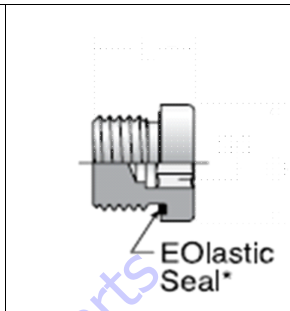
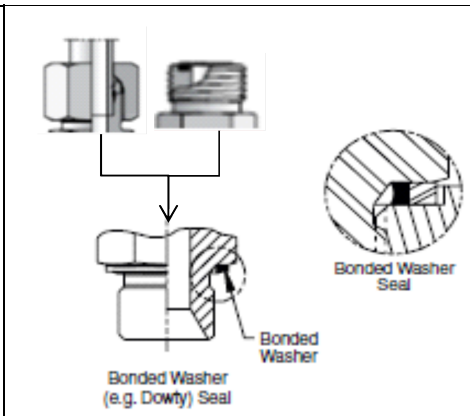
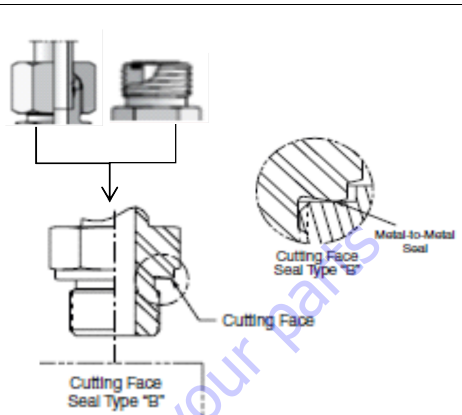
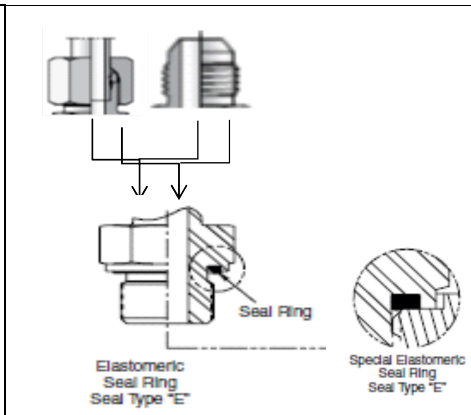
																				
TYPE/FITTING IDENTIFICATION			**BANJO FITTINGS with L series DIN (MBTL) opposite end**						**HIGH PRESSURE BANJO FITTINGS with L series DIN (MBTL) opposite end**						**FORM E (EOLASTIC SEALING RING) HOLLOW HEX PLUGS**					
MATERIAL	**Thread M Size**	**Connecting Tube O.D.**	**Torque**						**Torque**						**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

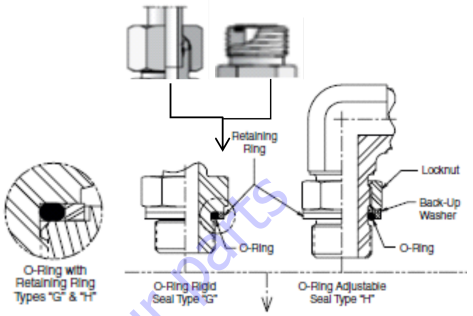
Table 5-21. Metric Flat Face Port (MFF) - S Series - Table 1 of 3

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

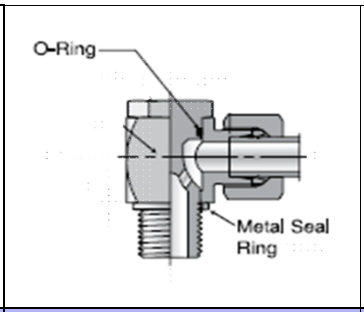
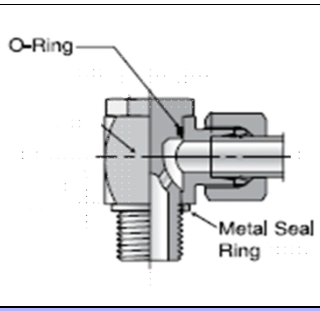
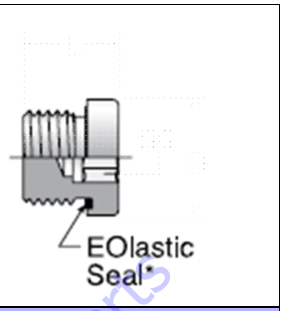
Table 5-22. Metric Flat Face Port (MFF) - S Series - Table 2 of 3





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 5-23. Metric Flat Face Port (MFF) - S Series - Table 3 of 3

																		
TYPE/FITTING IDENTIFICATION			**BANJO FITTINGS with S series DIN (MBTS) opposite end**						**HIGH PRESSURE BANJO FITTINGS with S series DIN (MBTS) opposite end**						**FORM E (EOLASTIC SEALING RING) HOLLOW HEX PLUGS**					
MATERIAL	**Thread M Size**	**Connecting Tube O.D.**	**Torque**						**Torque**						**Torque**					
			[Ft-Lb]			**[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 5-24 while using the Double Wrench Method.

NOTE: *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.*

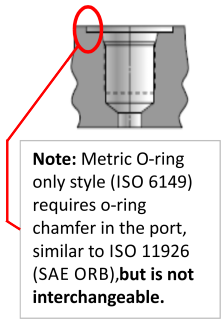
NOTE: *Torque values provided in Table 5-24 are segregated based on the material configuration of the connection.*

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

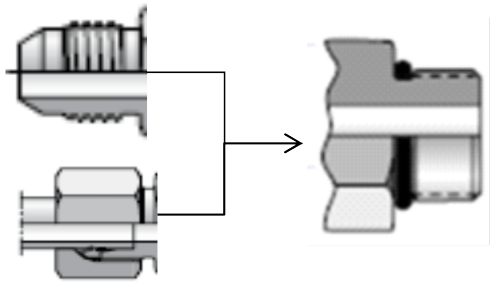
   a. STEEL fittings with ALUMINUM or BRASS mating components.
   b. ALUMINUM or BRASS fittings with STEEL mating components.
   c. ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

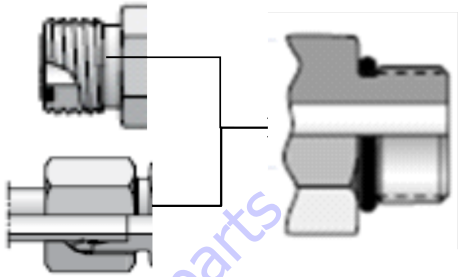
7. Inspect to ensure the O-ring is not pinched and the washer is seated flat on the counterbore of the port.

Table 5-24. 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 5-25, Table 5-26, Table 5-27, Table 5-28, Table 5-29, or Table 5-30 while using the Double Wrench Method.

NOTE: *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.*

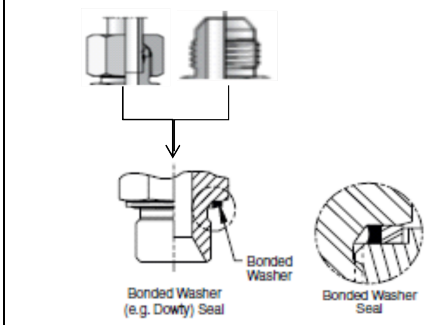
NOTE: *Torque values provided in Table 5-25, Table 5-26, Table 5-27, Table 5-28, Table 5-29, and Table 5-30 are segregated based on the material configuration of the connection.*

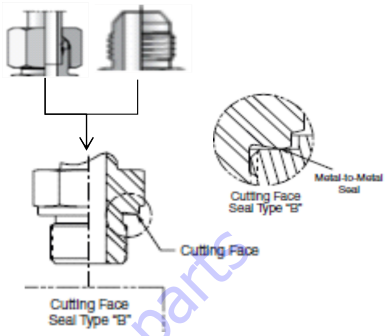
'ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- **a.** STEEL fittings with ALUMINUM or BRASS mating components.
- **b.** ALUMINUM or BRASS fittings with STEEL mating components.
- **c.** ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

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

Table 5-25. British Standard Parallel Pipe Port (BSPP) - L Series - Table 1 of 3





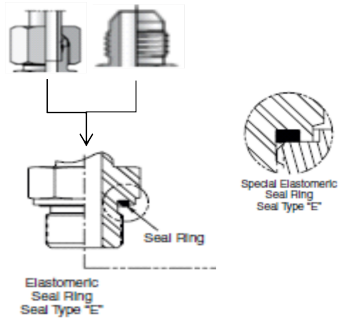
TYPE/FITTING IDENTIFICATION			FORM A**(SEALING WASHER) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM B** (CUTTING FACE) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[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

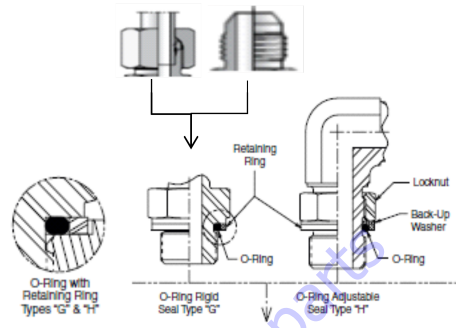
* Typical for JLG Straight Male Stud Fittings

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

*** Typical for JLG Adjustable Fittings

Table 5-26. British Standard Parallel Pipe Port (BSPP) - L Series - Table 2 of 3





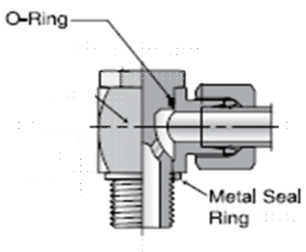
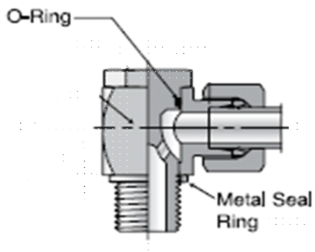
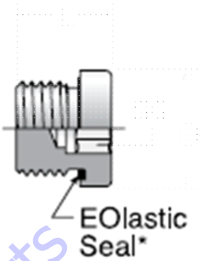
TYPE/FITTING IDENTIFICATION			FORM E* (EOLASTIC SEALING RING) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM G/H*** (O-RING W/ RETAINING RING) STUD ENDS & ADJUSTABLE STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	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 5-27. 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 [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	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

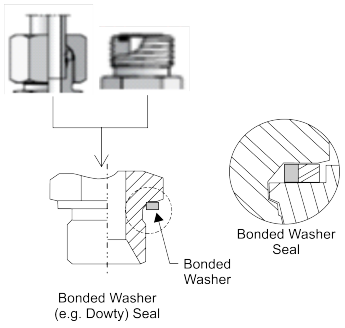
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque [Ft-Lb]			Torque [N-m]			Torque [Ft-Lb]			Torque [N-m]			Torque [Ft-Lb]			Torque [N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	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

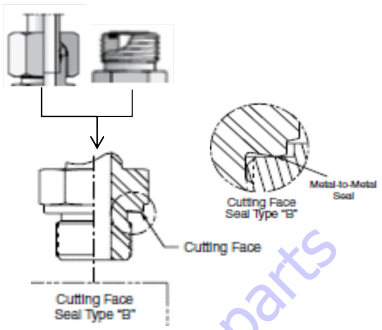
* Typical for JLG Straight Male Stud Fittings

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

*** Typical for JLG Adjustable Fittings

Table 5-28. British Standard Parallel Pipe Port (BSPP) - S Series - Table 1 of 3





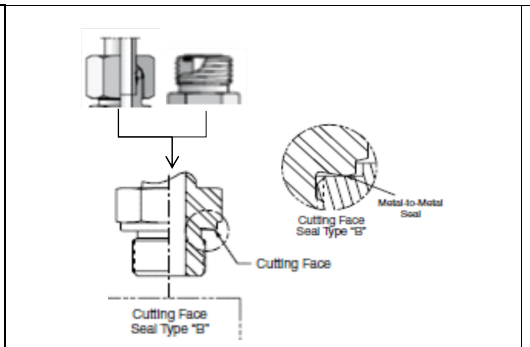
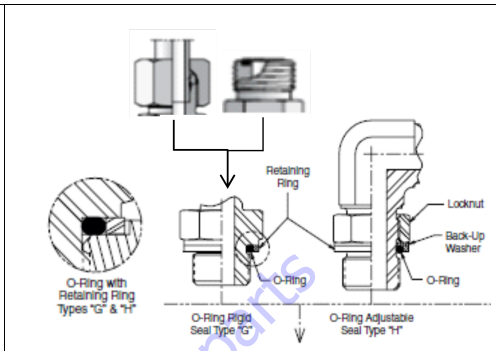
TYPE/FITTING IDENTIFICATION			FORM A** (SEALING WASHER) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end						FORM B** (CUTTING FACE) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque [Ft-Lb]			Torque [N-m]			Torque [Ft-Lb]			Torque [N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
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 [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
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 5-29. 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 [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
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

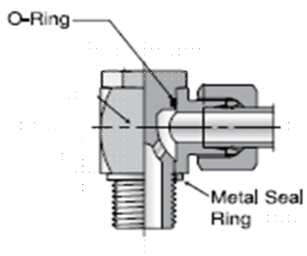
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque [Ft-Lb]			Torque [N-m]			Torque [Ft-Lb]			Torque [N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	27	28	29	37	38	39	17	18	19	23	24	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

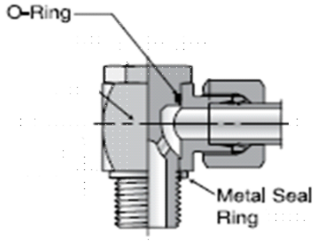
* Typical for JLG Straight Male Stud Fittings

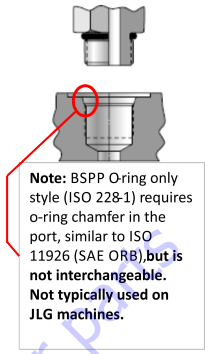
** Non typical for JLG Straight Male Stud Fittings, reference only.

*** Typical for JLG Adjustable Fittings

Table 5-30. 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						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	G1/4A	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.					
	G1/4A	8	30	32	33	40	43	45	33	35	36	45	47	49						
	G3/8A	10	48	51	53	65	69	72	52	55	57	70	75	77						
	G3/8A	12	48	51	53	65	69	72	52	55	57	70	75	77						
	G1/2A	14	66	70	73	90	95	99	89	94	98	120	127	133						
	G1/2A	16	66	70	73	90	95	99	89	94	98	120	127	133						
	G3/4A	20	92	97	101	125	132	137	170	179	187	230	243	254						
	G1A	25	--	--	--	--	--	--	236	248	260	320	336	353						
	G1-1/4A	30	--	--	--	--	--	--	398	418	438	540	567	594						
	G1-1/2A	38	--	--	--	--	--	--	516	542	568	700	735	770						
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	G1/4A	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.					
	G1/4A	8	20	21	21	27	28	28	22	22	23	30	30	31						
	G3/8A	10	31	33	34	42	45	46	34	36	37	46	49	50						
	G3/8A	12	31	33	34	42	45	46	34	36	37	46	49	50						
	G1/2A	14	43	45	47	58	61	64	58	61	64	79	83	87						
	G1/2A	16	43	45	47	58	61	64	58	61	64	79	83	87						
	G3/4A	20	60	63	66	81	85	89	111	117	122	150	159	165						
	G1A	25	--	--	--	--	--	--	153	161	169	207	218	229						
	G1-1/4A	30	--	--	--	--	--	--	259	272	285	351	369	386						
	G1-1/2A	38	--	--	--	--	--	--	335	352	368	454	477	499						

*Typical for JLG Straight Male Stud Fittings

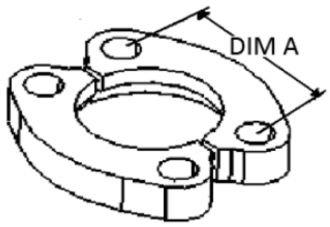
**Non typical for JLG Straight Male Stud Fittings, reference only.

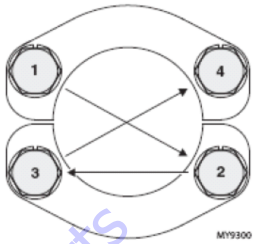
***Typical for JLG Adjustable Fittings

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. See O-ring Installation (Replacement) for O-ring installation instructions.
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 5-31and Table 5-32.

Table 5-31. Flange Code (FL61 & FL62) - Inch Fasteners

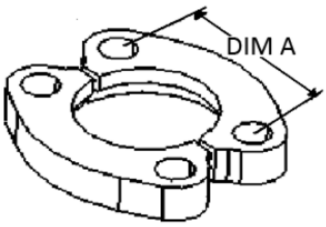


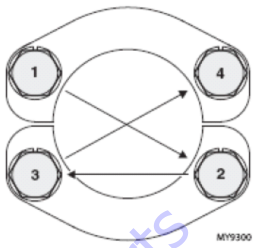


TYPE/FITTING IDENTIFICATION						STEEL 4-BOLT FLANGE SAE J518 (INCH FASTENERS)													
TYPE	Inch Flange SAE Dash Size	Flange Size		A*		Bolt Thread Size	Fastener Torque for Flanges Equipped with GRADE 5 Screws						Fastener Torque for Flanges Equipped with GRADE 8 Screws						
							[Ft-Lb]			[N-m]			[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 5-32. 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 5-12. for double wrench method requirements.

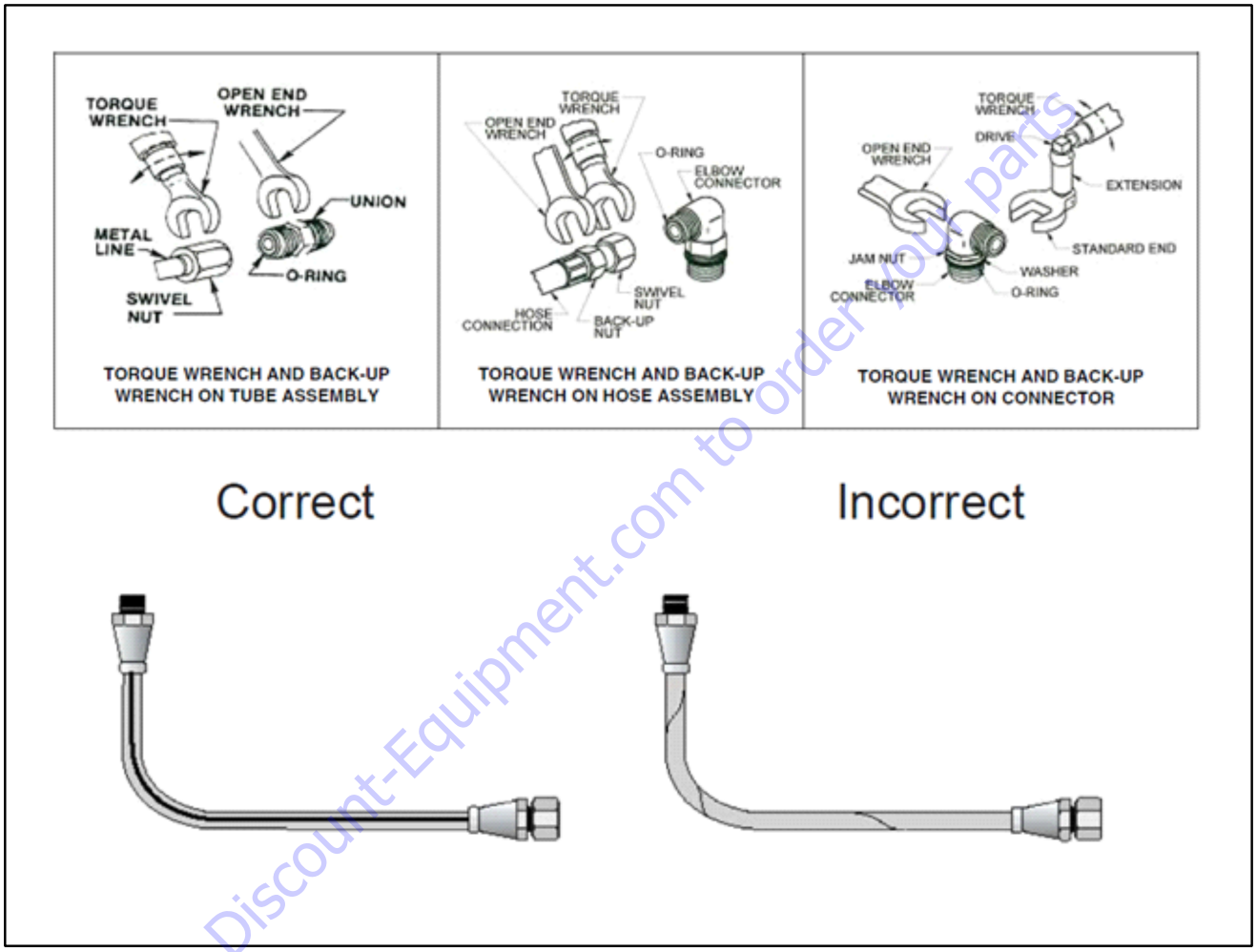


Figure 5-12. Double Wrench Method

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 5-13.
3. Use the double wrench method, turn the swivel nut to tighten as shown in Figure 5-13. 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 5-13.

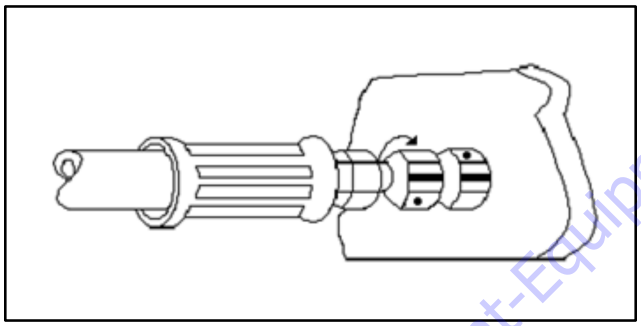


Figure 5-13. FFWR Method

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, 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.

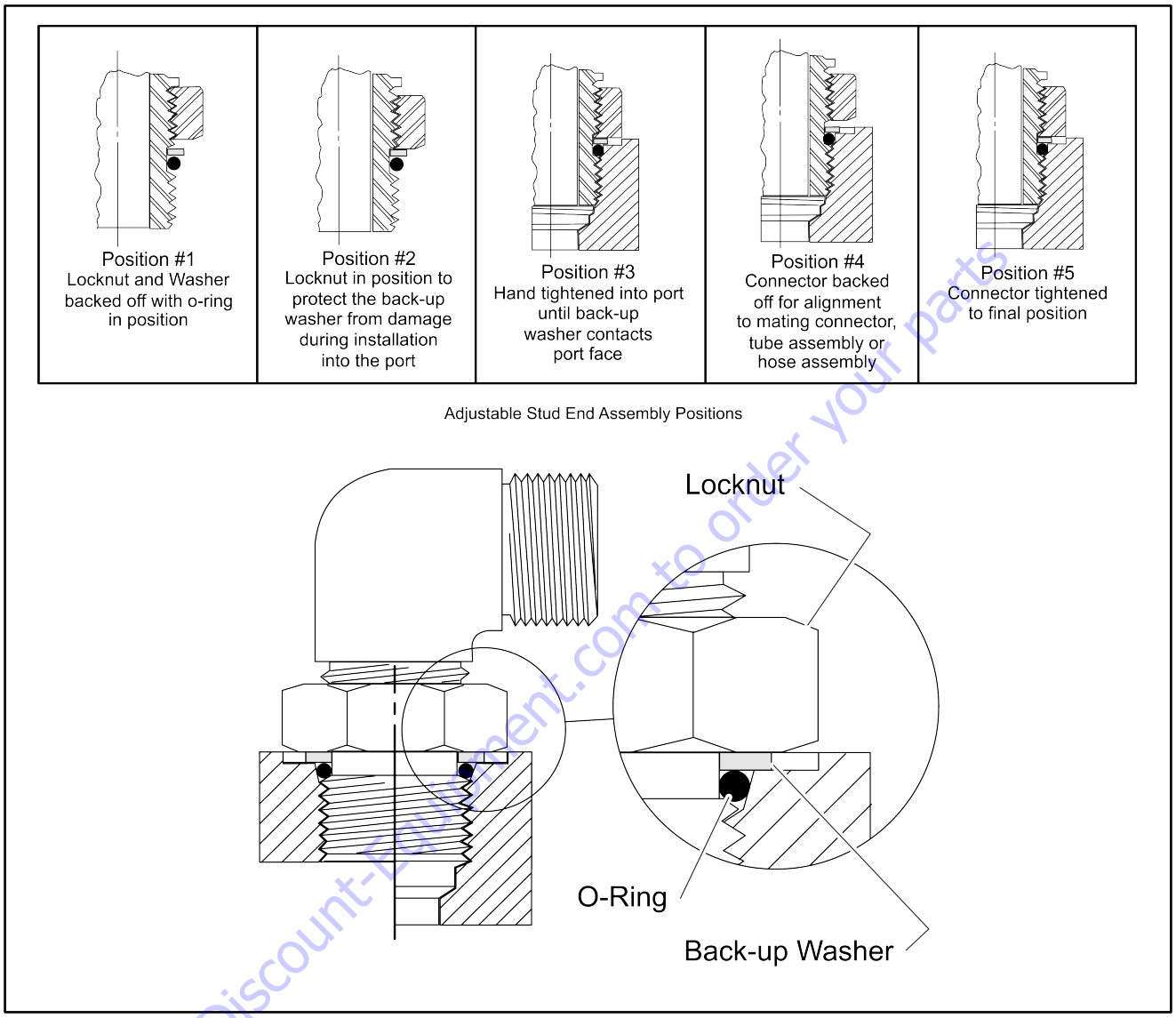


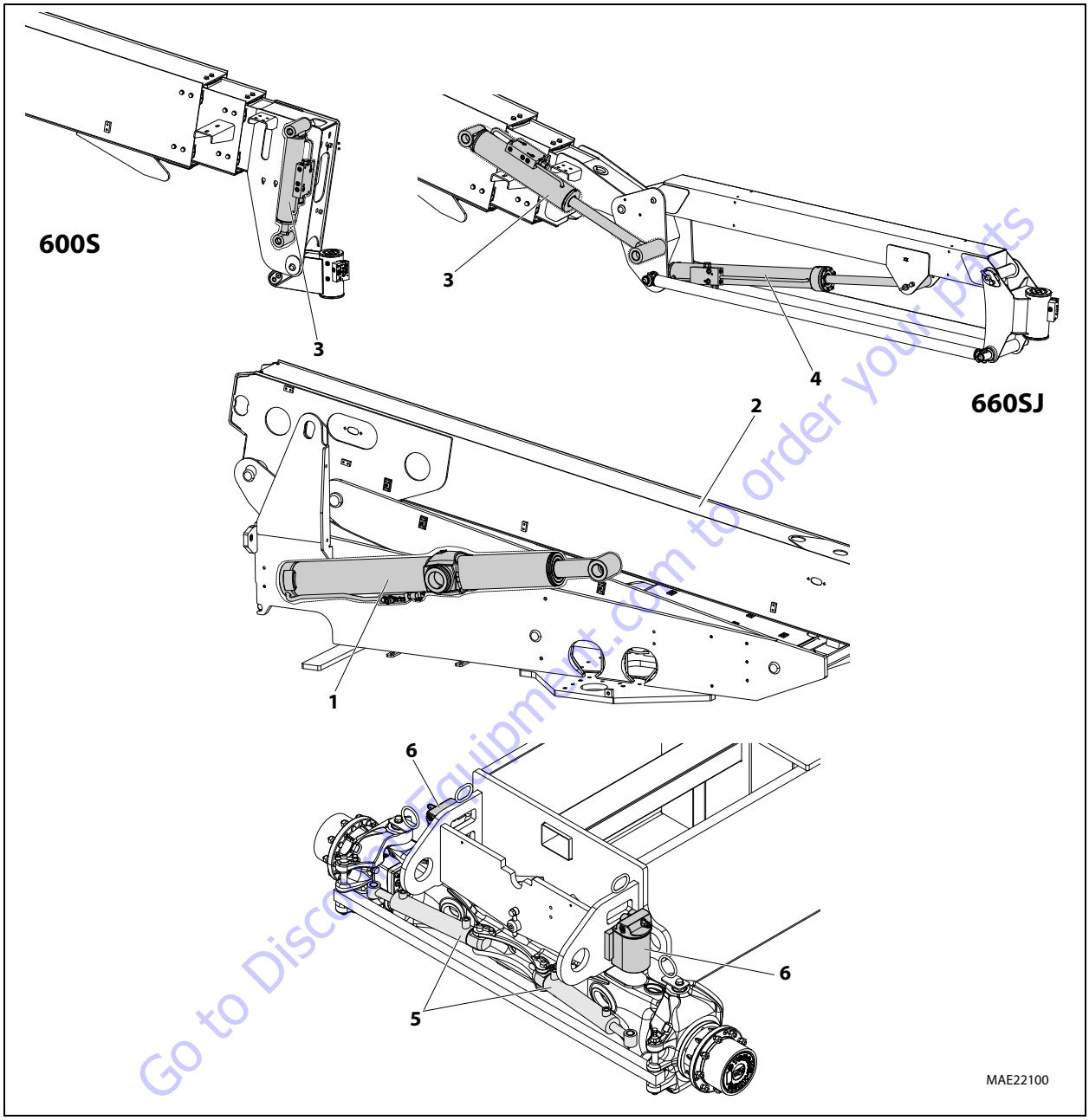
Figure 5-14. Adjustable Stud End Assembly

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.

5.3 HYDRAULIC CYLINDERS



1. Main Lift Cylinder
2. Telescope Cylinder
3. Platform Level Cylinder
4. Jib Lift Cylinder
5. Steer Cylinder
6. Axle Lockout Cylinder

Figure 5-15. Hydraulic Cylinder Locations

Main Lift Cylinder

DISASSEMBLY

NOTE: *Refer to Figure 5-19. Main Lift Cylinder.*

NOTICE

CONTAMINATION MAY DAMAGE EQUIPMENT. DISASSEMBLE CYLINDER ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

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

⚠ WARNING

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

2. Operate hydraulic power source and extend cylinder. Shut down and disconnect power source. Adequately support cylinder rod, if applicable.
3. If applicable, remove cartridge-type counterbalance valve and fittings from cylinder port block. Discard O-rings.
4. Place cylinder barrel in a suitable holding fixture. Tap around outside of cylinder head retainer with a suitable hammer to break thread-locking compound.

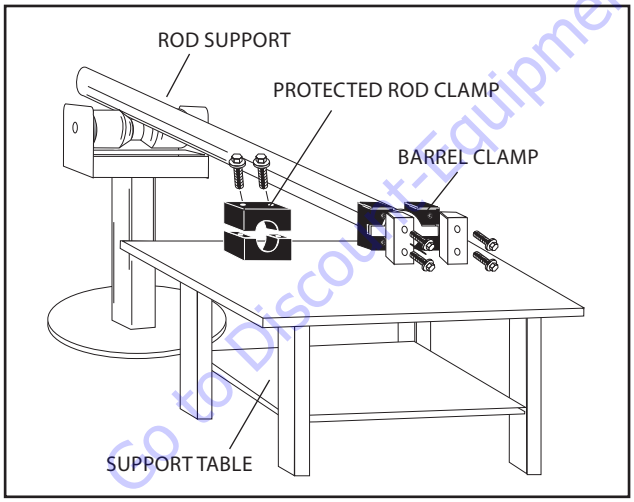


Figure 5-16. Cylinder Barrel Support

5. Unscrew cylinder head (5) with pin-face spanner wrench.

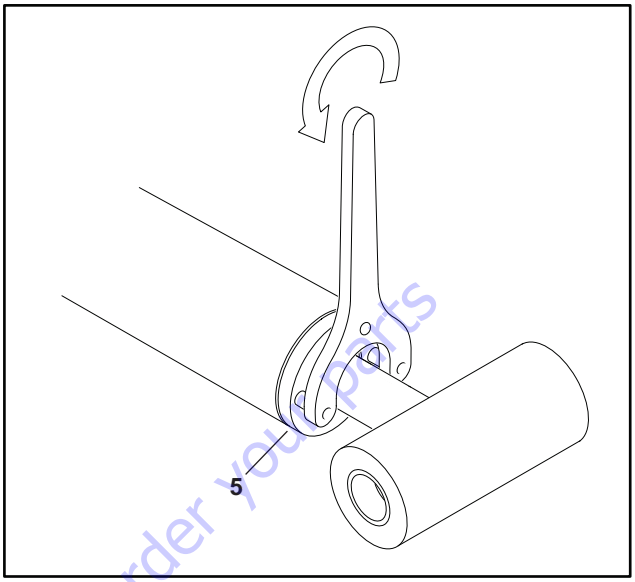


Figure 5-17. Cylinder Head Removal

NOTICE

PULLING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN REMOVING CYLINDER ROD, HEAD, AND PISTON.

6. Clamp barrel securely. Pull rod assembly and cylinder head from barrel.
7. Protect cylinder rod from damage and clamp in a vise or holding fixture as close to piston as possible.

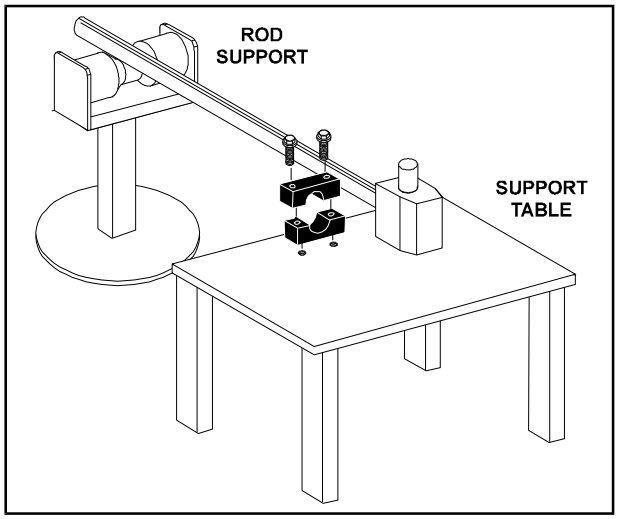
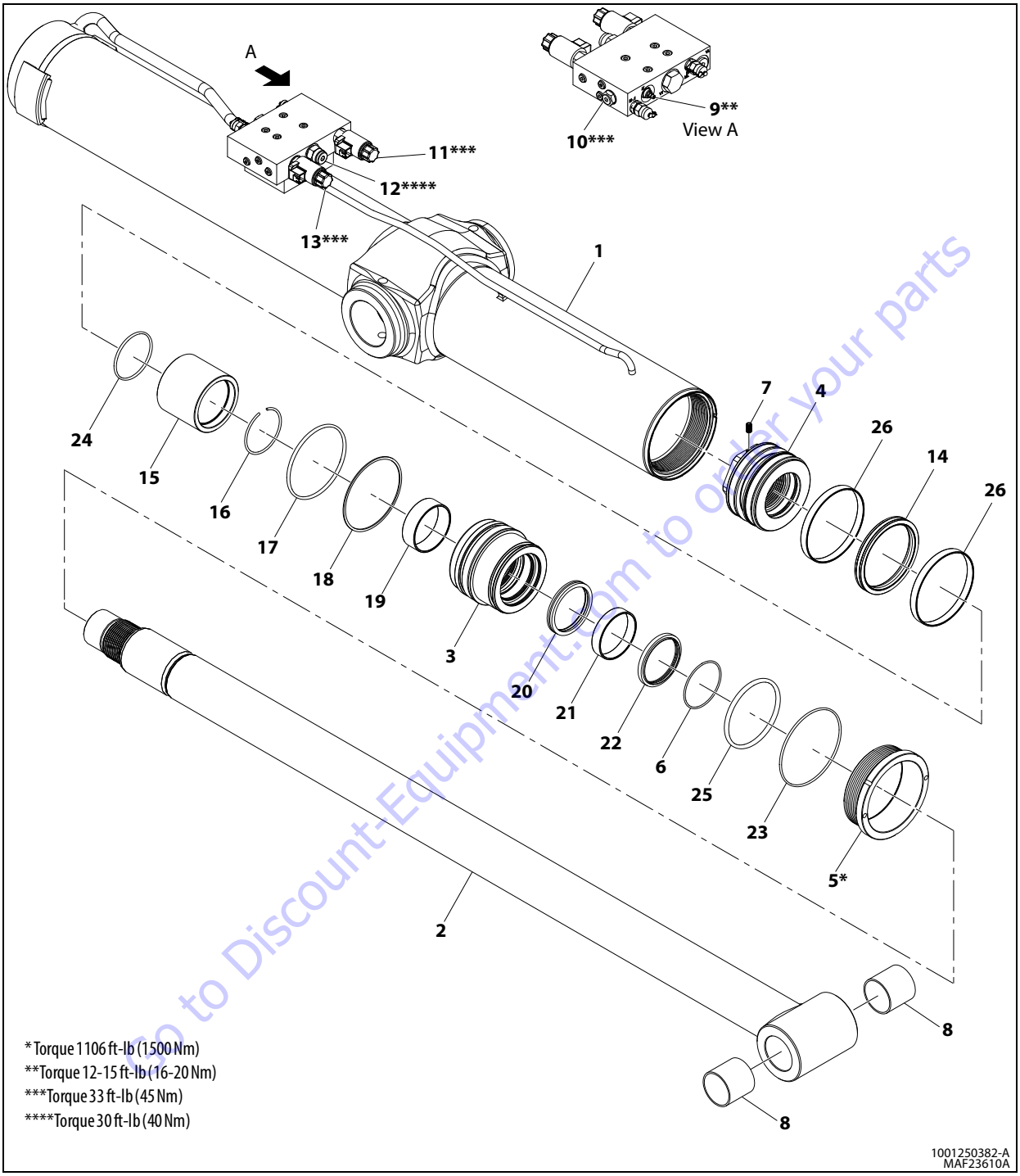


Figure 5-18. Cylinder Rod Support



1. Barrel	7. Setscrew	13. Solenoid Valve	19. Bearing Ring	25. O-Ring
2. Rod	8. Bushing	14. Seal	20. Seal	26. Bearing Ring
3. Head	9. Relief valve	15. Spacer	21. Bearing Ring	
4. Piston	10. Check Valve	16. Wire	22. Wiper	
5. Collar	11. Solenoid Valve	17. O-Ring	23. O-Ring	
6. Ring	12. Check valve	18. Backup Ring	24. O-Ring	

Figure 5-19. Main Lift Cylinder

NOTICE

REMOVE SEALS USING A BRASS OR PLASTIC PICK ONLY. DO NOT USE A KNIFE, SHARP OBJECT, OR SCREW DRIVER. NOTE SEAL ORIENTATION BEFORE REMOVING FOR PROPER INSTALLATION.

8. Loosen setscrew (7) in piston (4).
9. Screw piston counterclockwise and remove from rod.
10. Remove and discard O-ring (24), bearing rings (26) and seal (14).

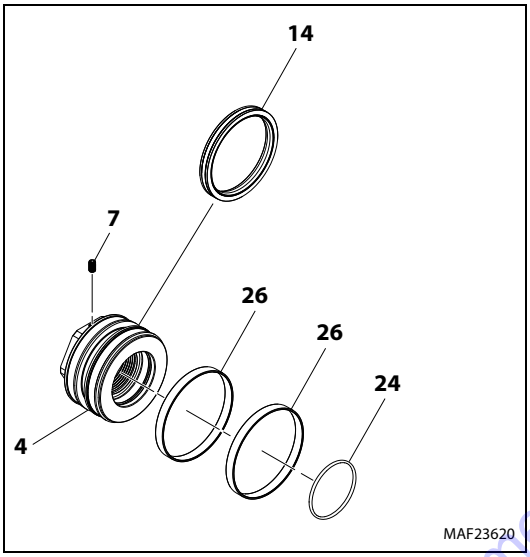


Figure 5-20. Piston Disassembly

11. Remove rod from holding fixture.
12. Remove cylinder head assembly (3) from rod (2).
13. Remove and discard O-ring (17), backup ring (18), and O-ring (25) from cylinder head.
14. Remove and discard retaining ring (16), wiper (22), bearing ring (19), rod seal (20), and ring (21) from cylinder head (3).

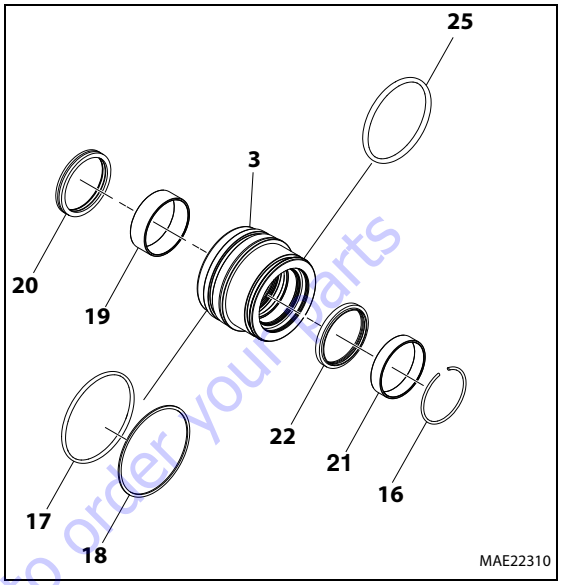


Figure 5-21. Cylinder Head Disassembly

CLEANING AND INSPECTION

1. Clean parts thoroughly with approved cleaning solvent.
2. Inspect cylinder rod for scoring, tapering, ovality, 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 ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage, scoring, or 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 surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage, and for ovality 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, damage, ovality, 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 the steel bushing with WD40 prior to bearing installation.

NOTE: *Lubrication is not required with nickel plated pins and bearings. Install pin in composite bushing dry.*

    d. Press composite bushing into barrel or rod bushing with correct size arbor.

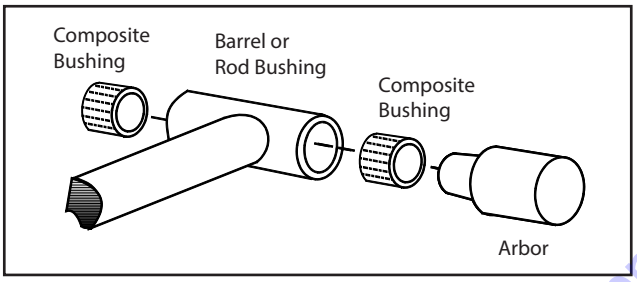


Figure 5-22. Composite Bushing Installation

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 oil ports for blockage or 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

NOTICE

INCORRECT SEAL INSTALLATION CAN CAUSE CYLINDER LEAKS AND IMPROPER CYLINDER OPERATION. ENSURE ALL PISTON SEALS ARE CORRECTLY INSTALLED. REFER TO CROSS SECTION ILLUSTRATIONS FOR CORRECT SEAL ORIENTATION.

NOTE: *Use proper cylinder seal kit for cylinder assembly. See your JLG Parts Manual.*

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

1. Support rod in holding fixture.
2. Install retaining ring (16), bearing ring (19), seal (20), and wiper (22) inside cylinder head (3).
3. Install O-ring (17), backup ring (18), and O-ring (19) on cylinder head.
4. Slide cylinder head assembly on rod (2) to rod end. Do not dislodge or damage seals.

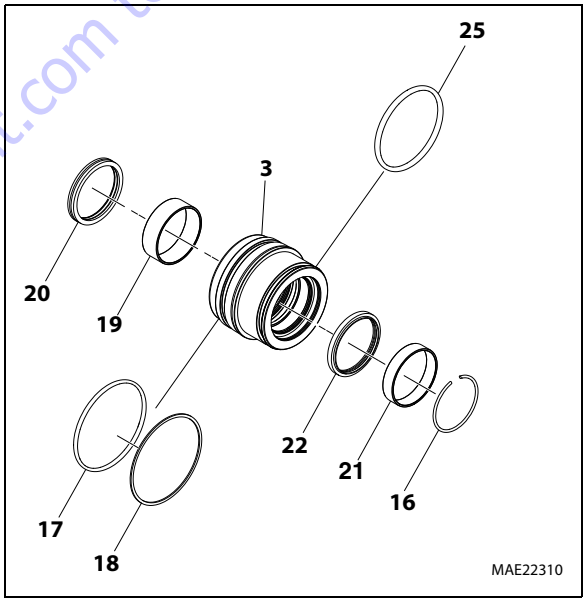


Figure 5-23. Cylinder Head Assembly

5. Install two seals (14) and O-rings (24) on piston.
6. Apply Medium Strength Threadlocking Compound to piston threads. Install piston on rod. Torque to 1475 ft-lb (2000 Nm).
7. Install setscrew (7).

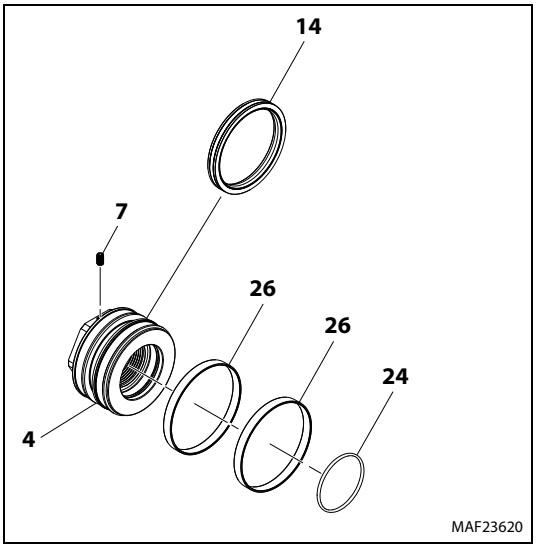


Figure 5-24. Piston Assembly

8. Carefully install piston on cylinder rod. Do not damage or dislodge O-ring and backup rings.

NOTICE

INSERTING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN INSTALLING CYLINDER ROD, HEAD, AND PISTON.

9. Clamp barrel clamped securely and support rod. Insert piston end into barrel cylinder. Do not damage or dislodge piston loading O-ring and seal ring.
10. Remove cylinder rod from holding fixture.
11. Place cylinder barrel in suitable holding fixture.
12. Apply anti-seize to cylinder head (5) threads. Screw in cylinder head. Torque to 1106 ft-lb (1500 Nm). Adjust cylinder head so screw hole is aligned between cylinder head and barrel. Secure cylinder head gland using washer ring and socket head bolts.

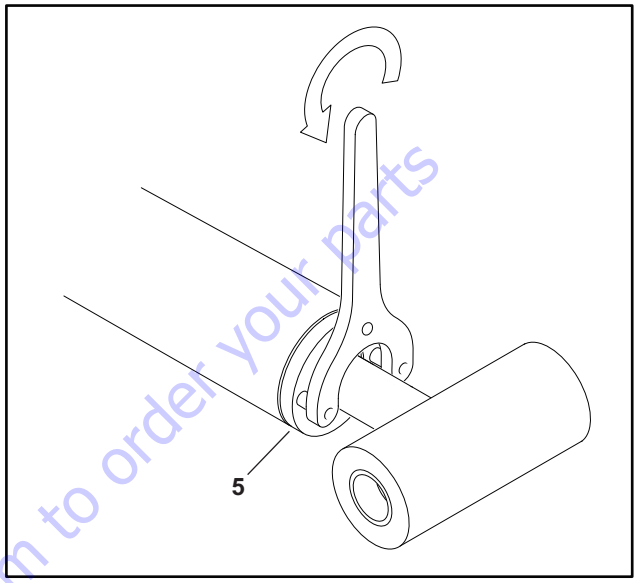


Figure 5-25. Cylinder Head Installation

Telescope Cylinder

DISASSEMBLY

NOTE: *Refer to Figure 5-29. Telescope Cylinder.*

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.

NOTICE

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. Remove the check valves, counterbalance valves, and relief valve from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

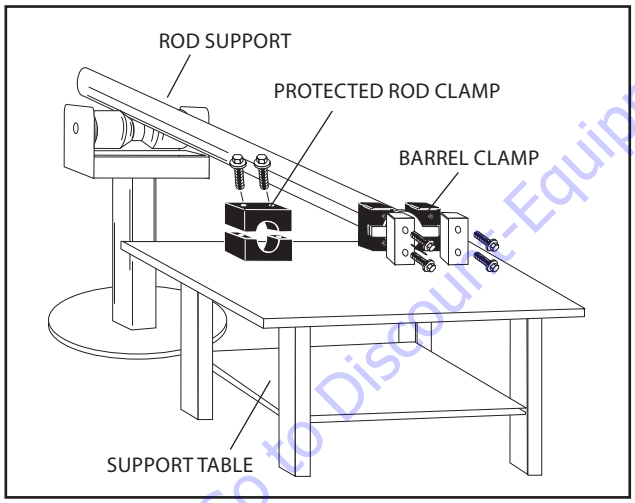


Figure 5-26. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an Allen wrench, loosen the cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

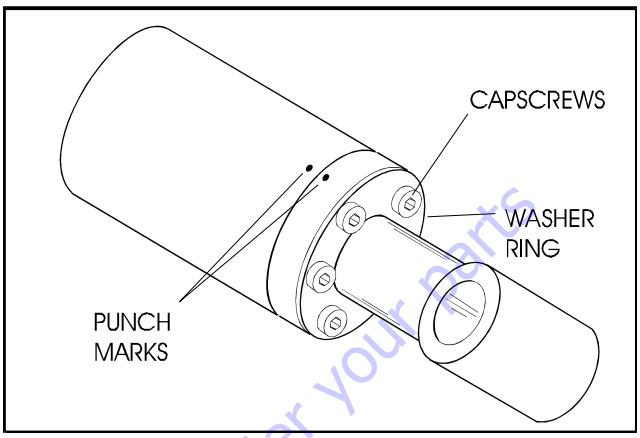


Figure 5-27. Capscrew Removal

6. Attach a suitable pulling device to the cylinder rod end.

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.

7. With the barrel clamped securely, carefully withdraw the complete rod assembly from the cylinder barrel.

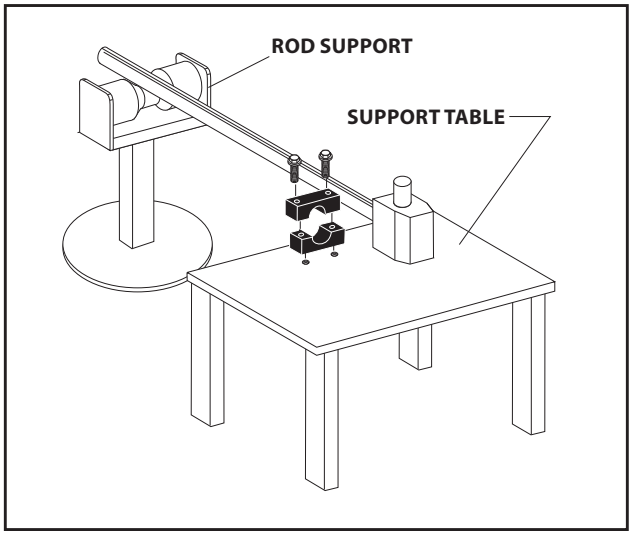
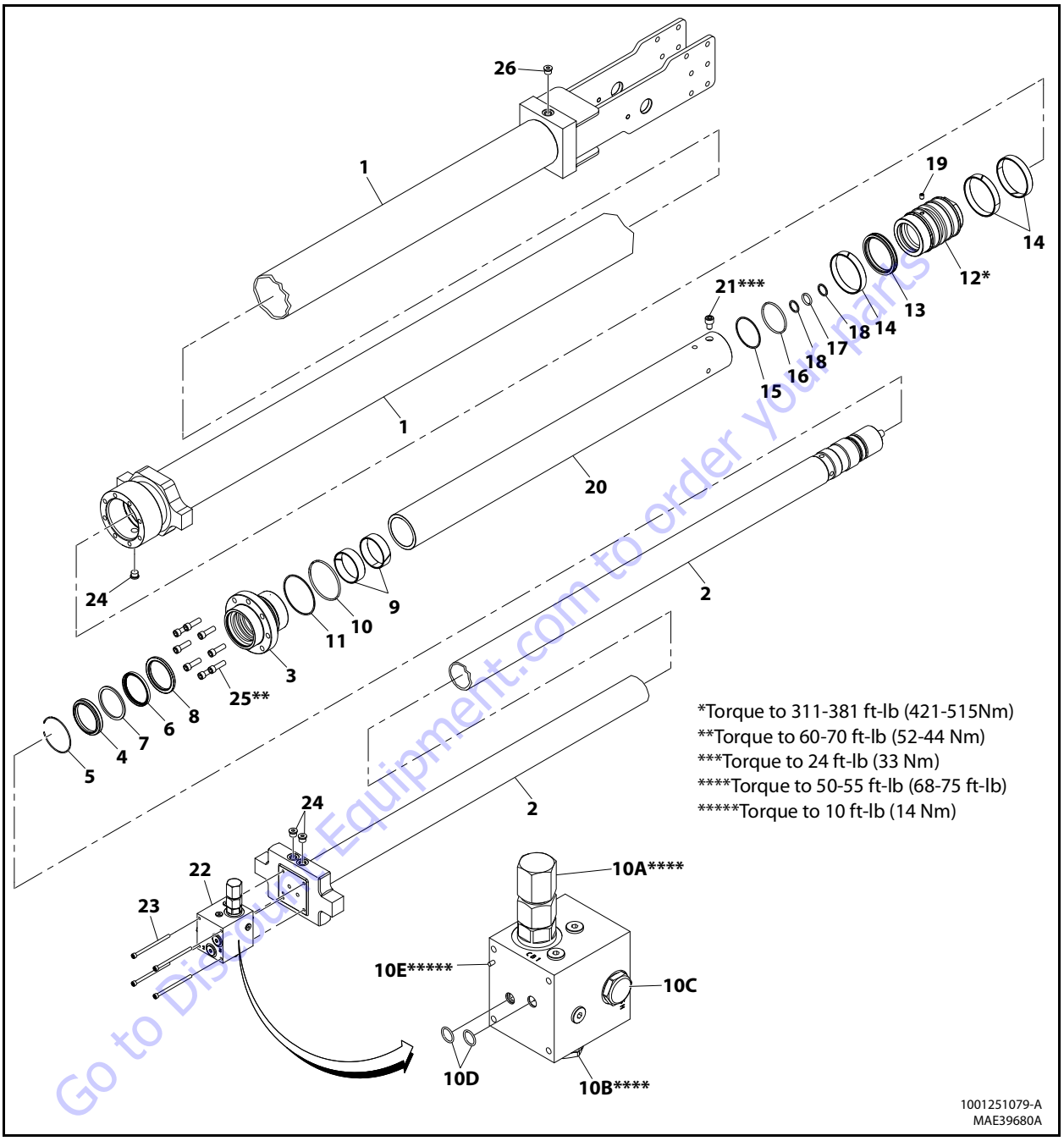


Figure 5-28. Cylinder Rod Support

8. Protect cylinder rod from damage and clamp in a vise or holding fixture as close to piston as possible.



1. Barrel
2. Rod
3. Head
4. Wiper Seal
5. Retaining Ring
6. Rod Seal
7. Backup Ring
8. Buffer Ring
9. Wear Ring
10. O-ring
10A. Cartridge
10B. Cartridge
10C. Cartridge
10D. Seal
10E. Roll Pin
11. Backup Ring
12. Piston
13. Piston Seal
14. Wear Ring
15. O-ring
16. Backup Ring
17. O-ring
18. Backup Ring
19. Setscrew
20. Spacer
21. Capscrew
22. Valve Assembly
23. Capscrew
24. Plug
25. Capscrew
26. Plug

Figure 5-29. Telescope Cylinder

9. Loosen and remove the setscrew (19) which is attached to the piston assembly.
10. Screw the piston (12) counterclockwise and remove the piston from cylinder rod (2).
11. Remove and discard o-ring (15) and backup ring (16) from inside of piston (12).
12. Remove and discard o-ring (17) and backup ring (18) from inside of piston (12).
13. Remove and discard piston seal (13) and wear ring (14) from outside grooves of piston (12).

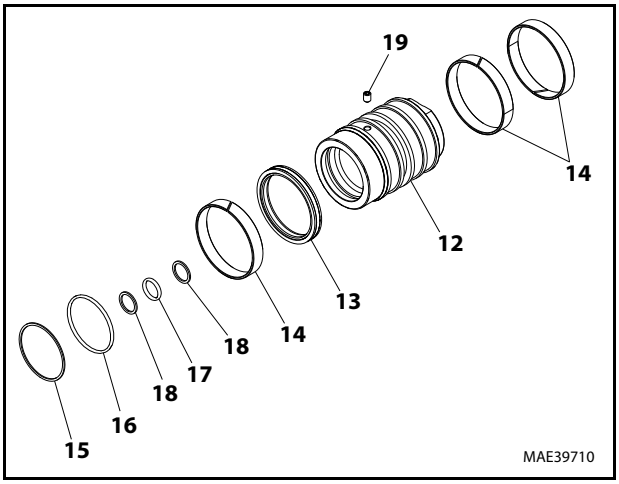


Figure 5-30. Piston Disassembly

14. Remove spacer (20) from rod (2).
15. Remove rod from holding fixture. Remove cylinder head gland.
16. Remove and discard wear ring (9) and wiper (4) from inside of cylinder head (3).
17. Remove and discard retaining ring (5), rod seal (6), backup ring (7) and buffer ring (8) from inside of cylinder head (3).
18. Remove and discard o-ring (10) and backup ring (11) from outside of cylinder head (3).

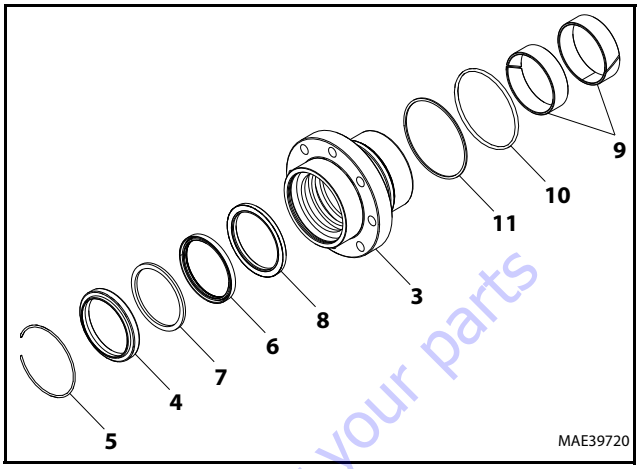


Figure 5-31. Cylinder Head Disassembly

CLEANING AND INSPECTION

1. Clean parts thoroughly with approved cleaning solvent.
2. Inspect cylinder rod for scoring, tapering, ovality, 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 ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage, scoring, or 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 surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage, and for ovality 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, damage, ovality, and tapering. Replace as necessary.

13. 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 the steel bushing with WD40 prior to bearing installation.

NOTE: *Lubrication is not required with nickel plated pins and bearings. Install pin in composite bushing dry.*

    d. Press bushing into barrel or rod bushing with correct size arbor.

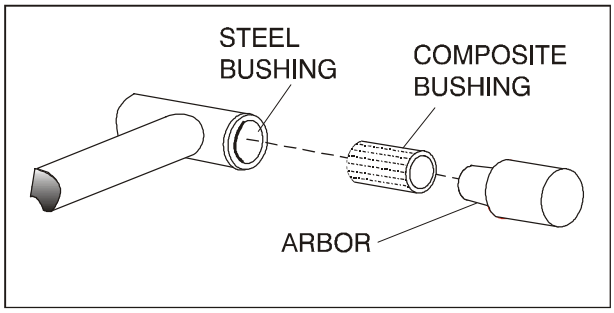


Figure 5-32. Bushing Installation

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

ASSEMBLY

NOTE: *Use proper cylinder seal kit for cylinder assembly. See your JLG Parts Manual.*

NOTE: *Apply a light film of hydraulic oil to all components before assembly.*

NOTICE

IMPROPER SEAL INSTALLATION CAN CAUSE CYLINDER LEAKS AND IMPROPER CYLINDER OPERATION.

1. Support rod in holding fixture.
2. Install rod seal (6), backup ring (7) and buffer ring (8) inside the cylinder head (3).
3. Install wear ring (9), wiper (4) and retaining ring (5) inside the cylinder head (3).
4. Install o-ring (10) and backup ring(11) on outside grooves of the cylinder head (3).

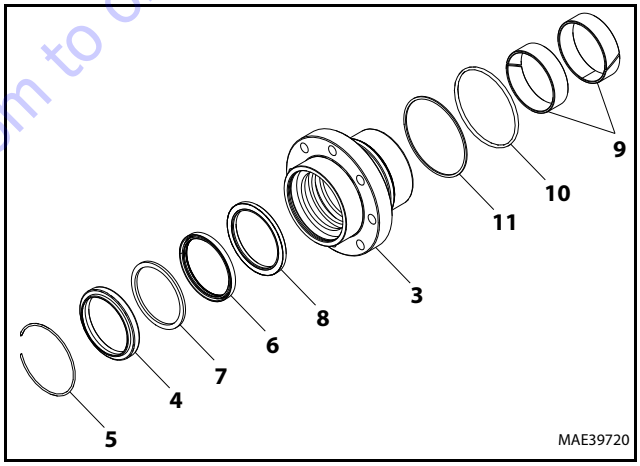


Figure 5-33. Cylinder Head Assembly

5. Slide cylinder head assembly on rod (2) to rod end. Do not dislodge or damage seals.
6. Carefully slide the spacer (20) onto rod (2).
7. Install o-ring (15) and backup ring (16) inside the piston (12).
8. Install o-ring (17) and backup ring (18) inside the piston (12).
9. Install Piston seal (13) and wear ring (14) on outside grooves of the piston (12).

10. Using suitable protection, clamp cylinder rod (2) in a vise or similar holding fixture as close to piston as possible.
11. Carefully thread piston (12) on cylinder rod (2) hand tight. Do not damaged or dislodge O-ring and backup rings.
12. Install setscrew (19) on the piston (12) and attach piston (12) to the rod (2).

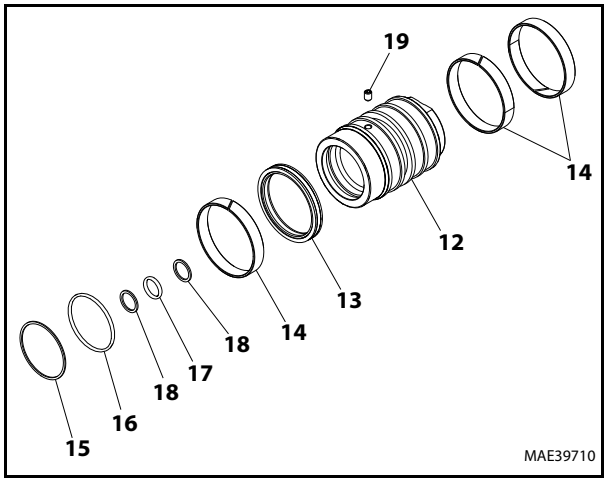


Figure 5-34. Piston Assembly

13. Position cylinder barrel (1) in a suitable holding fixture.

NOTICE

INSERTING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN INSTALLING CYLINDER ROD, HEAD, AND PISTON.

14. Continue pushing rod in barrel until cylinder head (3) can be inserted into the barrel.
15. Secure the cylinder head gland using the washer ring and socket head bolts.
16. 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.
17. Install the valve assembly, counterbalance valve if applicable.

Platform Level Cylinder

DISASSEMBLY

NOTE: *Refer to Figure 5-38. Platform Level Cylinder - 600S and Figure 5-39. Platform Level Cylinder - 660SJ.*

NOTICE

CONTAMINATION MAY DAMAGE EQUIPMENT. DISASSEMBLE CYLINDER ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

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

⚠ WARNING

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

2. Operate hydraulic power source and extend cylinder. Shut down and disconnect power source. Adequately support cylinder rod, if applicable.
3. If applicable, remove cartridge-type counterbalance valve and fittings from cylinder port block. Discard O-rings.
4. Place cylinder barrel in a suitable holding fixture. Tap around outside of cylinder head retainer with a suitable hammer to break thread-locking compound.

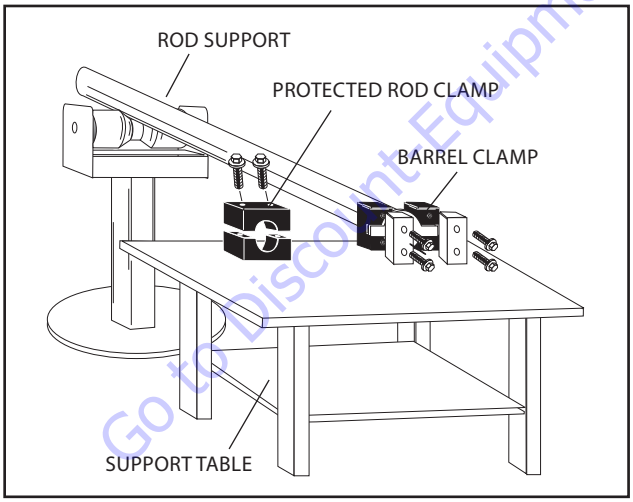


Figure 5-35. Cylinder Barrel Support

5. Unscrew cylinder head with hook spanner wrench.

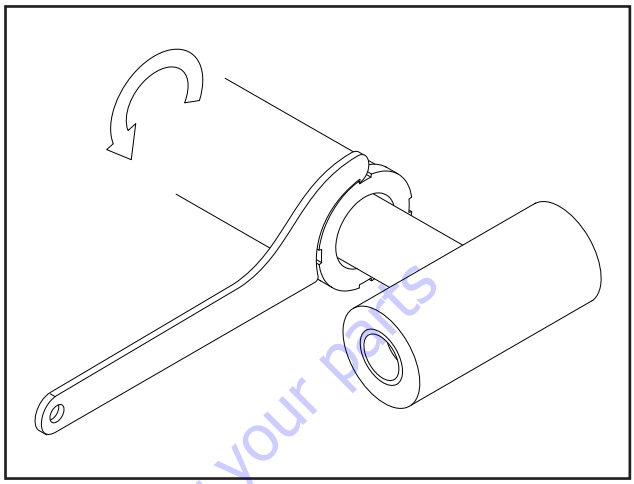


Figure 5-36. Marking Cylinder for Alignment

NOTICE

PULLING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN REMOVING CYLINDER ROD, HEAD, AND PISTON.

6. Clamp barrel securely. Pull rod assembly and cylinder head from barrel.
7. Protect cylinder rod from damage and clamp in a vise or holding fixture as close to piston as possible.

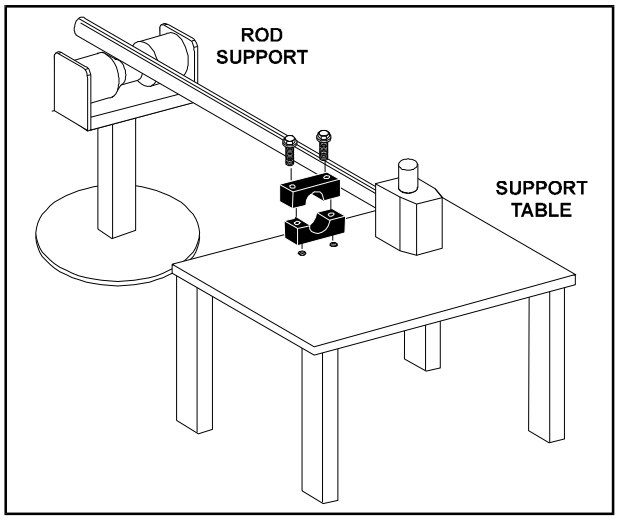
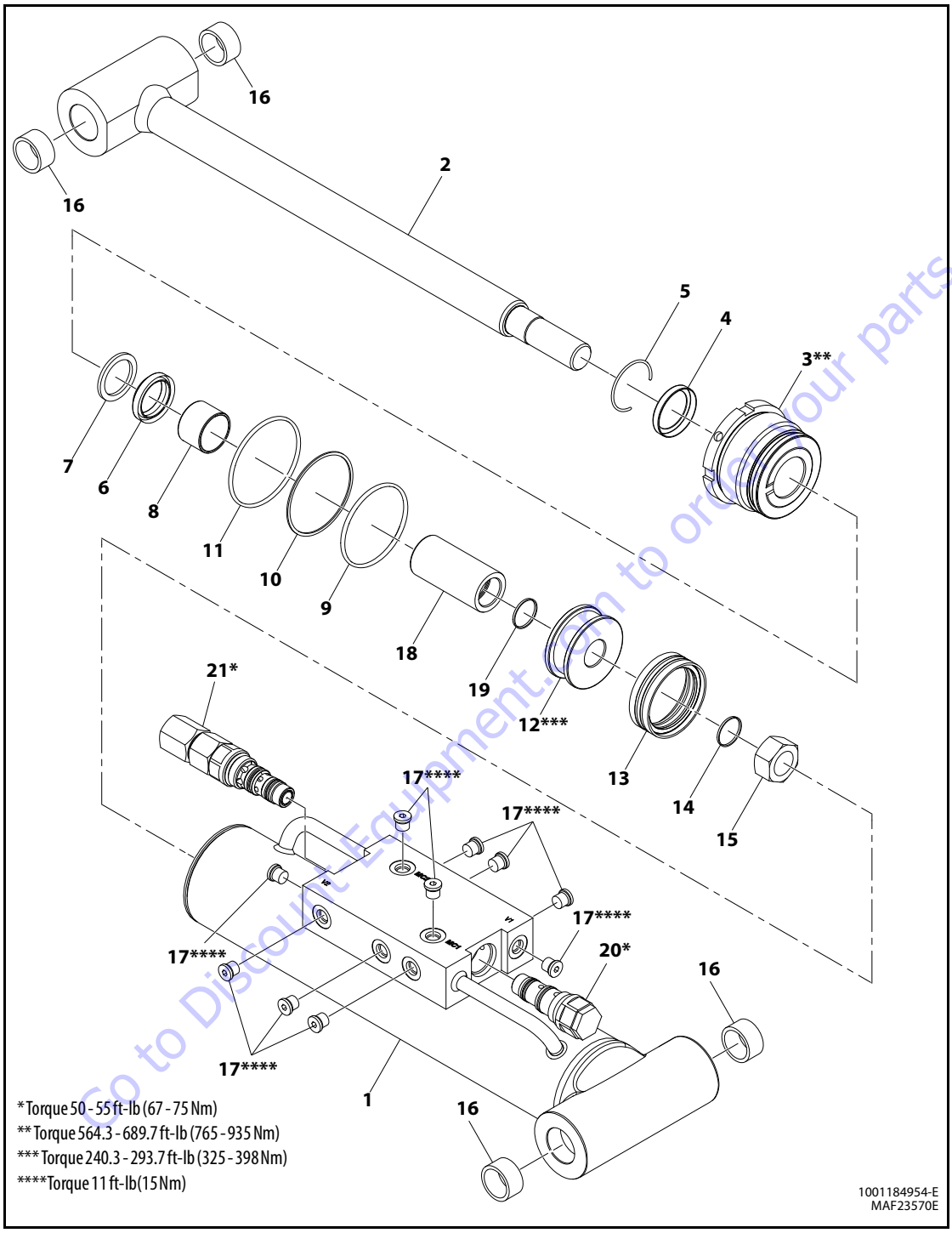
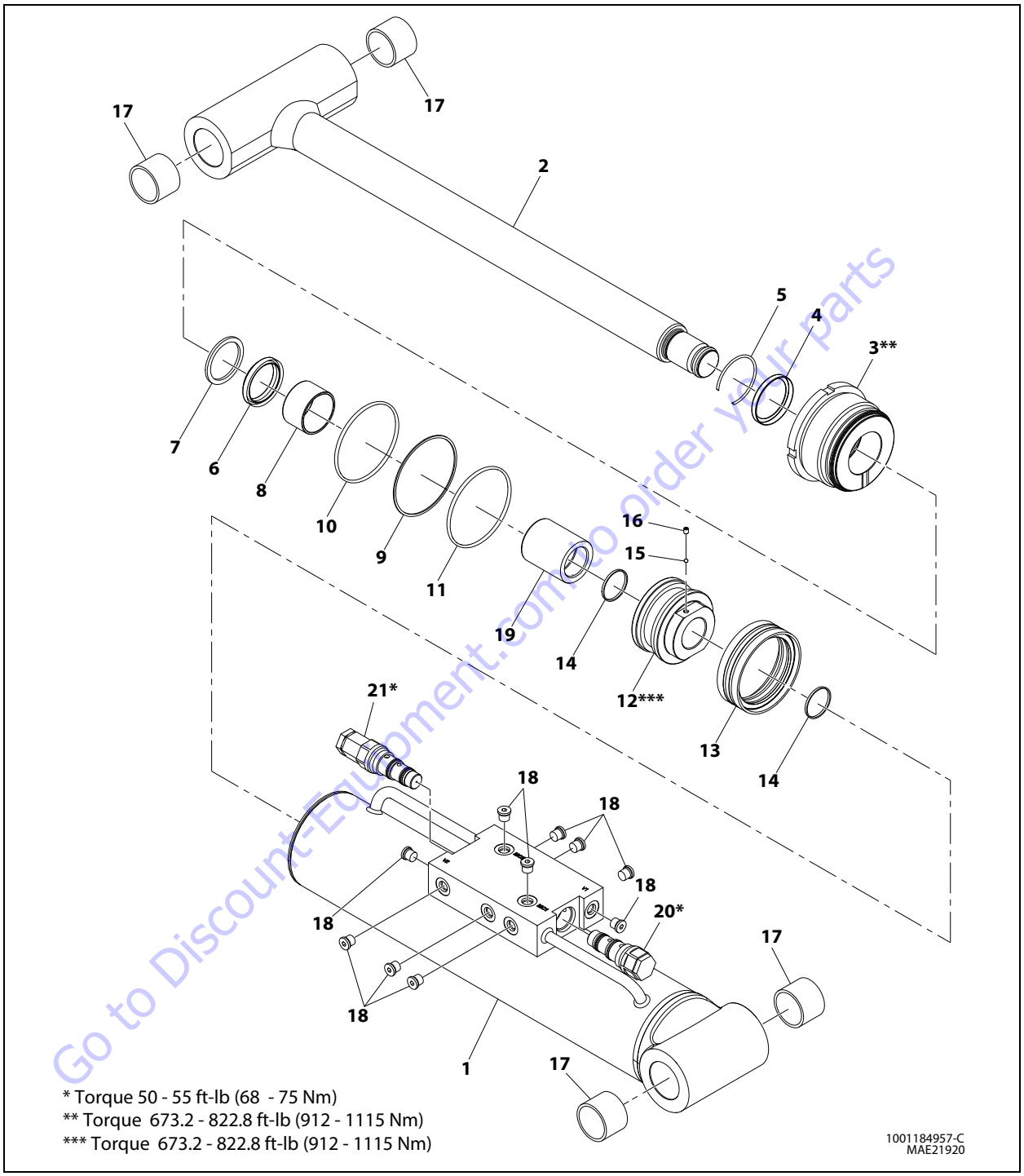


Figure 5-37. Cylinder Rod Support



1. Barrel
2. Rod
3. Head
4. Wiper
5. Retaining Ring
6. Rod Seal
7. Backup Ring
8. Bearing
9. O-Ring
10. Backup Ring
11. O-Ring
12. Piston
13. Piston Seal
14. O-Ring
15. Nut
16. Bearing
17. Plug
18. Spacer
19. O-Ring
20. Counterbalance Valve
21. Counterbalance Valve

Figure 5-38. Platform Level Cylinder - 600S



1. Barrel
2. Rod
3. Head
4. Wiper
5. Retaining Ring
6. Rod Seal
7. Backup Ring
8. Bearing
9. O-Ring
10. Backup Ring
11. O-Ring
12. Piston
13. Piston Seal
14. O-Ring
15. Ball
16. Setscrew
17. Bearing
18. Plug
19. Spacer
20. Counterbalance Valve
21. Counterbalance Valve

Figure 5-39. Platform Level Cylinder - 660SJ

8. Loosen setscrew (16) retaining ball (15) in piston (12).
9. Screw piston counterclockwise and remove from rod.
10. Remove and discard O-ring (14) and seal (13).

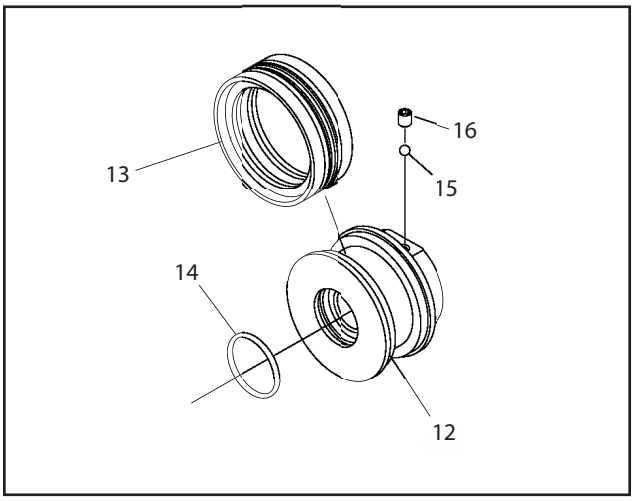


Figure 5-40. Piston Disassembly

11. Remove rod from holding fixture.
12. Remove cylinder head assembly (3) from rod (2).
13. Remove and discard O-ring (9), backup ring (10), and O-ring (11) from cylinder head.
14. Remove and discard retaining ring (5), wiper (4), dry bearing (8), rod seal (7), and backup ring (6) from cylinder head (3).

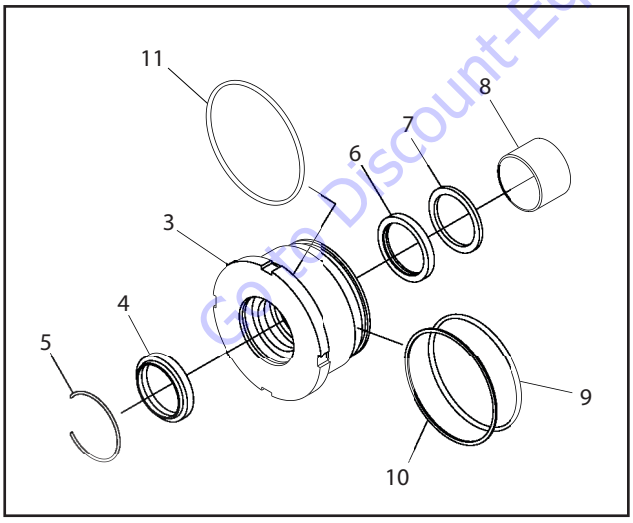


Figure 5-41. Cylinder Head Disassembly

CLEANING AND INSPECTION

1. Clean parts thoroughly with approved cleaning solvent.
2. Inspect cylinder rod for scoring, tapering, ovality, 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 ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage, scoring, or 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 surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage, and for ovality 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, damage, ovality, 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 the steel bushing with WD40 prior to bearing installation.

NOTE: *Lubrication is not required with nickel plated pins and bearings. Install pin in composite bushing dry.*

    d. Press composite bushing into barrel or rod bushing with correct size arbor.

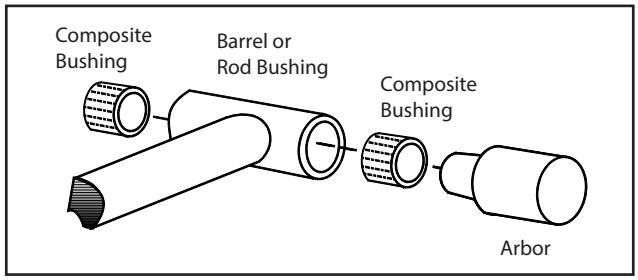


Figure 5-42. Composite Bushing Installation

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 oil ports for blockage or 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

NOTICE

INCORRECT SEAL INSTALLATION CAN CAUSE CYLINDER LEAKS AND IMPROPER CYLINDER OPERATION. ENSURE ALL PISTON SEALS ARE CORRECTLY INSTALLED. REFER TO CROSS SECTION ILLUSTRATIONS FOR CORRECT SEAL ORIENTATION.

NOTE: *Use correct cylinder seal kit for cylinder assembly. See your JLG Parts Manual.*

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

1. Support rod in holding fixture.
2. Install backup ring (6), rod seal (7), and dry bearing (8) in cylinder head (3).
3. Install wiper (4) and retaining ring (5) in cylinder head.
4. Install O-ring (11) on cylinder head.
5. Install backup ring (10) and O-ring (9) on cylinder head.
6. Slide cylinder head assembly on rod (2) to rod end. Do not dislodge or damage seals.

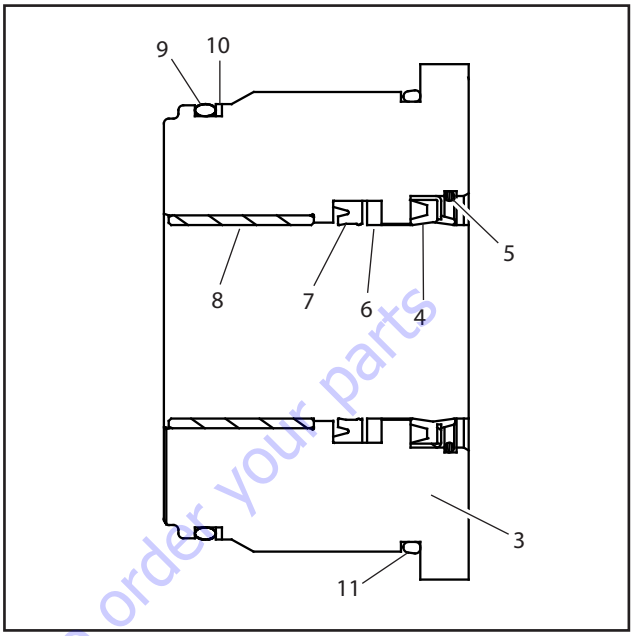


Figure 5-43. Cylinder Head Seal Installation

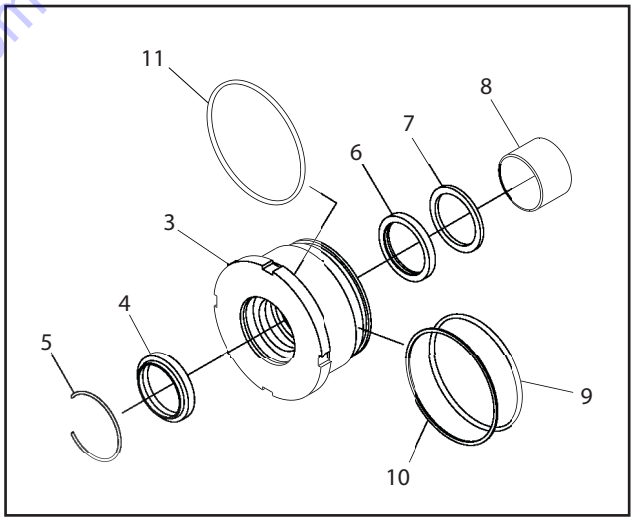


Figure 5-44. Cylinder Head Assembly

7. Install O-ring (14) in piston (12).
8. Install seal (16) on piston.
9. Apply Medium Strength Threadlocking Compound to piston threads. Install piston on rod.
10. Install ball (15) and setscrew (16).

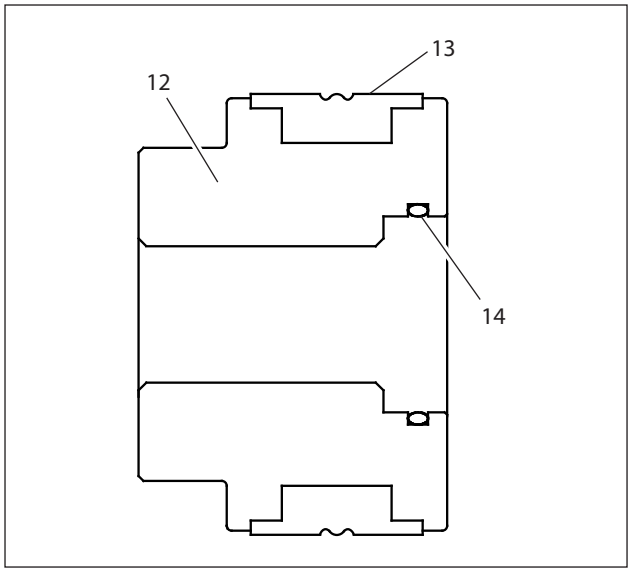


Figure 5-45. Piston Seal Installation

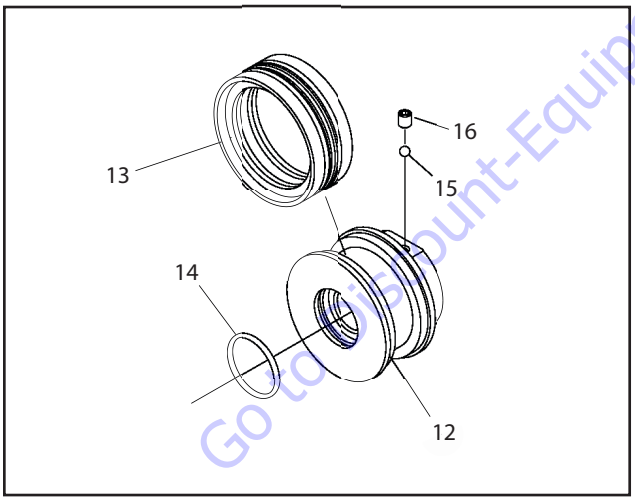


Figure 5-46. Piston Assembly

11. Position cylinder barrel in a suitable holding fixture.

NOTICE

INSERTING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN INSTALLING CYLINDER ROD, HEAD, AND PISTON.

12. Clamp barrel securely and support rod. Insert piston end into barrel cylinder. Do not damage or dislodge seal.
13. Remove cylinder rod from holding fixture.
14. Place cylinder barrel in suitable holding fixture.

NOTICE

INSERTING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN INSTALLING CYLINDER ROD, HEAD, AND PISTON.

15. Clamp barrel securely and support rod. Insert piston end into barrel cylinder. Do not damage or dislodge piston O-rings and backup ring.
16. Continue pushing rod into barrel. Screw in cylinder head.

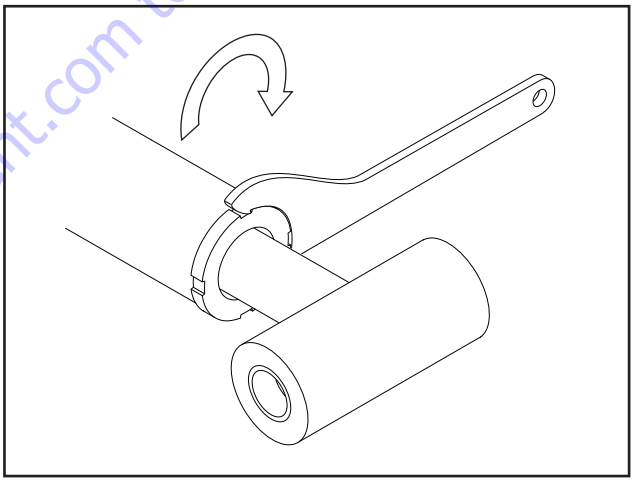


Figure 5-47. Cylinder Head Installation

Jib Lift Cylinder (660SJ Only)

DISASSEMBLY

NOTE: *Refer to Figure 5-51. Jib Lift Cylinder (660SJ).*

NOTICE

CCONTAMINATION MAY DAMAGE EQUIPMENT. DISASSEMBLE CYLINDER ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

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

⚠ WARNING

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

2. Operate hydraulic power source and extend cylinder. Shut down and disconnect power source. Adequately support cylinder rod, if applicable.
3. If applicable, remove cartridge-type counterbalance valve and fittings from cylinder port block. Discard O-rings.
4. Place cylinder barrel in a suitable holding fixture. Tap around outside of cylinder head retainer with a suitable hammer to break thread-locking compound.

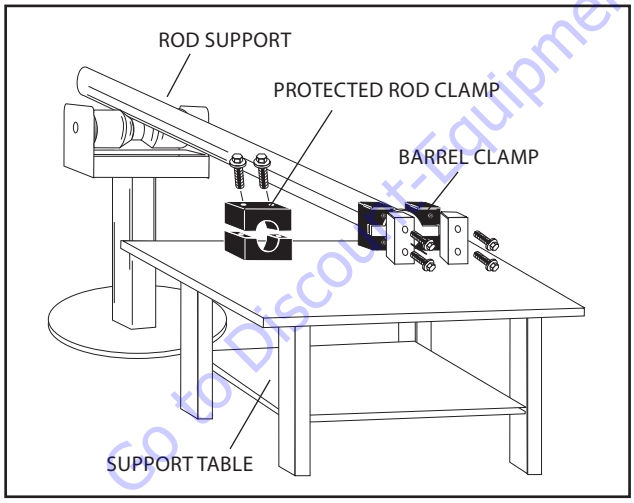


Figure 5-48. Cylinder Barrel Support

5. Mark cylinder head (1) and barrel (2) with center punch marks (3) for later realignment. Remove eight cylinder head capscrews (4).

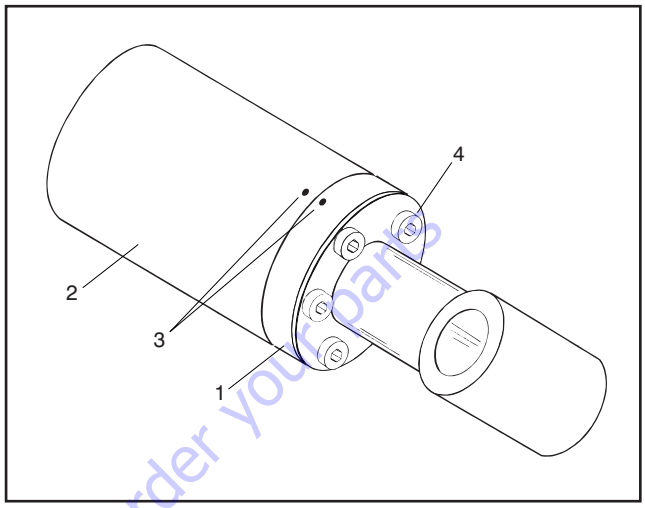


Figure 5-49. Marking Cylinder for Alignment

NOTICE

PULLING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN REMOVING CYLINDER ROD, HEAD, AND PISTON.

6. Clamp barrel securely. Pull rod assembly and cylinder head from barrel.
7. Protect cylinder rod from damage and clamp in a vise or holding fixture as close to piston as possible.

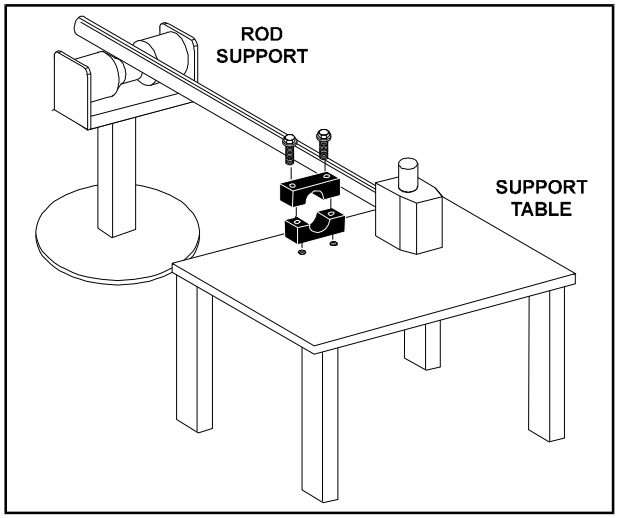
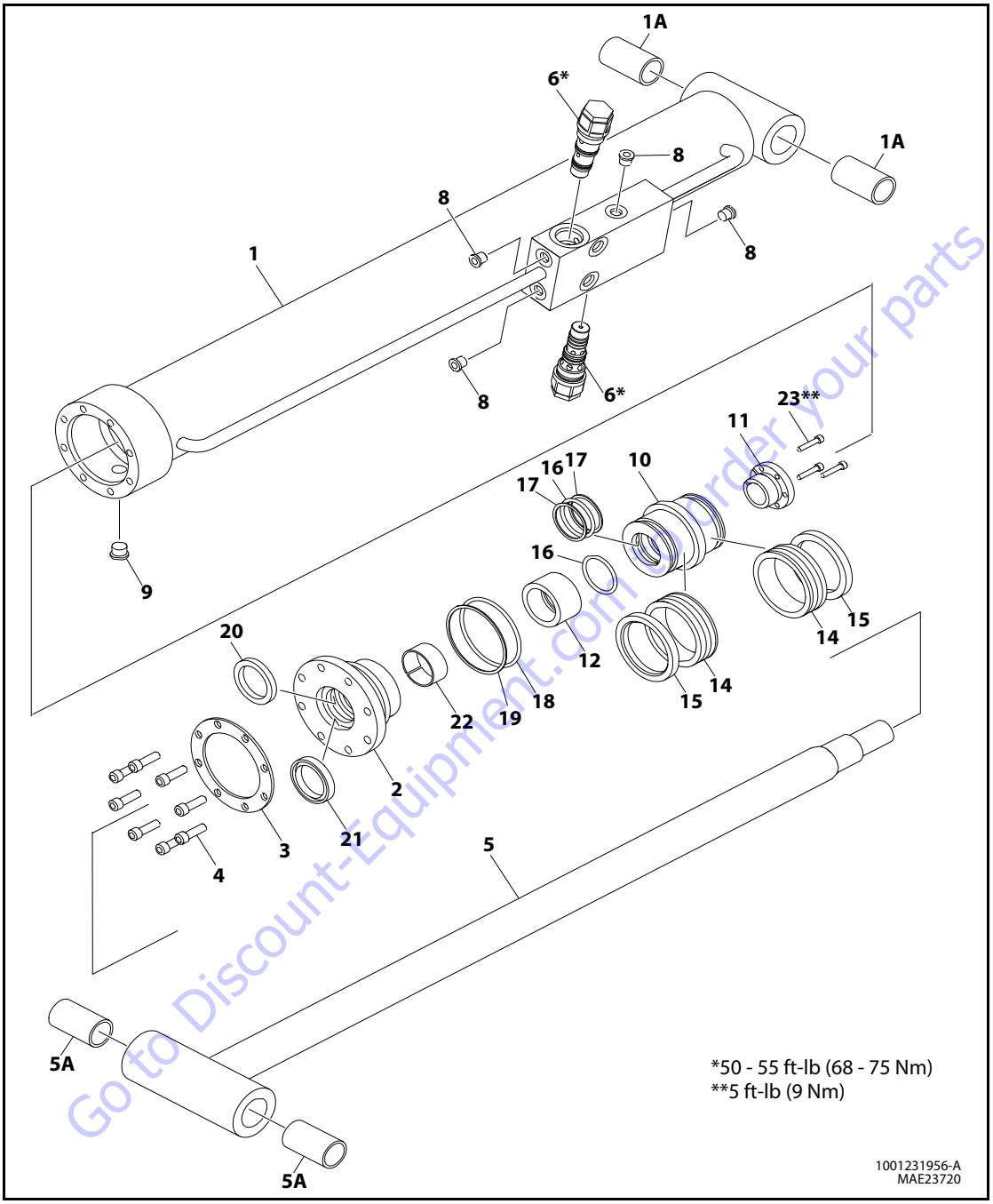


Figure 5-50. Cylinder Rod Support



1.	Barrel	5.	Rod	9.	O-Ring Plug	14.	Seal	19.	Wiper
1A.	Bushing	5A.	Bushing	10.	Piston	15.	Lock Ring	20.	Wear Ring
2.	Head	6.	Cartridge Valve	11.	Tapered Bushing	16.	O-Ring	21.	Wiper
3.	Ring Washer	7.	Not Used	12.	Spacer	17.	Back Up Ring	22.	Wear Ring
4.	Capscrew	8.	O-Ring Plug	13.	Not Used	18.	Rod Seal	23.	Bolt

Figure 5-51. Jib Lift Cylinder (660SJ)

8. Using suitable protection, clamp cylinder rod in a vise or similar holding fixture as close to piston as possible.
9. Loosen and remove nut attaching piston to rod. Remove piston.
10. Loosen and remove capscrew(s), if applicable, attaching tapered bushing to piston.
11. Insert capscrew(s) in threaded holes in outer piece of tapered bushing. Progressively tighten capscrew(s) until bushing is loose on piston.
12. Remove tapered bushing from piston.
13. Screw piston counterclockwise by hand and remove from cylinder rod.

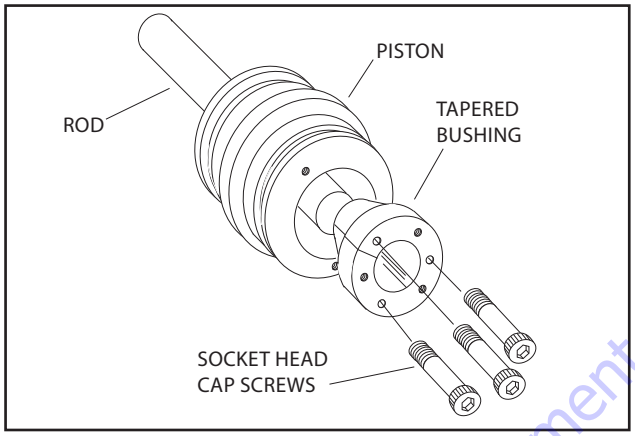


Figure 5-52. Tapered Bushing Removal

14. Remove and discard piston O-rings, seal rings, and backup rings.
15. Remove piston spacer, if applicable, from rod.
16. Remove rod from holding fixture. Remove cylinder head gland and retainer plate, if applicable. Discard O-rings, backup rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean parts thoroughly with approved cleaning solvent.
2. Inspect cylinder rod for scoring, tapering, ovality, 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 ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage, scoring, or 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 surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage, and for ovality 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, damage, ovality, 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 the steel bushing with WD40 prior to bearing installation.

NOTE: *Lubrication is not required with nickel plated pins and bearings. Install pin in composite bushing dry.*

    d. Press composite bushing into barrel or rod bushing with correct size arbor.

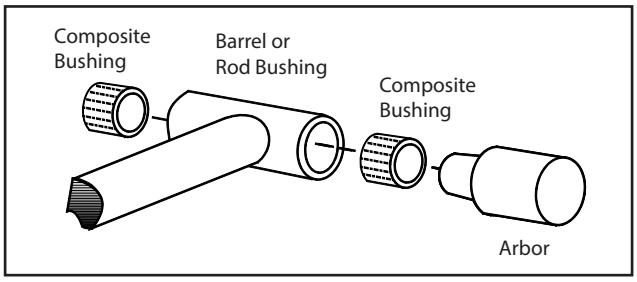


Figure 5-53. Composite Bushing Installation

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 oil ports for blockage or 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: *Use proper cylinder seal kit for cylinder assembly. See your JLG Parts Manual.*

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

1. Use seal tool to install new rod seal into applicable cylinder head gland groove.

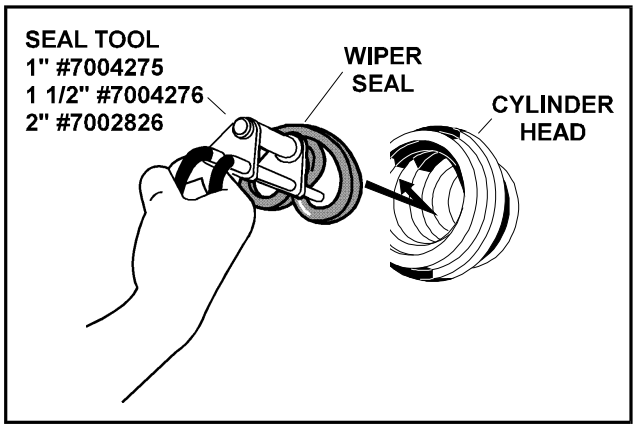


Figure 5-54. Rod Seal Installation

NOTICE

IMPROPER SEAL INSTALLATION CAN CAUSE CYLINDER LEAKS AND IMPROPER CYLINDER OPERATION. ENSURE 'POLY-PAK' PISTON SEALS ARE PROPERLY INSTALLED. REFER TO WIPER SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION.

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

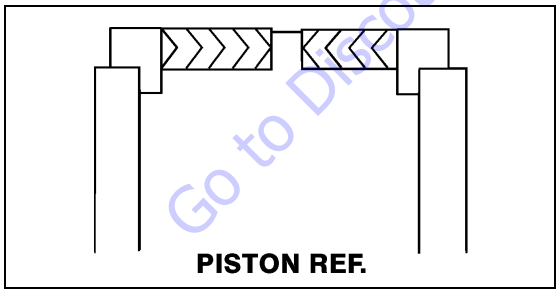


Figure 5-55. Poly-Pak Piston Seal Installation

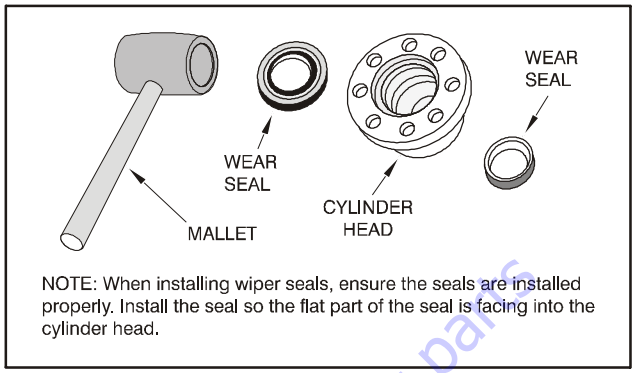


Figure 5-56. Wiper Seal Installation

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

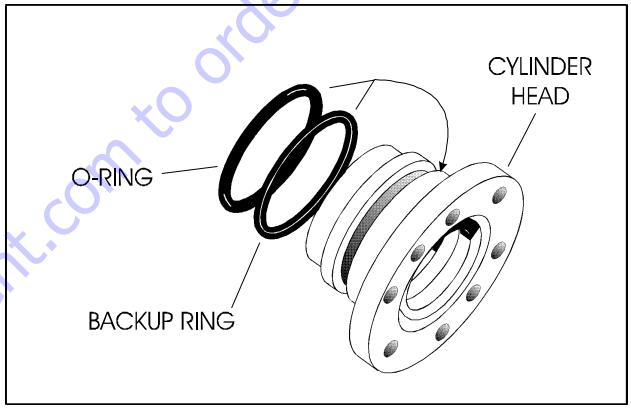


Figure 5-57. Head Seal Kit Installation

4. Install washer ring on rod. Carefully install head gland on rod. Do not damage or dislodge wiper and rod seals. Push head along rod to rod end, as applicable.
5. Carefully slide piston spacer on rod.

6. If applicable, place new O-ring and backup rings in inner piston diameter groove.

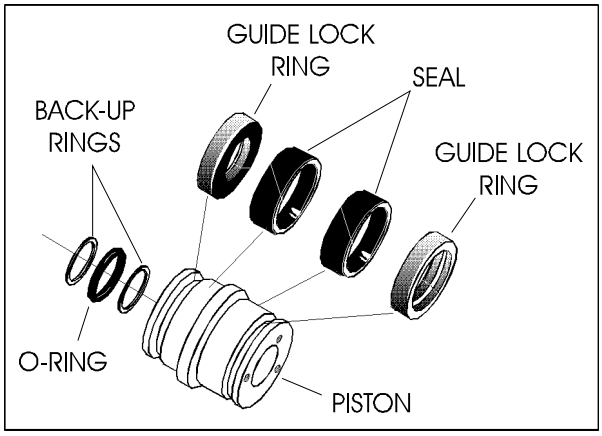


Figure 5-58. Piston Seal Kit Installation

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

8. Carefully thread piston on cylinder rod hand tight, Ensure O-ring and backup rings are not damaged or dislodged.

NOTE: *Piston and mating end of rod must be free of oil when installing tapered bushing.*

9. Thread piston onto rod until it aligns with spacer end and install tapered bushing.

NOTE: *Apply Medium Strength Threadlocking Compound or equivalent to tapered bushing bolts when rebuilding slave, lift, and telescope cylinders.*

10. Install bolts in tapered bushing using Medium Strength Threadlocking Compound.

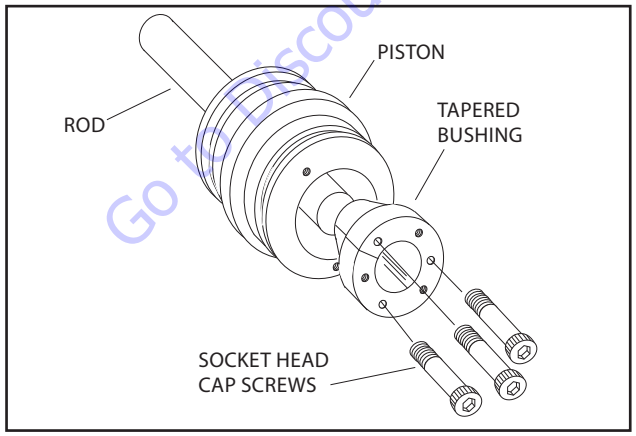


Figure 5-59. Tapered Bushing Installation

11. Remove cylinder rod from holding fixture.

12. Place new guide locks and seals in applicable outside diameter grooves of cylinder piston. (See Figure 5-58. Piston Seal Kit Installation.)

13. Position cylinder barrel in a suitable holding fixture.

NOTICE

INSERTING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN INSTALLING CYLINDER ROD, HEAD, AND PISTON.

14. Clamp barrel clamped securely and support rod. Insert piston end into barrel cylinder. Do not damage or dislodge piston loading O-ring and seal ring.

15. Continue pushing rod into barrel until cylinder head gland can be inserted into barrel cylinder.

16. Secure cylinder head gland using washer ring and socket head bolts.

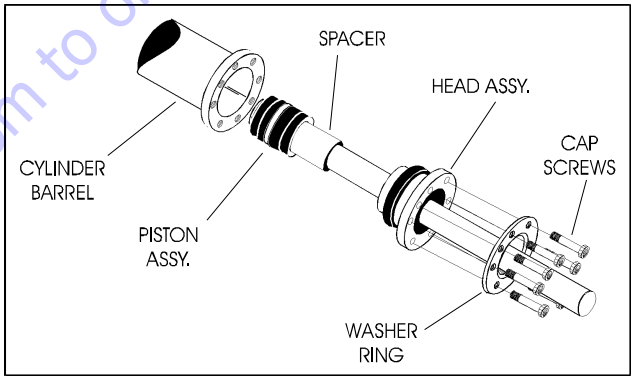


Figure 5-60. Rod Assembly Installation

Steer Cylinder

DISASSEMBLY

NOTE: *Refer to Figure 5-64. Steer Cylinder Assembly.*

NOTICE

CONTAMINATION MAY DAMAGE EQUIPMENT. DISASSEMBLE CYLINDER ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

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

⚠ WARNING

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

2. Operate hydraulic power source and extend cylinder. Shut down and disconnect power source. Adequately support cylinder rod, if applicable.
3. Place cylinder barrel in a suitable holding fixture. Tap around outside of cylinder head retainer with a suitable hammer to break thread-locking compound.

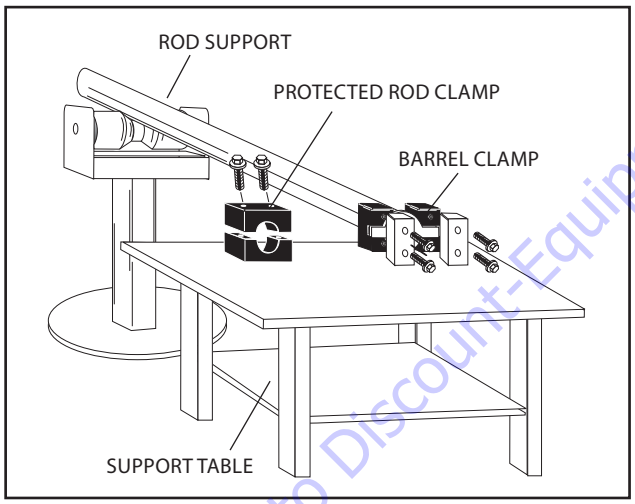


Figure 5-61. Cylinder Barrel Support

4. Remove burrs and contamination from cylinder before disassembly.
5. Unscrew Spanner Nut (12) with hook spanner.

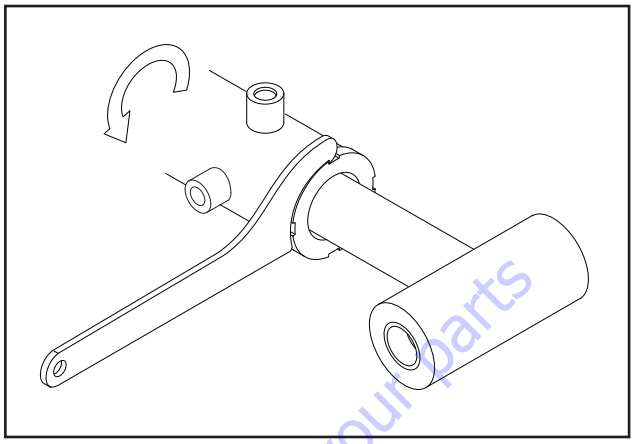


Figure 5-62. Removing Spanner Nut

NOTICE

PULLING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE WHEN REMOVING CYLINDER ROD AND PISTON.

6. Clamp barrel securely. Apply pressure to rod pulling device and carefully withdraw complete rod assembly from cylinder barrel.

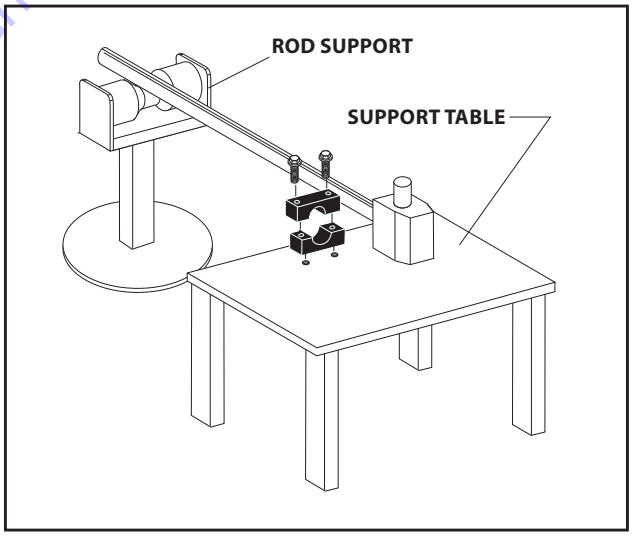
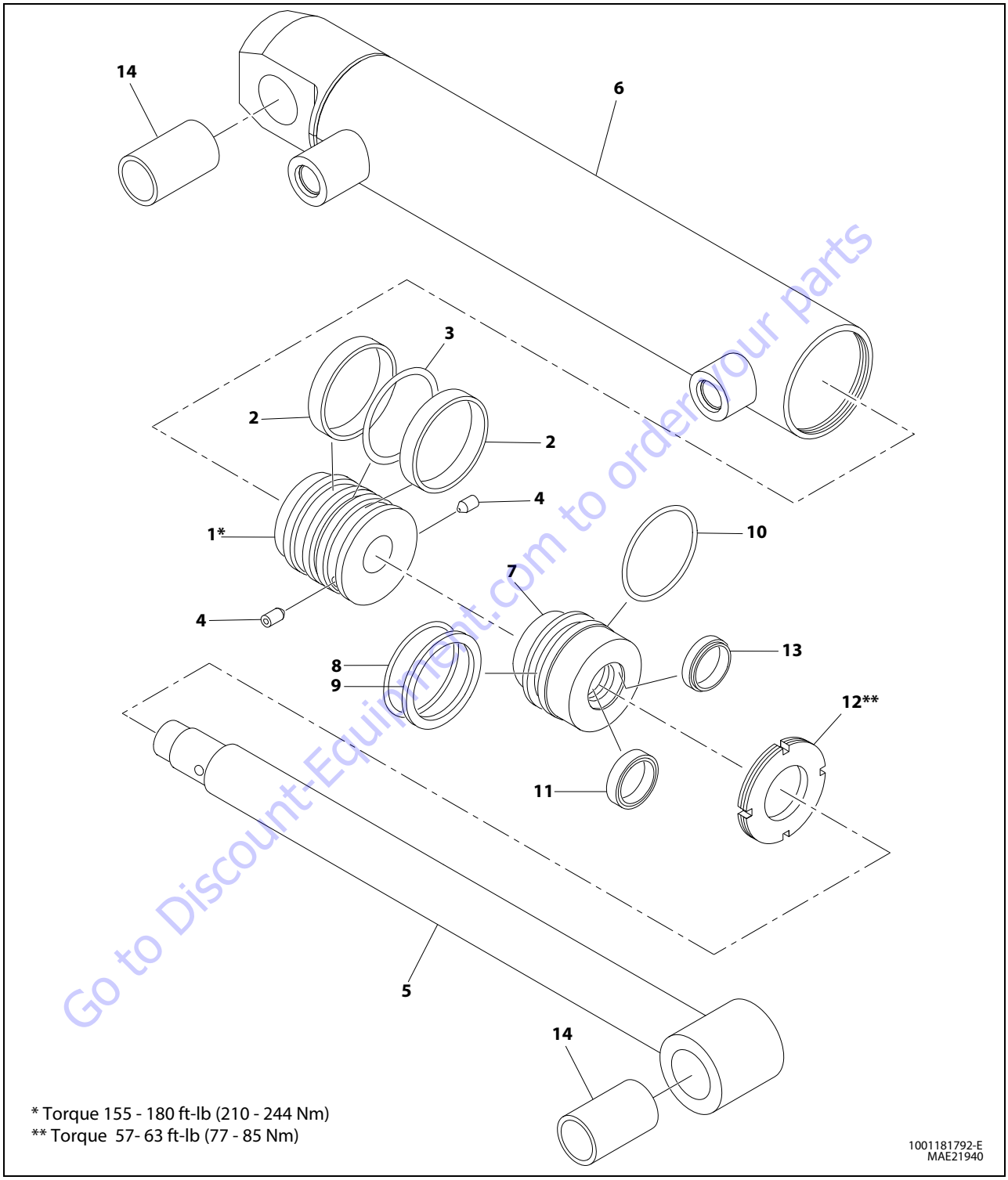


Figure 5-63. Cylinder Rod Support



1. Piston
2. Wear Ring
3. Piston Seal
4. Setscrew
5. Rod
6. Barrel
7. Head
8. O-Ring
9. Ring
10. Ring
11. Rod Seal
12. Nut
13. Wiper
14. Bearing

Figure 5-64. Steer Cylinder Assembly

7. Remove two Seals (2) and O-Ring (3) from Piston (1).

8. Loosen two Setscrews (4) in Piston (1). Unscrew and remove Piston (1) from Rod (5) with strap wrench.

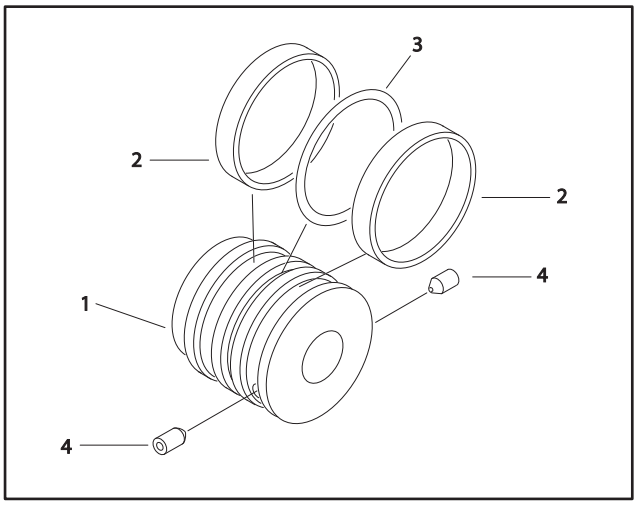


Figure 5-65. Piston Seal and Wear Ring

9. Remove Cylinder Head (7) from Rod (5).

10. Remove O-Ring (8), O-Ring (10), and Backup Ring (9) from Cylinder Head (7).

11. Remove Wiper (13) and Rod Seal (11). Do not damage cylinder head groove.

12. Remove Spanner Nut (12) from Rod (5).

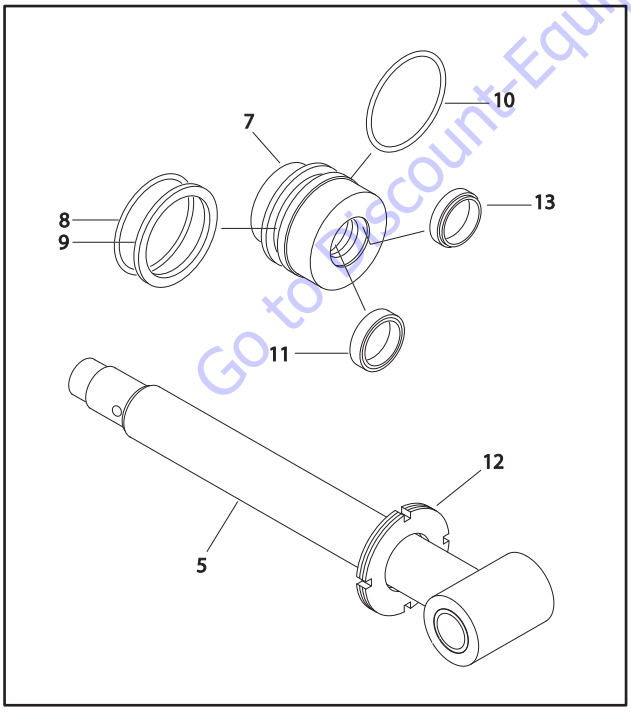


Figure 5-66. Cylinder Head Disassembly

CLEANING AND INSPECTION

1. Clean all parts in an approved cleaning solvent.

2. Inspect cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite™ or equivalent. Replace rod if necessary.

3. Inspect inner surface of cylinder barrel tube for scoring, tapering, ovality, or other damage. Replace if necessary.

4. Inspect threaded portion of barrel for damage. Dress threads as necessary.

5. Inspect piston surface for damage and scoring and for distortion. Inspect seal and O-ring grooves in piston for burrs and sharp edges. Dress piston surfaces or replace rod assembly as necessary.

6. Inspect rod bushings for excessive wear or damage. Replace as necessary.

   a. Thoroughly clean rod bushing of burrs, dirt, etc.

   b. Inspect rod bushing for wear or other damage. If rod bushing is worn or damaged, rod must be replaced.

   c. Lubricate inside of rod bushing with WD40 before installing composite bushing.

   d. Press composite bushing in rod bushing using correct size arbor.

NOTE: *Pin is installed in composite bushing dry. Lubrication is not required with nickel plated pins and bearings.*

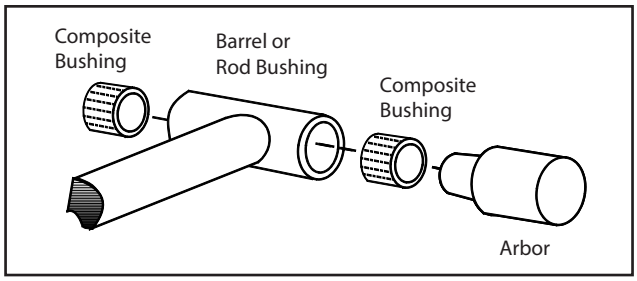


Figure 5-67. Composite Bushing Installation

7. Inspect cylinder head inside diameter for scoring, tapering, ovality, or other damage. Replace as necessary.

8. Inspect threads, and seal and O-Ring grooves in head for burrs, sharp edges, and other damage. Dress surfaces as necessary.

9. Inspect oil ports for blockage or contamination. Repair as necessary.

ASSEMBLY

NOTE: *Apply a light film of hydraulic oil to all components before assembly.*

1. Position cylinder barrel in a suitable holding fixture.

NOTICE

IMPROPER SEAL INSTALLATION CAN CAUSE CYLINDER LEAKS AND IMPROPER CYLINDER OPERATION.

2. Install Spanner Nut (3) on Rod (5).
3. Install Rod Seal (11) and Wiper (13) in Cylinder Head (7).
4. Install O-Ring (8), Backup Ring (9), and O-Ring (10).

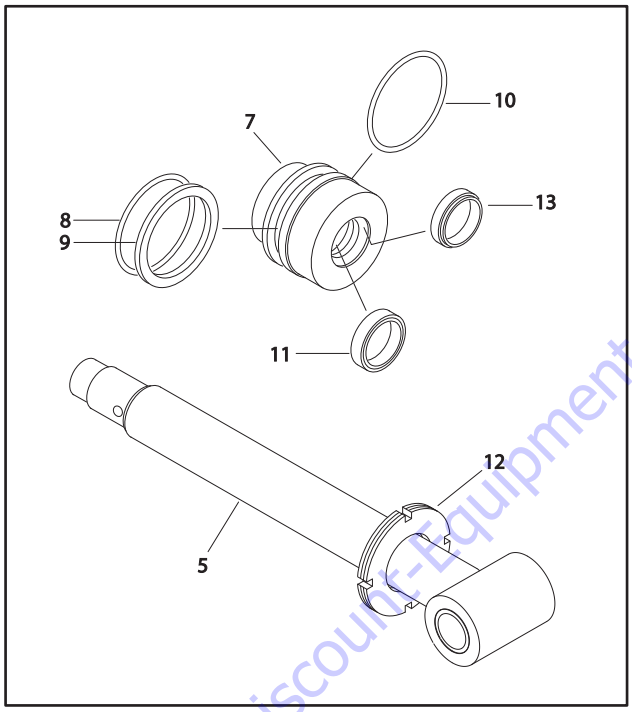


Figure 5-68. Cylinder Head Assembly

5. Install wear ring (2) in piston groove.
6. Install seal (3) in piston groove.
7. Install setscrew (4) to piston.

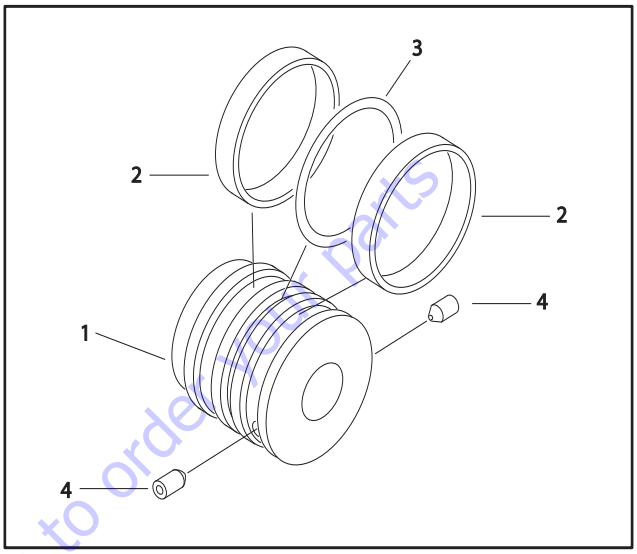


Figure 5-69. Piston Seal and Wear Ring

NOTICE

INSERTING ROD OFF-CENTER CAN DAMAGE PISTON AND CYLINDER BARREL SURFACES. USE EXTREME CARE INSTALLING CYLINDER ROD AND PISTON.

8. Insert Rod Assembly in Barrel (1).
9. Apply Locking Primer and Medium Strength Threadlocking Compound (or equivalent) to threads of Spanner Nut (3). Tighten spanner nut (3) with hook spanner to 57- 63 ft-lb (77 - 85 Nm).

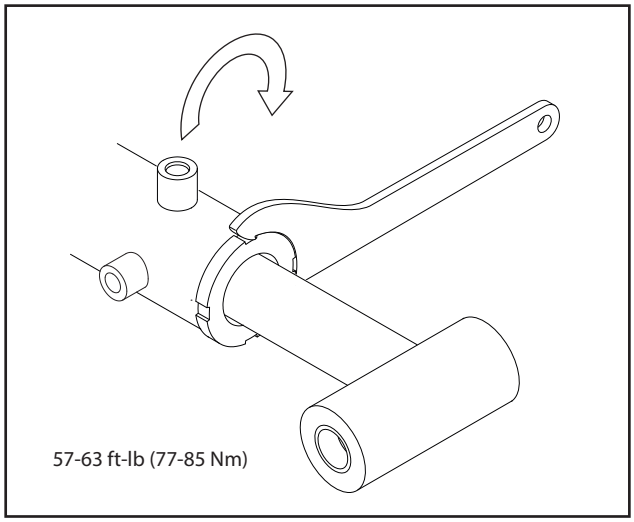


Figure 5-70. Spanner Nut Torque

Axle Lockout Cylinder

NOTE: *Refer to Figure 5-71. Axle Lockout Cylinder.*

DISASSEMBLY

NOTICE

CONTAMINATION MAY DAMAGE EQUIPMENT. DISASSEMBLE CYLINDER ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

⚠ CAUTION

PISTON CAN FALL OUT OF HOUSING AND CAUSE INJURY OR DAMAGE TO EQUIPMENT. BE CAREFUL WHEN REMOVING AXLE CYLINDER. OPENING BLEED VALVE CAN CAUSE PISTON TO FALL OUT OF HOUSING.

1. Open bleed valve (3). Rotate piston (1) and remove from housing (4).
2. Remove wiper (8). Do not scratch housing bore.
3. Remove two wear rings (6) and rod seal (7) from grooves in piston bore. Do not scratch housing bore.
4. Remove check valve (5), if required.
5. Inspect bore and piston for scoring, pitting, or excessive wear.
6. Remove minor surface blemishes with wet 2000-grit sandpaper. Pitting requires replacement of housing or piston.
7. Clean all parts with approved solvent and dry with compressed air.

ASSEMBLY

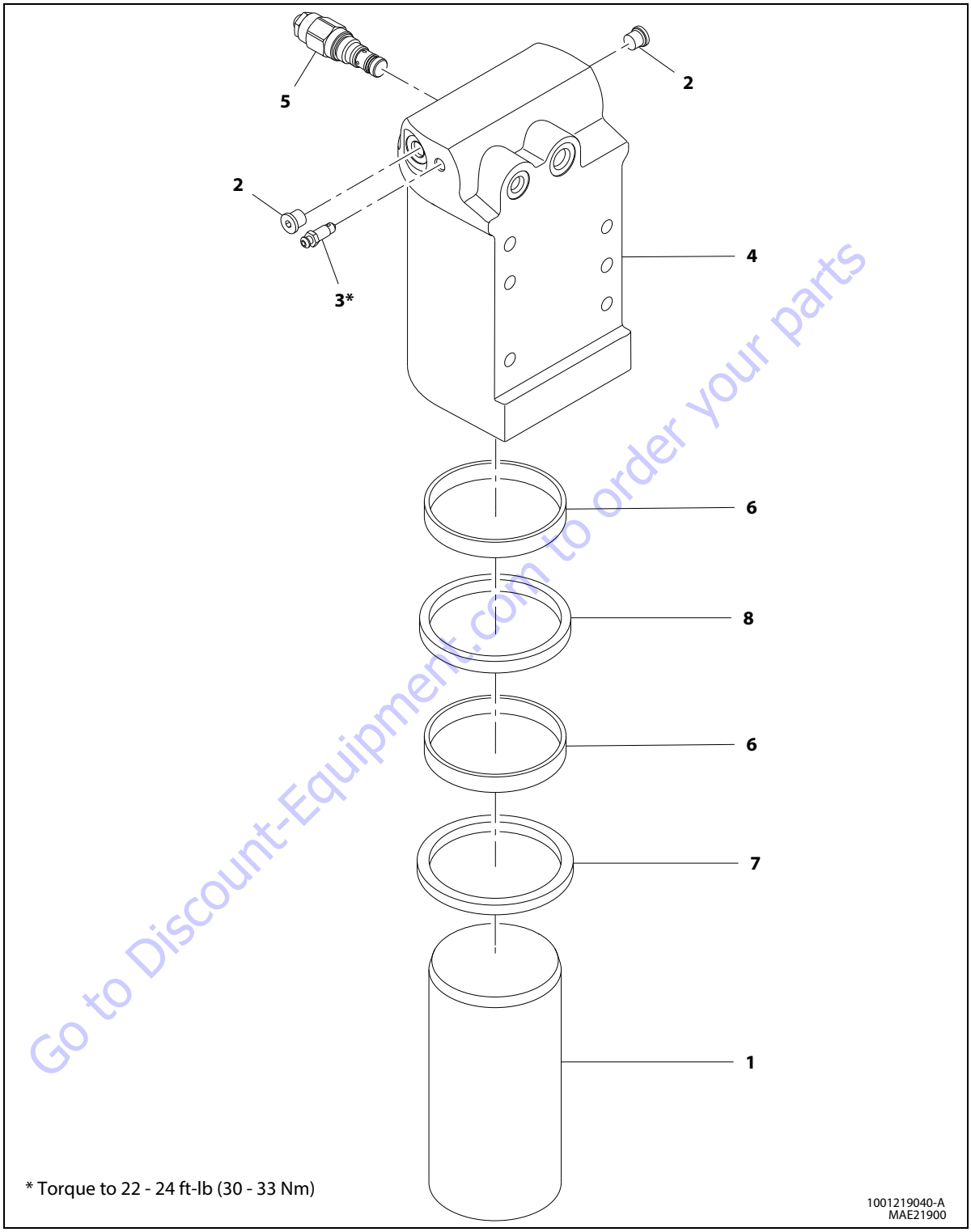
Refer to Figure 5-71. Axle Lockout Cylinder.

1. Install two new wear rings (6) and rod seal (7) in piston bore grooves. Make sure they are not twisted.
2. Install new wiper (8) in housing.
3. Lubricate piston bore with clean hydraulic fluid.

NOTICE

INSERTING PISTON OFF-CENTER CAN DAMAGE PISTON AND PISTON BORE SURFACES. USE EXTREME CARE WHEN INSTALLING PISTON.

4. Install piston (1) in bore and push to top of bore.
5. Install check valve (5). Torque to 22 - 24 ft-lb (30 - 33 Nm).
6. Bleed system.



1. Rod
2. Plug
3. Bleed Valve
4. Barrel
5. Cartridge Valve
6. Ring
7. Seal
8. Wiper

Figure 5-71. Axle Lockout Cylinder

5.4 HYDRAULIC PUMP (GEAR)

Removal

⚠ WARNING

ENSURE THE PRESSURE IS PROPERLY RELIEVED FROM THE HYDRAULIC SYSTEM BEFORE PROCEEDING TO REMOVAL OF THE PUMP MOTOR.

1. Disconnect the hydraulic hoses from inlet and outlet ports of the gear pump.

NOTICE

CAP ALL THE HYDRAULIC HOSES TO PREVENT ENTRAPPING OF THE DUST AND DIRT INTO IT.

2. Remove bolts and washers secured on the gear pump.
3. Carefully remove the gear pump shaft from the piston pump assembly.
4. Carefully place the gear pump on the clean working surface.

Assembly/Disassembly

For detail assembly/disassembly procedure, contact local JLG or JLG dealer for information.

Installation

NOTICE

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

1. Check for gear teeth on shaft for scoring, pitting tapering and damage. If damaged need to be replaced with a new assembly completely.
2. Apply thin film of spline grease on the gear shaft.
3. Carefully insert the shaft into the piston pump and secure the pump using two bolts and washers. Apply Medium Strength Threadlocking Compound to end of bolts. Torque bolts to 20-24 ft.lbs (27-33 Nm).
4. Remove cap from the hydraulic hoses and re-connect to their original locations.

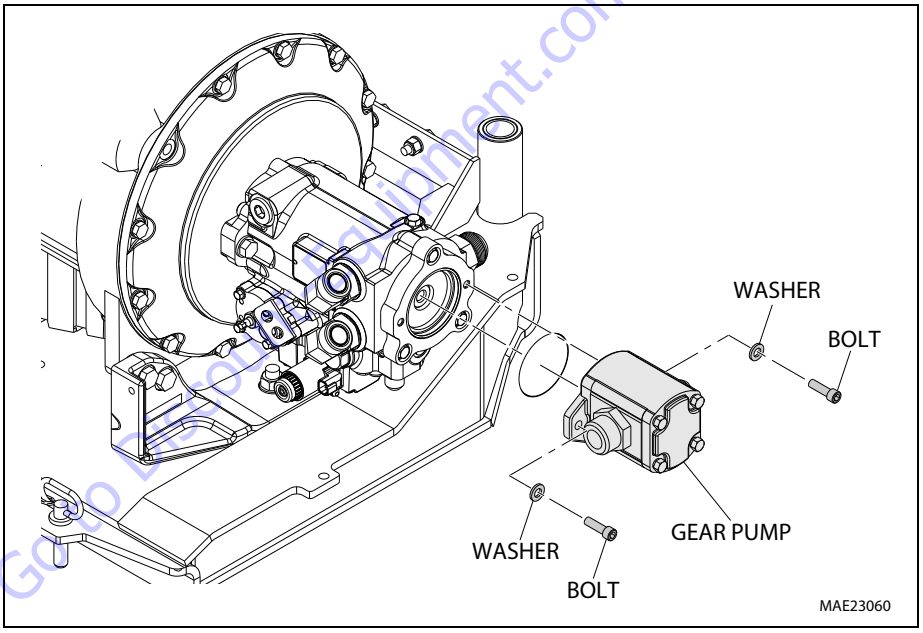


Figure 5-72. Hydraulic Pump Installation

5.5 VARIABLE PUMP

Removal

⚠ WARNING

ENSURE THE PRESSURE IS PROPERLY RELIEVED FROM THE HYDRAULIC SYSTEM BEFORE PROCEEDING TO REMOVAL OF THE PUMP MOTOR.

1. Disconnect the hydraulic hoses from inlet and outlet ports of the variable pump.

NOTICE

CAP ALL THE HYDRAULIC HOSES TO PREVENT ENTRAPPING OF THE DUST AND DIRT INTO IT.

2. Remove bolts and washers secured on the variable pump.
3. Carefully remove the variable pump shaft from the engine assembly.
4. Carefully place the variable pump on the clean working surface.

Assembly/Disassembly

For detail assembly/disassembly instruction, contact local JLG or JLG dealer for information.

Installation

NOTICE

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

1. Check for gear teeth on shaft for scoring, pitting tapering and damage. If damaged need to be replaced with a new assembly completely.
2. Apply thin film of spline grease on the gear shaft.
3. Carefully insert the shaft into the engine and secure the pump using two bolts and washers. Apply Medium Strength Threadlocking Compound to end of bolts. Torque bolts to 46-56 ft.lbs (62-76 Nm).
4. Remove cap from the hydraulic hoses and re-connect to their original locations.

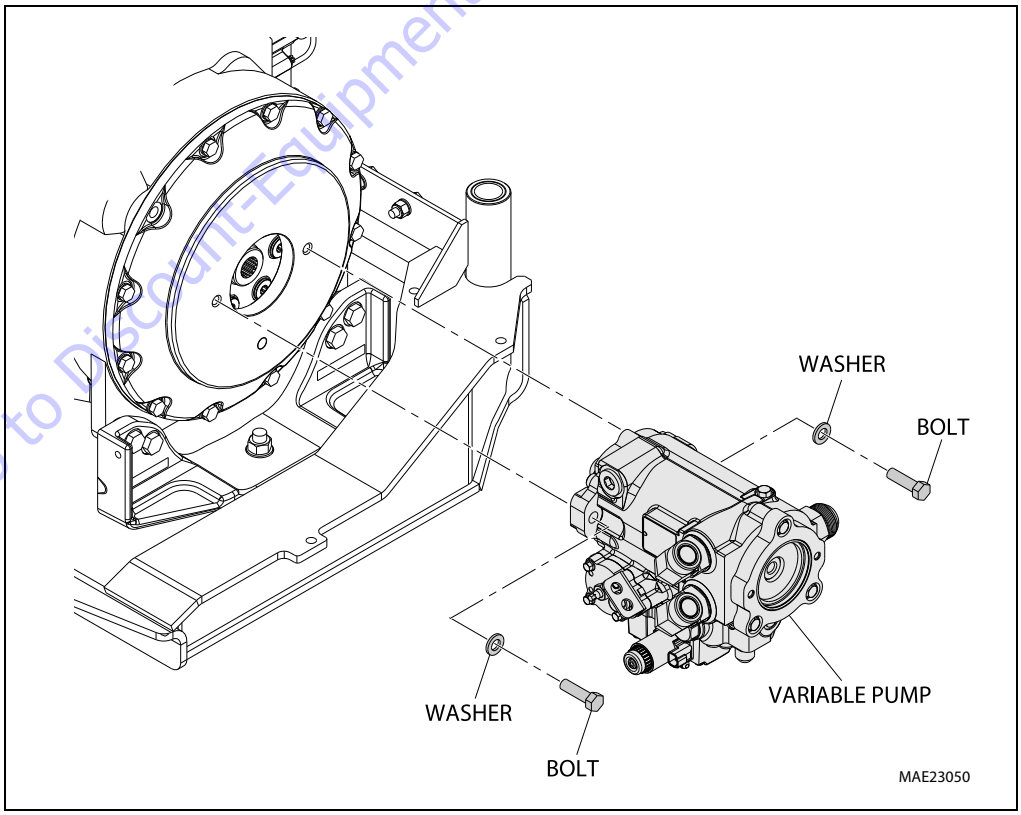


Figure 5-73. Variable Pump Installation

5.6 MAIN VALVE BLOCK PRESSURE SETTING PROCEDURE

Refer to Figure 5-74. Main Control Valve Block (2WS) and Figure 5-75. Main Control Valve Block (4WS).

NOTICE

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.

Load Sense Compensator

1. Install a pressure gauge at port MP1 of the main control valve capable of reading pressures up to 1000 psi (70 bar).
2. Start the Engine.
3. Adjust Load Sense Compensator (1) to 400 - 450 psi (27.5 - 31 bar). Turn adjuster clockwise to increase or counterclockwise to decrease pressure.

Main Relief Valve

1. Install a pressure gauge at port MP1 of the main control valve capable of reading pressures up to 5000 psi (345 bar).
2. Activate telescope in and hold.
3. Adjust main relief valve (2) to 3350 - 3400 psi (231 - 234.5 bar). Turn adjuster clockwise to increase or counterclockwise to decrease pressure.
4. If the pressure will not rise to 3350 psi, the load sense relief valve will have to increase. Locate the load sense relief valve. Increase this setting by 1 turn clockwise. Go back to the main relief valve and increase until the correct pressure is achieved.

Load Sense Relief Valve

1. Install a pressure gauge at port MJ of the main control valve capable of reading pressures up to 5000 psi (345 bar).
2. Activate telescope in and hold.
3. Adjust load sense relief valve (3) to 3200 - 3250 psi (220.6 - 224.1 bar). Turn adjuster clockwise to increase or counterclockwise to decrease pressure.

2 Wheel Steer, Relief Valves

1. Install a pressure gauge at port MJ of the main control valve capable of reading pressures up to 3000 psi (207 bar).
2. Activate wheel steer left and right.
3. Adjust front steer relief valves (4, 5) to 1800 ± 50 psi (124 ± 3.5 bar) in both directions. Turn adjuster clockwise to increase pressure or counterclockwise to decrease pressure.

4 Wheel Steer, Front & Rear Steering Relief Valves

1. Install a pressure gauge at port MJ of the main control valve capable of reading pressures up to 3000 psi (207 bar).
2. Activate wheel steer left and right.
3. Adjust front steer relief valves (6, 7) to 2450 - 2500 psi (169 - 172.5 bar) in both directions. Turn adjuster clockwise to increase pressure or counterclockwise to decrease pressure.

Rear Axle Relief Valves

1. Install a pressure gauge at port MJ of the main control valve. capable of reading pressures up to 3000 psi (207 bar).
2. To check or set the rear steer reliefs, remove the wires from the front axle steer directional valve. Select either crab OR coordinated steer. Only the rear axle will steer.
3. Activate steer left to the end of stroke, set relief, and rear steer right to the end of stroke and set relief.
4. Adjust rear steer relief valve (8, 9) to 2350 psi (162 bar). Turn adjuster clockwise to increase or counterclockwise to decrease pressure.

NOTE: *There must be difference of 100 psi between the front and rear axle relief valves. The front must be higher than the rear.*

Turntable Swing Relief Valve

1. Install a pressure gauge at port MJ of the main control valve. capable of reading pressures up to 3000 psi (207 bar).
2. The turntable should be locked in place with the turntable lock pin. Activate swing right.
3. Adjust Relief Valve (10) to 1700 - 1750 psi (117 - 12.5 bar).
4. One adjustment will take care of both directions. Swing left will be approximately 50 - 100 psi (3.5 - 7 bar) lower. Turn adjuster clockwise to increase pressure or counterclockwise to decrease pressure.

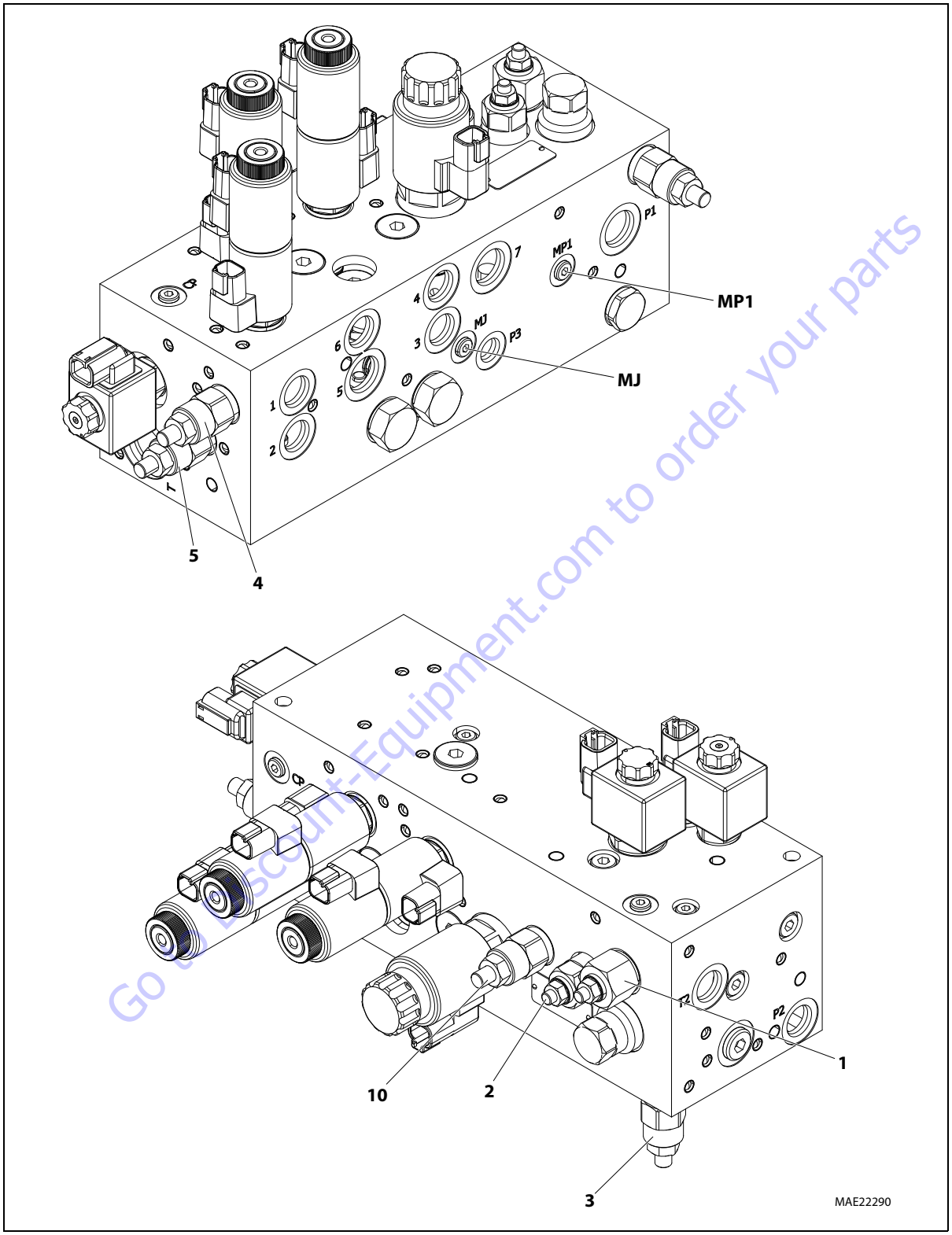


Figure 5-74. Main Control Valve Block (2WS)

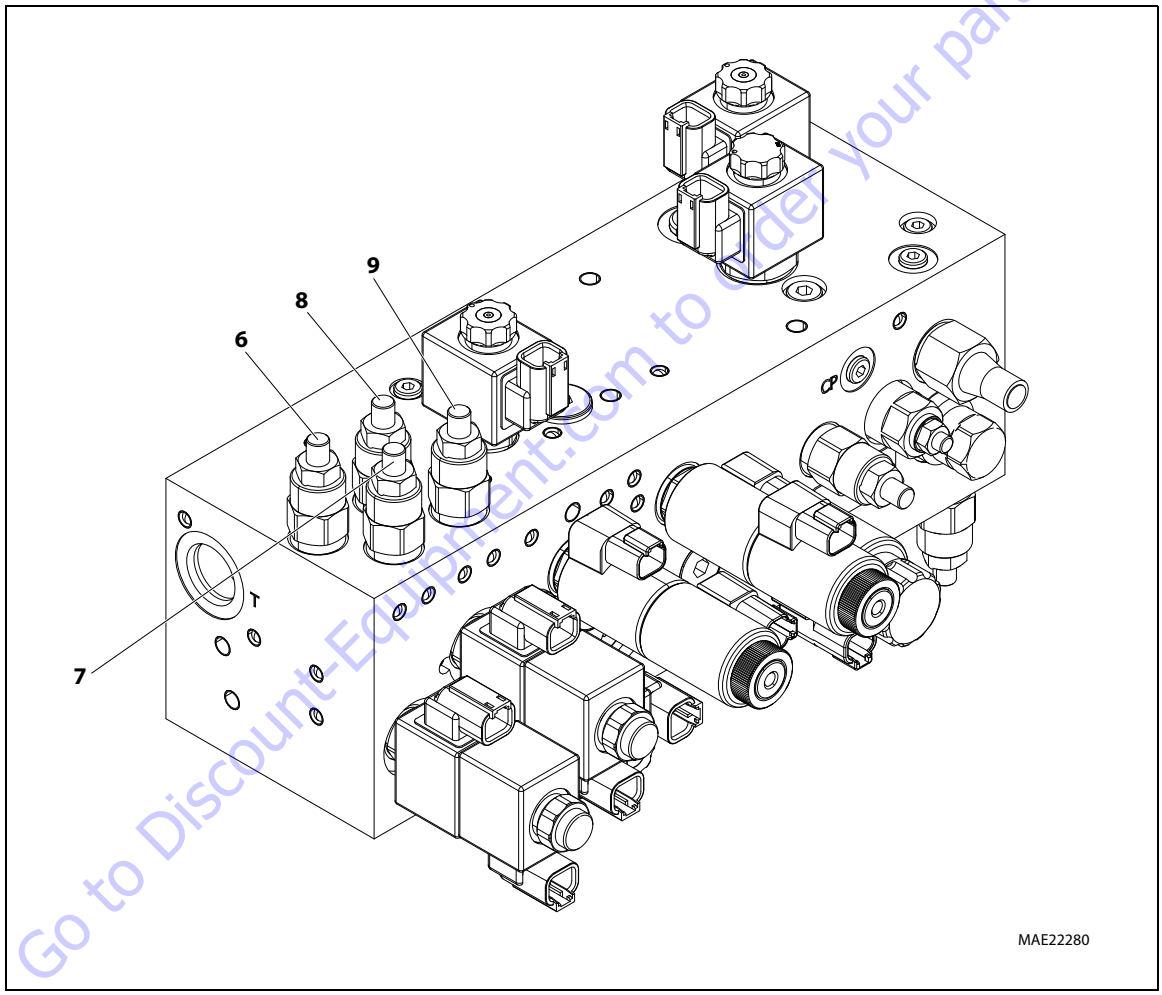


Figure 5-75. Main Control Valve Block (4WS)

5.7 PLATFORM VALVE BLOCK PRESSURE SETTING PROCEDURE

Refer to Figure 5-76. Platform Control Valve Block.

Main High Pressure Relief Valve

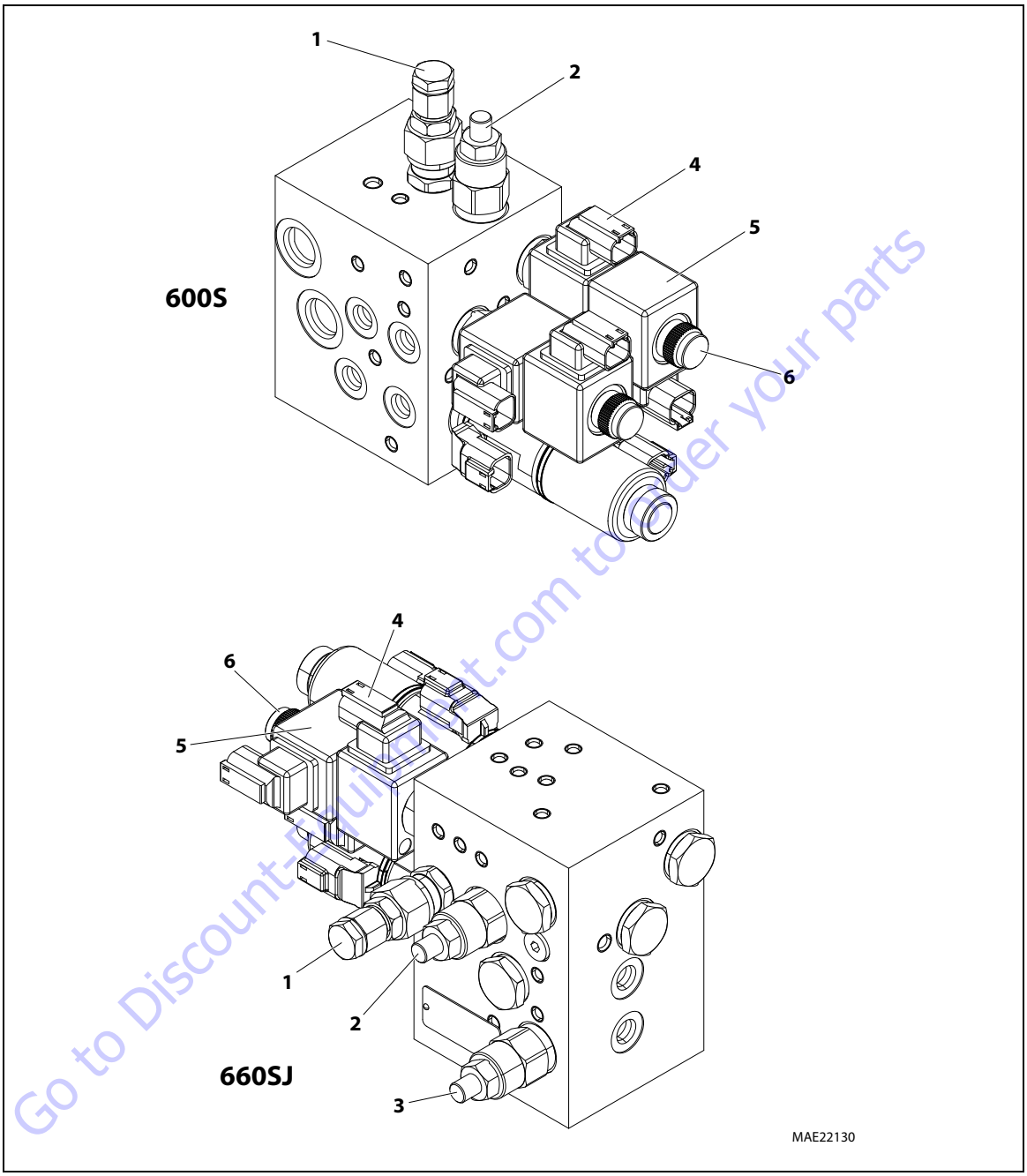
1. Install a pressure gauge at port MP1 of the platform control valve capable of reading pressures up to 5000 psi (345 bar).
2. Activate platform right or left to the end of stroke and hold.
3. Adjust Relief Valve (1) to 2950 - 3000 psi (204.5 - 207 bar). Turn adjuster clockwise to increase pressure or counterclockwise to decrease pressure.

Low Pressure Relief Valve

1. Install a pressure gauge at port MP1 of the platform control valve capable of reading pressures up to 5000 psi (345 bar).
2. To check or set this adjustment locate the dump directional valve (6) at the platform manifold (12). Flip the wires between the two solenoid coils. After the relief has been set, flip the wires back to their original place.
3. Activate rotate right or left to the end of stroke.
4. Adjust Relief Valve (12) to 2200 ± 50 psi (152 ± 3.5 bar). Turn adjuster clockwise to increase pressure or counterclockwise to decrease pressure.

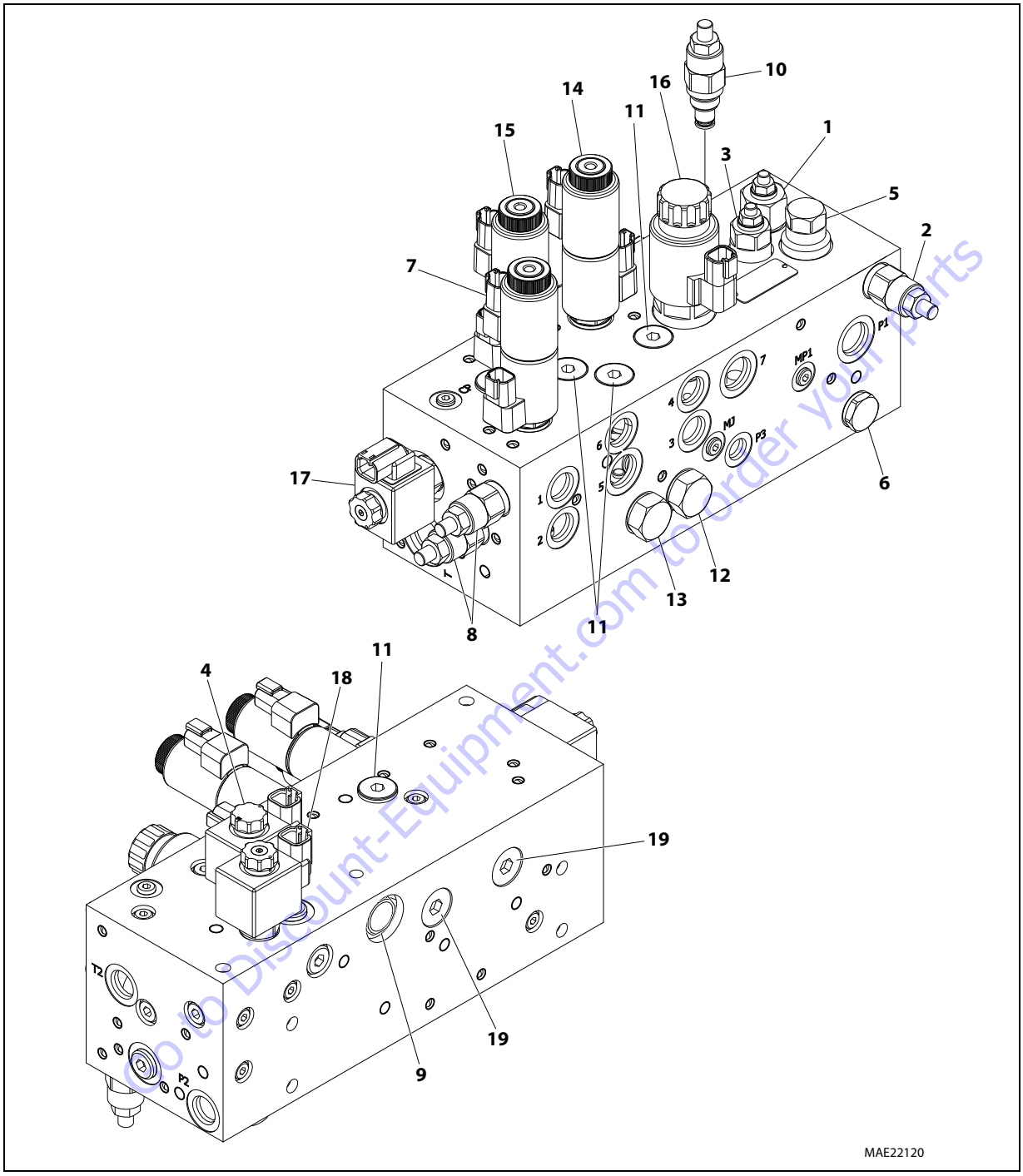
Platform Jib Down Relief Valve

1. Install a pressure gauge at port M5-6 of the platform control valve capable of reading pressures up to 5000 psi (345 bar).
2. Activate jib down to the end of stroke and hold.
3. Adjust Relief Valve (13) to 1600 - 1650 psi (110 - 113.5 bar).
4. This one adjustment will take care of jib up and down. Jib up will automatically be approximately 50 - 100 psi (3.5 - 7 bar) higher than jib down. Turn adjuster clockwise to increase pressure or counterclockwise to decrease pressure.



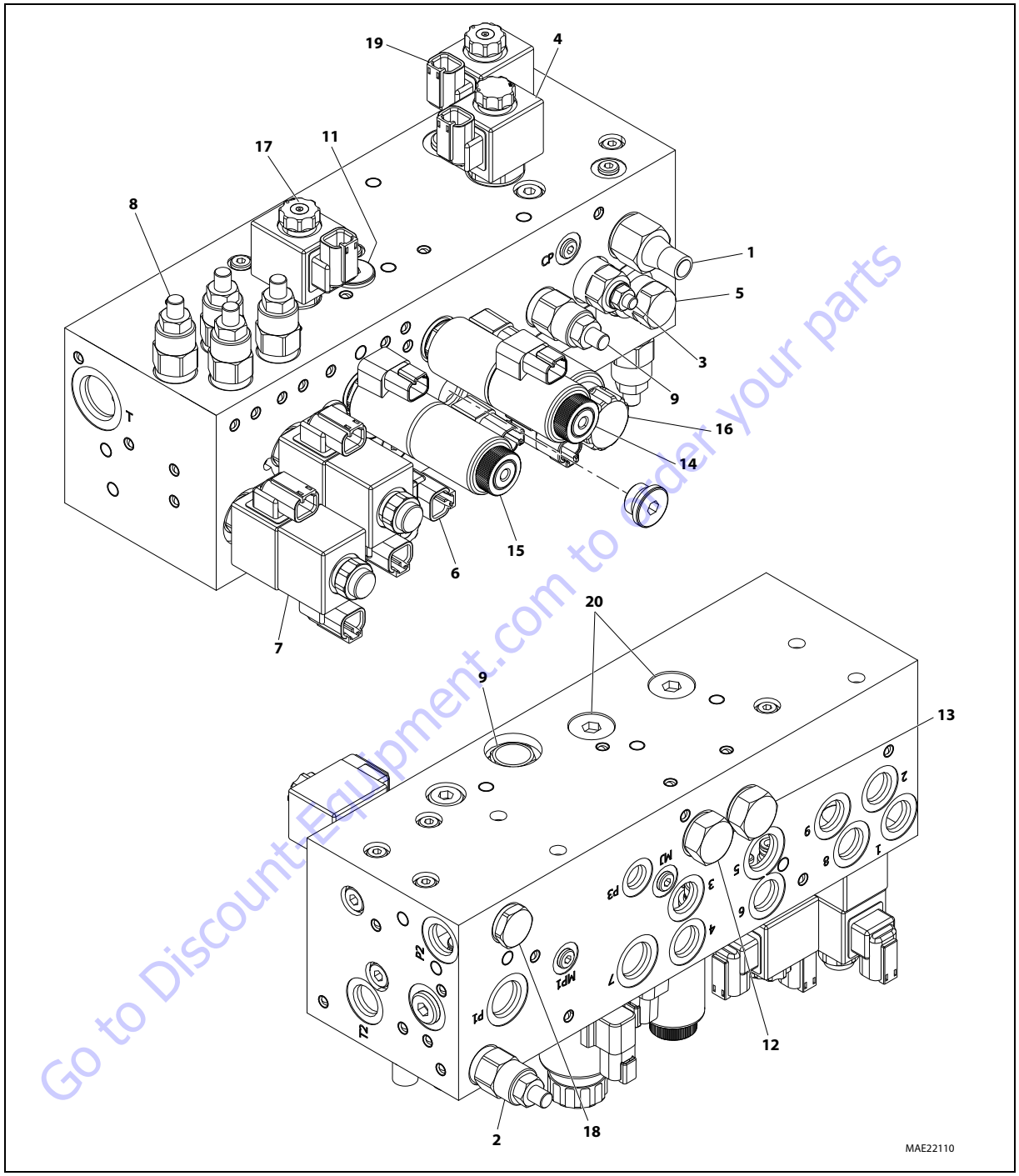
1. Main High Pressure Relief Valve
2. Low Pressure Relief Valve
3. Jib Relief Valve
4. Low Pressure Relief Solenoid
5. High Pressure Relief Solenoid
6. Dump Directional Valve

Figure 5-76. Platform Control Valve Block



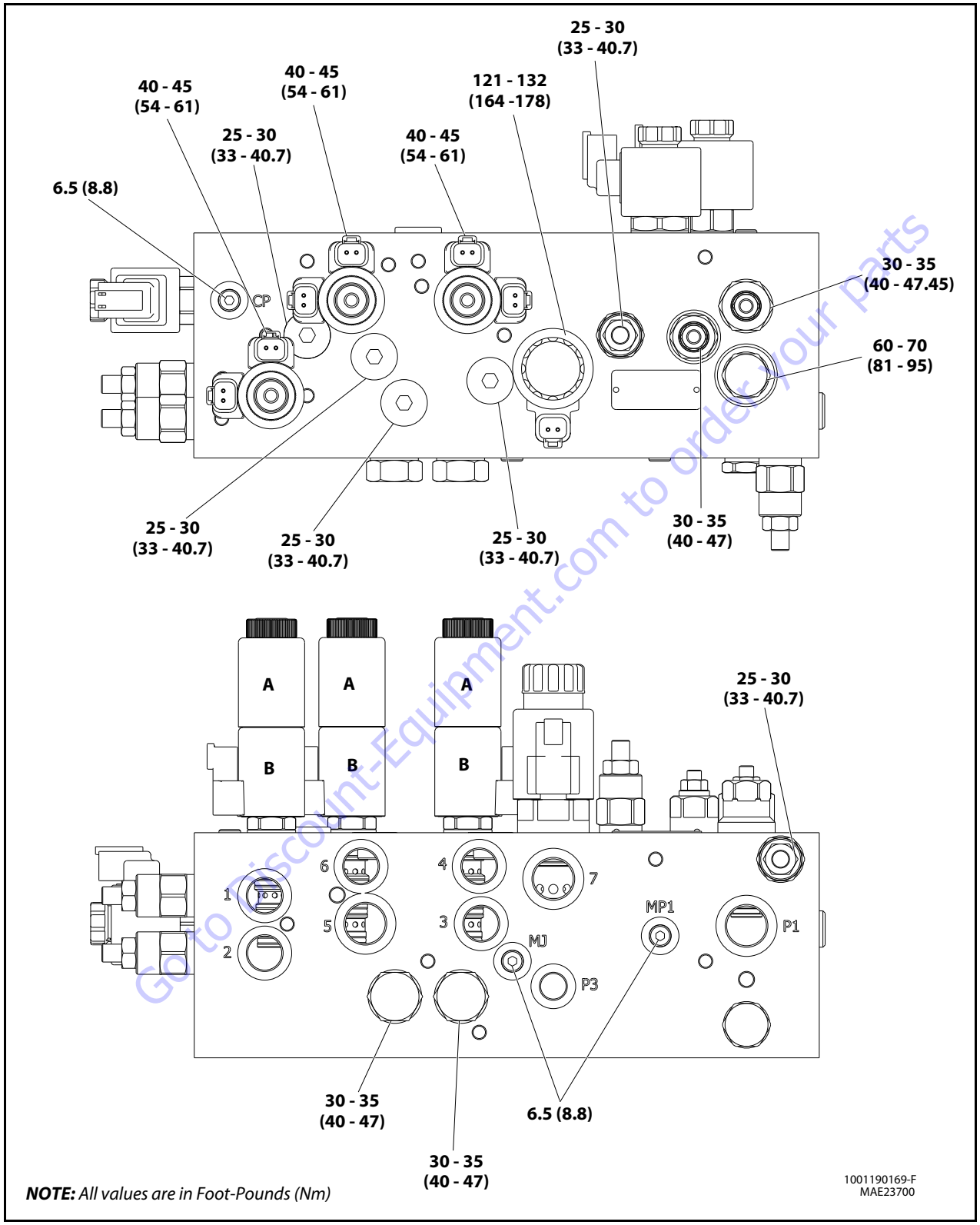
1. Flow/Pressure Control Valve
2. Relief Valve
3. Relief Valve
4. Solenoid Valve
5. Load Sense Valve
6. Check Valve
7. Solenoid Valve
8. Relief Valve
9. Flow/Pressure Control Valve
10. Relief Valve
11. Relief Valve
12. Pressure Compensator Valve
13. Pressure Compensator Valve
14. Solenoid Valve
15. Solenoid Valve
16. Solenoid Valve
17. Solenoid Valve
18. Solenoid Valve
19. Check Valve

Figure 5-77. Main Control Valve (2WS)



1. Flow/Pressure Control Valve
2. Relief Valve
3. Relief Valve
4. Solenoid Valve
5. Load Sense Valve
6. Solenoid Valve
7. Solenoid Valve
8. Relief Valve
9. Flow/Pressure Control Valve
10. Relief Valve
11. Relief Valve
12. Pressure Compensator Valve
13. Pressure Compensator Valve
14. Solenoid Valve
15. Solenoid Valve
16. Solenoid Valve
17. Solenoid Valve
18. Check Valve
19. Solenoid Valve
20. Check Valve

Figure 5-78. Main Control Valve (4WS)



NOTE: *All values are in Foot-Pounds (Nm)*

Figure 5-79. Main Control Valve Torque Values (2WS) - Sheet 1 of 3

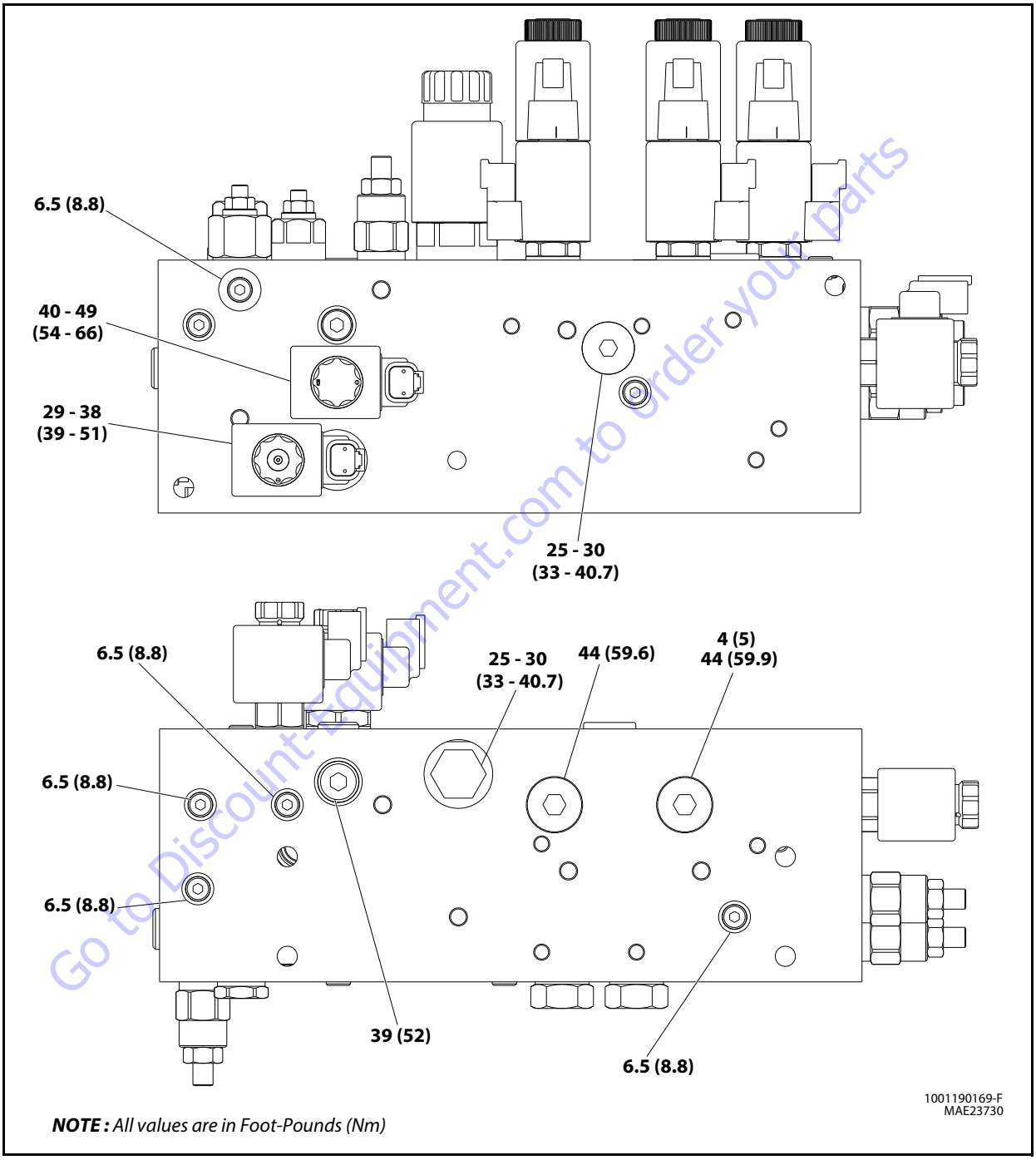


Figure 5-80. Main Control Valve Torque Values (2WS) - Sheet 2 of 3

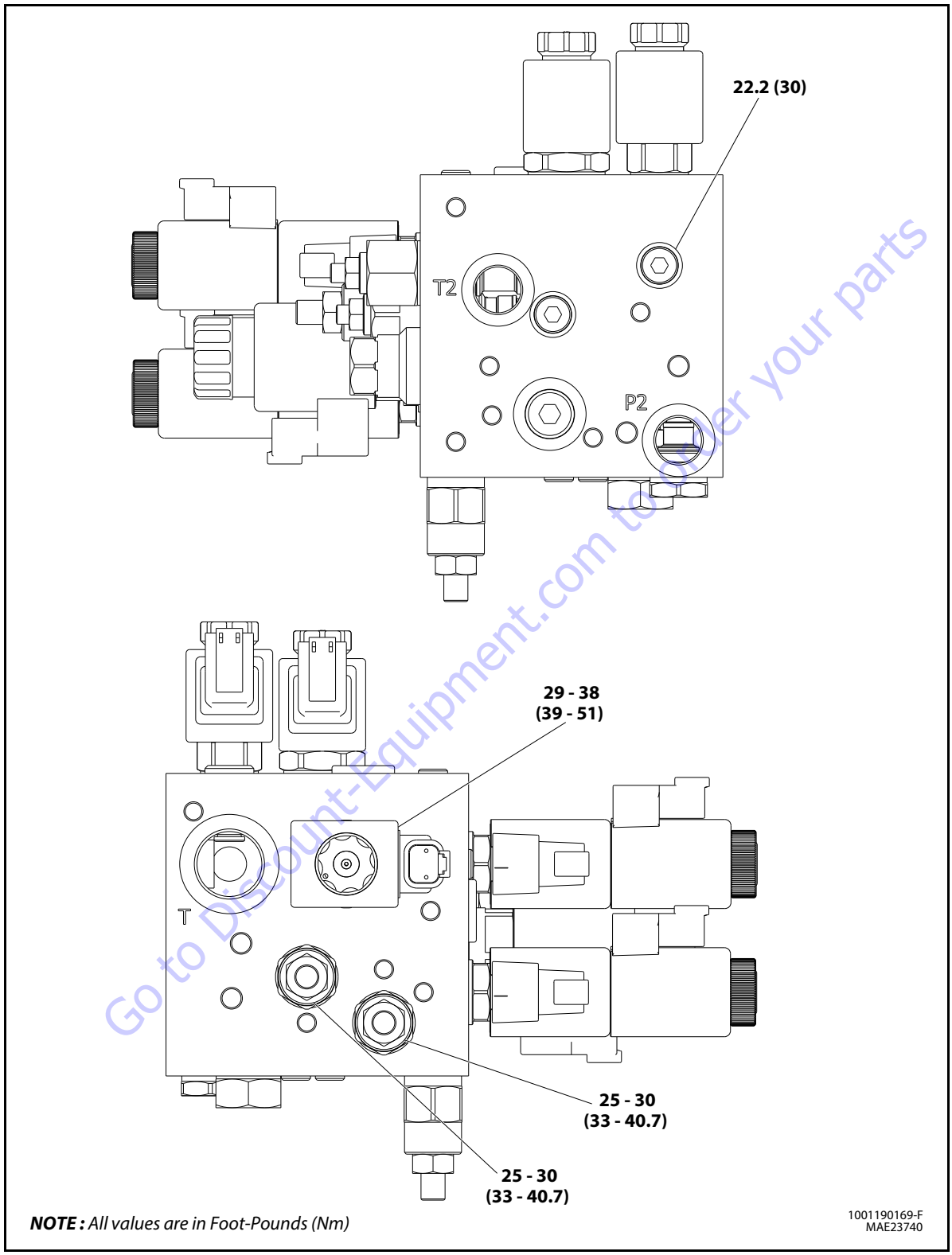


Figure 5-81. Main Control Valve Torque Values (2WS) - Sheet 3 of 3

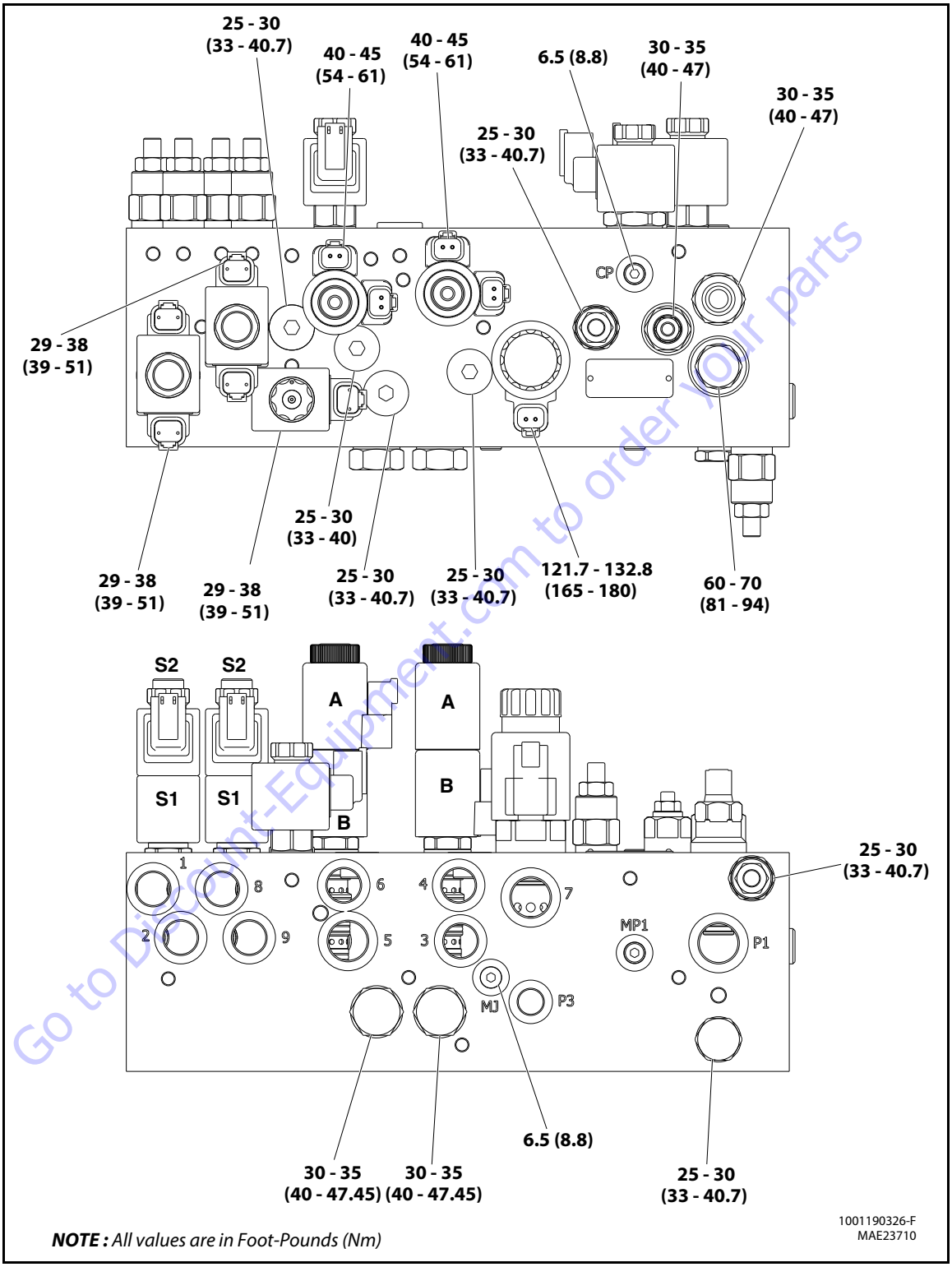
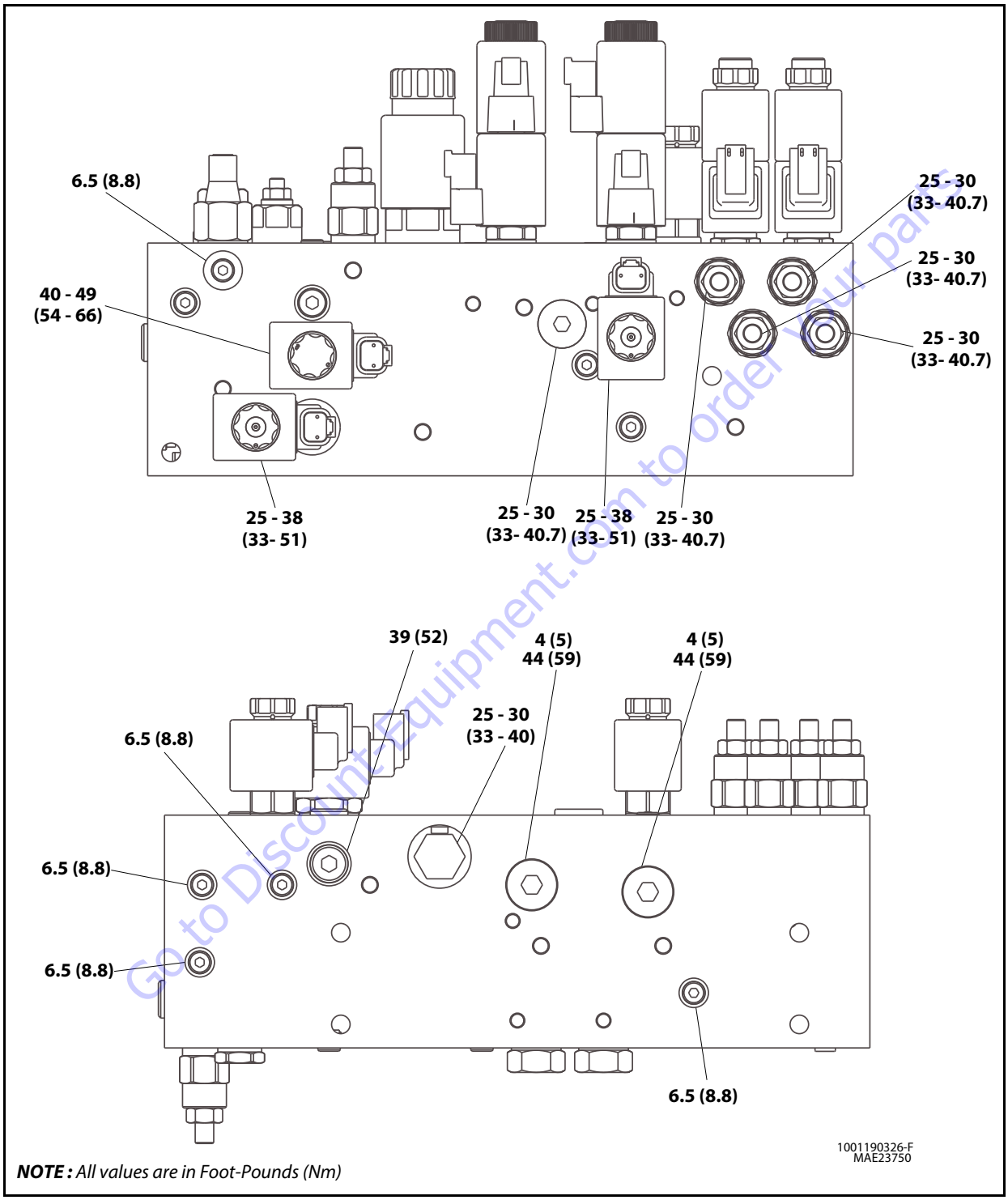


Figure 5-82. Main Control Valve Torque Values (4WS) - Sheet 1 of 3



NOTE : *All values are in Foot-Pounds (Nm)*

Figure 5-83. Main Control Valve Torque Values (4WS) - Sheet 2 of 3

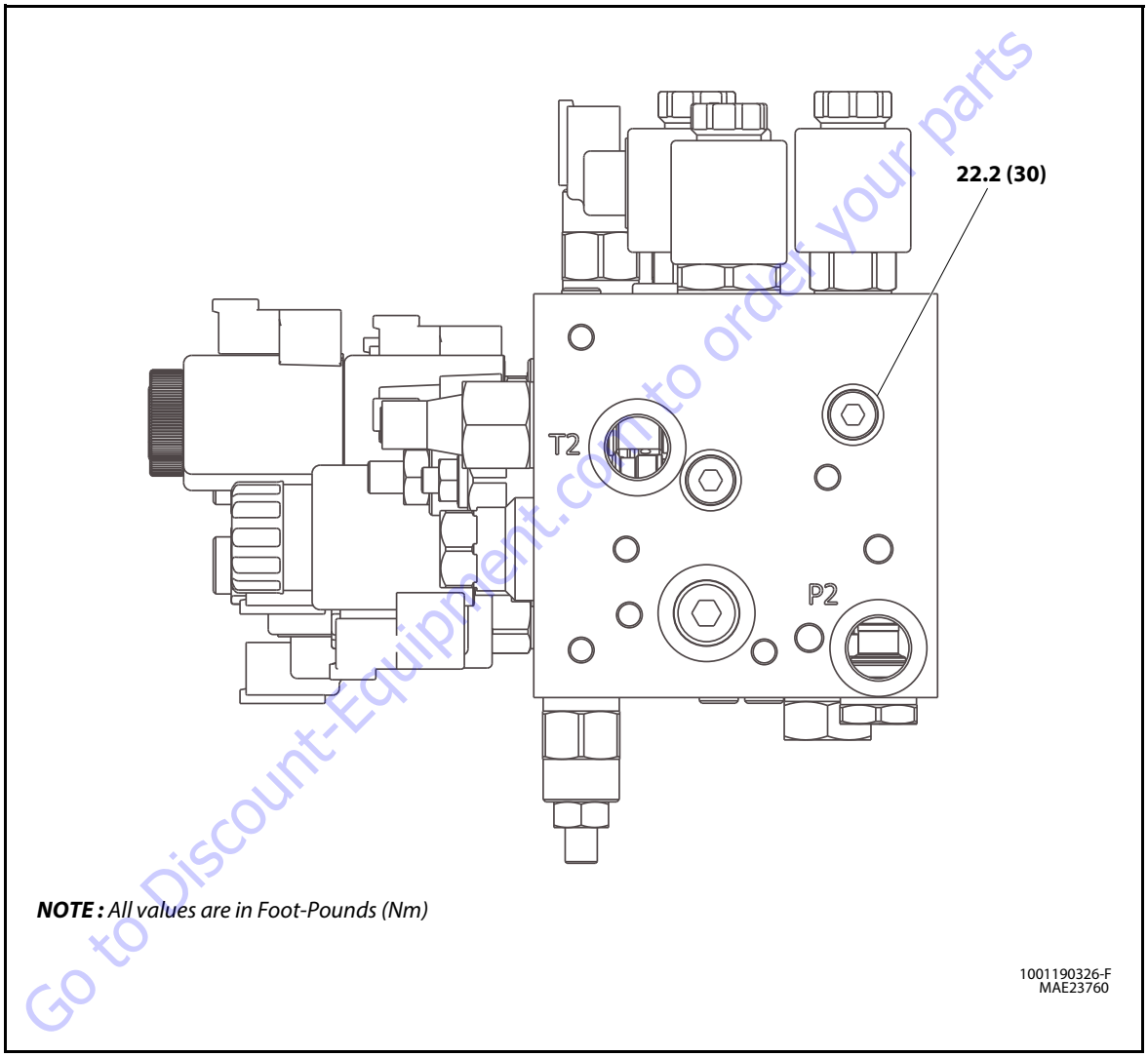


Figure 5-84. Main Control Valve Torque Values (4WS) - Sheet 3 of 3

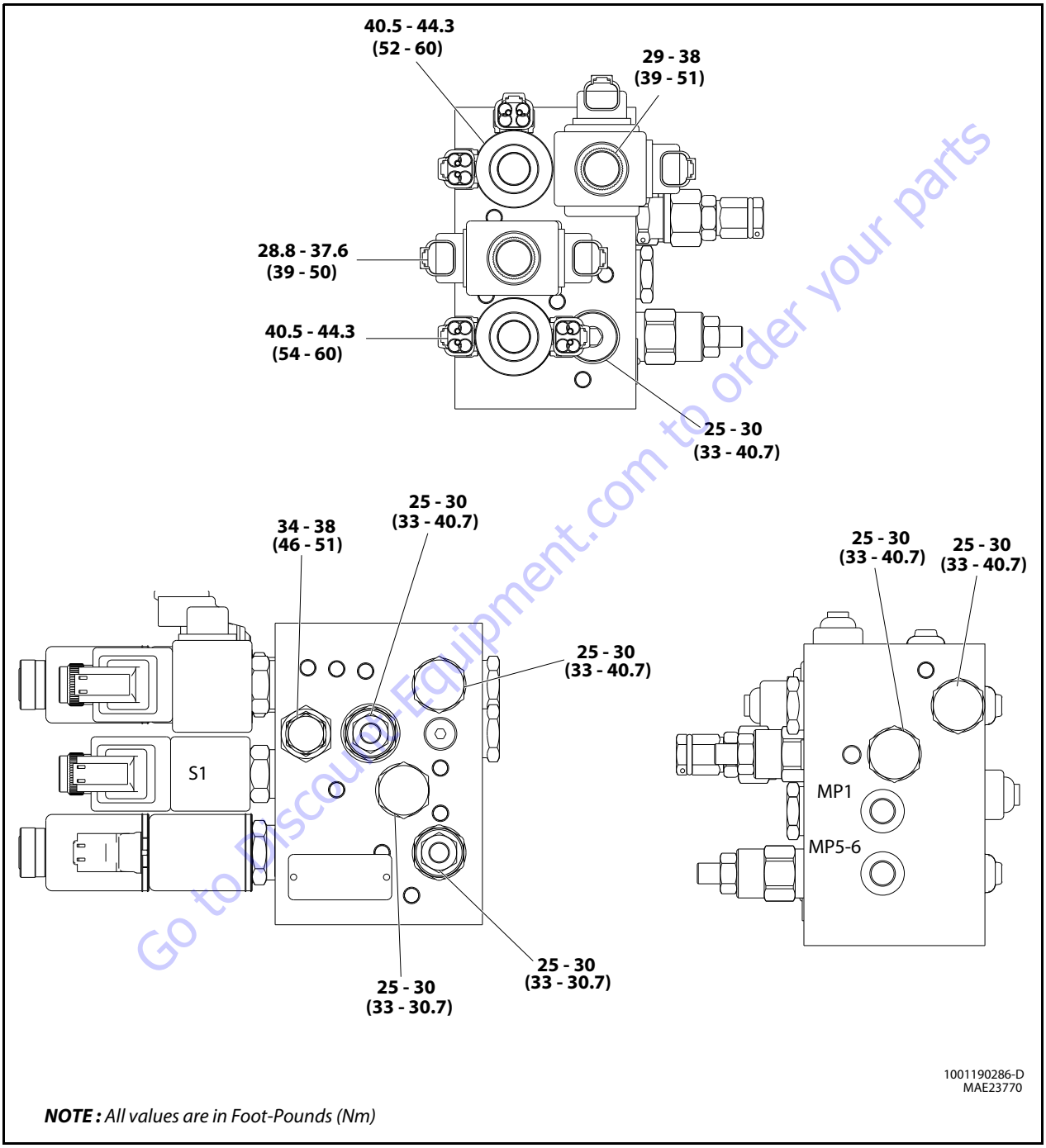


Figure 5-85. Platform Valve Torque Values

5.8 HYDRAULIC SCHEMATICS

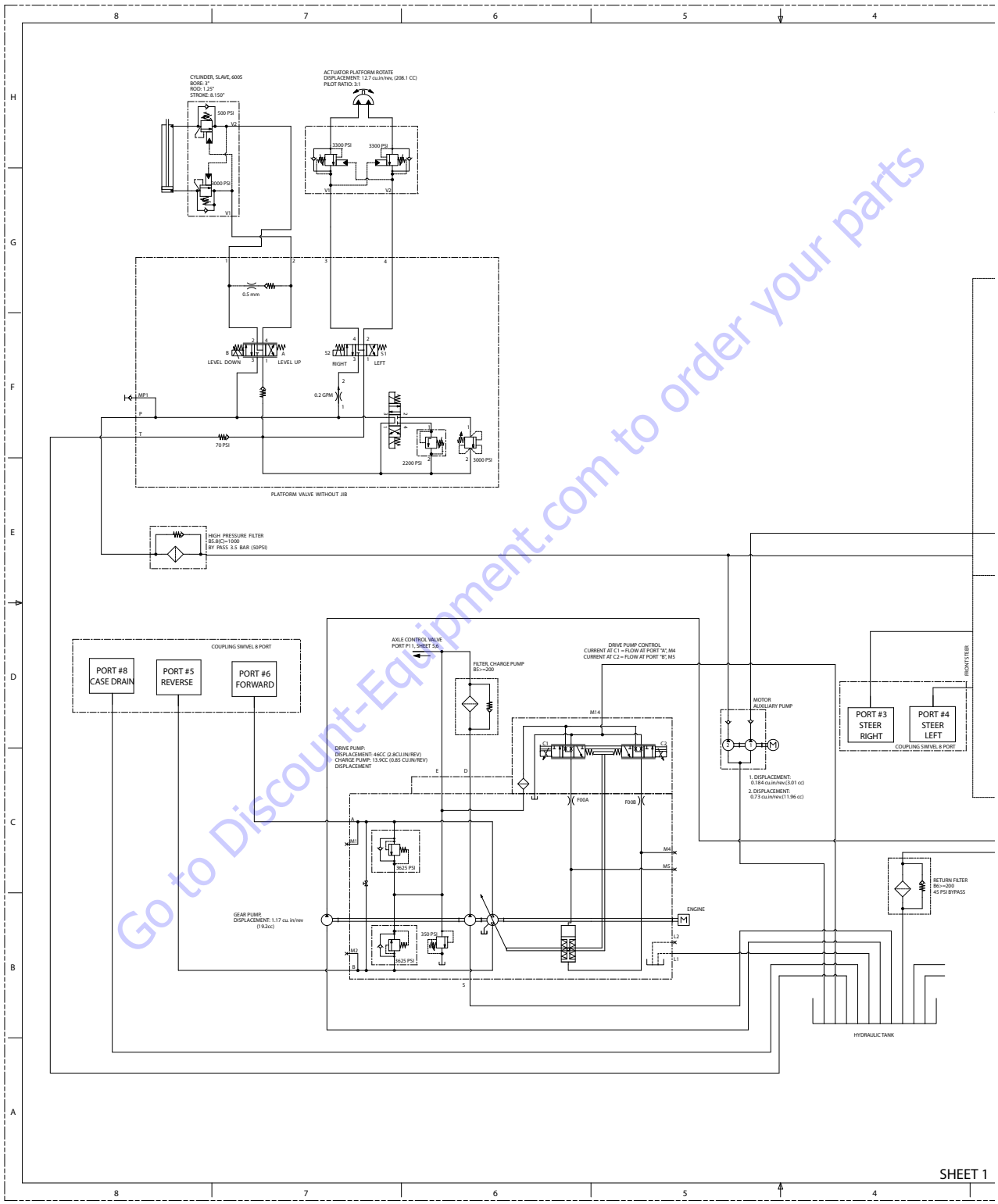


Figure 5-86. 2-Wheel Steer (2WS) without Jib Hydraulic Schematic - Sheet 1 of 2

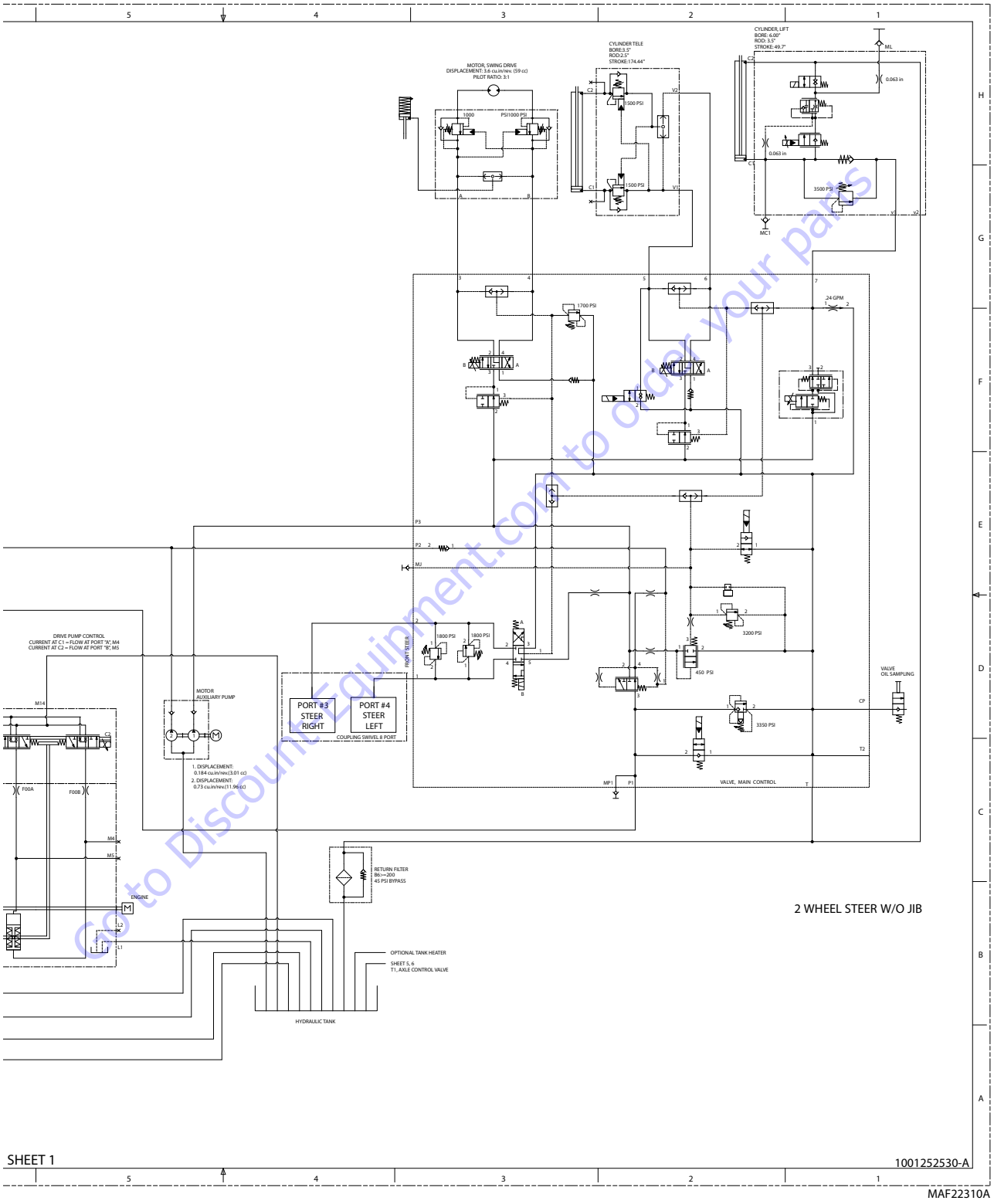


Figure 5-87. 2-Wheel Steer (2WS) without Jib Hydraulic Schematic - Sheet 2 of 2

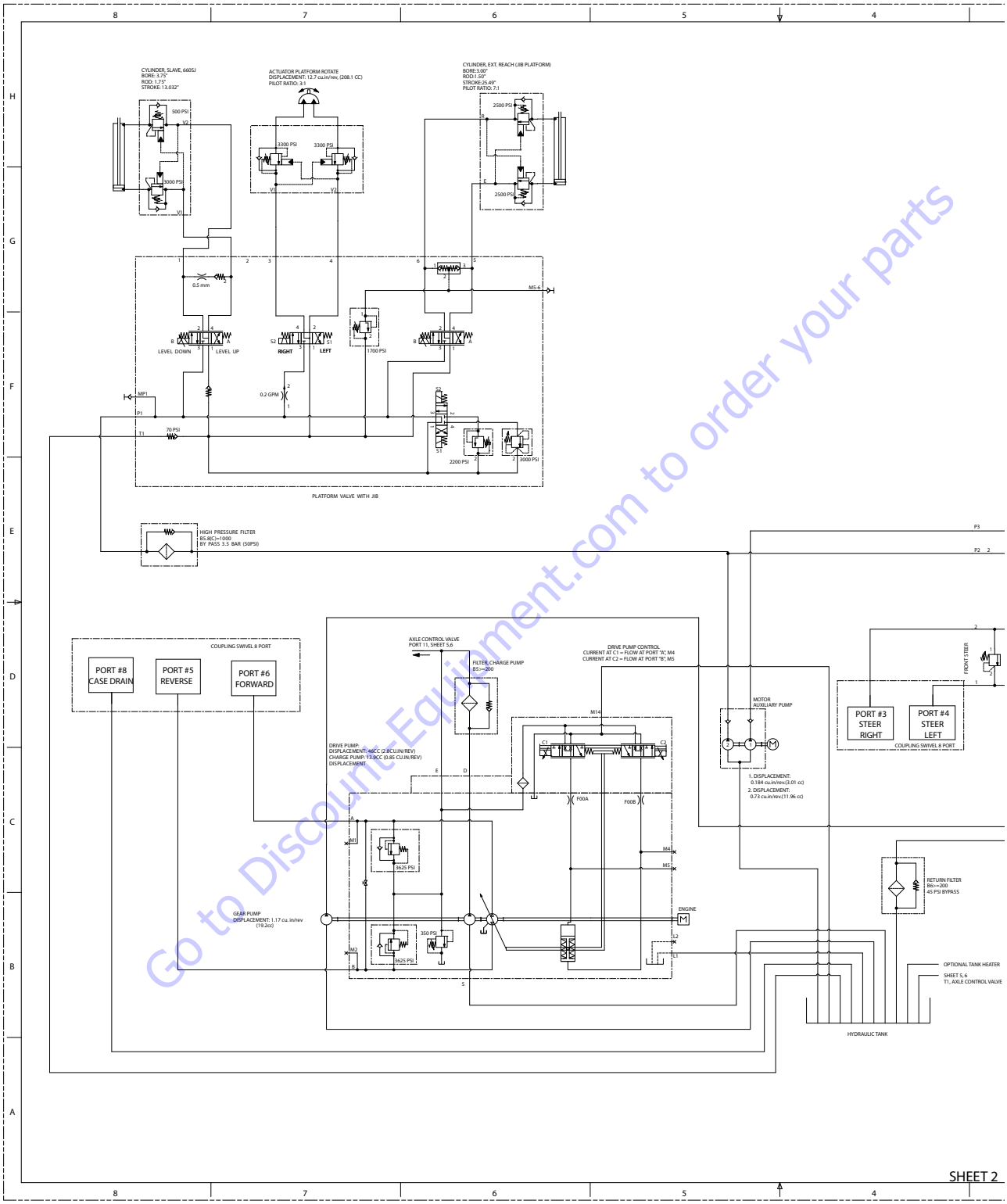


Figure 5-88. 2-Wheel Steer (2WS) with Jib Hydraulic Schematic - Sheet 1 of 2

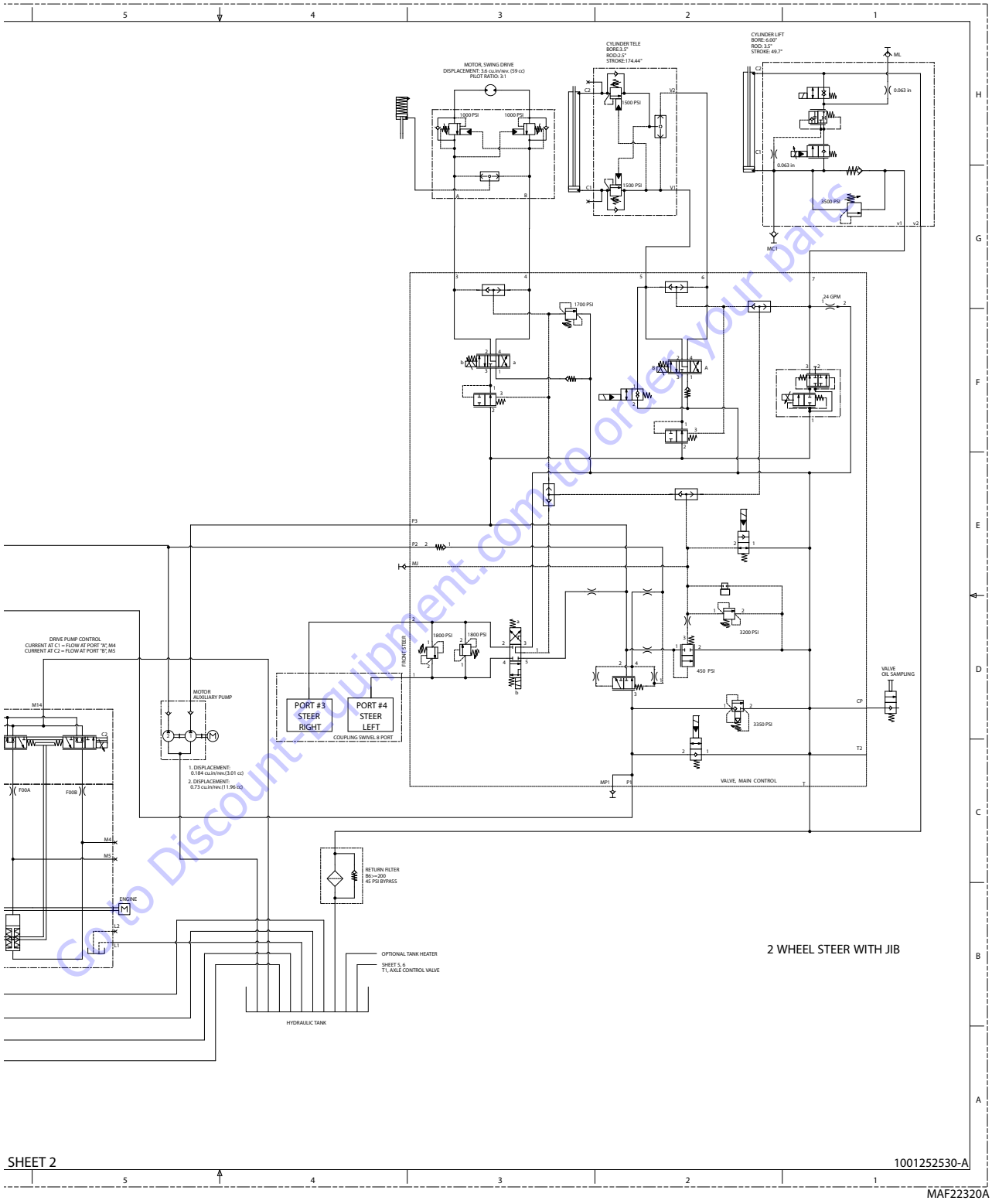


Figure 5-89. 2-Wheel Steer (2WS) with Jib Hydraulic Schematic - Sheet 2 of 2

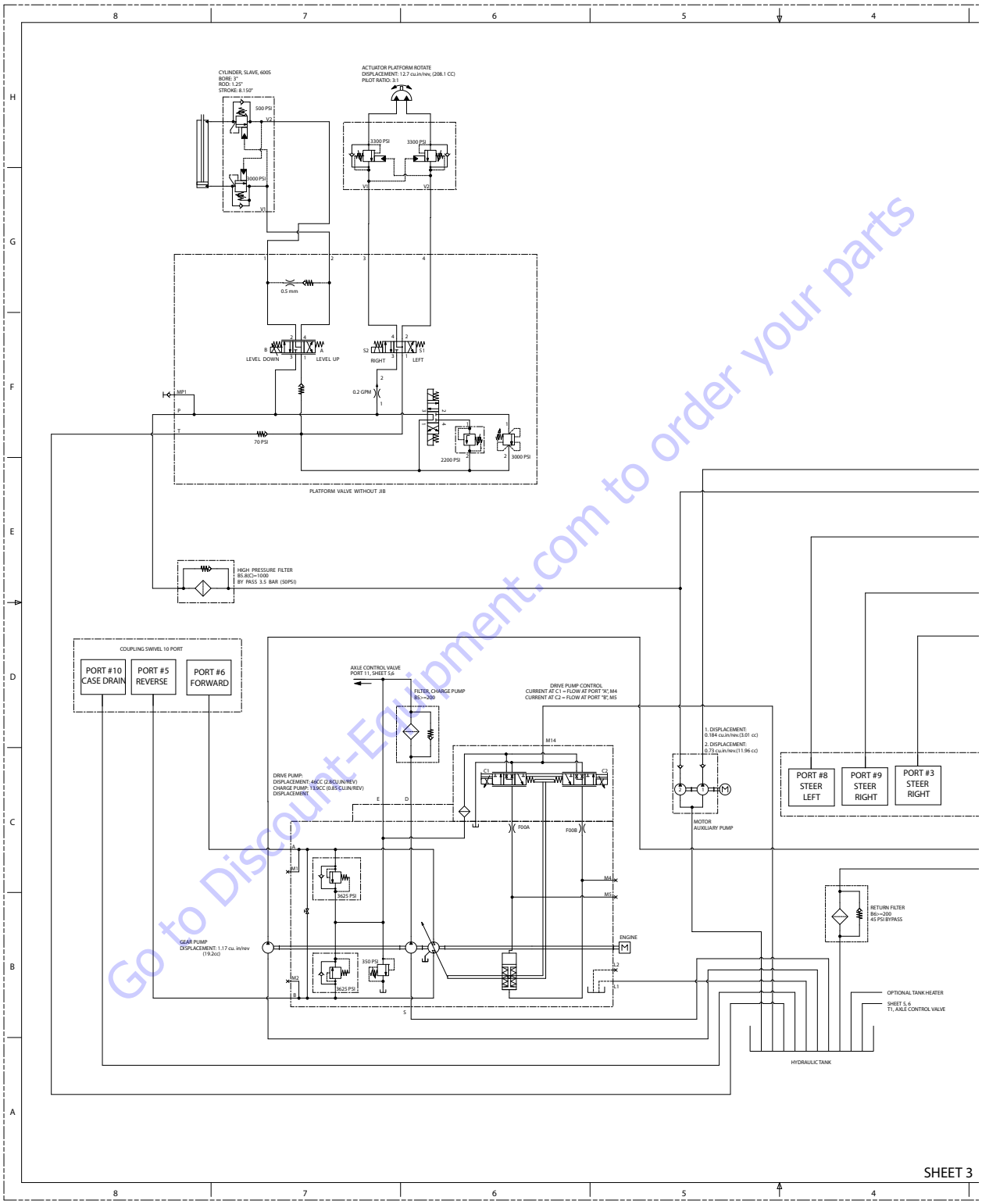


Figure 5-90. 4-Wheel Steer (4WS) without Jib Hydraulic Schematic - Sheet 1 of 2

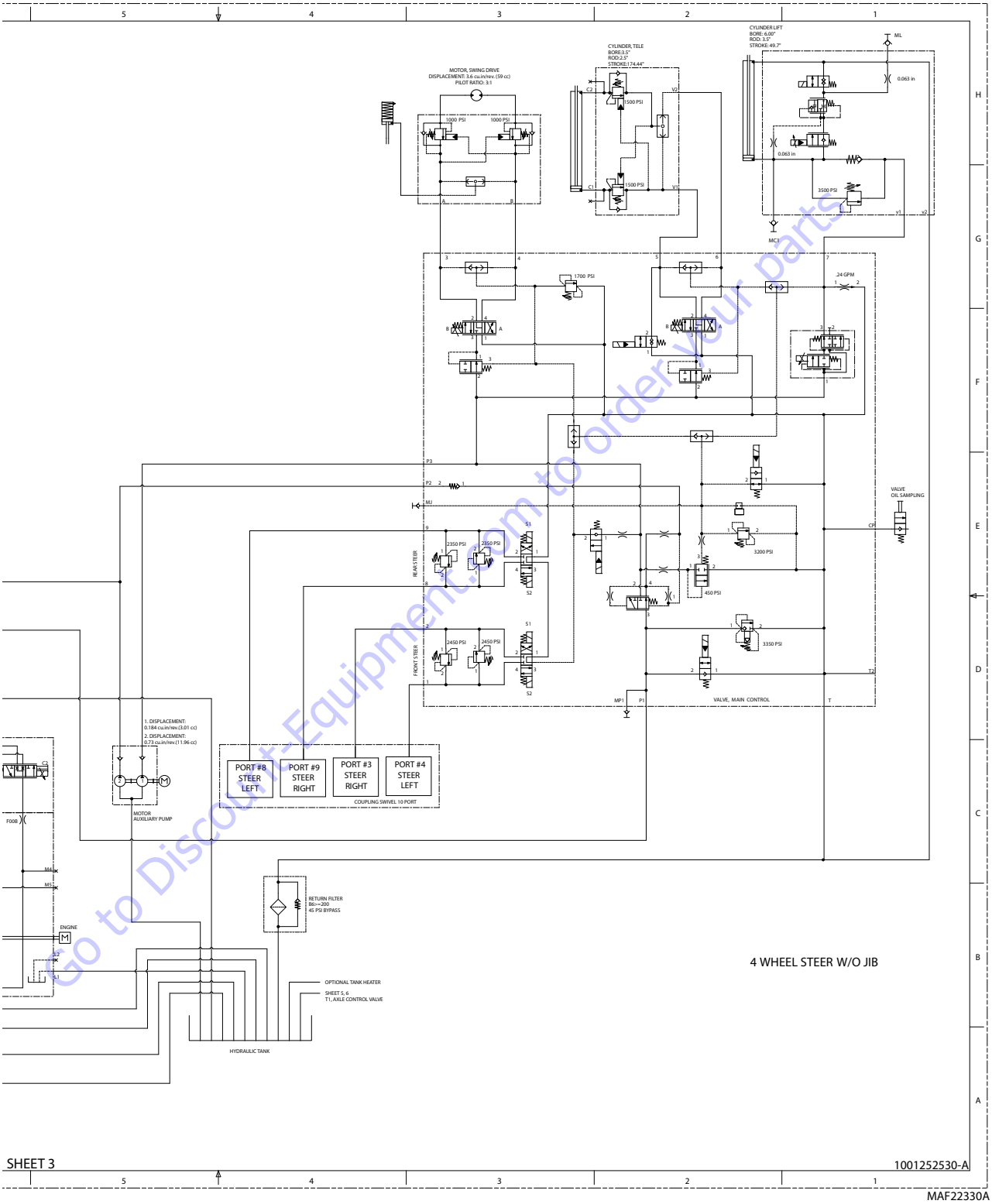


Figure 5-91. 4-Wheel Steer (4WS) without Jib Hydraulic Schematic - Sheet 2 of 2

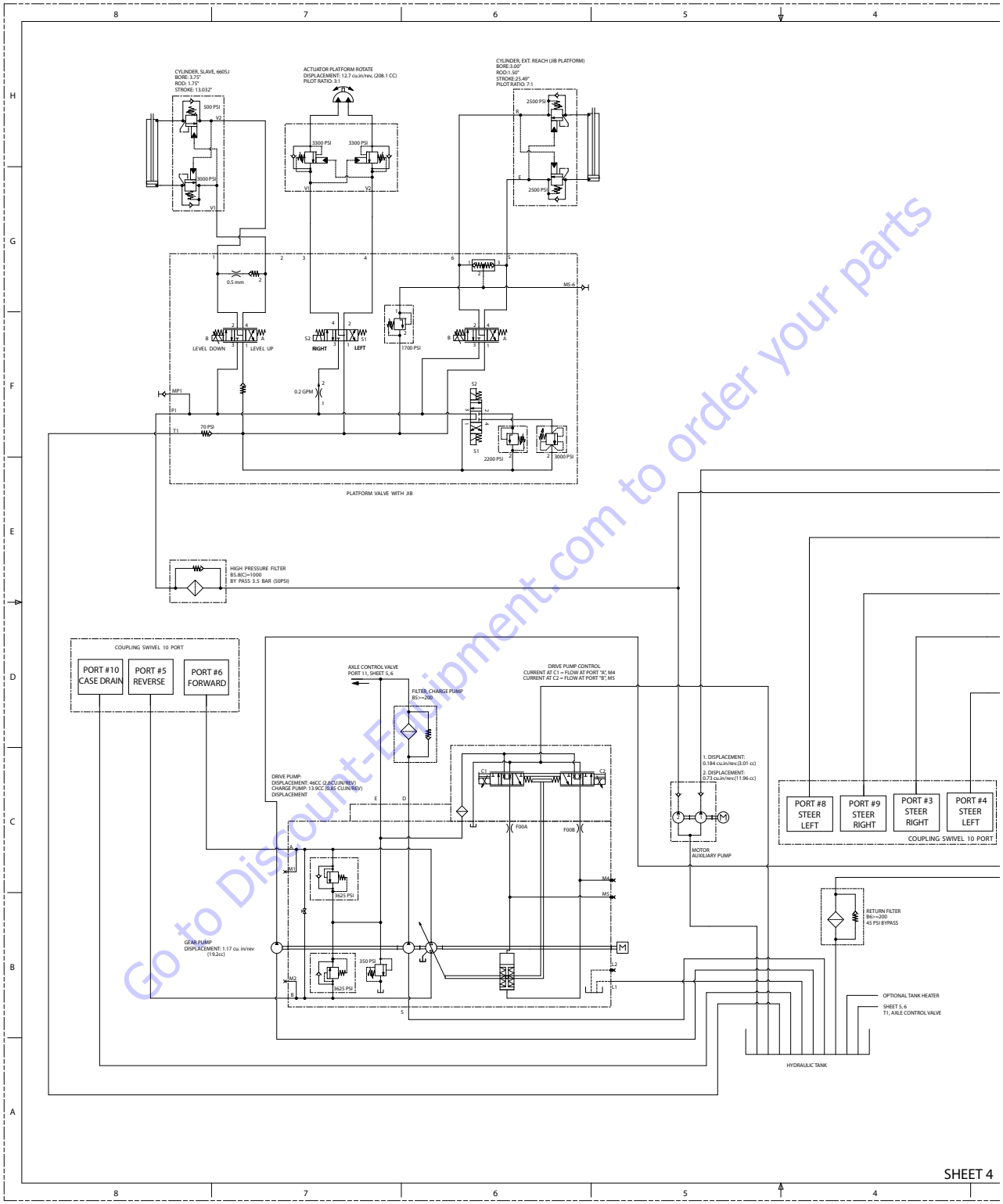


Figure 5-92. 4-Wheel Steer (4WS) with Jib Hydraulic Schematic - Sheet 1 of 2

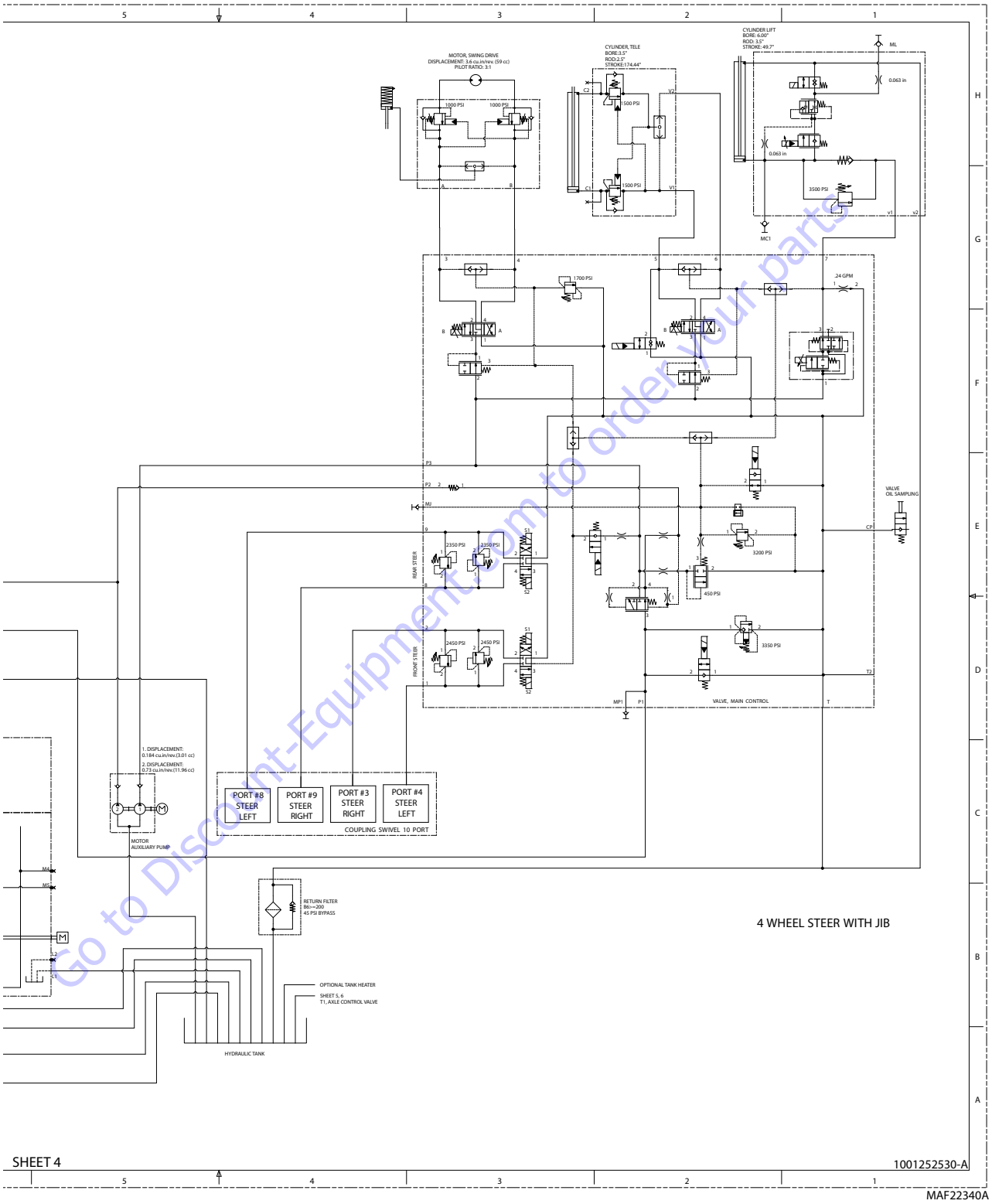


Figure 5-93. 4-Wheel Steer (4WS) with Jib Hydraulic Schematic - Sheet 2 of 2

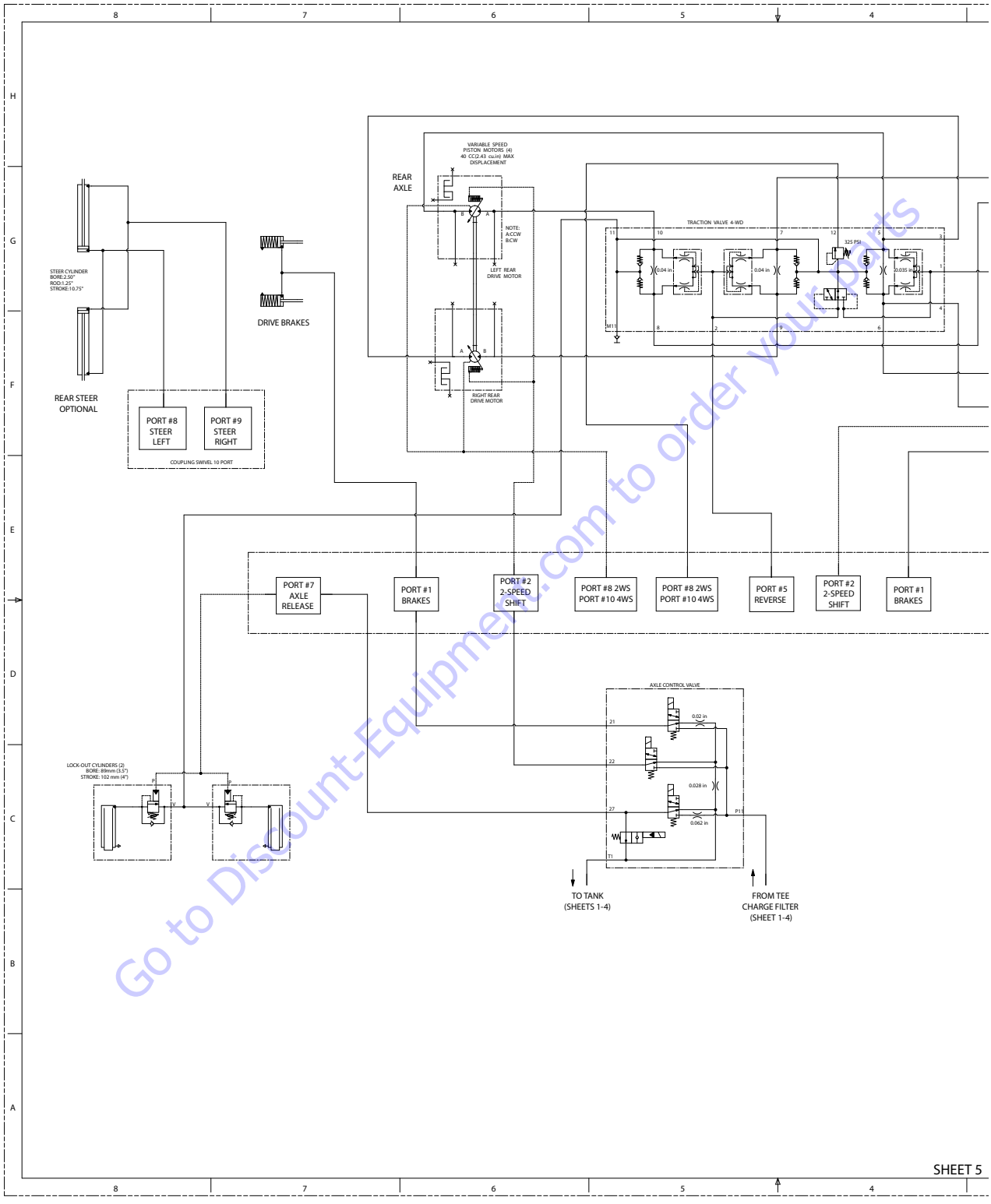


Figure 5-94. 4-Wheel Drive (4WD) Hydraulic Schematic - Sheet 1 of 2

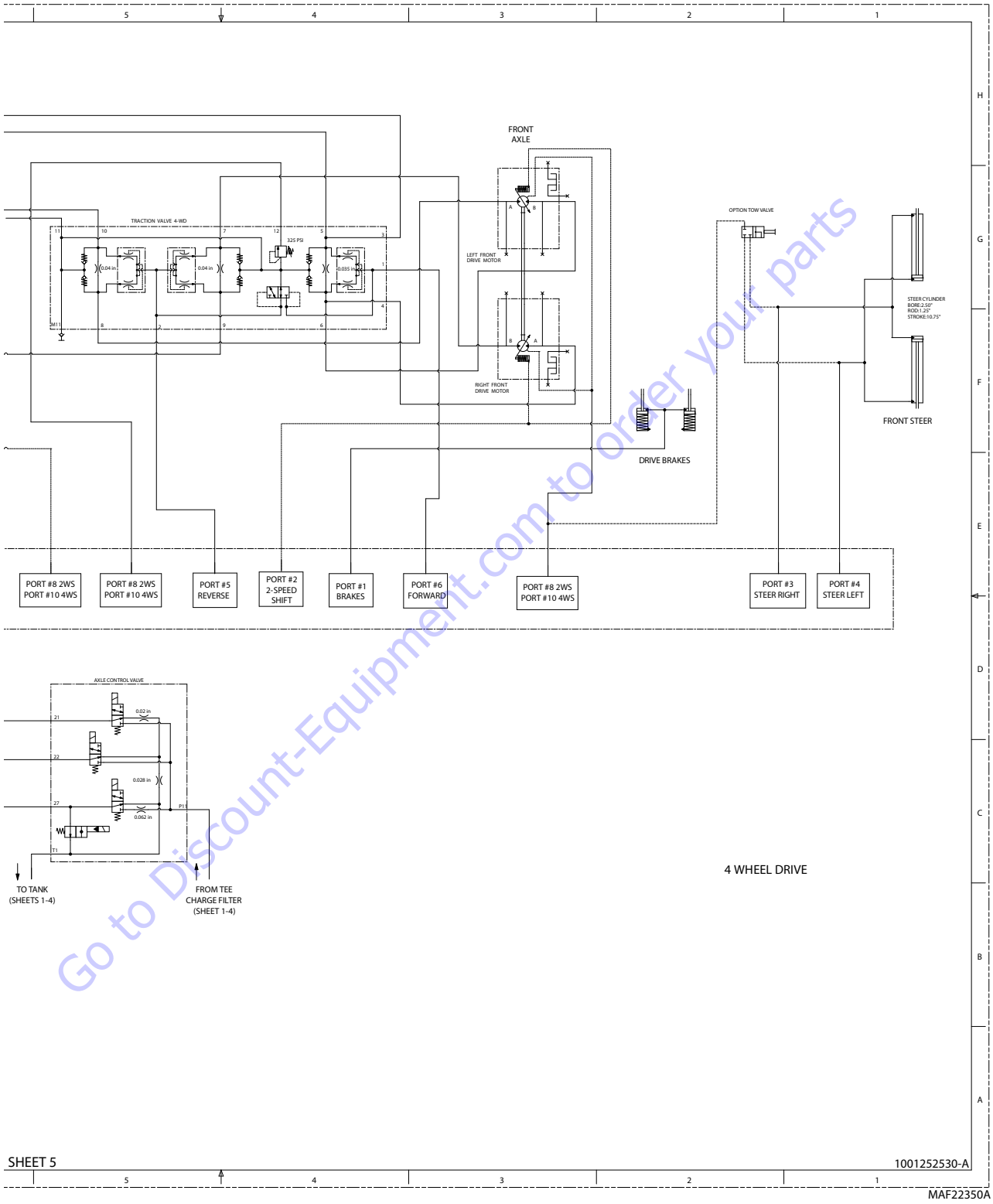


Figure 5-95. 4-Wheel Drive (4WD) Hydraulic Schematic - Sheet 2 of 2

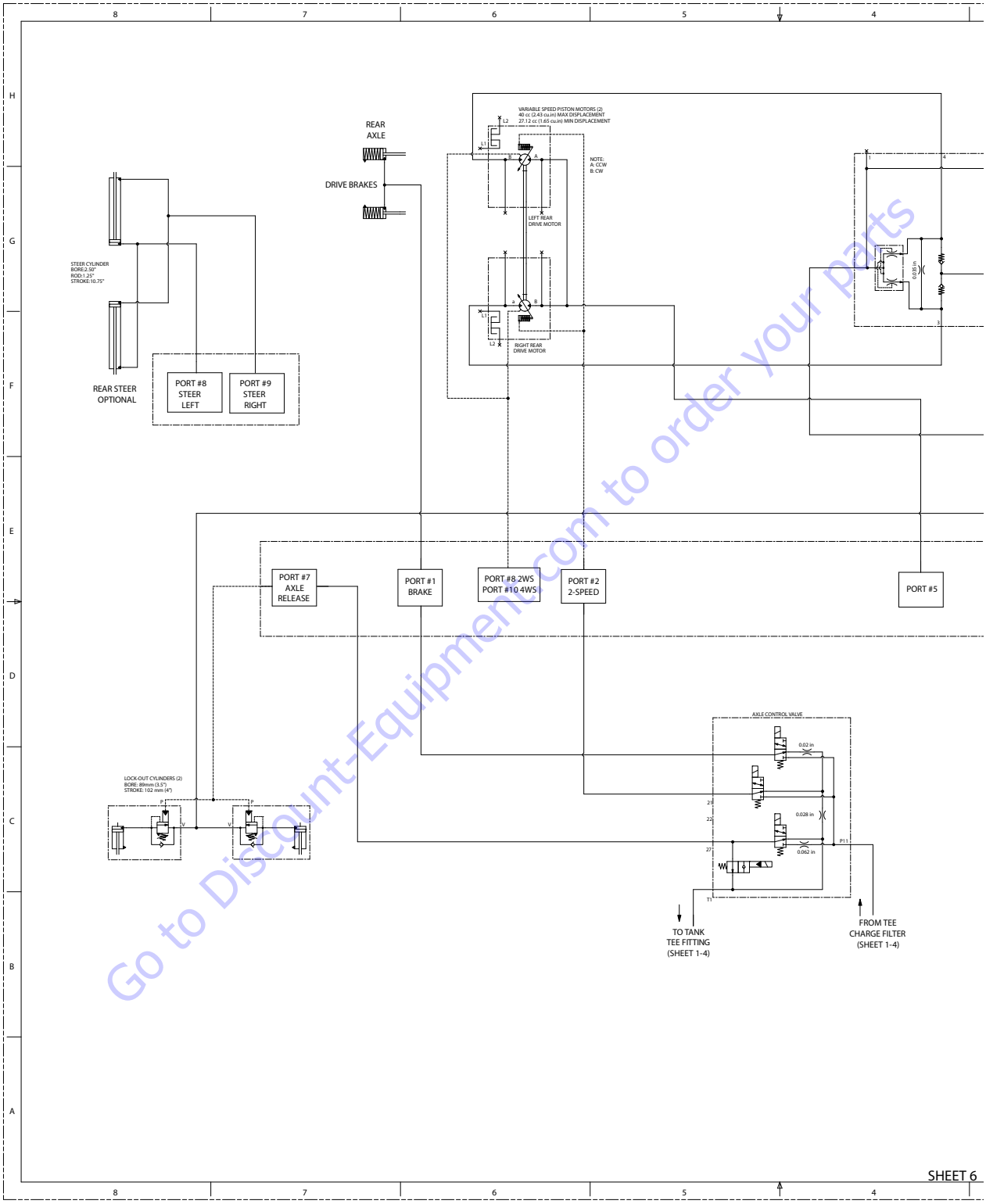


Figure 5-96. 2-Wheel Drive (2WD) Hydraulic Schematic - Sheet 1 of 2

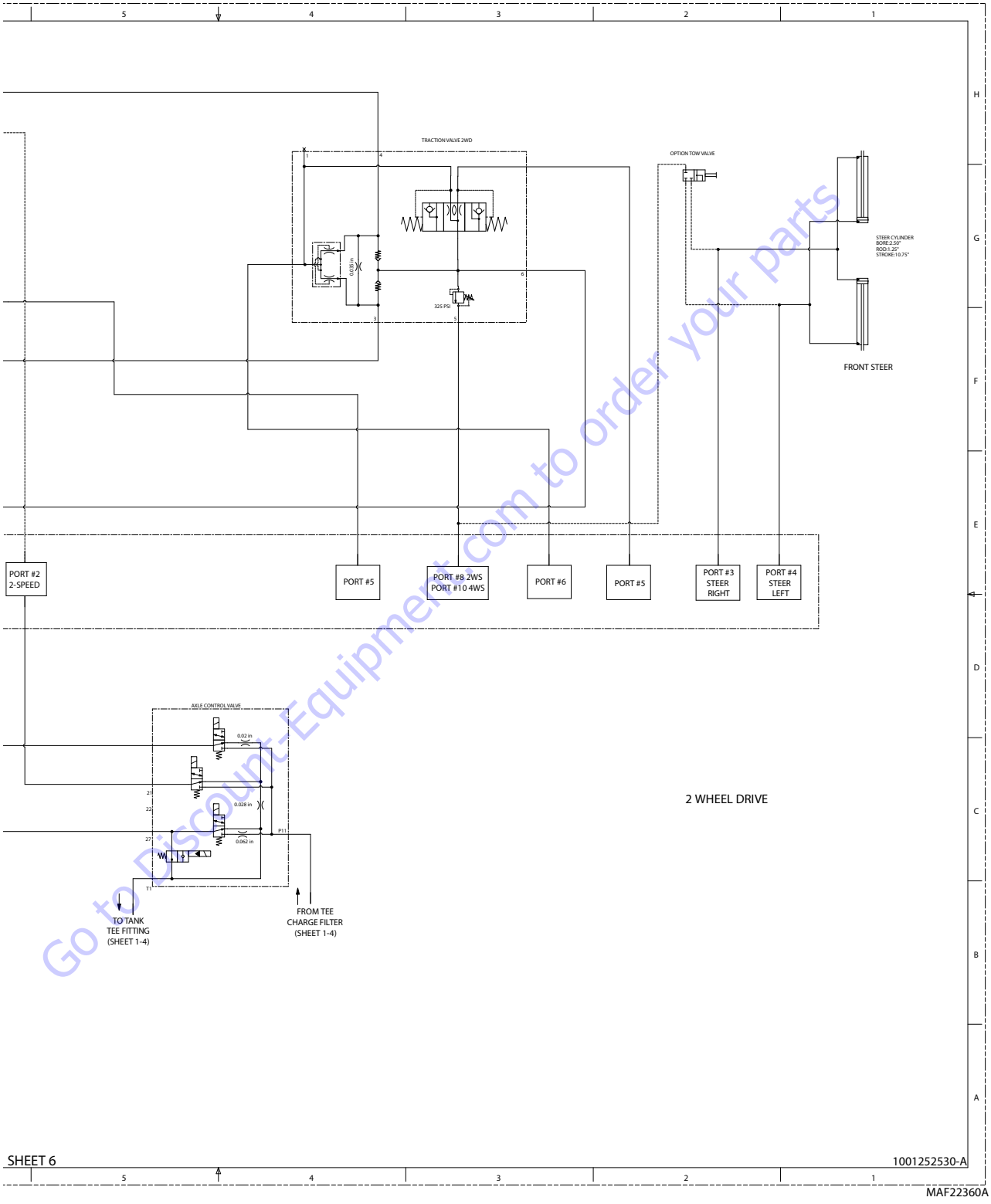


Figure 5-97. 2-Wheel Drive (2WD) Hydraulic Schematic - Sheet 2 of 2

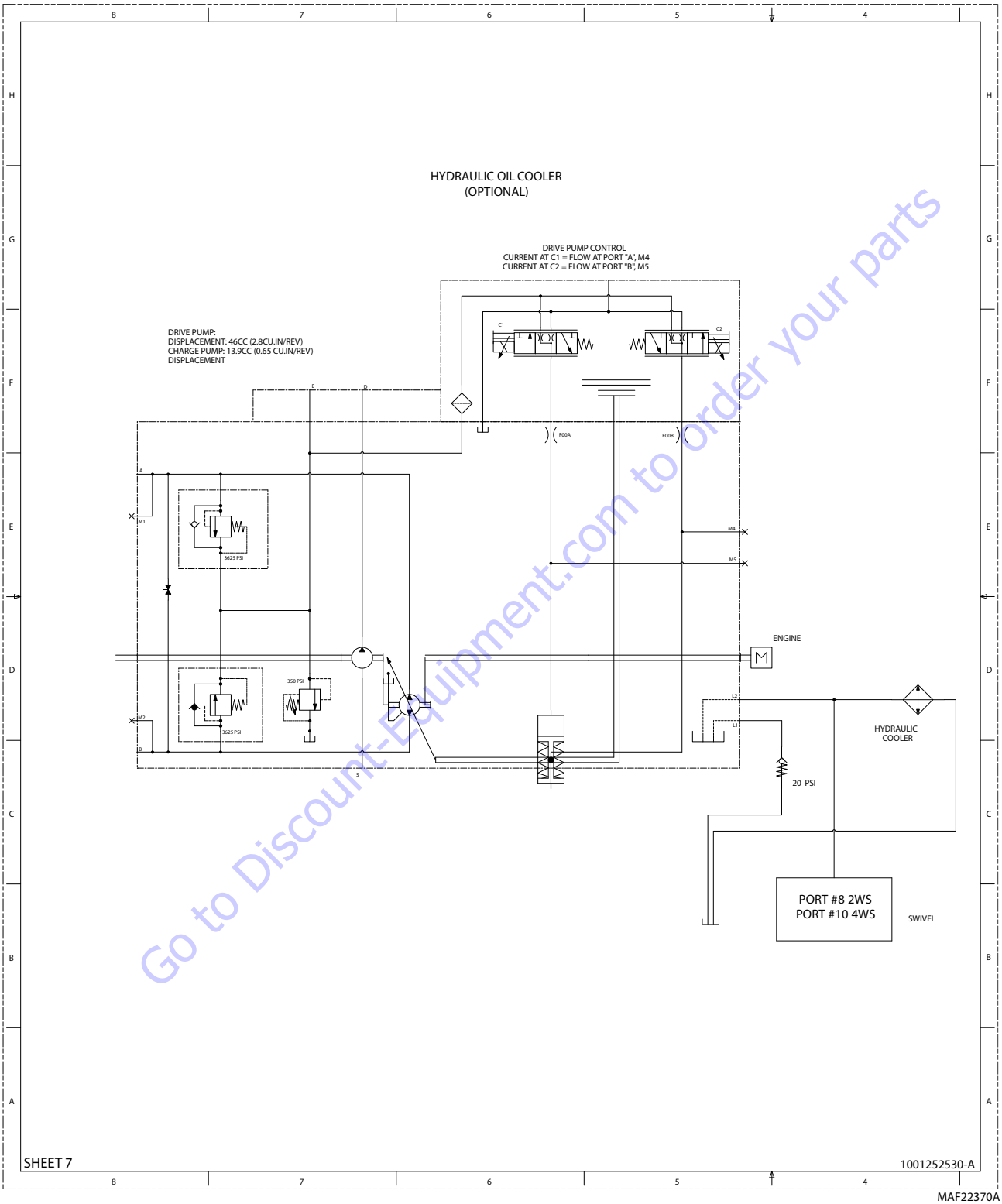


Figure 5-98. Hydraulic Oil Cooler Schematic

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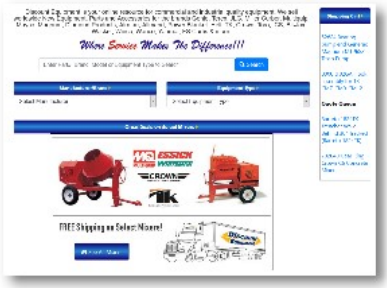
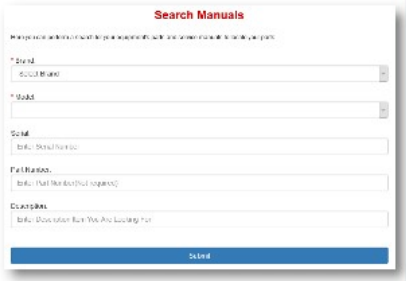


Search Manual Library For Parts Manual & Lookup Part Numbers – Purchase or Request Quote



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SECTION 6. JLG CONTROL SYSTEM

6.1 JLG CONTROL SYSTEM ANALYZER KIT INSTRUCTIONS

NOTICE

WHEN INSTALLING A NEW GROUND MODULE CONTROLLER IT IS NECESSARY TO PROGRAM THE CONTROLLER FOR PROPER MACHINE CONFIGURATION, INCLUDING OPTIONS.

NOTICE

AVOID PRESSURE-WASHING ELECTRICAL/ELECTRONIC COMPONENTS. IF PRESSURE-WASHING IS USED 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) FROM THESE COMPONENTS. IF ELECTRICAL/ELECTRONIC COMPONENTS ARE SPRAYED, SPRAYING MUST NOT BE DIRECT AND FOR BRIEF TIME PERIODS TO AVOID HEAVY SATURATION.

The JLG designed Control System is a 12 volt based motor control unit installed on the boom lift.

The JLG Control System has reduced the need for exposed terminal strips, diodes and trimpots and provides simplicity in viewing and adjusting the various personality settings for smooth control of: acceleration, deceleration, creep, min speed, and max.-speed for all boom, drive, and steering functions.

Upper lift, swing, and drive are controlled by individual joysticks. Steering is controlled by a rocker switch built in the top of the drive joystick. To activate Drive, Lift, and Swing; pull up the slide lock on the joystick and move the handle in the desired direction.

The control system provides voltage output to the valves and pump, as programmed, for smooth operation and maximum cycle time. Ground control speeds for all boom functions can also be programmed in the control system.

The JLG Control System controller has a built in LED to indicate any faults. The system stores recent faults which may be accessed for troubleshooting. Optional equipment includes a soft touch system, head and tail lights, and ground alarm. These options may be added later but must be programmed into the control system when installed.

The Control System may be accessed with a custom designed, direct connect hand held analyzer or wireless adapter using an app on your Android or iPhone/iPad device. The analyzer or wireless output displays two lines of information at a time, by scrolling through the program.

Each module has a label with JLG part number and a serial number containing a date code.

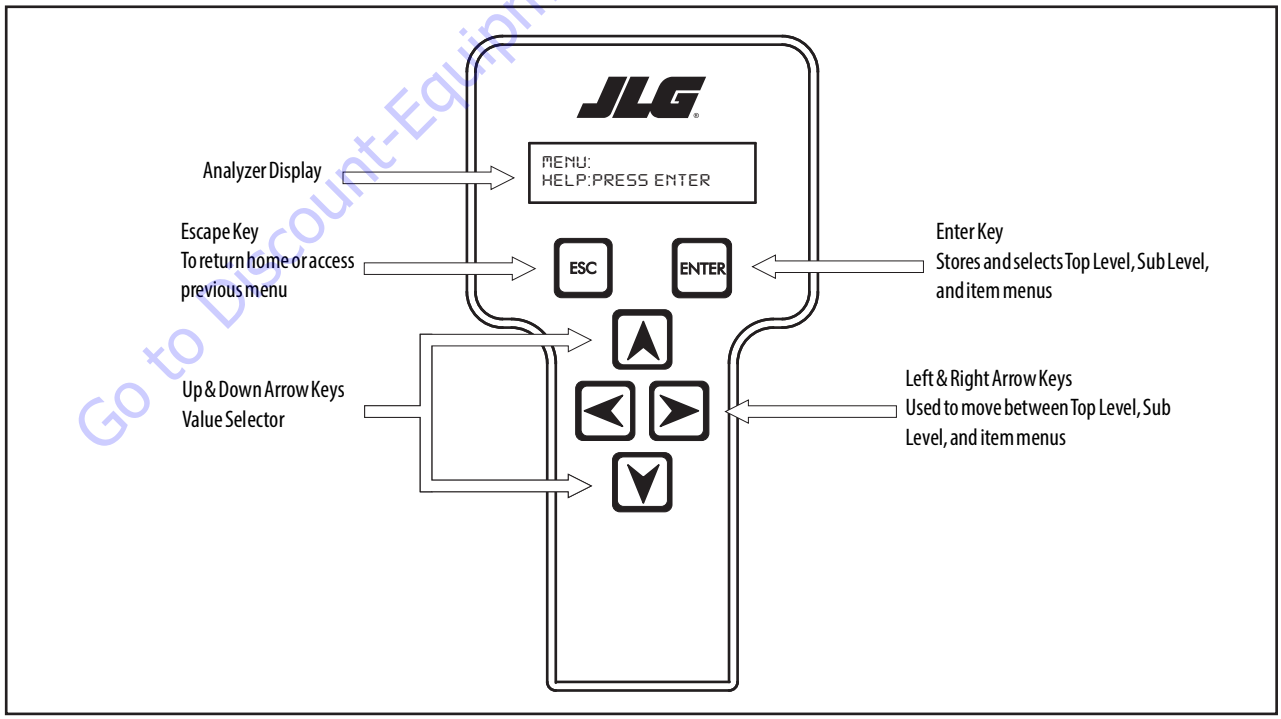


Figure 6-1. Hand Held Analyzer

Connect JLG Control System Analyzer

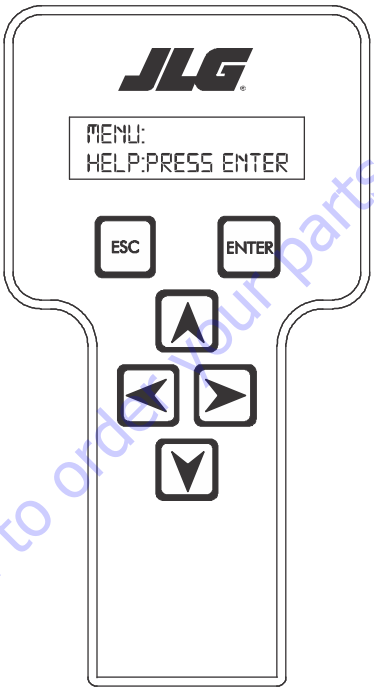
1. Connect the four pin end of the cable supplied with the analyzer, to the motor controller module located in the platform box or at the power module and connect the remaining end of the cable to the analyzer.

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 lower key to the platform or ground position and pulling both emergency stop buttons on.

Using Analyzer

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



MENU:
HELP:PRESS ENTER

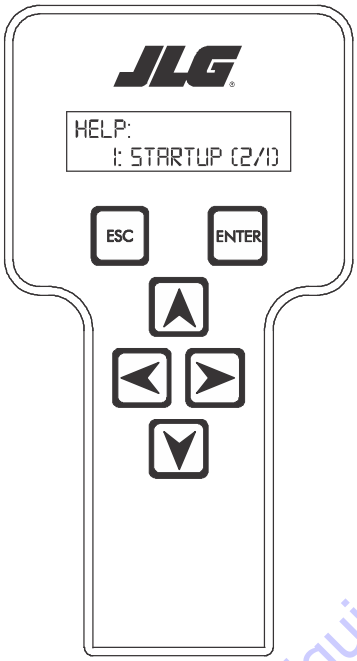
Move between top level menu items using **RIGHT** and **LEFT** arrow keys. To select a displayed menu item, press **ENTER**. To cancel a selected menu item press **ESC**. Scroll using right and left arrow keys to select a different menu item.

Top level menus are as follows:

HELP
DIAGNOSTICS
SYSTEM TEST
OPERATOR ACCESS
PERSONALITIES
MACHINE SETUP
CALIBRATIONS

If you press **ENTER** [ENTER], at the **HELP: PRESS ENTER** display, and a fault is present, the analyzer display will scroll the fault across the screen. If there was no fault detected, the display will read: **HELP: EVERYTHING OK.** If powered up at the ground station, the display shows: **GROUND OK.**

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



LOGGED HELP
1: STARTUP (2/1)

At this point, the analyzer will display the last fault the system has seen, if any are present. You may scroll through the fault logs to view what the last 25 faults were. Use the right and left arrow keys to scroll through the fault logs. To return to the beginning, press **ESC** [ESC] two times. **STARTUP (2/1)** indicates a power up.

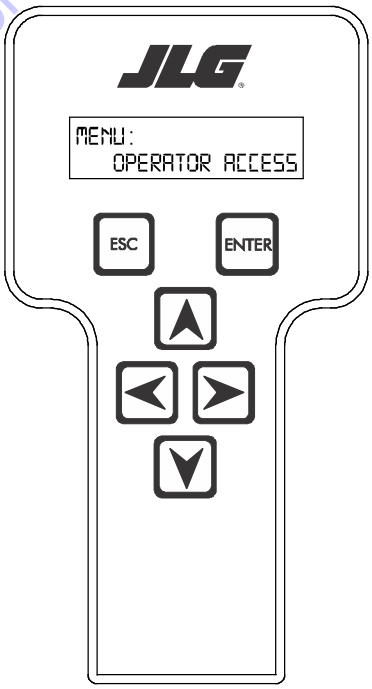
When a top level menu is selected, a new set of menu items may be offered: for example:

DRIVE
BOOM
ENGINE
SYSTEM
OPER CONTROLS
PLATFORM LOAD
CAN STATISTICS
CALIBRATION DATA
DATALOG
VERSIONS

Pressing **ENTER** [ENTER] with any of the above displayed menus, displays additional sub-menus within the selected menu. In some cases, such as **DRIVE**, 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 **ESCAPE** [ESC] key.

Changing Access Level

When analyzer is first connected, you will be in access level 2 which enables you to only view most 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 access level, the correct password must be entered. To enter password, scroll to **ACCESS LEVEL** menu. For example:



ACCESS LEVEL:
CODE 00000

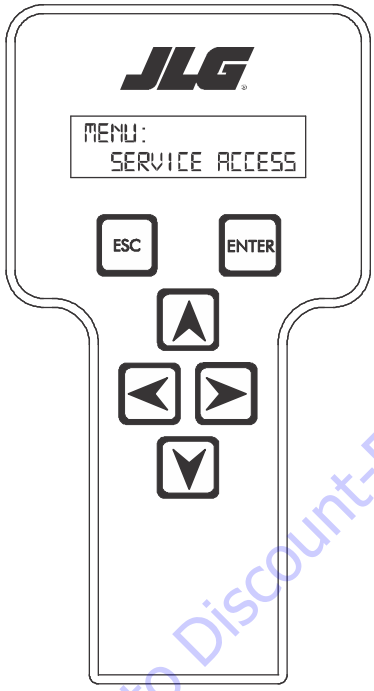
Press **ENTER** ENTER to select the **ACCESS LEVEL** menu.

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

Then using the **RIGHT** arrow key, position cursor 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 33271.

When correct password is displayed, press **ENTER** ENTER. The access level displays the following if password was entered correctly:

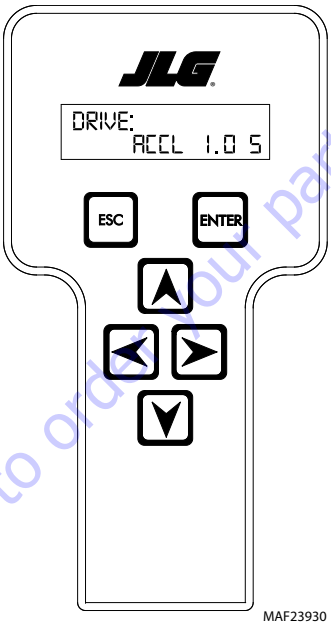


MENU:
SERVICE ACCESS

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

Adjust Parameters

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:

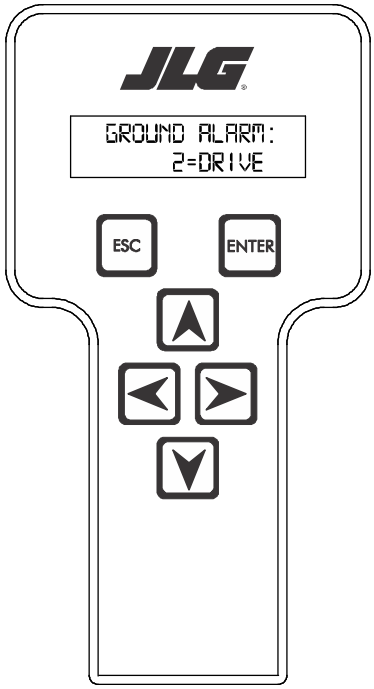


DRIVE:
ACCEL 1.0S

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 at maximum value or decrease if the **DOWN** arrow is pressed at minimum value for any personality. If value does not change when pressing up and down arrows, check access level is at access level 1.

Machine Setup

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



GROUND ALARM:
2 = DRIVE

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 selection the machine model to match the size of the machine, the personality settings will all default to the factory recommended setting.

NOTE: *Refer to Personality Ranges/Defaults for the recommended factory settings.*

NOTE: *Password 33271 allows access to level 1 to change machine personality settings.*

There is a setting that JLG strongly recommends that you do not change. This setting is so noted below:

ELEVATION CUTBACK

⚠ WARNING

CHANGING ELEVATION CUTBACK SETTING MAY ADVERSELY AFFECT PERFORMANCE OF YOUR MACHINE.

NOTICE

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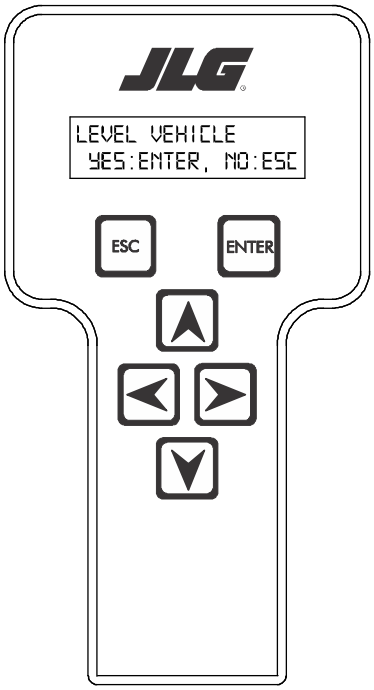
Level Vehicle Description

⚠ WARNING

DO NOT LEVEL VEHICLE EXCEPT ON A LEVEL SURFACE.



LEVEL VEHICLE
YES:ENTER, NO:ESC

Not available at password level 2. **ENTER** confirms vehicle is currently level, and zeroes the tilt sensor measurements.

Table 6-1. Analyzer Abbreviations

ABBREVIATION	MEANING
ACCEL	ACCELERATE
ACT	ACTIVE
A/D	ANALOG DIGITAL CONVERTER COUNT
AMB.	AMBIENT
ANG	ANGLE
AUX	AUXILIARY
BCS	BOOM CONTROL SYSTEM
BM	BOOM LENGTH ANGLE MODULE
BLAM	BOOM LENGTH ANGLE MODULE
BR	BROKEN
BSK	BASKET
CAL	CALIBRATION
CL	CLOSED
CM	CHASSIS MODULE
CNTL	CONTROL
CNTRL	CONTROL
C/O	CUT OUT
CONT(S)	CONTRACTOR(S)
COOR	COORDINATED
CRK PT	CRACK POINT
CRP	CREEP
CUT	CUTOUT
CYL	CYLINDER
DECEL	DECELERATE
D	DOWN
DN	DOWN
DWN	DOWN
DEG.	DEGREE
DOS	DRIVE ORIENTATION SYSTEM
DRV	DRIVE
E	ERROR
E&T	ELEVATED & TILTED
ELEV	ELEVATION
ENG	ENGINE
EXT	EXTEND
F	FRONT
FL	FLOW
FNT	FRONT
FOR	FORWARD
FWD	FORWARD
FSW	FOOT SWITCH
FUNC	FUNCTION
G	GROUND

Table 6-1. Analyzer Abbreviations

ABBREVIATION	MEANING
GND	GROUND
GRN	GREEN
GM	GROUND MODULE
H	HOURS
HW	HARDWARE
HWFS	HARDWARE FAILSAFE
I	IN or CURRENT
JOY	JOYSTICK
L	LEFT
LB	POUND
LEN	LENGTH
LIM	LIMIT
LT	LEFT
LVL	LEVEL
M	MINUTES
MIN	MINIMUM
MAX	MAXIMUM
M	MAIN
MN	MAIN
NO	NORMALLY OPEN or NO
NC	NORMALLY CLOSED
O	OUT
O/C	OPEN CIRCUIT
OP	OPEN
O/R	OVERRIDE or OUTRIGGER
O//R	OVERRIDE
OSC	OSCILLATING
OVRD	OVERRIDE
P	PLATFORM
P	PRESSURE
PCV	PROPORTIONAL CONTROL VALVE
PLAT	PLATFORM
PLT	PLATFORM
PM	PLATFORM MODULE
POT	POTENTIOMETER
PRES	PRESSURE
PRS	PRESSURE
PT	POINT
R	REAR or RIGHT
REV	REVERSE or REVISION
RET	RETRACT
ROT.	ROTATE
RT	RIGHT

Table 6-1. Analyzer Abbreviations

ABBREVIATION	MEANING
S/C	SHORT CIRCUIT
SEL	SELECTOR
SN	SERIAL NUMBER
SPD	SPEED
STOW	STOWED
STOWD	STOWED
SW	SWITCH or SOFTWARE
TELE	TELESCOPE
TEMP	TEMPERATURE
TORQ.	TORQUE
TRN	TRANSPORT
T/T	TURNTABLE
T	TOWER
TURNTBL	TURNTABLE
TWR	TOWER
U	UPPER or UP
V	VOLT
VER	VERSION
VLV	VALVE
WIT	WITNESS
YEL	YELLOW

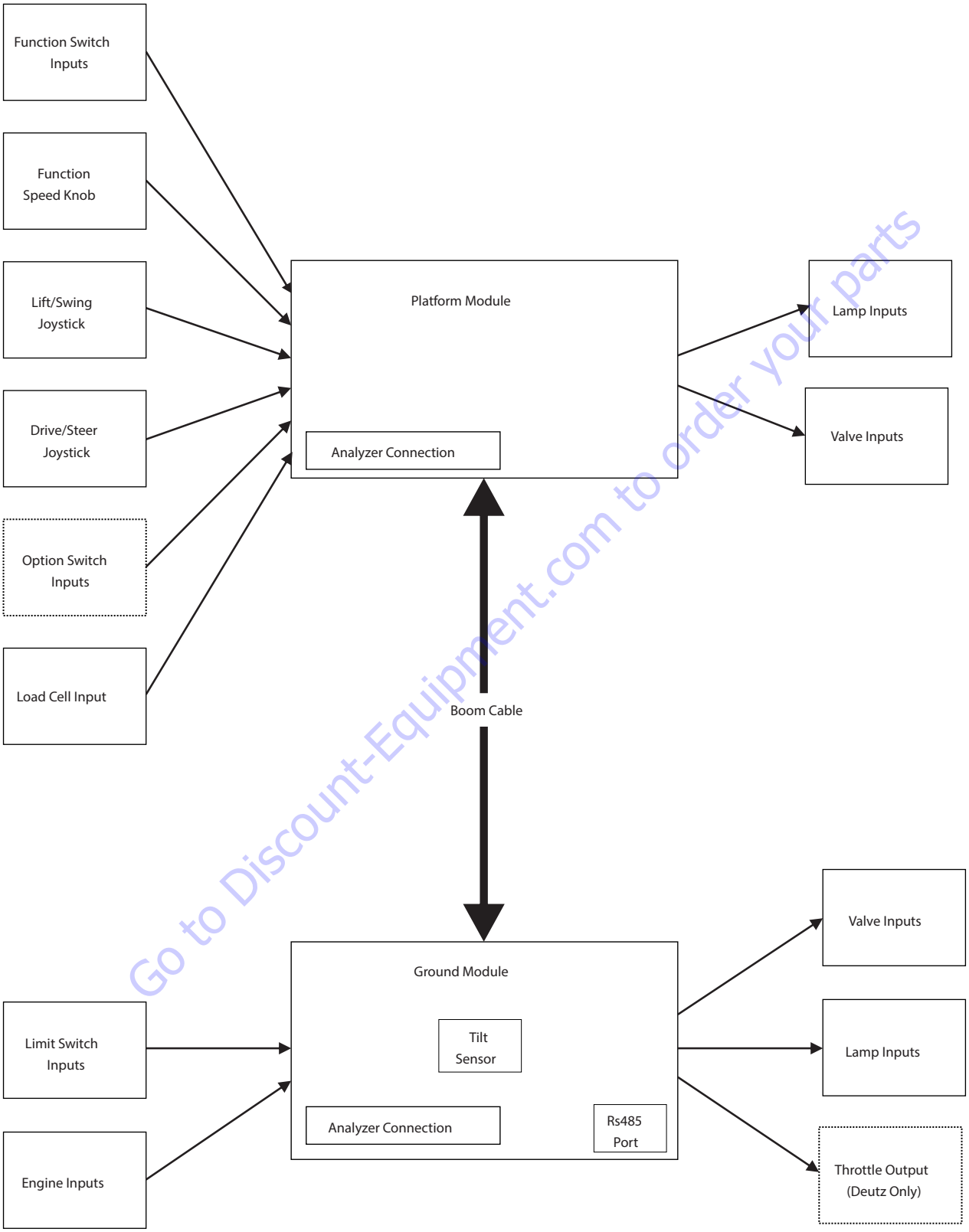
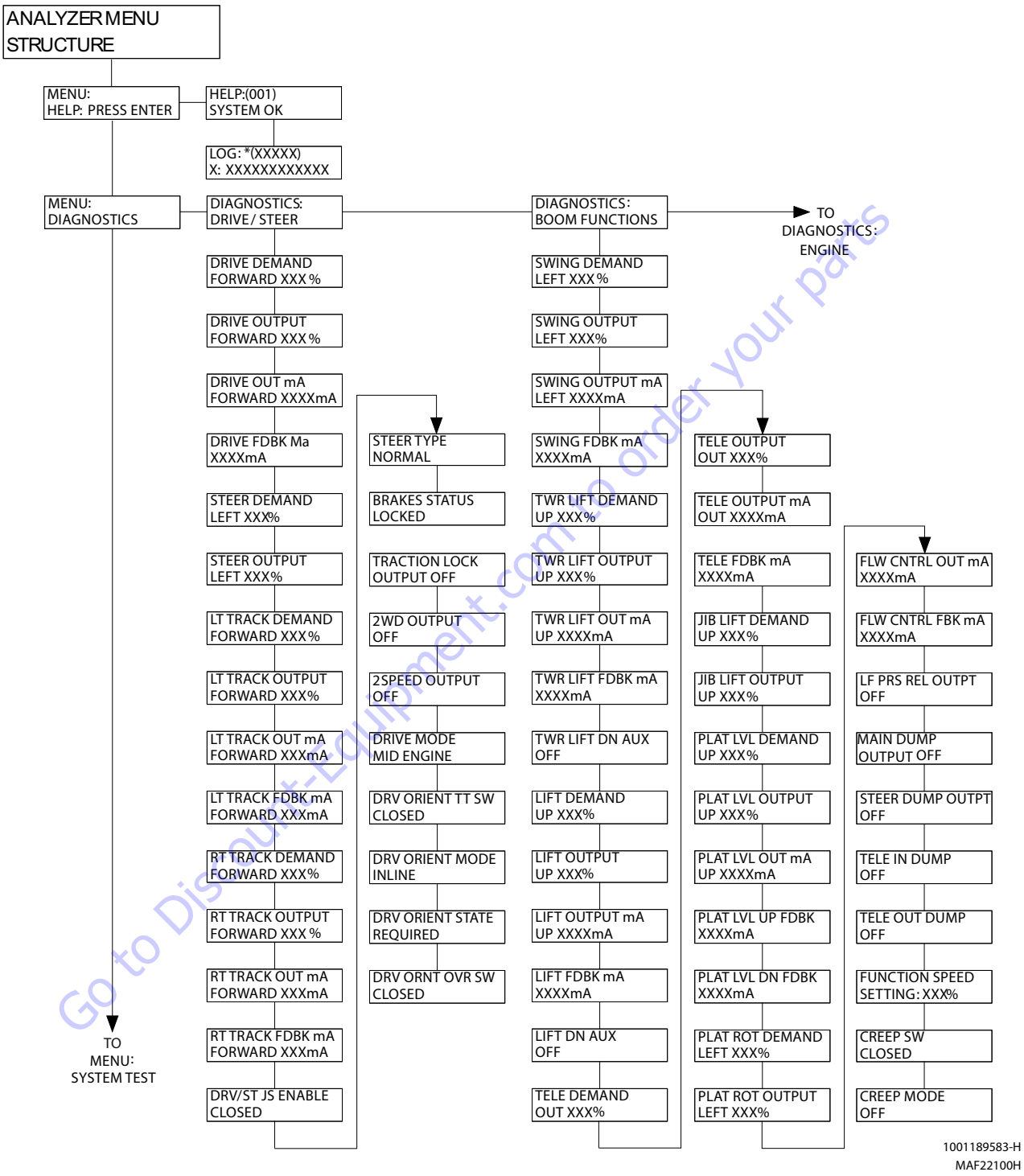
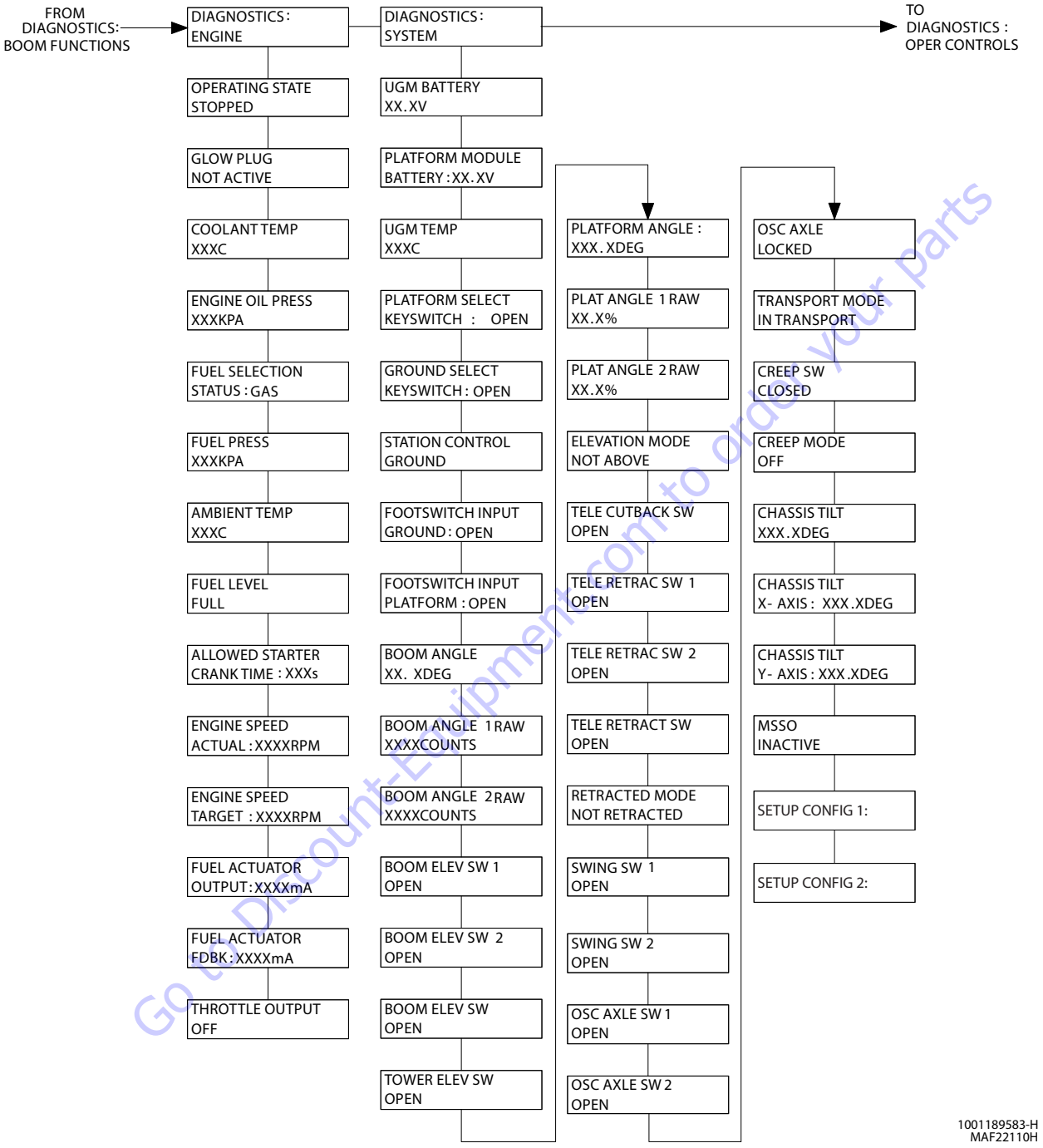


Figure 6-2. ADE Block Diagram



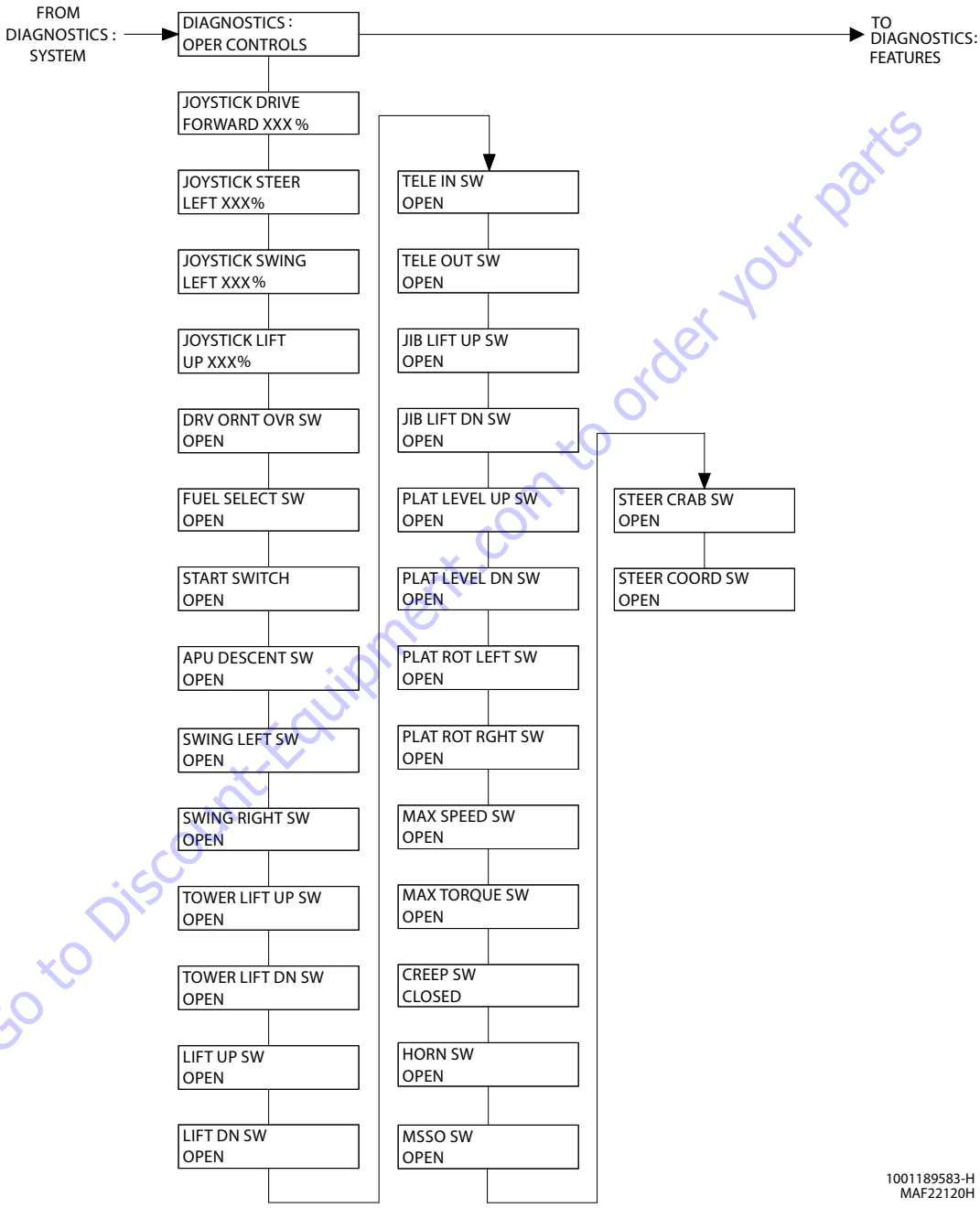
NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration and software versions.*

Figure 6-3. Analyzer Software P2.13 - Sheet 1 of 14



NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration and software versions.*

Figure 6-4. Analyzer Software P2.13 - Sheet 2 of 14



NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration and software versions.*

Figure 6-5. Analyzer Software P2.13 - Sheet 3 of 14

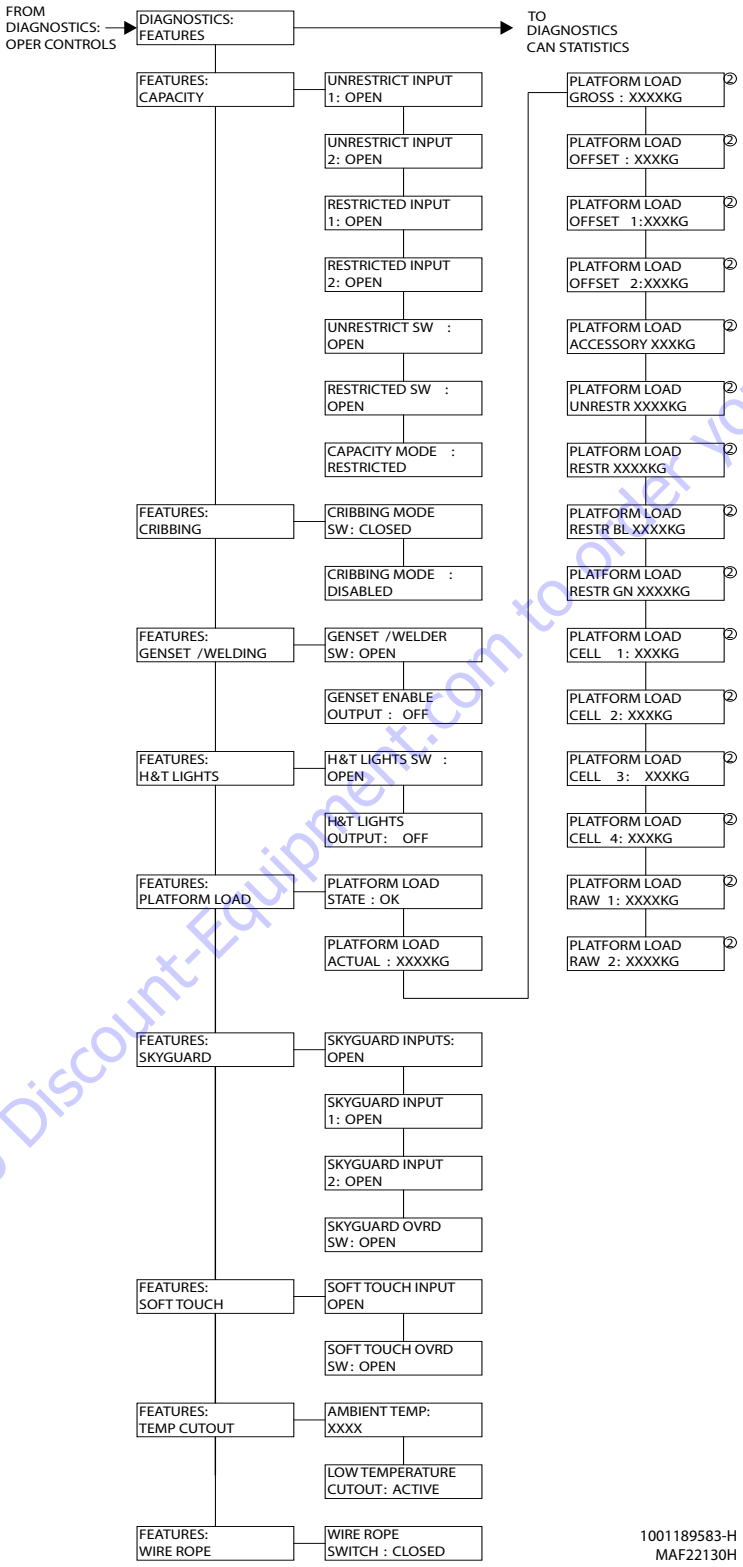
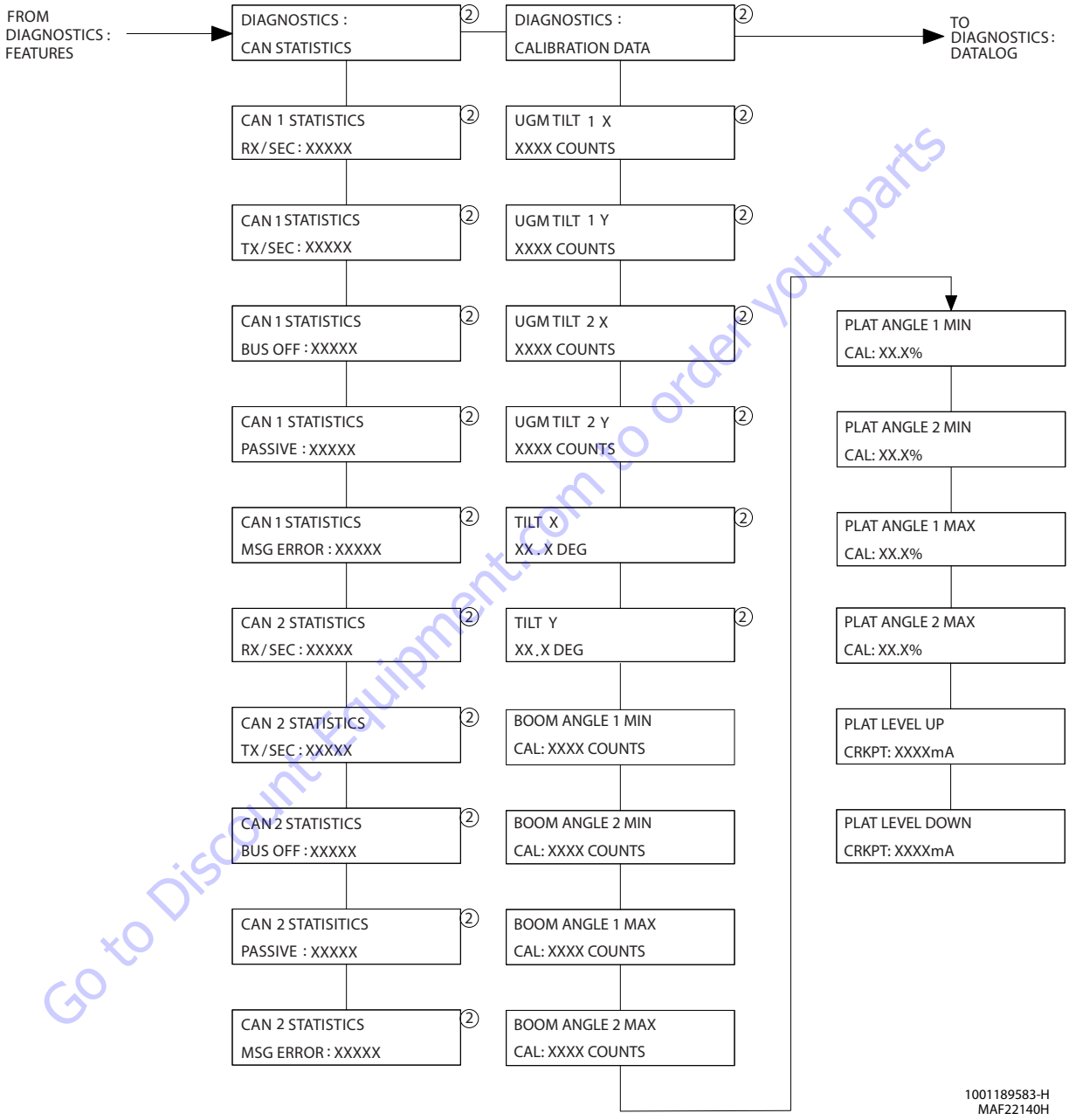
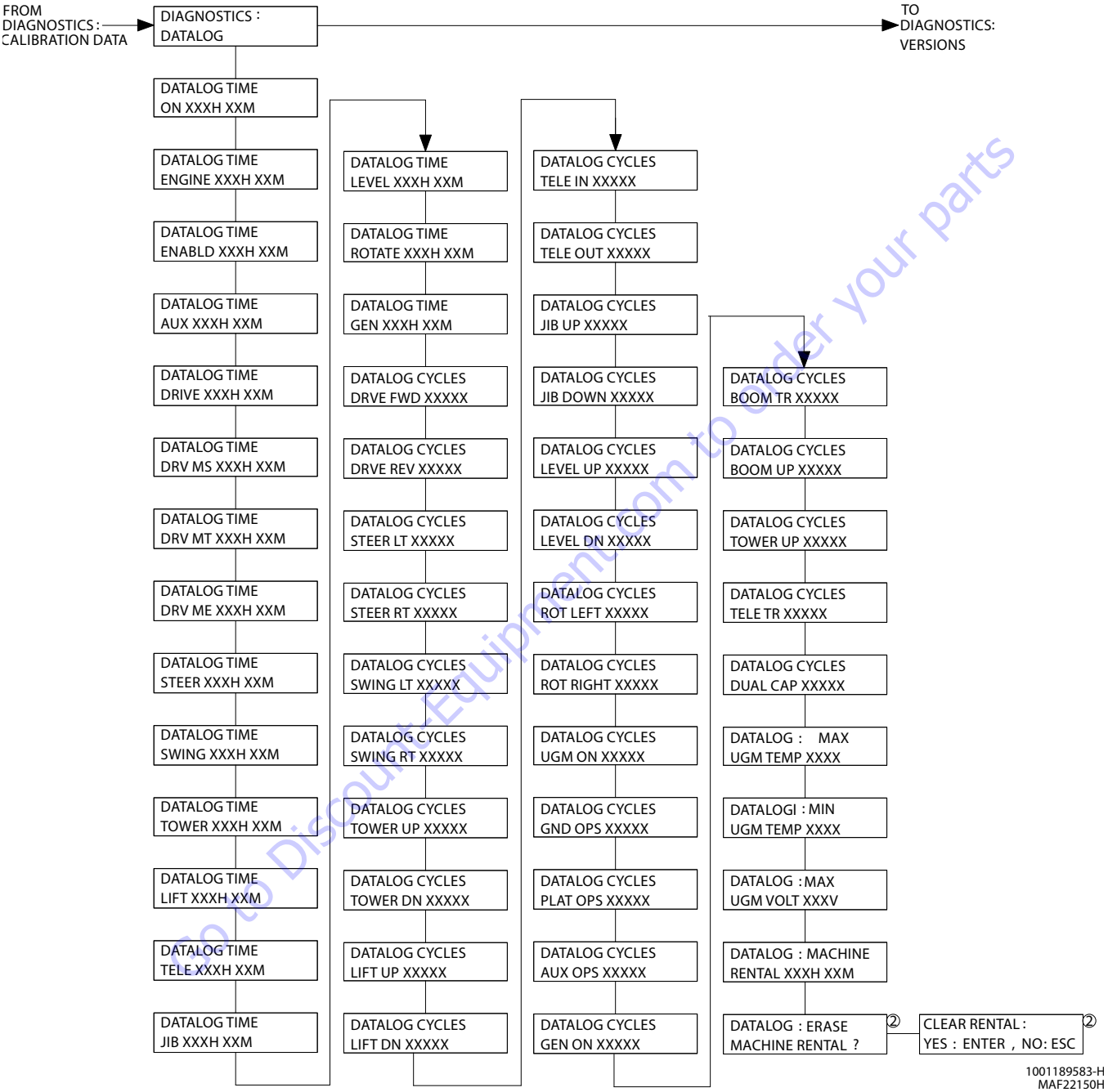


Figure 6-6. Analyzer Software P2.13 - Sheet 4 of 14



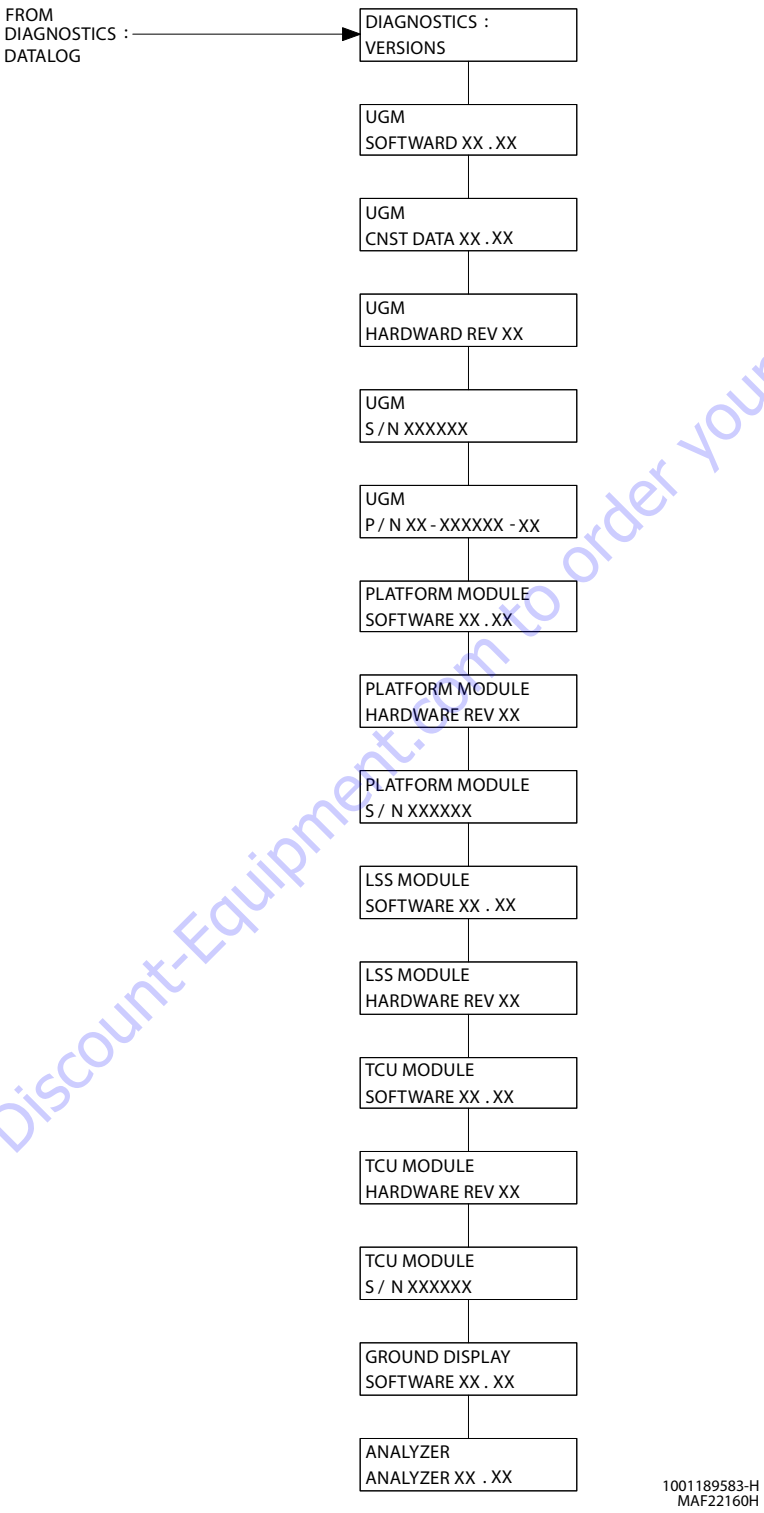
NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration and software versions.*

Figure 6-7. Analyzer Software P2.13 - Sheet 5 of 14



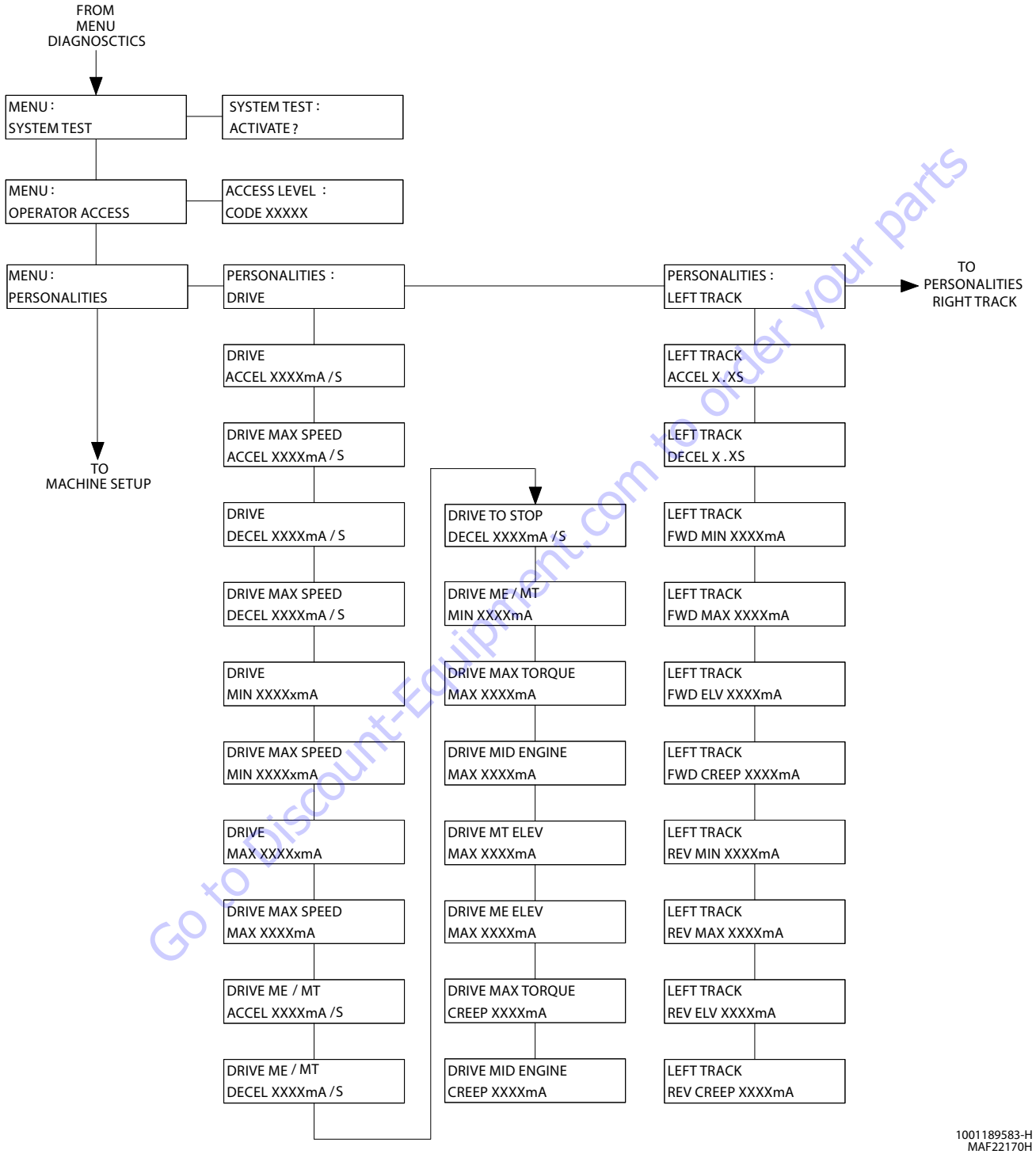
NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration and software versions.*

Figure 6-8. Analyzer Software P2.13 - Sheet 6 of 14



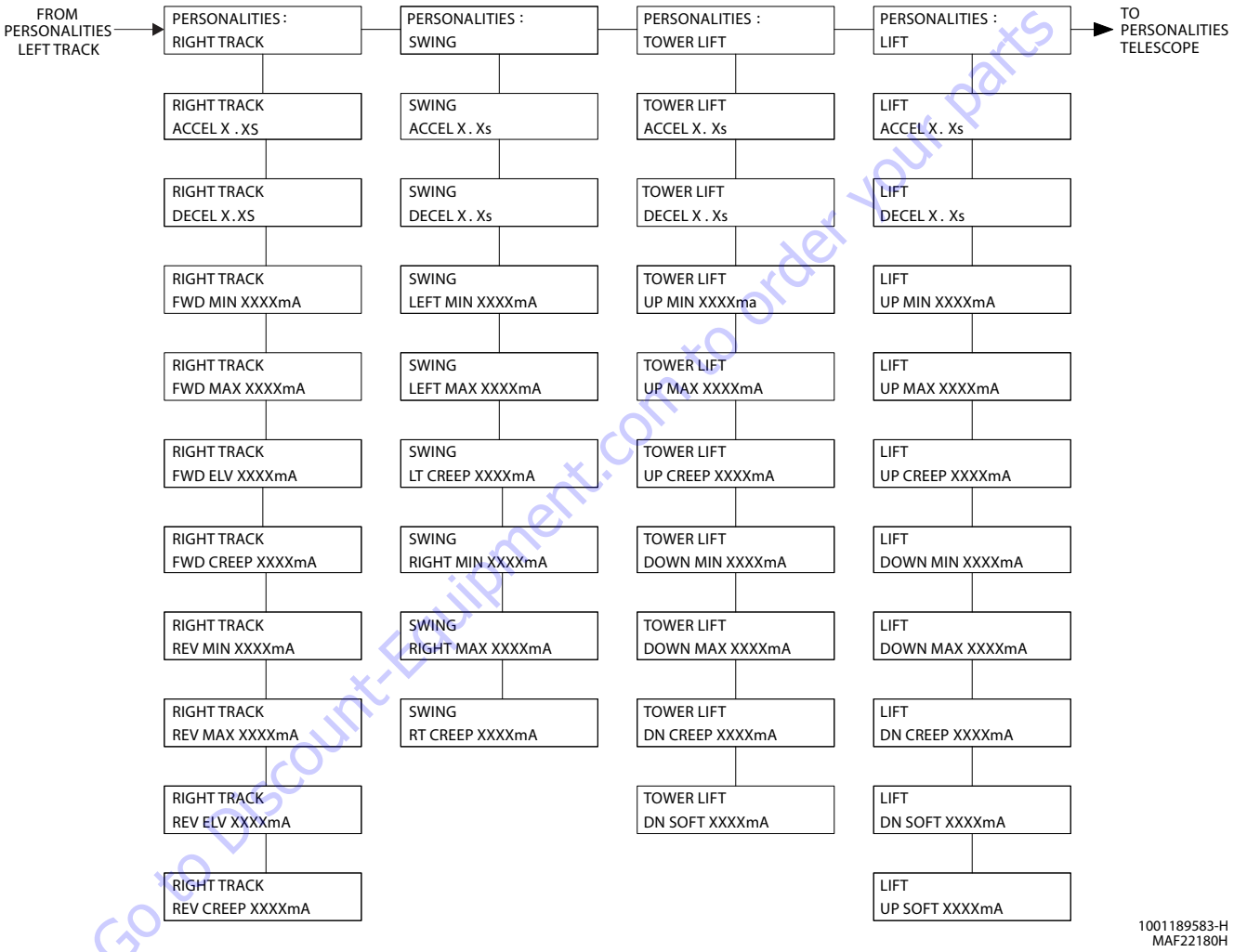
NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration and software versions.*

Figure 6-9. Analyzer Software P2.13 - Sheet 7 of 14



NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration and software versions.*

Figure 6-10. Analyzer Software P2.13 - Sheet 8 of 14

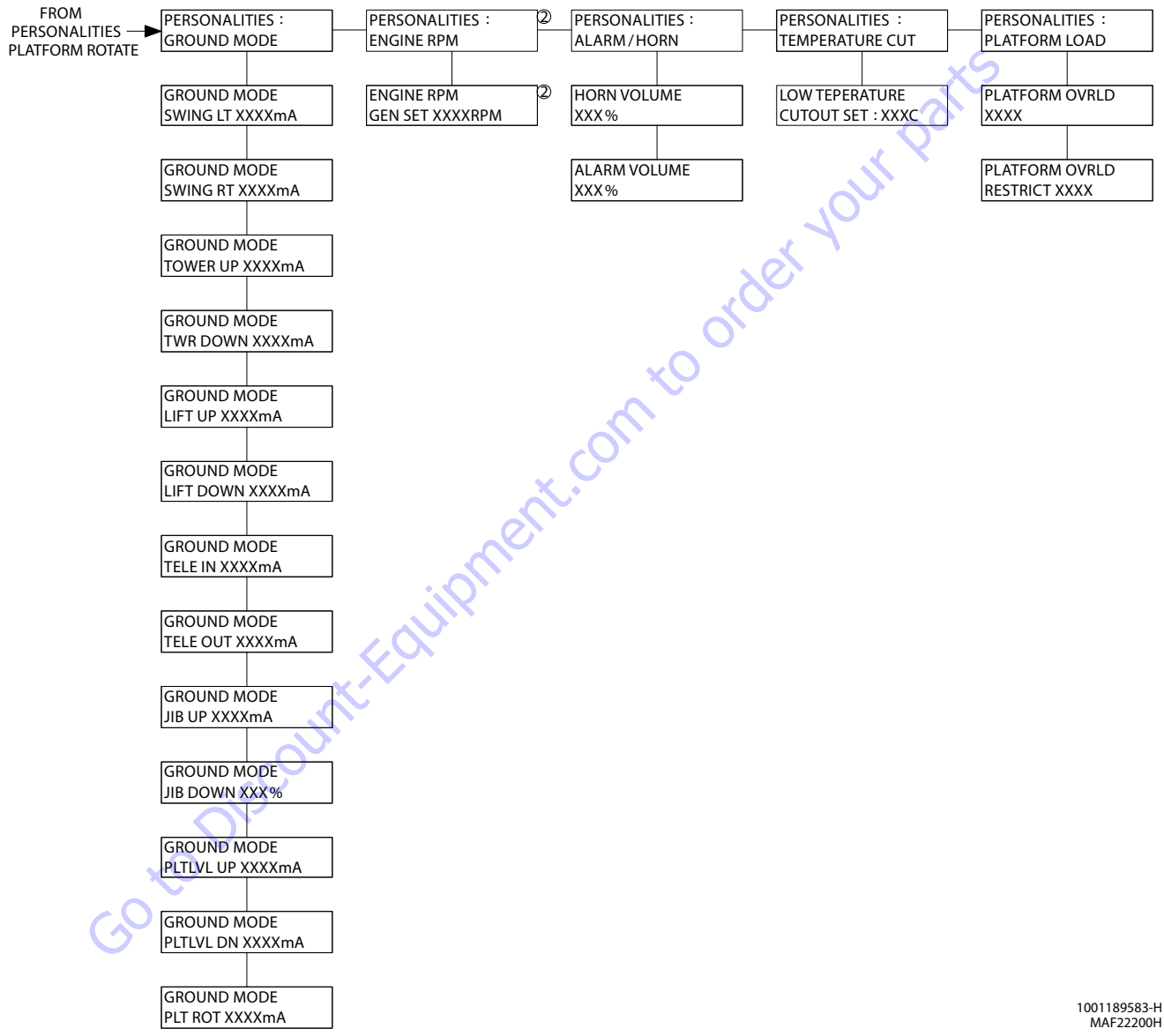


NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration and software versions.*

Figure 6-11. Analyzer Software P2.13 - Sheet 9 of 14

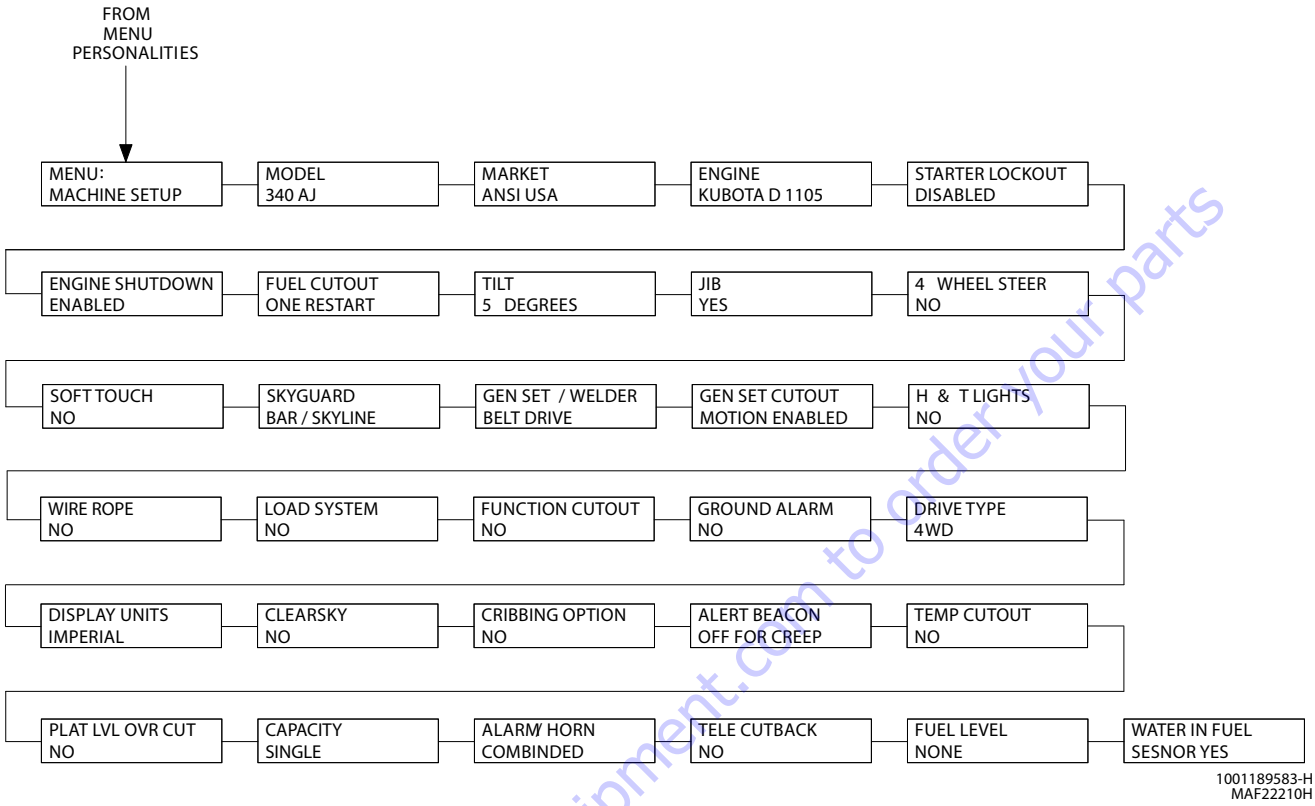
NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration and software versions.*

Figure 6-12. Analyzer Software P2.13 - Sheet 10 of 14



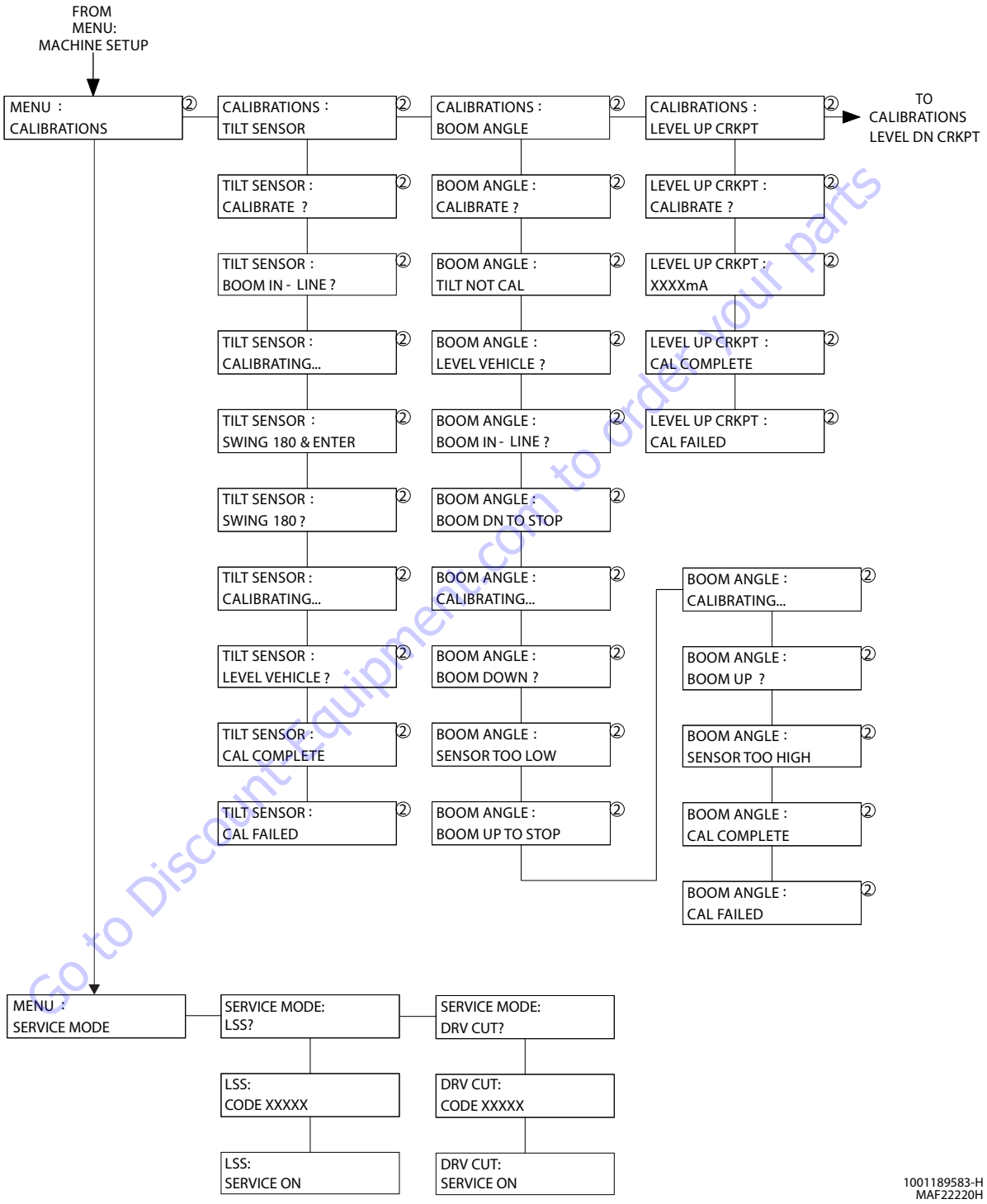
NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration and software versions.*

Figure 6-13. Analyzer Software P2.13 - Sheet 11 of 14



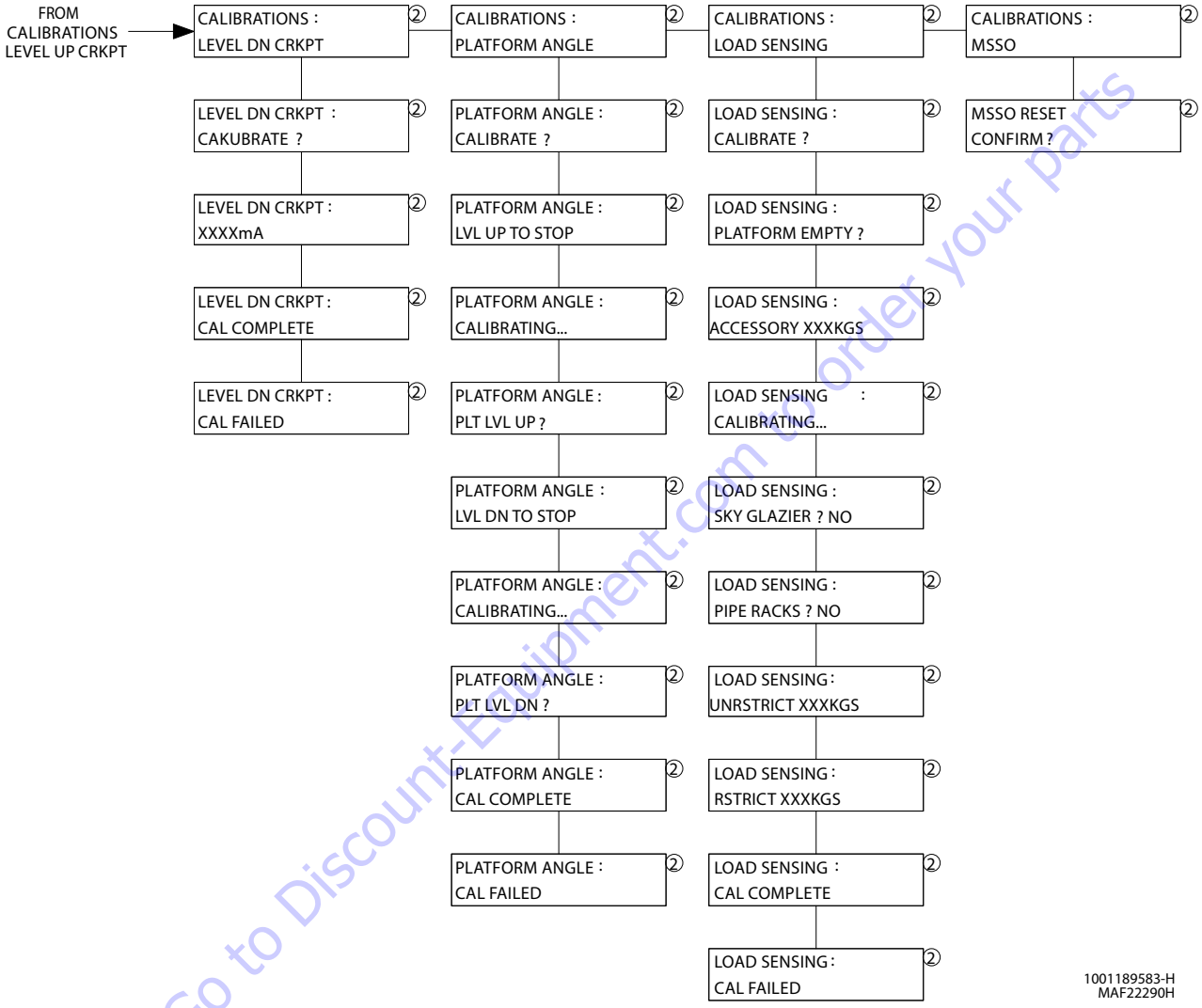
NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration and software versions.*

Figure 6-14. Analyzer Software P2.13 - Sheet 12 of 14



NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration and software versions.*

Figure 6-15. Analyzer Software P2.13 - Sheet 13 of 14



NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration and software versions.*

Figure 6-16. Analyzer Software P2.13 - Sheet 14 of 14

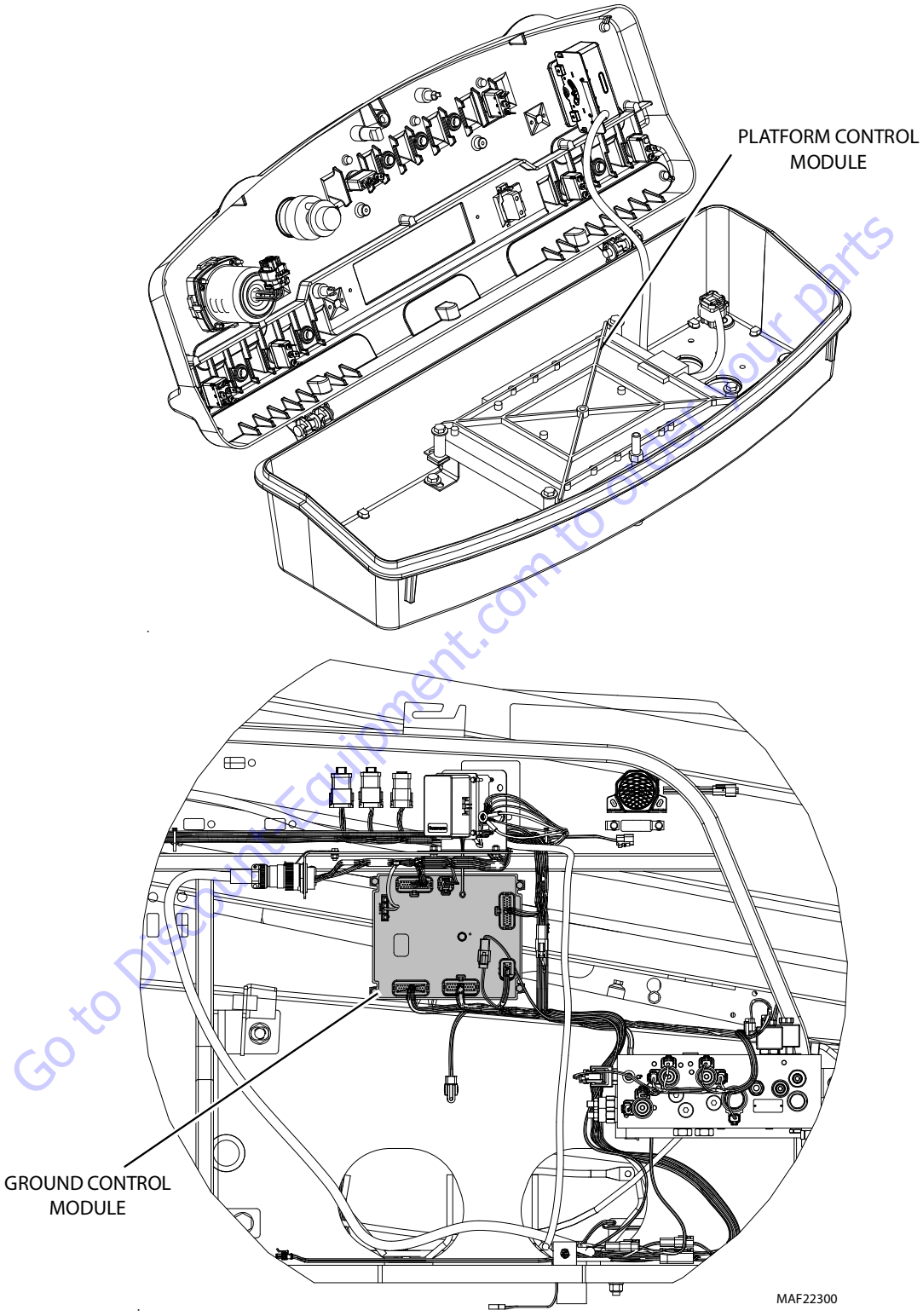


Figure 6-17. Control Module Locations

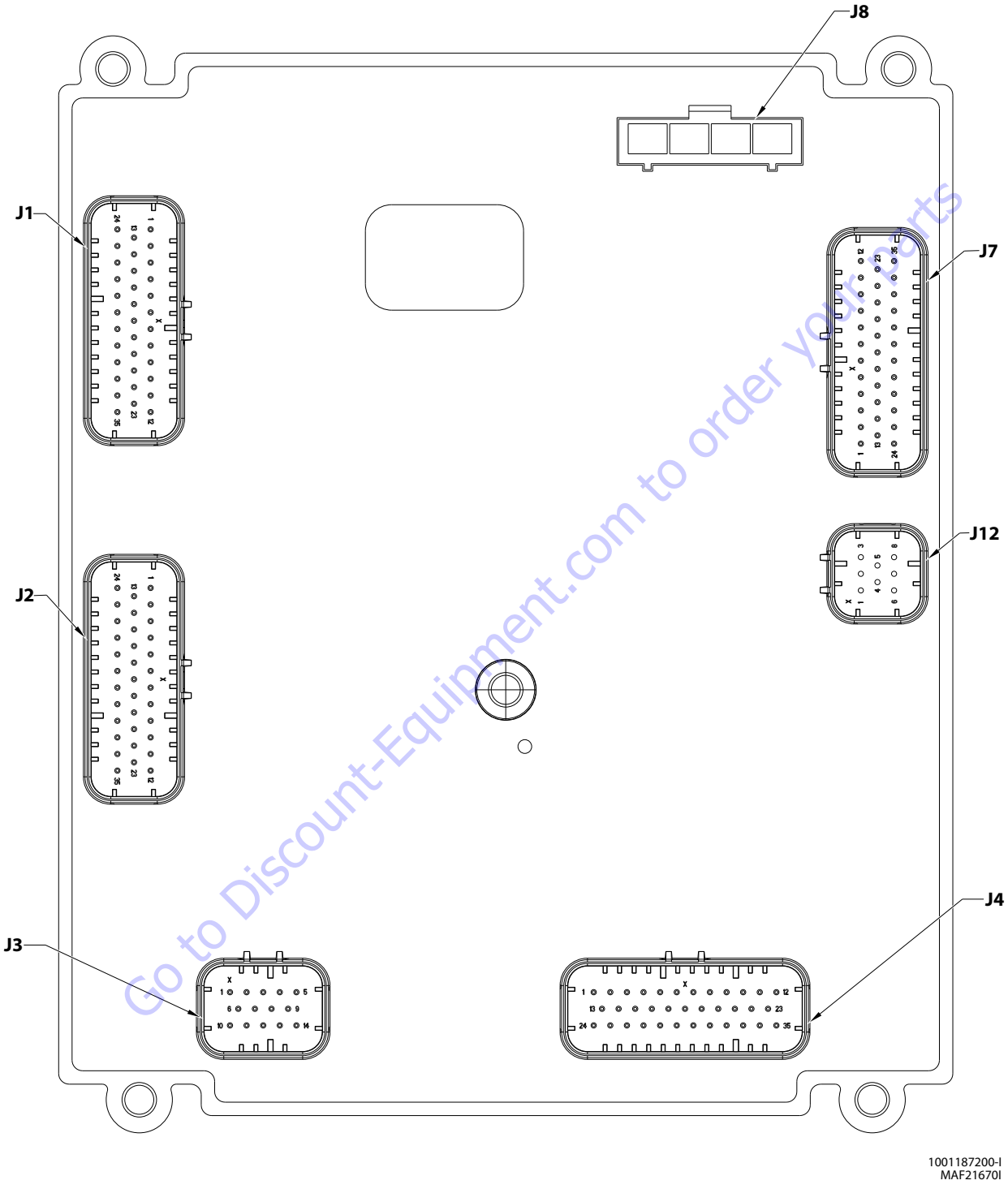


Figure 6-18. Ground Control Module Pin Connections

Connector	Pin	Function	Type	
J1 (Natural)	1	UNUSED (FUEL RACK ACTUATOR)	DIGITAL	OUTPUT
	2	OSCILLATING AXLE VALVE #2	DIGITAL	OUTPUT
	3	DRIVE FORWARD / LEFT TRACK FORWARD VALVE	DIGITAL	OUTPUT
	4	UNUSED	GROUND	INPUT
	5	UNUSED	GROUND	INPUT
	6	DRIVE REVERSE / LEFT TRACK REVERSE VALVE	DIGITAL	OUTPUT
	7	OSCILLATING AXLE VALVE #1	DIGITAL	OUTPUT
	8	UNUSED	GROUND	INPUT
	9	MSSO SWITCH GROUND	GROUND	INPUT
	10	ECU POWER	DIGITAL	OUTPUT
	11	ENGINE START	DIGITAL	OUTPUT
	12	ENGINE GLOW PLUGS	DIGITAL	OUTPUT
	13	APU ENABLE RELAY	DIGITAL	OUTPUT
	14	UNUSED (ENGINE COOLANT TEMPERATURE SENSOR)	ANALOG	INPUT
	15	UNUSED (ENGINE OIL PRESSURE SENSOR)	ANALOG	INPUT
	16	UNUSED (ENGINE SPEED SENSOR)	FREQUENCY	INPUT
	17	UNUSED (ENGINE SPEED SENSOR GROUND)	GROUND	INPUT
	18	UNUSED (ENGINE GROUND)	GROUND	INPUT
	19	UNUSED (ENGINE GROUND)	GROUND	INPUT
	20	2 SPEED VALVE	DIGITAL	OUTPUT
	21	UNUSED (TOWER ELEVATION SWITCH #2)	DIGITAL	INPUT
	22	GENERATOR ENABLE RELAY	DIGITAL	OUTPUT
	23	BRAKE VALVE	DIGITAL	OUTPUT
	24	UNUSED	N/C	N/C
	25	UNUSED (RS-485 HIGH)	SERIAL	I/O
	26	UNUSED (RS-485 LOW)	SERIAL	I/O
	27	BRAKE / 2 SPEED VALVE GROUND	GROUND	INPUT
	28	ANALYZER POWER	VOLTAGE	OUTPUT
	29	ANALYZER RS-232 RX	SERIAL	INPUT
	30	ANALYZER RS-232 TX	SERIAL	OUTPUT
	31	ANALYZER GROUND	GROUND	INPUT
	32	ALTERNATOR EXCITATION	DIGITAL	OUTPUT
	33	UNUSED (RS-485 GROUND)	GROUND	INPUT
	34	TELESCOPE RETRACTED SWITCH #2	DIGITAL	INPUT
	35	CAPACITY LENGTH SWITCH #2	DIGITAL	INPUT

Connector	Pin	Function	Type	
J8 (Black)	1	MODULE GROUND	GROUND	OUTPUT
	2	MODULE POWER	VBAT	INPUT
	3	GROUND TO PLATFORM MODULE	GROUND	INPUT
	4	POWER TO PLATFORM MODULE	VBAT	OUTPUT

Connector	Pin	Function	Type	
J2 (Gray)	1	STEER DUMP VALVE	DIGITAL	OUTPUT
	2	GROUND ALARM	DIGITAL	OUTPUT
	3	PLATFORM DUMP VALVE #1	DIGITAL	OUTPUT
	4	BYPASS DUMP VALVE	DIGITAL	OUTPUT
	5	PLATFORM LEVEL UP VALVE	DIGITAL	OUTPUT
	6	FUEL SENSOR GROUND	GROUND	INPUT
	7	PLATFORM LEVEL DOWN VALVE	DIGITAL	OUTPUT
	8	FRONT STEER RIGHT/RIGHTTRACK REVERSE VALVE	DIGITAL	OUTPUT
	9	MAIN TELESCOPE IN VALVE	DIGITAL	OUTPUT
	10	UNUSED (PLATFORM ROTATE LEFT VALVE)	DIGITAL	OUTPUT
	11	MAIN LIFT UP VALVE	DIGITAL	OUTPUT
	12	UNUSED (JIB LIFT UP VALVE)	DIGITAL	OUTPUT
	13	MAIN DUMP VALVE	DIGITAL	OUTPUT
	14	UNUSED (MAIN TELESCOPE VALVES GROUND)	GROUND	INPUT
	15	UNUSED (TOWER TELESCOPE OUT VALVE)	DIGITAL	OUTPUT
	16	USED (MAIN TELESCOPE OUT VALVE)	DIGITAL	OUTPUT
	17	UNUSED (PLATFORM ROTATE / JIB LIFT VALVE GROUND)	GROUND	INPUT
	18	STEER DUMP VALVE GROUND	GROUND	INPUT
	19	FRONT LEFT STEER VALVE / RIGHT TRACK FORWARD VALVE	DIGITAL	OUTPUT
	20	MAIN TELESCOPEOUT VALVE	DIGITAL	OUTPUT
	21	AUX MAIN LIFT DOWN VALVE	DIGITAL	OUTPUT
	22	MAIN LIFT DOWN VALVE	DIGITAL	OUTPUT
	23	PLATFORM DUMP VALVE #2	DIGITAL	OUTPUT
	24	CONFIGURATION #2	DIGITAL	INPUT
	25	FUEL SENSOR	ANALOG	INPUT
	26	HEAD / TAIL LIGHT ENABLE RELAY	DIGITAL	OUTPUT
	27	GROUND ALARM / HORN	DIGITAL	OUTPUT
	28	STEER VALVES GROUND	GROUND	INPUT
	29	GROUND ALARM / HORN GROUND	GROUND	INPUT
	30	MAIN/TELESCOPE IN/ BYPASS DUMP VALVE GROUND	GROUND	INPUT
	31	TELESCOPE IN DUMP VALVE	DIGITAL	OUTPUT
	32	REAR STEER RIGHT VALVE	DIGITAL	OUTPUT
	33	REAR STEER LEFT VALVE	DIGITAL	OUTPUT
	34	SWING LEFT VALVE	DIGITAL	OUTPUT
	35	SWING RIGHT VALVE	DIGITAL	OUTPUT

Connector	Pin	Function	Type	
J12 (RED)	1	UNUSED	FREQUENCY	INPUT
	2	UNUSED	FREQUENCY	INPUT
	3	CAN2 HIGH	SERIAL	I/O
	4	CAN2 LOW	SERIAL	I/O
	5	UNUSED (CAN2 SHIELD)	GROUND	INPUT
	6	CAN2 TERMINATOR	TERM	I/O
	7	CAN2 TERMINATOR	TERM	I/O
	8	MSSO SWITCH	DIGITAL	INPUT

Connector	Pin	Function	Type	
J3 (Black)	1	DRIVE/ LEFT TRACK DRIVE VALVES CURRENT FEEDBACK	GROUND	INPUT
	2	AUX DOWN / RIGHT TRACK VALVES CURRENT FEEDBACK	GROUND	INPUT
	3	WIRE ROPE SERVICE SWITCH GROUND	GROUND	INPUT
	4	SWING VALVES CURRENT FEEDBACK	GROUND	INPUT
	5	AUX DOWN VALVES CURRENT FEEDBACK	GROUND	INPUT
	6	TELESCOPE FLOW CONTROL VALVES CURRENT FEEDBACK	GROUND	INPUT
	7	GROUND ALARM POWER	VBAT	OUTPUT
	8	WIRE ROPE SERVICE SWITCH	DIGITAL	INPUT
	9	CRIBBING ENABLE SWITCH	DIGITAL	INPUT
	10	UNUSED	DIGITAL	INPUT
	11	CONFIGURATION #1	DIGITAL	INPUT
	12	UNUSED	VOLTAGE	OUTPUT
	13	UNUSED	ANALOG	INPUT
	14	MAIN LIFT VALVES CURRENT FEEDBACK	GROUND	INPUT

Connector	Pin	Function	Type	
J4 (Blue)	1	CRIBBING ENGAGED INDICATOR	DIGITAL	OUTPUT
	2	SYSTEM DISTRESS INDICATOR	DIGITAL	OUTPUT
	3	GLOWPLUG INDICATOR	DIGITAL	OUTPUT
	4	ENGINE START SWITCH	DIGITAL	INPUT
	5	PLATFORM LEVEL DOWN SWITCH	DIGITAL	INPUT
	6	PLATFORM ROTATE LEFT SWITCH	DIGITAL	INPUT
	7	MAIN TELESCOPE IN SWITCH	DIGITAL	INPUT
	8	JIB LIFT DOWN SWITCH	DIGITAL	INPUT
	9	UNUSED (JIB LEFT SWITCH)	DIGITAL	INPUT
	10	UNUSED (TOWER LIFT UP SWITCH)	DIGITAL	INPUT
	11	UNUSED (TOWER TELESCOPE IN SWITCH)	DIGITAL	INPUT
	12	UNUSED (HOURMETER)	DIGITAL	OUTPUT
	13	LOW FUEL INDICATOR	DIGITAL	OUTPUT
	14	PLATFORM OVERLOADED INDICATOR	DIGITAL	OUTPUT
	15	UNUSED (UMS INDICATOR)	DIGITAL	OUTPUT
	16	AUXILIARY POWER / FUNCTION ENABLE	DIGITAL	INPUT
	17	PLATFORM LEVEL UP SWITCH	DIGITAL	INPUT
	18	PLATFORM ROTATE RIGHT SWITCH	DIGITAL	INPUT
	19	JIB LIFT UP SWITCH	DIGITAL	INPUT
	20	UNUSED (JIB RIGHT SWITCH)	DIGITAL	INPUT
	21	UNUSED (TOWER LIFT DOWN SWITCH)	DIGITAL	INPUT
	22	UNUSED (TOWER TELESCOPE OUT SWITCH)	DIGITAL	INPUT
	23	MAIN LIFT UP SWITCH	DIGITAL	INPUT
	24	UNUSED	VBAT	OUTPUT
	25	SWITCHES POWER	VBAT	OUTPUT
	26	BATTERY LOW / NOT CHARGING INDICATOR	DIGITAL	OUTPUT
	27	UNUSED	DIGITAL	OUTPUT
	28	UNUSED	DIGITAL	OUTPUT
	29	CHECK ENGINE INDICATOR	DIGITAL	OUTPUT
	30	MAIN TELESCOPE OUT SWITCH	DIGITAL	INPUT
	31	INDICATORS GROUND	GROUND	INPUT
	32	INDICATORS GROUND	GROUND	INPUT
	33	MAIN LIFT DOWN SWITCH	DIGITAL	INPUT
	34	SWING LEFT SWITCH	DIGITAL	INPUT
	35	SWING RIGHT SWITCH	DIGITAL	INPUT

Connector	Pin	Function	Type	
J7 (Black)	1	PLATFORM EMS	DIGITAL	INPUT
	2	PLATFORM MODE	DIGITAL	INPUT
	3	GROUND MODE	DIGITAL	INPUT
	4	BOOM ANGLE SENSOR #1	ANALOG	INPUT
	5	UNUSED (ENGINE SPEED SENSOR)	VOLTAGE	OUTPUT
	6	CAN1 TERMINATOR	TERM	I/O
	7	BOOM ANGLE SENSOR #2	ANALOG	INPUT
	8	UNUSED	ANALOG	INPUT
	9	BOOM ANGLE SENSOR GROUND	GROUND	INPUT
	10	TILT SENSOR GROUND	GROUND	INPUT
	11	UNUSED (TOWER ELEVATION SWITCH #1)	DIGITAL	INPUT
	12	UNUSED (OSCILLATING AXLE SWING SWITCH #1)	DIGITAL	PUT
	13	CAN1 HIGH	SERIAL	I/O
	14	GROUND MODE POWER TO PLATFORM	DIGITAL	INPUT
	15	FOOTSWITCH	DIGITAL	INPUT
	16	BOOM ANGLE SENSOR POWER	VOLTAGE	OUTPUT
	17	CAN1 TERMINATOR	TERM	I/O
	18	UNUSED (CAN1 SHIELD)	GROUND	INPUT
	19	IGNITION RELAY GROUND	GROUND	INPUT
	20	UNUSED (OSCILLATING AXLE SWING SWITCH #2)	ANALOG	INPUT
	21	TELESCOPE RETRACTED SWITCH #1	DIGITAL	INPUT
	22	UNUSED	DIGITAL	INPUT
	23	CAPACITY LENGTH SWITCH #1	DIGITAL	INPUT
	24	CAN1 LOW	SERIAL	I/O
	25	GROUND DISPLAY GROUND	GROUND	INPUT
	26	UNUSED	VOLTAGE	OUTPUT
	27	UNUSED	VOLTAGE	OUTPUT
	28	TELESCOPE RETRACTED SWITCH GROUND	GROUND	INPUT
	29	GROUND DISPLAY POWER	VBAT	OUTPUT
	30	UNUSED	VBAT	OUTPUT
	31	WIRE ROPE SERVICE SWITCH POWER	VBAT	OUTPUT
	32	TRANSPORT SWITCHES POWER	VBAT	OUTPUT
	33	TELESCOPE RETRACTED SWITCH POWER	VBAT	OUTPUT
	34	TILT SENSOR POWER	VBAT	OUTPUT
	35	DOS SWITCH	DIGITAL	INPUT

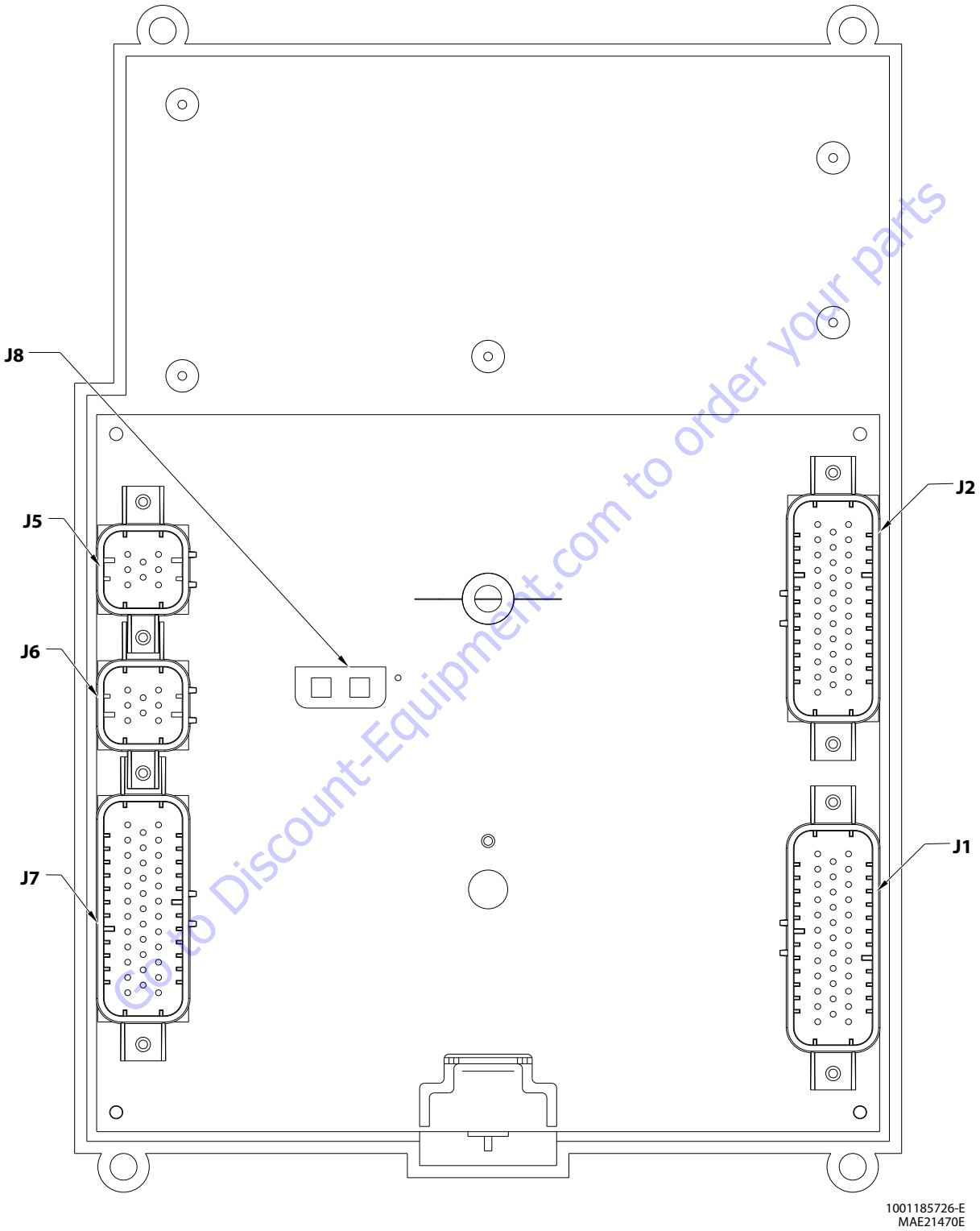


Figure 6-19. Platform Control Module Pin Connections

CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J1 (NATURAL)	1	UNUSED(TOWER LIFT UP SWITCH)	HS DIGITAL INPUT
	2	UNUSED(TOWER LIFT DOWN SWITCH)	HS DIGITAL INPUT
	3	UNUSED(TOWER TELESCOPE IN SWITCH)	HS DIGITAL INPUT
	4	UNUSED(TOWER TELESCOPE OUT SWITCH)	HS DIGITAL INPUT
	5	MAIN TELESCOPE IN SWITCH	HS DIGITAL INPUT
	6	MAIN TELESCOPE OUT SWITCH	HS DIGITAL INPUT
	7	PLATFORM ROTATE RIGHT SWITCH	HS DIGITAL INPUT
	8	PLATFORM ROTATE LEFT SWITCH	HS DIGITAL INPUT
	9	PLATFORM LEVEL UP SWITCH	HS DIGITAL INPUT
	10	PLATFORM LEVEL DOWN SWITCH	HS DIGITAL INPUT
	11	JIB LIFT UP SWITCH	HS DIGITAL INPUT
	12	JIB LIFT DOWN SWITCH	HS DIGITAL INPUT
	13	SPEED PUMP POTENTIOMETER GROUND	GROUND
	14	ENGINE START SWITCH	HS DIGITAL INPUT
	15	AUXILIARY POWER SWITCH	HS DIGITAL INPUT
	16	CRAB STEER SELECT SWITCH	HS DIGITAL INPUT
	17	COORDINATED STEER SELECT SWITCH	HS DIGITAL INPUT
	18	SWITCHES POWER	BATTERY VOLTAGE
	19	UNUSED	HS DIGITAL INPUT
	20	SOFT TOUCH SWITCH	HS DIGITAL INPUT
	21	CAPACITY SELECT SWITCH	HS DIGITAL INPUT
	22	UNUSED	HS DIGITAL INPUT
	23	SKYGUARD INPUT #2 SWITCH	HS DIGITAL INPUT
	24	UNUSED	HS DIGITAL INPUT
	25	PLATFORM ANGLE SENSOR #1	HS DIGITAL INPUT
	26	PLATFORM ANGLE SENSOR #2	HS DIGITAL INPUT
	27	MAX ENGINE SPEED SWITCH	HS DIGITAL INPUT
	28	MAX ENGINE TORQUE SWITCH	HS DIGITAL INPUT
	29	SOFT TOUCH / SKYGUARD OVERRIDE SWITCH	HS DIGITAL INPUT
	30	HEAD/TAIL LIGHT SWITCH	HS DIGITAL INPUT
	31	HORN	HS DIGITAL INPUT
	32	CREEP SWITCH	HS DIGITAL INPUT
	33	FUEL SELECT SWITCH	HS DIGITAL INPUT
	34	SPEED PUMP POTENTIOMETER POWER	+7 REFERENCE VOLTAGE
	35	SPEED PUMP POTENTIOMETER	ANALOG INPUT

CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J2 (BLUE)	1	UNUSED (JIB RIGHT SWITCH)	HS DIGITAL INPUT
	2	UNUSED (JIB LEFT SWITCH)	HS DIGITAL INPUT
	3	UNUSED	BATTERY VOLTAGE
	4	DRIVE ORIENTATION SYSTEM OVERRIDE SWITCH	HS DIGITAL INPUT
	5	UNUSED	HS DIGITAL INPUT
	6	CHASSIS TILT INDICATOR	LAMP OUTPUT
	7	FUNCTION ENABLE INDICATOR	LAMP OUTPUT
	8	VEHICLE SYSTEM DISTRESS INDICATOR	LAMP OUTPUT
	9	CREEP SPEED INDICATOR	LAMP OUTPUT
	10	WIRE ROPE SERVICE INDICATOR	LAMP OUTPUT
	11	PLATFORM OVERLOAD INDICATOR	LAMP OUTPUT
	12	UNRESTRICTED CAPACITY INDICATOR	LAMP OUTPUT
	13	RESTRICTED CAPACITY INDICATOR	LAMP OUTPUT
	14	DRIVE ORIENTATION SYSTEM INDICATOR	LAMP OUTPUT
	15	GENERATOR ON INDICATOR	LAMP OUTPUT
	16	SOFT TOUCH/ SKYGUARD INDICATOR	LAMP OUTPUT
	17	GLOW PLUG ENGAGED INDICATOR	LAMP OUTPUT
	18	INDICATOR GROUND	GROUND
	19	LEVEL SYSTEM INDICATOR	LAMP OUTPUT
	20	DRIVE DISABLED INDICATOR	LAMP OUTPUT
	21	LOW FUEL INDICATOR	LAMP OUTPUT
	22	1/4 FUEL LEVEL INDICATOR	LAMP OUTPUT
	23	3/4 FUEL LEVEL INDICATOR	LAMP OUTPUT
	24	1/2 FUEL LEVEL INDICATOR	LAMP OUTPUT
	25	INDICATOR GROUND	GROUND
	26	ANALYZER POWER	ANALYZER POWER
	27	ANALYZER GROUND	ANALYZER GROUND
	28	ANALYZER RX	ANALYZER RX
	29	ANALYZER TX	ANALYZER TX
	30	UNUSED	LAMP OUTPUT
	31	SOFT TOUCH POWER	DIGITAL OUTPUT
	32	LSS POWER	BATTERY VOLTAGE
	33	OPTION POWER	BATTERY VOLTAGE
	34	UNUSED	BATTERY VOLTAGE
	35	FUEL FULL INDICATOR	LAMP OUTPUT

CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J5 (NATURAL)	1	MAIN LIFT / SWING JOYSTICK POWER	SUPPLY VOLTAGE
	2	MAIN LIFT CENTER TAP	ANALOG INPUT
	3	MAIN LIFT SIGNAL	ANALOG INPUT
	4	SWING SIGNAL	ANALOG INPUT
	5	SWING CENTER TAP	ANALOG INPUT
	6	UNUSED	ANALOG INPUT
	7	MAIN LIFT / SWING JOYSTICK GROUND	GROUND
	8	UNUSED	GROUND

J6 (BLACK)	1	DRIVE / STEER JOYSTICK POWER	SUPPLY VOLTAGE
	2	DRIVE CENTER TAP	ANALOG INPUT
	3	DRIVE SIGNAL	ANALOG INPUT
	4	DRIVE ENABLE	ANALOG INPUT
	5	STEER LEFT / STEER SIGNAL	ANALOG INPUT
	6	STEER RIGHT / STEER CENTER TAP	ANALOG INPUT
	7	DRIVE / STEER JOYSTICK RETURN	GROUND
	8	UNUSED	GROUND

CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J8	1	MODULE GROUND	GROUND
	2	MODULE POWER	BATTERY VOLTAGE

CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J7 (BLACK)	1	GROUND MODE	GROUND MODE
	2	PLATFORM EMS	PLATFORM EMS
	3	PLATFORM EMS TO GROUND MODULE	PLATFORM MODE
	4	FOOTSWITCH (FUNCTION ENABLE SWITCH) POWER	BATTERY VOLTAGE
	5	PLATFORM ROTATE LEFT VALVE	ME DIGITAL OUTPUT
	6	PLATFORM ROTATE RIGHT VALVE	ME DIGITAL OUTPUT
	7	SKYGUARD POWER	BATTERY VOLTAGE
	8	FOOTSWITCH SIGNAL	DIGITAL INPUT
	9	GENERATOR SWITCH	DIGITAL INPUT
	10	UNUSED	+7 REFERENCE VOLTAGE
	11	PLATFORM ANGLE SENSOR POWER	+5V REFERENCE VOLTAGE
	12	UNUSED	+5V REFERENCE VOLTAGE
	13	UNUSED	ANALOG INPUT
	14	PLATFORM ANGLE SENSOR GROUND	GROUND
	15	PLATFORM LEVEL UP VALVE	HS DIGITAL OUTPUT
	16	PLATFORM LEVEL DOWN VALVE	HS DIGITAL OUTPUT
	17	UNUSED	HS DIGITAL INPUT
	18	SKYGUARD INPUT #1 SWITCH	HS DIGITAL INPUT
	19	PLATFORM ALARM	LAMP OUTPUT
	20	PLATFORM ALARM GROUND	GROUND
	21	SKYGUARD GROUND	GROUND
	22	LSS GROUND	GROUND
	23	VALVES GROUND	ANALOG INPUT
	24	UNUSED	DIGITAL OUTPUT
	25	JIB LIFT UP VALVE	ME DIGITAL OUTPUT
	26	JIB LIFT DOWN VALVE	ME DIGITAL OUTPUT
	27	UNUSED (JIG RIGHT VALVE)	ME DIGITAL OUTPUT
	28	UNUSED (JIG LEFT VALVE)	ME DIGITAL OUTPUT
	29	OPTIONS GROUND	GROUND
	30	CAN LOW	CAN LOW
	31	CAN HIGH	CAN HIGH
	32	UNUSED (CAN SHIELD)	CAN SHIELD
	33	UNUSED	GROUND
	34	UNUSED	GROUND
	35	UNUSED	ANALOG INPUT

Table 6-2. Machine Configuration Programming Information - Version P2.13

Configuration Digit	Number	Description	Default Number
NOTE: *The machine configuration must be completed before any personality settings can be changed. Changing personality settings first and then changing the model number of the machine configuration will cause personality settings to return to default.*			
MODEL NUMBER: 1	0 **1** 2	????: Visible only on a Non-Configured UGM **600S: For 600S / 600S HC3 / 660SJ / 660SJ HC3** 600SC: For 600SC / 660SJC	**1**
MARKET: 2*	**1** 2 3 4 5 6 7	**ANSI USA** ANSI EXPORT CSA CE AUSTRALIA JAPAN GB	**1**
* Certain model selections will limit market options.			
ENGINE: 3*	1 2 3 4 **5** 6	KUBOTA D1105 GM DUAL FUEL: GM/PSI 0.97L Duel Fuel (Tier 3) KUBOTA DUAL FUEL FORD DUAL FUEL **DEUTZ EMR2: (Tier 4i)** DEUTZ EMR4: (Tier 4f)	**5**
* Certain model selections will limit engine options. * Certain market selections will limit engine options.			
STARTER LOCKOUT: 4*	**1** 2	**DISABLED: Automatic pre-glow time determined by ambient air temperature; engine start can be attempted at any time during pre-glow.** ENABLED: Automatic pre-glow time determined by ambient air temperature; engine start is NOT permitted until pre-glow is finished.	**1**
* Only visible for diesel engine selections.			
ENGINE SHUTDOWN: 5	1 **2**	DISABLED: No engine shutdown. **ENABLED: Shutdown engine for high coolant temperature fault or low oil pressure fault**	 **2**

Table 6-2. Machine Configuration Programming Information - Version P2.13

Configuration Digit	Number	Description	Default Number
FUEL CUTOUT: 6*	1 2 3 **4**	ONE RESTART: One restart with limited run time when near Empty. ENGINE STOP: No starting permitted when near Empty. NONE **RESTART: Restarts allowed with limited run time when near Empty**	**4**
* Only visible for diesel engine selections.			
TILT: 7*	1 2 3 4 5 6 **7** 8 9	5 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also reduces drive speed to creep. 4 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also reduces drive speed to creep. 3 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also reduces drive speed to creep. 5 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up. 4 DEG + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also disallows tower lift up, drive, telescope out and lift up. 3 DEG + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also disallows tower lift up, drive, telescope out and lift up. **5 DEG + DRV CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also reduces drive speed to creep when drive reversal is allowed, drive is disallowed otherwise.** 4 DEG + DRV CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also reduces drive speed to creep when drive reversal is allowed, drive is disallowed otherwise. 3 DEG + DRV CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also reduces drive speed to creep when drive reversal is allowed, drive is disallowed otherwise.	**7**
* Certain market selections will limit tilt options and alter default setting.			
4 WHEEL STEER: 8*	**1** 2	**NO: 4 Wheel Steer not installed.** YES: 4 Wheel Steer installed.	**1**
* Certain model selections will limit visibility.			

Table 6-2. Machine Configuration Programming Information - Version P2.13

Configuration Digit	Number	Description	Default Number
JIB: 9*	**1** 2	**NO: No Jib installed.** YES: Jib installed which has up and down movements only.	**1**
* Certain model selections will limit visibility.			
SOFT TOUCH: 10*	**1** 2	**NO: No Soft Touch system installed.** YES: Soft Touch system installed.	**1**
* Certain model selections will limit visibility.			
SKYGUARD: 11	1 **2** 3	NO: No SkyGuard system installed. **BAR/SKYLINE: SkyGuard system installed.** SKYEYE: SkyGuard system installed.	**2**
GEN SET/WELDER: 12	**1** 2	**NO: No generator installed.** BELT DRIVE: Belt driven setup	**1**
GEN SET CUTOUT: 13*	**1** 2	**MOTION ENABLED: Motion enabled when generator is ON.** MOTION CUTOUT: Motion cutout in platform mode only.	**1**
* Only visible if gen set / welder selection is not NO.			
H & T LIGHTS: 14	**1** 2	**NO: No head and tail lights installed.** YES: Head and tail lights installed.	**1**
LOAD SYSTEM: 15*	1 2 **3** 4	NO: No load sensor installed. WARN ONLY: Functions in creep, overload lamp lit, platform alarm beeps. **CUTOUT PLATFORM: All functions cutout, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF).** CUTOUT ALL: All functions cutout, flash overload light (500mS on, 500mS off), platform alarm beeps (5 sec ON, 2 sec OFF).	**3**
* Certain market selections will limit load system options or alter default setting.			

Table 6-2. Machine Configuration Programming Information - Version P2.13

Configuration Digit	Number	Description	Default Number
FUNCTION CUTOUT: 16*	**1** 2 3 4	**NO: No drive cutout.** BOOM CUTOUT: Boom function cutout while driving above elevation. DRIVE CUTOUT: Drive and steer cutout above elevation. DRIVE CUT E/T: Drive & steer cutout above elevation or telescoped.	**1**
*Certain market selections will limit function cutout options or alter default setting.			
GROUND ALARM: 17	1 2 3 **4**	NO: No ground alarm installed. DRIVE: Travel alarm sounds when the drive function is active. DESCENT: Descent alarm sounds when lift down is active. **MOTION: Motion alarm sounds when any function is active.**	**4**
DRIVE TYPE: 18*	**1** 2	**4 WD: 4 wheel drive.** 2WD: 2 wheel drive.	**1**
*Certain model selections will limit visibility.			
DISPLAY UNITS: 19*	1 **2**	METRIC: Celsius, Kilograms, KiloPascal. **IMPERIAL: Fahrenheit, Pounds, Pounds/in^2**	**2**
*Certain market selections will alter default setting.			
CLEARSKY: 20	**1** 2	**NO: ClearSky (telematics) options is disabled.** YES: ClearSky (telematics) option is enabled.	**1**
CRIBBING OPTION: 21*	**1** 2	**NO: Cribbing Option is disabled.** YES: Cribbing Option is enabled.	**1**
*Certain model selections will limit visibility.			
ALERT BECON: 22	**1** 2	**OFF FOR CREEP** IN CREEP 20FPM	**1**
TEMP CUTOUT: 23*	**1** 2	**NO: No Low Temp Cutout system installed** YES: Low Temp Cutout system installed	**1**
*Only visible under certain market selections.			

Table 6-2. Machine Configuration Programming Information - Version P2.13

Configuration Digit	Number	Description	Default Number
PLAT LVL OVR CUT: 24	**1** 2	**NO: Platform Level functions above elevation** YES: Platform Level does not function above elevation	**1**
CAPACITY: 25*	1 **2** **3**	SINGLE: Single Capacity system installed. **DUAL: Dual Capacity system installed.** TRIPLE: Triple Capacity system installed.	**2**
* Certain model selections will limit visibility. * Certain model selections will limit capacity options. * Certain market selections will limit capacity options.			
ALARM / HORN: 26	1 **2**	SEPARATE: Ambient alarm installed. **COMBINED: Single Horn / Alarm installed.**	**2**
WATER IN FUEL SENSOR: 27*	1 **2**	NO: Water in Fuel Sensor not installed. **YES: Water in Fuel Sensor installed.**	**2**
* Only visible if engine selection is Deutz EMR4.			
LIFT CYL WITH: 28*	**1** 2	**AUX VALVE: Lift Down Aux Valve is installed.** ENABLE VALVE: Lift Down Enable Valve is installed	**1**
* Certain model selections will limit visibility.			
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Table 6-3. Machine Configuration Programming Settings - Version P2.13

600S	ANSI USA	ANSI Export	CSA	CE	Australia	Japan	GB
Model Number	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Market	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Engine	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
	4	4	4	4	4	4	4
	5	**5**	**5**	**5**	**5**	**5**	**5**
	6	6	6	6	6	6	6
Starter Lockout	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Engine Shutdown	1	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**	**2**
Fuel Cutout	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
	X	X	X	X	X	X	X
	4	**4**	**4**	**4**	**4**	**4**	**4**
Tilt	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
	4	4	4	4	4	4	4
	5	5	5	5	5	5	5
	6	6	6	6	6	6	6
	7	**7**	**7**	**7**	**7**	**7**	**7**
	8	8	8	8	8	8	8
	9	9	9	9	9	9	9
4 Wheel Steer	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Jib	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
SOFT TOUCH	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
SKYGUARD	1	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**	**2**
	3	3	3	3	3	3	3
Gen Set / Welder	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Gen Set Cutout	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Head & Tail lights	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2

Table 6-3. Machine Configuration Programming Settings - Version P2.13

600S	ANSI USA	ANSI Export	CSA	CE	Australia	Japan	GB
Load System	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
	3	**3**	**3**	X	**3**	**3**	**3**
	4	4	4	4	X	4	4
Function Cutout	**1**	**1**	**1**	X	**1**	**1**	**1**
	X	2	2	**2**	2	2	2
	3	3	3	X	3	3	3
	4	4	4	X	4	4	4
Ground Alarm	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
	3	3	3	3	3	3	3
	4	**4**	**4**	**4**	**4**	**4**	**4**
Drive Type	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Display Units	1	1	**1**	**1**	**1**	**1**	**1**
	2	**2**	2	2	2	2	2
Clearsky	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Cribbing Option	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	X	X	2	2
Alert Beacon	**1**	**1**	**1**	**1**	1	**1**	**1**
	2	2	2	2	**2**	2	2
Temp Cutout	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	X	2	X	2	X	X	2
PLAT LVL OVR CUT	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Capacity	X	X	X	X	X	X	X
	2	**2**	**2**	**2**	**2**	**2**	**2**
	3	3	3	3	3	3	3
ALARM / HORN	1	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**	**2**
Water in Fuel Sensor	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
LIFT CYL WITH	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2

BOLD BLUE text indicates the default setting. Plain text indicates another available selection. ***RED ITALIC*** text indicates the default when option is factory installed. SHADED CELLS indicate hidden menu or selection.

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Table 6-4. Machine Configuration Programming Settings - Version P2.13

660SJ	ANSI USA	ANSI Export	CSA	CE	Australia	Japan	GB
Model Number	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Market	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Engine	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
	4	4	4	4	4	4	4
	5	**5**	**5**	**5**	**5**	**5**	**5**
	6	6	6	6	6	6	6
Starter Lockout	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Engine Shutdown	1	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**	**2**
Fuel Cutout	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
	X	X	X	X	X	X	X
	4	**4**	**4**	**4**	**4**	**4**	**4**
Tilt	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
	4	4	4	4	4	4	4
	5	5	5	5	5	5	5
	6	6	6	6	6	6	6
	7	**7**	**7**	**7**	**7**	**7**	**7**
	8	8	8	8	8	8	8
	9	9	9	9	9	9	9
4 Wheel Steer	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Jib	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	***2***	***2***	***2***	***2***	***2***	***2***
SOFT TOUCH	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
SKYGUARD	1	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**	**2**
	3	3	3	3	3	3	3
Gen Set / Welder	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Gen Set Cutout	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Head & Tail lights	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2

Table 6-4. Machine Configuration Programming Settings - Version P2.13

660SJ	ANSI USA	ANSI Export	CSA	CE	Australia	Japan	GB
Load System	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
	3	**3**	**3**	X	**3**	**3**	**3**
	4	4	4	**4**	X	4	4
Function Cutout	**1**	**1**	**1**	X	**1**	**1**	**1**
	X	2	2	**2**	2	2	2
	3	3	3	X	3	3	3
	4	4	4	X	4	4	4
Ground Alarm	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
	3	3	3	3	3	3	3
	4	**4**	**4**	**4**	**4**	**4**	**4**
Drive Type	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Display Units	1	1	**1**	**1**	**1**	**1**	**1**
	2	**2**	2	2	2	2	2
Clearsky	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Cribbing Option	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	X	X	2	2
Alert Beacon	**1**	**1**	**1**	**1**	1	**1**	**1**
	2	2	2	2	**2**	2	2
Temp Cutout	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	X	2	X	2	X	X	2
PLAT LVL OVR CUT	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Capacity	X	X	X	X	X	X	X
	2	**2**	**2**	**2**	**2**	**2**	**2**
	3	3	3	3	3	3	3
ALARM / HORN	1	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**	**2**
Water in Fuel Sensor	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
LIFT CYL WITH	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2

BOLD BLUE text indicates the default setting. Plain text indicates another available selection. ***RED ITALIC*** text indicates the default when option is factory installed. SHADED CELLS indicate hidden menu or selection.

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6.2 MACHINE PERSONALITY SETTINGS

NOTE: *Personality settings can be adjusted within the adjustment range for optimum machine performance.*

Table 6-5. Machine Personality Settings and Function Speed (Software Release P2.13)

FUNCTION		ADJUSTMENT RANGES	MODEL DEFAULTS	MODEL TIME RANGE (IN SECONDS)
DRIVE				
Max Speed	Accel	25 – 2000 mA/s	500 mA/s	
	Decel	25 – 2000 mA/s	925 mA/s	
	MIn	250 – 1000 mA	625 mA	
	Max	250 – 1400 mA	1550 mA	35 to 39
Drive to Stop	Decel	25 – 2000 mA/s	725 mA/s	
Max Torque Elevated	Max	250 – 1200 mA	950 mA	85 to 97
Mid Engine Elevated	Max	250 – 1200 mA	1050 mA	85 to 97
Max Torque	Creep	250 – 1200 mA	850 mA	
Mid Engine	Creep	250 – 1200 mA	950 mA	
SWING				
	Accel	0.0 to 3.0 s	3.0 s	
	Decel	0.0 to 2.0 s	1.6 s	
LEFT	Min	250 to 1000 mA	430 mA	
	Max	250 to 1000 mA	875 mA	79 to 99
	Creep	250 to 1000 mA	675 mA	
RIGHT	Min	250 to 1000 mA	430 mA	
	Max	250 to 1000 mA	900 mA	79 to 99
	Creep	250 to 1000 mA	675 mA	
LIFT				
	Accel	0.0 to 3.0 s	2.5 s	
	Decel	0.0 to 2.0 s	1.2 s	
UP	Min	250 to 1500 mA	525 mA	
	Max	250 to 1500 mA	1400 mA	55 to 75
	Creep	250 to 1500 mA	1000 mA	
DOWN	Min	250 to 1300 mA	700 mA	
	Max	250 to 1300 mA	1200 mA	55 to 75
	Creep	250 to 1300 mA	1000 mA	
	Soft Down	250 to 1500 mA	900 mA	
	Soft Down	250 to 1300 mA	850 mA	

Table 6-5. Machine Personality Settings and Function Speed (Software Release P2.13)

FUNCTION		ADJUSTMENT RANGES	MODEL DEFAULTS	MODEL TIME RANGE (IN SECONDS)
TELESCOPE				
	Accel	0.0 to 3.0 s	0.7 s	
	Decel	0.0 to 2.0 s	0.5 s	
IN	Min	250 to 1200 mA	420 mA	
	Max	250 to 1200 mA	1000 mA	40 to 50
	Creep	250 to 1200 mA	650 mA	
OUT	Min	250 to 1200 mA	480 mA	
	Max	250 to 1200 mA	1050 mA	42 to 52
	Creep	250 to 1200 mA	710 mA	
JIB LIFT				
	Accel	0.0 to 3.0 s	3.0 s	
	Decel	0.0 to 2.0 s	0.8 s	
UP	Min	10 to 50%	27%	
	Max	10 to 50%	41%	25 to 32
	Creep	10 to 50%	34%	
DOWN	Min	10 to 50%	27%	
	Max	10 to 50%	40%	22 to 28
	Creep	10 to 50%	35%	
	Up Cutback	10 to 50%	33%	
	Down Cutback	10 to 50%	33%	
PLATFORM LEVEL				
	Accel	0.0 to 3.0 s	0.0 s	
	Decel	0.0 to 2.0 s	0.0 s	
UP	Min	250 to 1500 mA	800 mA	
	Max	250 to 1500 mA	1300 mA	
	Creep	250 to 1500 mA	1100 mA	
DOWN	Min	250 to 1500 mA	850 mA	
	Max	250 to 1500 mA	1400 mA	
	Creep	250 to 1500 mA	1250 mA	

Table 6-5. Machine Personality Settings and Function Speed (Software Release P2.13)

FUNCTION		ADJUSTMENT RANGES	MODEL DEFAULTS	MODEL TIME RANGE (IN SECONDS)
GROUND MODE				
SWING	Left	250 to 1000 mA	670 mA	
	Right	250 to 1000 mA	895 mA	
Lift	Up	250 to 1500 mA	1395 mA	
	Down	250 to 1300 mA	1195 mA	
Telescope	In	250 to 1200 mA	995 mA	
	Out	250 to 1200 mA	1045 mA	
JIB	Up	10 to 50%	40%	
	Down	10 to 50%	39%	
Platform	Up	250 to 1500 mA	1295 mA	
	Down	250 to 1500 mA	1395 mA	

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6.3 MACHINE ORIENTATION WHEN SETTING FUNCTION SPEEDS

DRIVE (Below Elevation): Test should be done on a smooth, level surface. The Drive Select Switch should be in the "Max Speed" position. Start approximately 25 ft (7.6m) from starting point so the unit is at a maximum speed when starting the test. Results should be recorded for a 200ft (61m) course. Drive forward, "High Speed", record time.

DRIVE (Above Elevation): Test should be done on a smooth, level surface. The Drive Select Switch should be in the "Max Speed" position, the boom should be > 10° above horizontal to ensure the drive is operating in Max Torque mode. Results should be recorded for a 15.2m (50ft) course. Drive forward, record time. Drive Reverse, record time. Turn Platform Speed Control Knob fully counterclockwise to enter Creep mode; Creep light on Panel must be energized. Verify that machine will Drive Forward and Reverse. Return Knob to fully clockwise.

SWING: Boom at full elevation, Telescope retracted. Swing Right until over rear axle or end stop (if equipped). Swing Left 360° or end stop (if equipped), record time. Swing Right 360° or end stop (if equipped), record time. Turn Platform Speed Control Knob fully counterclockwise to enter Creep mode; Creep light on Panel must be energized. Verify that machine will swing left and right. Return Knob to fully clockwise.

MAIN LIFT: Main Lift in stowed position, Telescope Retracted. Main Lift Up, record time. Main Lift Down, record time. Turn Platform Speed Control Knob fully counterclockwise to enter Creep mode; Creep light on Panel must be energized. Verify that machine will Lift Up and Down. Return Knob to fully clockwise.

TELESCOPE: Main Lift at full elevation, Telescope Retracted. Telescope Out, record time.Telescope In, record time. Turn Platform Speed Control Knob fully counterclockwise to enter Creep mode; Creep light on Panel must be energized. Verify that machine will Telescope In and Out. Return Knob to fully clockwise.

JIB LIFT: Platform level and centered with the boom. Jib Lift Down until stop. Jib Lift Up, record time.Jib Lift Down, record time. Turn Platform Speed Control Knob fully counterclockwise to enter Creep mode; Creep light on Panel must be energized. Verify that machine will Jib Lift Up and Down. Return Knob to fully clockwise.

PLATFORM ROTATE: Platform level, Rotate Platform Right until stop. Platform Left, record time. Platform Right, record time. Turn Platform Speed Control Knob fully counterclockwise to enter Creep mode; Creep light on Panel must be energized. Verify that machine will Platform Rotate Left and Right. Return Knob to fully clockwise.

NOTE: *When the platform speed control knob is turned fully counterclockwise. The platform rotate may not work, this is acceptable.*

Test Notes

1. Personality settings can be adjusted anywhere within the adjustment range for optimum machine performance.
2. Stop watch should be started with the function movement, not with actuation of the joystick or switch.
3. Drive speeds should be set to the values below regardless of the tire size.
4. All speed tests are run from the platform, these speeds do not reflect the ground control operation.
5. The Platform Speed Control knob must be at full speed (turned clockwise completely) unless noted.
6. Some flow control functions may not work with the Platform Speed Control knob clicked into the creep position.
7. Functional speeds may vary due to cold thick hydraulic oil. Test should be run with the oil temperature above 38° C (100° F).

6.4 CANBUS COMMUNICATIONS

CANbus: CAN (Control Area Network) is a two wire differential serial link between the Platform and Ground Modules providing bi-directional communications.

Two-wire: One wire (red) is driven high (5v) and the other low (black) (0v) to send a signal. Both wires "float" (2.5v) when no signal is being sent.

Differential: Any electrical line noise can affect the high or the low wires but never both, so communications is not corrupted.

Serial Link: Messages are being sent bit by bit along the wires; the high bus speed allow all modules to be constantly updated around 20 times per second. Typical traffic is 300 - 500 messages per second.

A complete CANbus circuit is approximately 60 ohms, which can be verified at the "T" fitting inside the ground station. Individual circuits are approximately 120 ohms.

The GROUND MODULE (UGM) is the master system controller. Most functions are dispatched and coordinated from this module. The PLATFORM MODULE handles sub-tasks. All characterized information (values) are stored in the ground module (i.e., Personalities or Calibrations).

Interlocks: Any device that sends an electrical input. (For an example a limit switch, proximity switch, etc;).

Platform Level: The GROUND MODULE stores default values and handles interlocks. The PLATFORM MODULE reads sensors mounted on the platform assembly and controls Level Up / Down valves to maintain setpoint sent from the GROUND MODULE.

Steer: The GROUND MODULE stores crack points, and sends desired drive direction, steering mode, and axle extend/retract commands. The PLATFORM MODULE reports steering switch position to the GROUND MODULE.

Drive: The GROUND MODULE stores crack points and sends commands for each drive pump. (Command is computed from drive joystick input, interlocks, wheel angle, etc).

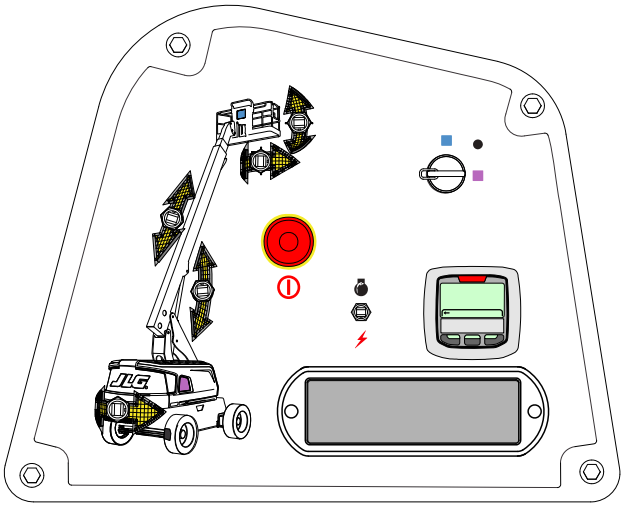
Lift, Tele, & Swing: The GROUND MODULE stores default values, and handles interlocks and calibration information. Lift, Telescope, and Swing commands depend on interlocks through out the machine. Boom angle, length, and swing are controlled by the GROUND MODULE

6.5 SYSTEM TEST

The Control System Incorporates a built-in system test to check the system components and functions. To use this function, use the following procedures.

Test from the Platform

1. Position the Platform/Ground select switch to the Platform position.



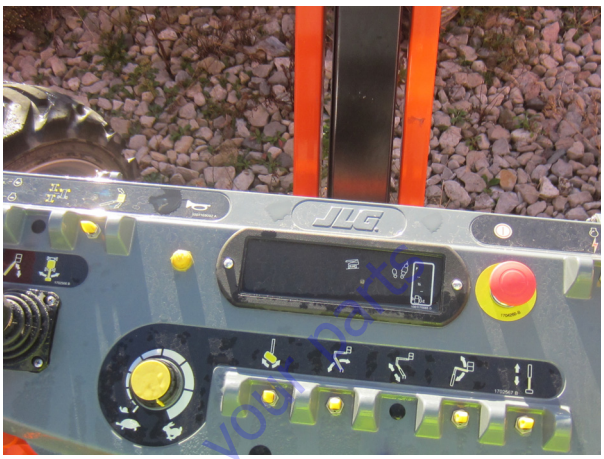
MAF19660

2. Plug the analyzer into the connector at the base of the platform control box.

MAE15680

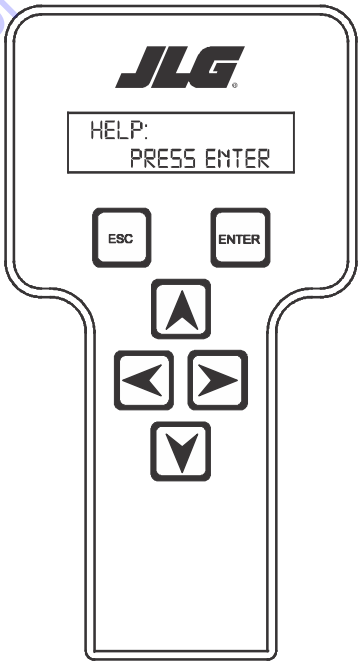
3. Before proceeding, ensure that the switches on the platform console are in the following positions:
   - **a.** Drive speed dial is in the slow position. (Turtle Icon)
   - **b.** Function speed potentiometer out of creep mode switch.
   - **c.** Generator (if equipped) switched to the off position.
   - **d.** Head and Tail lights (if equipped) switched to the off position.

4. Pull out the Emergency Stop switch and Start the engine.



MAE15700

5. The analyzer screen should read:



6. Use the arrow button to reach SYSTEM TEST. Hit Enter. The analyzer will prompt you asking if you want to activate the system test; hit Enter again to activate.

7. Follow the flow path in Figure 6-20., System Test Flow Chart - Platform Tests (Sheet 1 of 2) and Figure 6-21., System Test Flow Chart - Platform Tests (Sheet 2 of 2) and go through the component tests. Hit the ESC key during any part of the test to return to the main menu without completing all tests or wait until all tests are complete. During the TEST ALL INPUTS sequence, the analyzer allows control switches to be operated and shows if they are closed (CL) or open (OP).

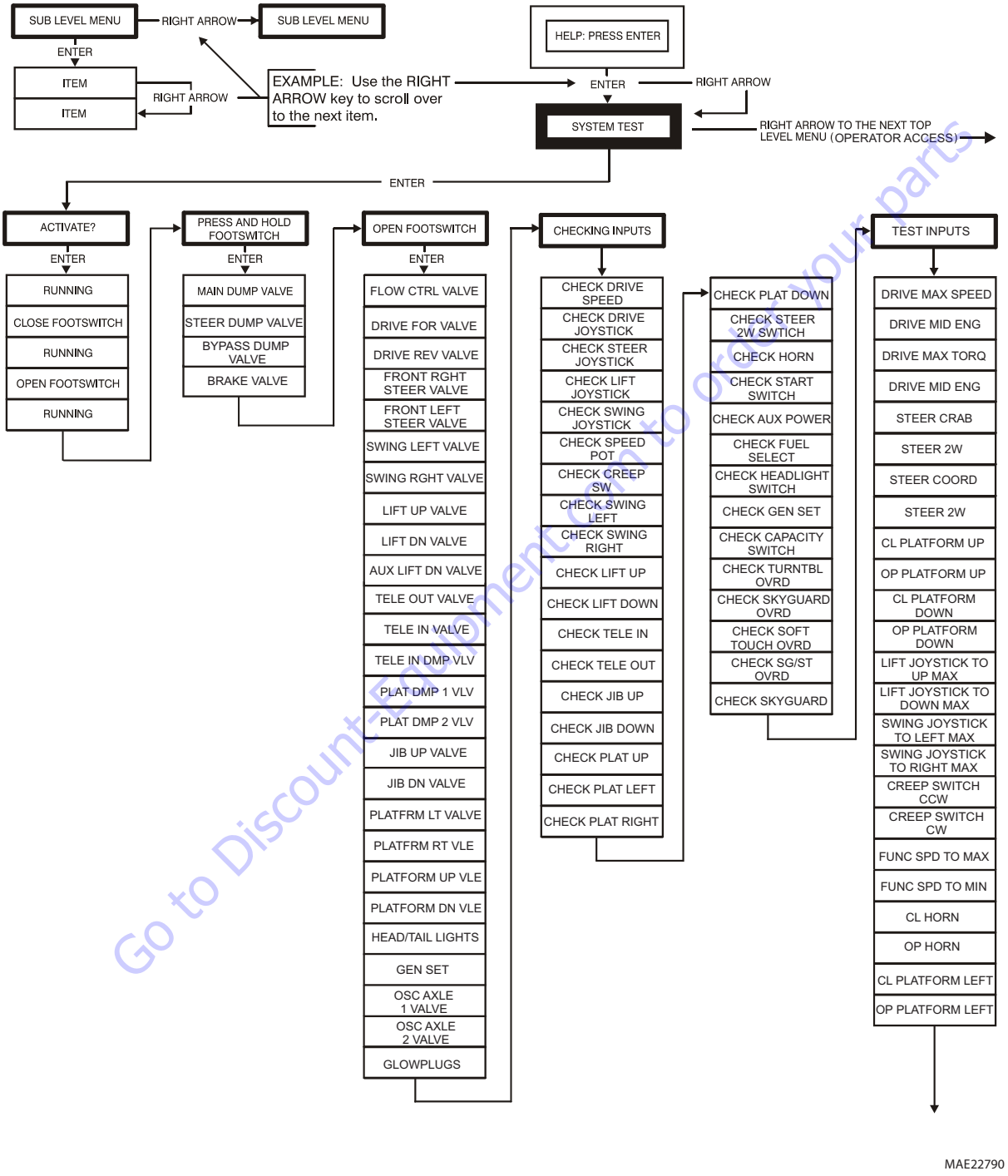


Figure 6-20. System Test Flow Chart - Platform Tests (Sheet 1 of 2)

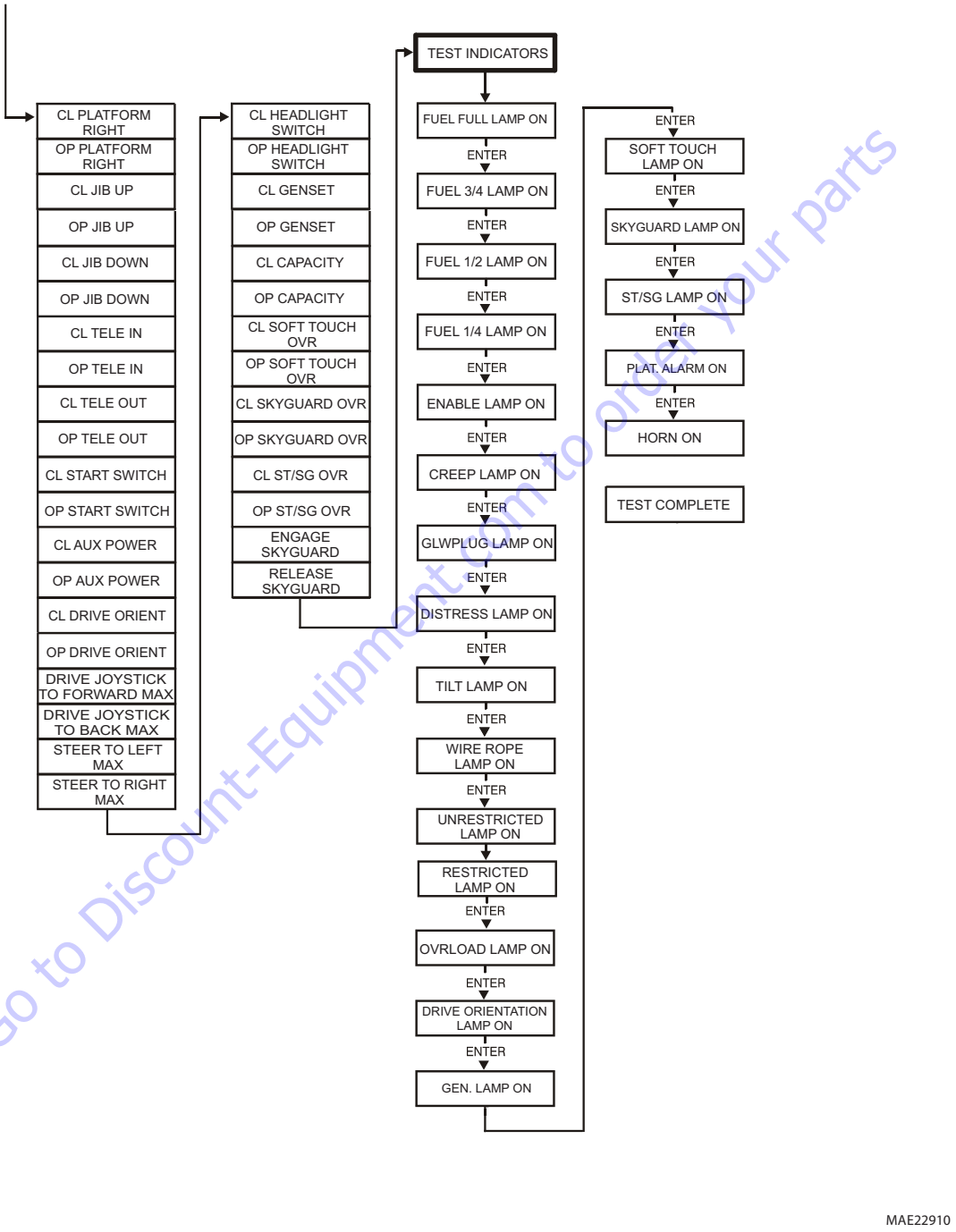
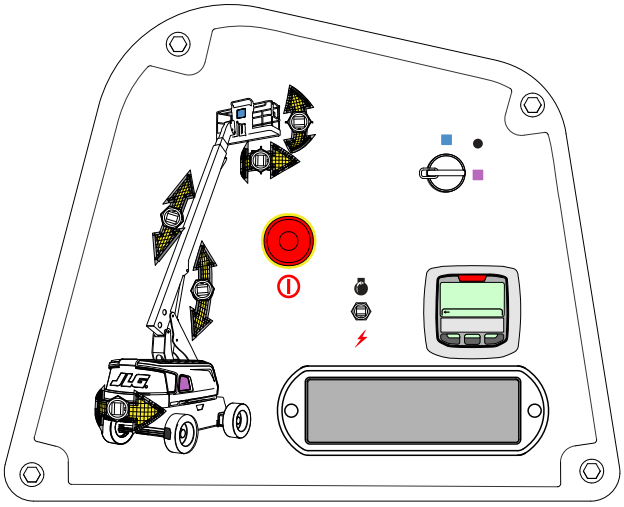


Figure 6-21. System Test Flow Chart - Platform Tests (Sheet 2 of 2)

Test from the Ground Station

1. Position the Platform/Ground select switch to the Platform position.



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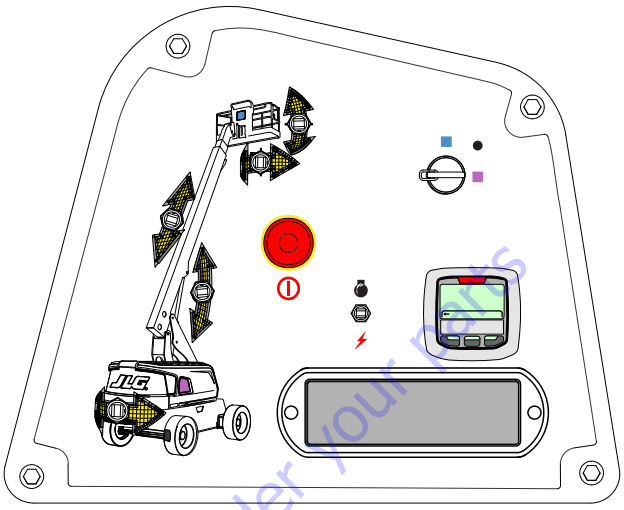
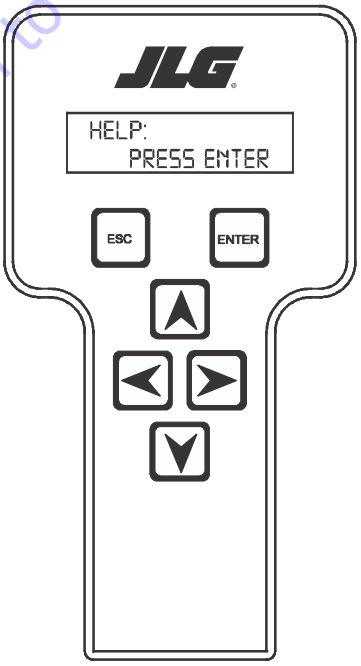
2. Plug the analyzer into the connector inside the Ground control box.

3. Pull out the Emergency Stop switch and Start the engine.



MAF19660

4. The analyzer screen should read:



5. Use the arrow button to reach SYSTEM TEST. Hit Enter. The analyzer will prompt you asking if you want to activate the system test; hit Enter again to activate.

6. Follow the flow path in Figure 6-22., System Test Flow Chart - Ground Station Tests and go through the component tests. Hit the ESC key during any part of the test to return to the main menu without completing all tests or wait until all tests are complete. During the TEST ALL INPUTS sequence, the analyzer allows control switches to be operated and shows if they are closed (CL) or open (OP).

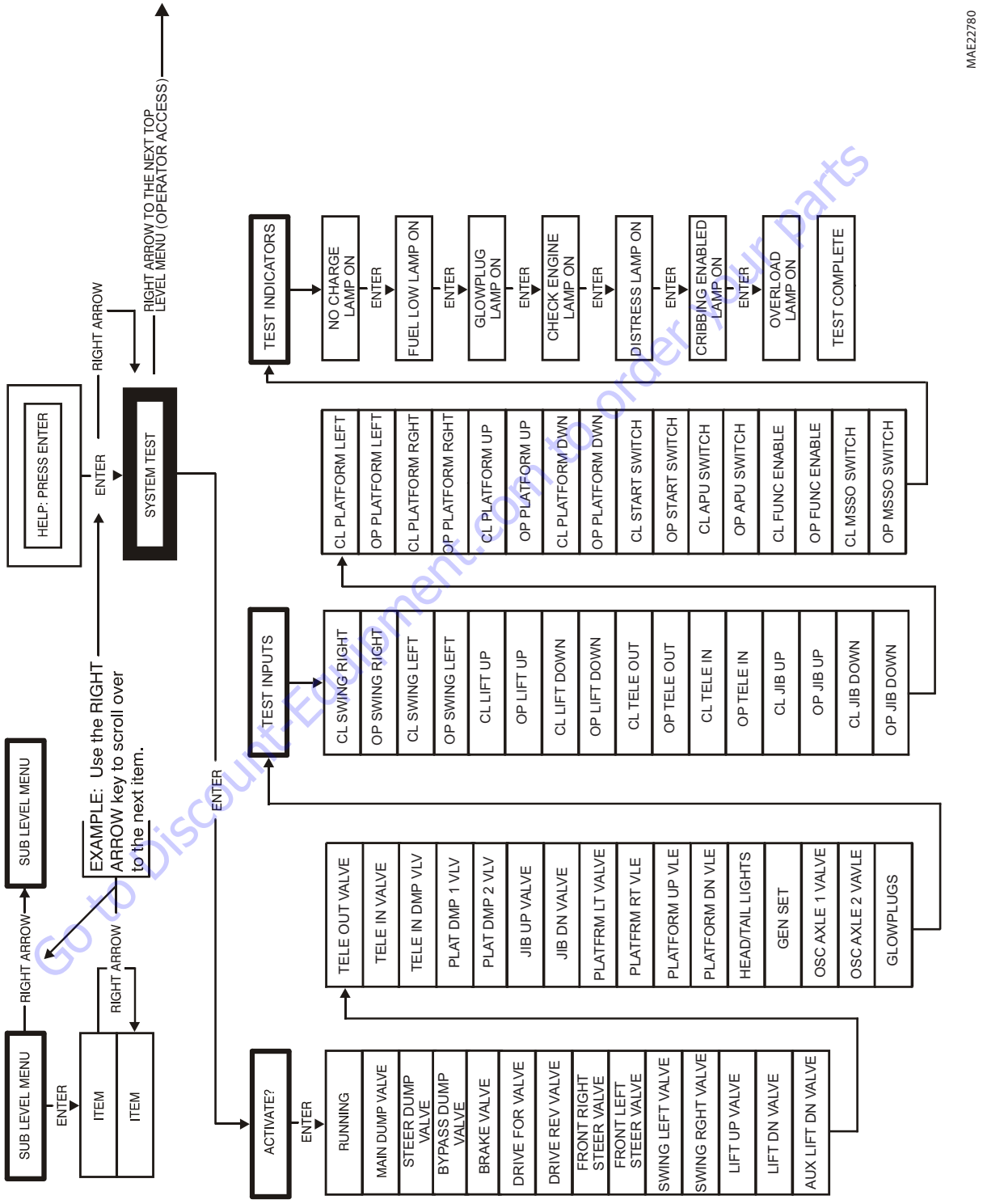


Figure 6-22. System Test Flow Chart - Ground Station Tests

6.6 SYSTEM TEST MESSAGES

Table 6-6. System Test Messages

Message Displayed on Analyzer	Message Displayed on Analyzer	Description
RUNNING		Initial display when system test is run while running certain "critical" checks are made
	CHECK GROUND/ PLATFORM SELECT	The analyzer must be connected to the active control station to run the system test
	BATTERY VOLTAGE TOO LOW	The system test may not run properly with battery voltage below 11V
	BATTERY VOLTAGE TOO HIGH	The system test may not operate properly with the battery voltage above 16V
	CHECK CAN WIRING	The system test will not operate properly unless the CAN bus is functional
	ENGINE RUNNING?	The LOSS OF ENGINE SPEED SENSOR fault 4322 is active or CANBUS FAILURE – ENGINE CONNTROL-LER fault 666 is active
	HIGH TILT ANGLE	The CHASSIS TILT SENSOR OUT OF RANGE fault 814 is active
	HOT ENGINE	The HIGH ENGINE TEMP fault 438 is active
	OPEN FOOTSWITCH	In platform mode, the footswitch must be open at the start of the test
	CLOSE FOOTSWITCH	In platform mode, the operator must close the footswitch when this message is displayed
	BAD FOOTSWITCH	The two footswitch signals are not changing together, probably because one is open circuit. Check footswitch and wiring
	OPEN FOOTSWITCH	In platform mode, the operator must open the footswitch when this message is displayed
	PLATFORM OVERLOADED	Load Sensing is configured and the ground module considers the platform to be overloaded
TESTING VALVES		Indicates that the valve test is beginning. Each valve is alternately energized and de-energized; checks are made for open- and short- circuit valve coils NOTE: In platform mode, the footswitch must be closed NOTE: Tower lift valves are not tested if TOWER LIFT=NO. Tower telescope valves are not tested if TOWER TELE=NO. Jib valves are not tested if JIB = NO. Extendable axle valves are not tested if EXT AXLES=NO. Four wheel steer valves are not tested if 4WS=NO NOTE: Left/right jib valves are not tested unless JIB = SIDESWING Problems that can be reported include below messages
	CANT TEST VALVES	There is a wiring problem, which prevents the valve test from functioning correctly. Check valve wiring. Check ground alarm & hour meter wiring
	XXXXXXX S/C	The named valve is drawing too much current so is presumed to be short-circuited. Check valve wiring
	XXXXXXX O/C	The named valve is drawing too little current so is presumed to be open-circuit. Check valve wiring
CHECKING INPUTS		Indicates that the inputs test is beginning. Every input is checked to ensure that it is in its "normal" position; function switches should be open, cutout switches should be closed, joysticks should be in neutral In platform mode any non-neutral platform switch or joystick is reported; any active cutouts are reported In ground mode any non-neutral ground switches is reported; any active cutouts are reported. NOTE: Switches, which are not in use (due to the settings of machine digits), are not checked. NOTE: The pump pot is checked only for a wire-off condition; it can be at any demand from creep to maximum Problems that can be reported include below messages
	CHECK XXXXXXX	The named switch is not in its "normal" position. Check switch & wiring
	CHECK XXXXXXX JOY	The named joystick appears to be faulty. Check joystick

Table 6-6. System Test Messages

Message Displayed on Analyzer	Message Displayed on Analyzer	Description
TESTING LAMPS		Indicates that the lamps test is beginning. Each lamp is energized in turn; a prompt asks for confirmation that the lamp is lit ENTER must be pressed or clicked to continue the test NOTE: Lamps, which are not in use (due to the settings of machine digits), are not checked NOTE: Platform Lamps are only tested in platform mode NOTE: The GM overload lamp and 500# capacity lamp are not tested NOTE: Head and tail lamps are tested in both platform and ground mode if enabled by a machine digit
TESTING ALARMS		Indicates that the alarms test is beginning. Each alarm is energized in turn; a prompt asks for confirmation that the alarm is sounding
		ENTER must be pressed or clicked to continue the test
		NOTE: The platform alarm and the horn are only tested in platform mode
		NOTE: The ground alarm is not tested if GROUND ALARM = NO
TEST ALL INPUTS?		Prompts whether to check every operator input. If ESC is pressed or clicked, the system test ends If ENTER is pressed or clicked, each operator input is prompted for in turn In platform mode every platform switch and joystick is tested In ground mode every ground switch is tested. NOTE: Tower lift switches are not tested if TOWER LIFT=NO. Tower telescope switches are not tested if TOWER TELE=NO. Jib switches are not tested if JIB = NO. Extendable axle switches are not tested if EXT AXLES=NO. Four wheel steer switches are not tested if 4WS=NO. NOTE: Left/right jib switches are not tested unless JIB = SIDESWING. Prompts displayed during the operator input test below messages.
	CLOSE XXXXXXX	The named switch should be closed
	OPEN XXXXXXX	The named switch should be opened
	XXXXXXX XXXXXXX TO MAX	The named joystick should be pushed to its full extent in the named direction
	XXXXXXX XXXXXXX TO MIN	The named joystick should be returned to neutral from the named direction
	PUMP POT TO MAX	The pump pot should be turned to maximum
	PUMP POT TO MIN	The pump pot should be turned to minimum
	MULTIPLE CLOSURE	More than one operator input is closed; if only one has been operated, there could be a short between two inputs
TESTS COMPLETE		Indicates that the system test is complete. Any problems reported should have been noted and should now be rectified. Press ESC/CANCEL to return to the RUN SYSTEM TEST Analyzer menu

6.7 MACHINE DIAGNOSTICS PARAMETERS

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 1st Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
DRIVE/STEER	DRIVE DEMAND	FORWARD/REVERSE XXX%	Direction and command percentage of Drive as reported by PM
	DRIVE OUTPUT	FORWARD/REVERSE XXX%	Direction and current output percentage
	DRIVE OUT mA	FORWARD/REVERSE XXXXmA	Direction and current output command
	DRIVE FDBK mA	XXXXmA	Current feedback measurement
	STEER DEMAND	LEFT/RIGHT XXX%	Direction and command percentage of Steer as reported by PM.
	STEER OUPTUT	LEFT/RIGHT XXX%	Direction and PWM output percentage
	STEER TYPE	NORMAL/CRAB/COORDINATED	Steer Type Status (MACHINE SETUP ⟶ 4 WHEEL STEER = YES)
	BRAKES STATUS	LOCKED/RELEASED	Status of Brake Valve output
	2SPEED OUTPUT	ON/OFF	Status of 2 Speed Valve output (600S)
	DRIVE MODE	MAX SPEED/MAX TORQUE/MID ENGINE	Drive Mode Status
	DRV ORIENT TT SW	OPEN /CLOSED	State of DOS Switch (600S)
	DRV ORIENT MODE	INLINE/SWUNG	DOS state
	DRV ORIENT STATE	CONFIRMED/REQUIRED	InLine and DOS Active = Confirmed
	DRV ORNT OVR SW	CLOSED/OPEN	State of Drive Orientation Override Switch
	CRIBBING MODE SW	CLOSED/OPEN	State of Cribbing Mode Switch; only displayed if MACHINE SETUP ⟶ CRIBBING = YES
	CRIBBING MODE	DISBLED/ENABLED	Reflects state of Cribbing Mode Switch; only displayed if MACHINE SETUP ⟶ CRIBBING = YES
BOOM FUNCTIONS	SWING DEMAND	LEFT/RIGHT XXX%	Direction and percentage of input command from Swing Joystick or Ground%
	SWING OUTPUT	LEFT/RIGHT XXX%	Direction and current output percentage
	SWING OUTPUT mA	LEFT/RIGHT XXXXmA	Direction and current output command
	SWING FDBK mA	XXXXmA	Current feedback measurement
	LIFT DEMAND	UP/DOWN XXX%	Direction and percentage of Lift input command
	LIFT OUTPUT	UP/DOWN XXX%	Direction and current output percentage
	LIFT OUTPUT mA	UP/DOWN XXXXmA	Direction and current output command
	LIFT FDBK mA	XXXXmA	Current feedback measurement
	LIFT DN AUX	ON/OFF	Status of Aux Lift Down (600S)
	TELE DEMAND	IN/OUT XXX%/CREEP	Direction and percentage of input command (or CREEP if selected) from Function Speed Pot or Ground%
	TELE OUTPUT	IN/OUT XXX%	Direction and current output percentage for Flow Control Valve mapped to Tele Personalities
	TELE OUTPUT mA	IN/OUT XXXXmA	Direction and current output command (600S)
	TELE FDBK mA	XXXXmA	Current feedback measurement (600S)

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 1st Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
	JIB LIFT DEMAND	UP/DOWN XXX%/CREEP	Direction and percentage of input command (or CREEP if selected) from Function Speed Pot or Ground%; only displayed if MACHINE SETUP ⟶ JIB = YES
	JIB LIFT OUTPUT	UP/DOWN XXX%	For Up, direction and current output percentage for Flow Control mapped to Jib Lift Up Personality range; for Down, direction and PWM output percentage; only displayed if MACHINE SETUP ⟶ JIB = YES
	PLAT LVL DEMAND	UP/DOWN XXX%/CREEP	Direction and percentage of input command (or CREEP if selected) from Function Speed Pot or Ground% (600S)
	PLAT LVL OUTPUT	UP/DOWN XXX%	Direction and current output percentage for Flow Control mapped to Platform Level Personality range (600S)
	PLAT LVL OUT mA	UP/DOWN XXXXmA	Direction and current output command (600S)
	PLAT LVL UP FDBK	XXXXmA	Platform Level Up Current feedback measurement (600S)
	PLAT LVL DN FDBK	XXXXmA	Platform Level Down Current feedback measurement (600S)
	PLAT ROT DEMAND	LEFT/RIGHT XXX%/CREEP	Direction and percentage of input command (or CREEP if selected) from Function Speed Pot or Ground% (600S)
	PLAT ROT OUTPUT	LEFT/RIGHT XXX%	Direction and current output percentage for Flow Control mapped to Platform Rotate Personality range; for 600S value = 0% or 100%
	LF PRS REL OUTPT	ON/OFF	Status of Low Flow Pressure Release Valve; Only display if Low Flow Pressure Release is Configured
	MAIN DUMP OUTPUT	ON/OFF	Status of Main Dump Valve
	TELE IN DUMP	ON/OFF	Status of Telescope In Dump Valve (600S)
	FUNCTION SPEED	SETTING: XXX%	Displays the percentage demand from the Function Speed Potentiometer.
	CREEP SW	OPEN/CLOSED	Status of Creep Switch Input
	CREEP MODE	ON/OFF	Displays status of Creep Mode
ENGINE	OPERATING STATE	STOPPED/CRANKING/ STARTING/RUNNING	Displays Engine State
	GLOW PLUG	NOT ACTIVE/ACTIVE	Display diagnostic if glow plugs configured: MACHINE SETUP ⟶ GLOW PLUG ≠ NO GLOW PLUGS
	COOLANT TEMP	XXXC/XXXF	Degrees F or C displayed depending on Machine Setup Configuration
	ENGINE OIL PRESS	XXXXPSI/XXXXKPA	If Ford read > 10 PSI display OK, else LOW If Deutz, display transmitted value
	FUEL SELECTION	STATUS GAS/LP	MACHINE SETUP ⟶ ENGINE = FORD DUAL FUEL
	FUEL PRESS	XXXXPSI/XXXXKPA	MACHINE SETUP ⟶ ENGINE = EMR 4
	AMBIENT TEMP	XXXC/XXXF	
	FUEL LEVEL	FULL; ¾; ½; ¼; LOW; EMPTY; OK; ERROR	MACHINE SETUP ⟶ FUEL LEVEL ≠ NONE
	ENGINE SPEED	ACTUAL XXXXRPM	RPM read from speed sensor if engine = over CAN2 for Deutz, Ford Dual Fuel

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 1st Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
	ENGINE SPEED	TARGET XXXXRPM	UGM - commanded Target RPM
SYSTEM	UGM BATTERY	XX.XV	UGM measured battery voltage
	PLATFORM MODULE	BATTERY XX.XV	PM measured battery voltage
	UGM TEMP	XXXC/XXXF	UGM on-board temperature measurement
	PLATFORM SELECT	KEYSWITCH: OPEN KEYSWITCH: CLOSED	Displays whether Platform Keyswitch position is being selected
	GROUND SELECT	KEYSWITCH: OPEN KEYSWITCH: CLOSED	Displays whether Ground Keyswitch position is being selected
	STATION CONTROL	GROUND/PLATFORM	Displays Active control station per System Mode definition
	FOOTSWITCH INPUT	GROUND: OPEN GROUND: CLOSED	State of Footswitch input at UGM
	FOOTSWITCH INPUT	PLATFORM: OPEN PLATFORM: CLOSED	State of Footswitch input at PM (closed when footswitch not activated)
	PLATFORM ANGLE:	XXX.XDEG	Platform Angle with respect to Chassis (600S)
	PLAT ANGLE 1 RAW	XX.X%	Platform Angle sensor #1 raw PWM% (600S)
	PLAT ANGLE 2 RAW	XX.X%	Platform Angle sensor #2 raw PWM% (600S)
	ELEVATION MODE	ABOVE/NOT ABOVE	Elevation State
	CAPACITY MODE	RESTRICTED/UNRESTRICTED/ERROR	Dual Capacity State; Dual Capacity is configured
	TRANSPORT MODE	IN TRANSPORT/OUT OF TRANSPORT	Transport Position
	CREEP SW	OPEN/CLOSED	Status of Creep Switch Input
	CREEP MODE	ON/OFF	Displays status of Creep Mode
	CHASSIS TILT	XX.XDEG	Combined X/Y Absolute Angle
	CHASSIS TILT	X-AXIS: XX.XDEG	X Angle with respect to sign
	CHASSIS TILT	Y-AXIS: XX.XDEG	Y Angle with respect to sign
	GENSET/WELDER SW	OPEN/CLOSED	Platform Generator Enable switch; only displayed if MACHINE SETUP ⟶ GEN SET/WELDER ≠ NO
	GENSET ENABLE	OUTPUT: ON/OFF	UGM Generator Relay Enable output; only displayed if MACHINE SETUP ⟶ GEN SET/WELDER ≠ NO
	H&T LIGHTS SW	OPEN/CLOSED	Only displayed if in Platform Mode and MACHINE SETUP ⟶ H&T LIGHTS = YES
	H&T LIGHTS OUT	ON/OFF	UGM Nite Brite Relay Enable output; only displayed if in Platform Mode and MACHINE SETUP ⟶ H&T LIGHTS = YES
	SOFT TOUCH INPUT	OPEN/CLOSED	State of Soft Touch Platform Input (J1-20); closed when active; only displayed if in Platform Mode and MACHINE SETUP ⟶ SOFT TOUCH = YES.
	SKYGUARD INPUTS	OPEN/CLOSED/DISAGREE	SkyGuard Input #1 (PLT J7-18) AND SkyGuard Input #2 (PLT J1-23) state; only displayed if in Platform Mode and MACHINE SETUP ⟶ SKYGUARD = YES.

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 1st Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
	SKYGUARD INPUT 1	OPEN/CLOSED	State of SkyGuard Platform Input #1 (J7-18); relay NC contacts – closed when active; only displayed if in Platform Mode and MACHINE SETUP ⟶ SKYGUARD = YES.
	SKYGUARD INPUT 2	OPEN/CLOSED	State of SkyGuard Platform Input #2 (J1-23); relay NC contacts – closed when active; only displayed if in Platform Mode and MACHINE SETUP ⟶ SKYGUARD = YES.
	AMBIENT TEMP	XXXC/XXXF	Ambient Temperature sensor reading; Only displayed if MACHINE SETUP ⟶ TEMP CUTOUT = YES
	LOW TEMPERATURE	CUTOUT: ACTIVE/INACTIVE/FAULTY	Status of Low Temperature Cutout; Only displayed if MACHINE SETUP ⟶ TEMP CUTOUT = YES
	MSSO	ACTIVE/INACTIVE	Status of MSSO; Only displayed if MACHINE SETUP ⟶ MARKET = CE
	WIRE ROPE	SWITCH: OPEN/CLOSED	State of Wire Rope Service Switch input (J3-8); closed when active; MACHINE SETUP ⟶ CABLE SWITCH = YES
OPER CONTROLS	JOYSTICK DRIVE	FORWARD/REVERSE XXX%	Drive Joystick drive direction and command percentage as reported from PM; only displayed if in Platform Mode
	JOYSTICK STEER	LEFT/RIGHT XXX%	Drive Joystick steer direction and percentage command as reported from PM; only displayed if in Platform Mode
	JOYSTICK SWING	LEFT/RIGHT XXX%	Lift/Swing Joystick Swing direction and percentage command as reported from PM; only displayed if in Platform Mode
	JOYSTICK LIFT	UP/DOWN XXX%	Lift/Swing Joystick Lift direction and percentage command as reported from PM; only displayed if in Platform Mode
	DRV ORNT OVR SW	CLOSED/OPEN	State of Drive Orientation Override Switch if in Platform Mode
	FUEL SELECT SW	OPEN/CLOSED	Status of Platform Toggle Switch Input if in Platform Mode and MACHINE SETUP ⟶ ENGINE = FORD DUAL FUEL
	START SWITCH	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input
	SWING LEFT SW	OPEN/CLOSED	Status of Ground Toggle Switch Input if in Ground Mode
	SWING RIGHT SW	OPEN/CLOSED	Status of Ground Toggle Switch Input if in Ground Mode
	LIFT UP SW	OPEN/CLOSED	Status of Ground Toggle Switch Input if in Ground Mode
	LIFT DN SW	OPEN/CLOSED	Status of Ground Toggle Switch Input if in Ground Mode
	TELE IN SW	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input
	TELE OUT SW	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 1st Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
	JIB LIFT UP SW	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input; only displayed if MACHINE SETUP⟶ JIB = YES
	JIB LIFT DN SW	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input; only displayed if MACHINE SETUP ⟶ JIB = YES
	PLAT LEVEL UP SW	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input
	PLAT LEVEL DN SW	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input
	PLAT ROT LEFT SW	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input
	PLAT ROT RGHT SW	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input
	MAX SPEED SW	OPEN/CLOSED	Status of Platform Toggle Switch Input; only displayed if in Platform Mode
	MAX TORQUE SW	OPEN/CLOSED	Status of Platform Toggle Switch Input; only displayed if in Platform Mode
	CREEP SW	OPEN/CLOSED	Status of Creep Switch Input; only displayed if in Platform Mode
	HORN SW	OPEN/CLOSED	Status of Platform Switch Input; only displayed if in Platform Mode
	H&T LIGHT SW	OPEN/CLOSED	Status of Platform Toggle Switch Input; only displayed if in Platform Mode and MACHINE SETUP ⟶ H&T LIGHTS = YES
	GENSET/WELDER SW	OPEN/CLOSED	Status of Platform Toggle Switch Input; only displayed if MACHINE SETUP ⟶ GEN SET/WELDER ≠ NO
	SG OVERRIDE SW	OPEN/CLOSED	Status of Platform SkyGuard Override Switch Input; only displayed if in Platform Mode MACHINE SETUP ⟶ SOFT TOUCH = NO and MACHINE SETUP ⟶ SKYGUARD = YES
	ST OVERRIDE SW	OPEN/CLOSED	Status of Platform SkyGuard Override Switch Input; only displayed if in Platform Mode and MACHINE SETUP ⟶ SOFT TOUCH = YES and MACHINE SETUP ⟶ SKYGUARD = NO
	SG/ST OVRIDE SW	OPEN/CLOSED	Status of Platform SkyGuard Override Switch Input; only displayed if in Platform Mode and MACHINE SETUP ⟶ SOFT TOUCH = YES and MACHINE SETUP ⟶ SKYGUARD = YES
	MSSO SW	OPEN/CLOSED	Status of Ground MSSO Switch Input; only displayed if MACHINE SETUP ⟶ MARKET = CE
	CAPACITY SW	OPEN/CLOSED	Status of Platform Dual Capacity Switch Input; only displayed if Dual Capacity is configured
	STEER CRAB SW	OPEN/CLOSED	Status of the Crab Steer Select Switch Input (MACHINE SETUP ⟶ 4 WHEEL STEER = YES)
	STEER COORD SW	OPEN/CLOSED	Status of the Coordinated Steer Select Switch Input (MACHINE SETUP ⟶ 4 WHEEL STEER = YES)

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 1st Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
PLATFORM LOAD (DISPLAY ONLY IF MACHINE SETUP → LOAD SYSTEM ≠ NO)	PLATFORM LOAD	STATE: OK/OVERLOAD	LSS Status
	PLATFORM LOAD	ACTUAL: XXXXLBS	Platform Load??? if Platform Load == Unhealthy
	PLATFORM LOAD[2]	GROSS: XXXXLBS	If 4-Cell LSS; Combined weight of all cells (accounting for sign) If 1-Cell LSS; Platform Gross used to calculate Platform Load ??? if (Platform Gross 1 == Unhealthy and Platform Gross 2 == Unhealthy)
	PLATFORM LOAD[2]	OFFSET: XXXLBS	If 4-Cell LSS; Stored Platform Empty weight
	PLATFORM LOAD[2]	OFFSET 1: XXXLBS	If 1-Cell LSS; Stored Unloaded Platform Weight of Strain Gauge 1 ??? if DTC 825 is active
	PLATFORM LOAD[2]	OFFSET 2: XXXLBS	If 1-Cell LSS; Stored Unloaded Platform Weight of Strain Gauge 2 ??? if DTC 825 is active
	PLATFORM LOAD[2]	ACCESSORY XXXLBS	Stored Accessory weight; ??? if DTC 825 is active
	PLATFORM LOAD[2]	UNRSTRICT XXXLBS	Stored Unrestricted Rated Load; ??? if DTC 825 is active
	PLATFORM LOAD[2]	RSTRICT XXXXLBS	If Dual Capacity is Configured; Stored Restricted Rated Load; ??? if DTC 825 is active
	PLATFORM LOAD[2]	CELL 1: XXXLBS	If 4-Cell LSS; Gross weight reading of Cell 1
	PLATFORM LOAD[2]	CELL 2: XXXLBS	If 4-Cell LSS; Gross weight reading of Cell 2
	PLATFORM LOAD[2]	CELL 3: XXXLBS	If 4-Cell LSS; Gross weight reading of Cell 3
	PLATFORM LOAD[2]	CELL 4: XXXLBS	If 4-Cell LSS; Gross weight reading of Cell 4
	PLATFORM LOAD[2]	RAW 1: XXXXLBS	If 1-Cell LSS; Platform Gross 1; ??? if Platform Gross 1 == Unhealthy
	PLATFORM LOAD[2]	RAW 2: XXXXLBS	If 1-Cell LSS; Platform Gross 2; ??? if Platform Gross 2 == Unhealthy

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 1st Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
CAN STATISTICS[2]	CAN 1 STATISTICS	RX/SEC: XXX	
	CAN 1 STATISTICS	TX/SEC: XXX	
	CAN 1 STATISTICS	BUS OFF: XXX	
	CAN 1 STATISTICS	PASSIVE: XXX	
	CAN 1 STATISTICS	MSG ERROR: XXXX	
	CAN 2 STATISTICS	RX/SEC: XXX	
	CAN 2 STATISTICS	TX/SEC: XXX	
	CAN 2 STATISTICS	BUS OFF: XXX	
	CAN 2 STATISTICS	PASSIVE: XXX	
	CAN 2 STATISTICS	MSG ERROR: XXXX	

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 1st Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
DEBUG UGM I/O[2]	DEBUG DIAG DIGITAL INPUTS	DIG IN J1-21 HIGH/LOW DIG IN J1-34 HIGH/LOW DIG IN J1-35 HIGH/LOW DIG IN J2-24 HIGH/LOW DIG IN J3-8 HIGH/LOW DIG IN J3-9 HIGH/LOW DIG IN J3-10 HIGH/LOW DIG IN J3-11 HIGH/LOW DIG IN J4-4 HIGH/LOW DIG IN J4-5 HIGH/LOW DIG IN J4-6 HIGH/LOW DIG IN J4-7 HIGH/LOW DIG IN J4-8 HIGH/LOW DIG IN J4-9 HIGH/LOW DIG IN J4-10 HIGH/LOW DIG IN J4-11 HIGH/LOW DIG IN J4-16 HIGH/LOW DIG IN J4-17 HIGH/LOW DIG IN J4-18 HIGH/LOW DIG IN J4-19 HIGH/LOW DIG IN J4-20 HIGH/LOW DIG IN J4-21 HIGH/LOW DIG IN J4-22 HIGH/LOW DIG IN J4-23 HIGH/LOW DIG IN J4-30 HIGH/LOW DIG IN J4-33 HIGH/LOW DIG IN J4-34 HIGH/LOW DIG IN J4-35 HIGH/LOW DIG IN J7-2 HIGH/LOW DIG IN J7-3 HIGH/LOW DIG IN J7-12 HIGH/LOW DIG IN J7-15 HIGH/LOW DIG IN J7-21 HIGH/LOW DIG IN J12-8 HIGH/LOW	Left and Right arrow keys scroll through the inputs. 1st Line = DIG IN JX.XX and 2nd Line displays measurement value

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 1st Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
	DEBUG DIAG DIGITAL OUTPUTS	DIG OUT J1-2 ON/OFF DIG OUT J1-7 ON/OFF DIG OUT J1-11 ON/OFF DIG OUT J1-12 ON/OFF DIG OUT J1-13 ON/OFF DIG OUT J1-23 ON/OFF DIG OUT J1-32 ON/OFF DIG OUT J2-2 ON/OFF DIG OUT J2-3 ON/OFF DIG OUT J2-4 ON/OFF DIG OUT J2-5 ON/OFF DIG OUT J2-7 ON/OFF DIG OUT J2-10 ON/OFF DIG OUT J2-12 ON/OFF DIG OUT J2-13 ON/OFF DIG OUT J2-15 ON/OFF DIG OUT J2-16 ON/OFF DIG OUT J2-21 ON/OFF DIG OUT J2-23 ON/OFF DIG OUT J2-32 ON/OFF DIG OUT J2-33 ON/OFF DIG OUT J4-1 ON/OFF DIG OUT J4-2 ON/OFF DIG OUT J4-3 ON/OFF DIG OUT J4-13 ON/OFF DIG OUT J4-14 ON/OFF DIG OUT J4-15 ON/OFF DIG OUT J4-26 ON/OFF DIG OUT J4-27 ON/OFF DIG OUT J4-28 ON/OFF DIG OUT J4-29 ON/OFF DIG OUT CS1GC ON/OFF[1] DIG OUT CS2GC ON/OFF[1] DIG OUT LED ON/OFF DIG OUT TP1[1]	Left and Right arrow keys scroll through the inputs. 1st Line = DIG OUT JX.XX and 2nd Line displays output value

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 1st Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
	DEBUG DIAG PWM OUTPUTS	PWM J1-1 XXX.XX% XXXHZ PWM J1-3 XXX.XX% XXXHZ PWM J1-6 XXX.XX% XXXHZ PWM J1-10 XXX.XX% XXXHZ PWM J1-20 XXX.XX% XXXHZ PWM J1-22 XXX.XX% XXXHZ PWM J2-8 XXX.XX% XXXHZ PWM J2-9 XXX.XX% XXXHZ PWM J2-11 XXX.XX% XXXHZ PWM J2-19 XXX.XX% XXXHZ PWM J2-20 XXX.XX% XXXHZ PWM J2-22 XXX.XX% XXXHZ PWM J2-26 XXX.XX% XXXHZ PWM J2-27 XXX.XX% XXXHZ PWM J2-31 XXX.XX% XXXHZ PWM J2-34 XXX.XX% XXXHZ PWM J2-35 XXX.XX% XXXHZ FET J3-1 XXX.XX% XXXHZ FET J3-2 XXX.XX% XXXHZ FET J3-4 XXX.XX% XXXHZ FET J3-5 XXX.XX% XXXHZ FET J3-6 XXX.XX% XXXHZ	

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 1st Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
		FET J3-14 XXX.XX% XXXHZ PWM J4-12 XXX.XX% XXXHZ	
	ANALOG INPUTS	ADC J1-01 FB XXXX1 ADC J1-01 IS XXXX1 ADC J1-02 FB XXXX1 ADC J1-03 FB XXXX1 ADC J1-06 FB XXXX1 ADC J1-07 FB XXXX1 ADC J1-10 FB XXXX1 ADC J1-11 FB XXXX1 ADC J1-12 FB XXXX1 ADC J1-13 FB XXXX1 ADC J1-14 XXXX ADC J1-15 XXXX ADC J1-20 FB XXXX1 ADC J1-22 FB XXXX1 ADC J1-23 FB XXXX1 ADC J2-01 FB XXXX1 ADC J2-02 FB XXXX1 ADC J2-03 FB XXXX1 ADC J2-04 FB XXXX1 ADC J2-05 FB XXXX1 ADC J2-07 FB XXXX1 ADC J2-08 FB XXXX1 ADC J2-09 FB XXXX1 ADC J2-10 FB XXXX1 ADC J2-11 FB XXXX1 ADC J2-12 FB XXXX1 ADC J2-13 FB XXXX1 ADC J2-15 FB XXXX1 ADC J2-16 FB XXXX1 ADC J2-19 FB XXXX1 ADC J2-20 FB XXXX1 ADC J2-22 FB XXXX1 ADC J2-23 FB XXXX1 ADC J2-25 XXXX ADC J2-26 FB XXXX1 ADC J2-27 FB XXXX1 ADC J2-31 FB XXXX1 ADC J2-32 FB XXXX1 ADC J2-33 FB XXXX1	Left and Right arrow keys scroll through the inputs. 1st Line = ADC JX.XX and 2nd Line displays raw A/D counts XXXX of measurement

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 1st Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
		ADC J2-34 FB XXXX1 ADC J2-35 FB XXXX1 ADC J3-01 IS XXXX1 ADC J3-02 IS XXXX1 ADC J3-04 IS XXXX1 ADC J3-05 IS XXXX1 ADC J3-06 IS XXXX1 ADC J3-13 XXXX ADC J3-14 IS XXXX1 ADC J4-12 FB XXXX1 ADC J7-2 XXXX ADC J7-04 XXXX ADC J7-07 XXXX ADC J7-08 XXXX ADC J7-20 XXXX ADC J8-02 XXXX ADC AMBIENT XXXX1 ADC VOFCS XXXX1	
	FREQUENCY INPUTS	FREQ IN J1-16 XXXXX HZ FREQ IN J12-1 XXXXX HZ FREQ IN J12-2 XXXXX HZ	Left and Right arrow keys scroll through the inputs. 1st Line = FREQ IN JX.XX and 2nd Line displays frequency of measurement XXXXX Hz
DATALOG	DATALOG TIME	ON XXXXH XXM	*Controller On time
	DATALOG TIME	ENGINE XXXXH XXM	*Engine Running time
	DATALOG TIME	ENABLD XXXXH XXM	*Combined time for Machine Enabled in Platform Mode while ENGINE RUNNING + any function active while in Ground Mode (excludes APU/ Emergency Descent)
	DATALOG TIME	AUX XXXXH XXM	Auxiliary Power/Emergency Descent Active time
	DATALOG TIME	DRIVE XXXXH XXM	Drive Forward + Reverse time
	DATALOG TIME	DRV MS XXXXH XXM	Max Speed Drive Forward + Reverse time
	DATALOG TIME	DRV MT XXXXH XXM	Max Torque Drive Forward + Reverse time
	DATALOG TIME	DRV ME XXXXH XXM	Mid Engine Drive Forward + Reverse time
	DATALOG TIME	DRV CP XXXXH XXM	Creep Drive Forward + Reverse time
	DATALOG TIME	STEER XXXXH XXM	Steer Left + Right time
	DATALOG TIME	SWING XXXXH XXM	Swing Left + Right time
	DATALOG TIME	LIFT XXXXH XXM	Lift Up + Down time
	DATALOG TIME	TELE XXXXH XXM	Tele In + Out time
	DATALOG TIME	JIB XXXXH XXM	Jib Lift Up + Down time (MACHINE SETUP → JIB = YES)
	DATALOG TIME	LEVEL XXXXH XXM	Platform Level Up + Down time
	DATALOG TIME	ROTATE XXXXH XXM	Platform Rotate Left + Right time
	DATALOG TIME	GEN XXXXH XXM	*Generator Enable Relay on time

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 1st Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
	For time logging of functions with 30-second resolution, the first 15 seconds of function run time shall be logged as a ½ minute increment and there after every 30 seconds of run time shall be logged as a ½ minute increment. *The functions annotated with an asterisk in the description are function timers with 60-second resolution, for which the timer in the rule above is doubled.		
	DATALOG CYCLES	DRVE FWD XXXXXXX	Number of times Drive Forward is commanded
	DATALOG CYCLES	DRVE REV XXXXXXX	Number of times Drive Reverse is commanded
	DATALOG CYCLES	STEER LT XXXXXXXX	Number of times Steer Left Output is commanded
	DATALOG CYCLES	STEER RT XXXXXXXX	Number of times Steer Right Output is commanded
	DATALOG CYCLES	SWING LT XXXXXXX	Number of times Swing Left output is commanded
	DATALOG CYCLES	SWING RT XXXXXXX	Number of times Swing Right output is commanded
	DATALOG CYCLES	LIFT UP XXXXXXX	Number of times Lift Up output is commanded
	DATALOG CYCLES	LIFT DN XXXXXXX	Number of times Lift Down output is commanded
	DATALOG CYCLES	TELE IN XXXXXXX	Number of times Tele In output is commanded
	DATALOG CYCLES	TELE OUT XXXXXXX	Number of times Tele Out output is commanded
	DATALOG CYCLES	JIB UP XXXXXXX	Number of times Jib Lift Up is commanded (MACHINE SETUP ⟶ JIB = YES)
	DATALOG CYCLES	JIB DOWN XXXXXXX	Number of times Jib Lift Down is commanded (MACHINE SETUP⟶ JIB = YES)
	DATALOG CYCLES	LEVEL UP XXXXXXX	Number of times Level Up is commanded
	DATALOG CYCLES	LEVEL DN XXXXXXX	Number of times Level Down is commanded
	DATALOG CYCLES	ROT LEFT XXXXXXX	Number of times Rotate Left is commanded
	DATALOG CYCLES	ROT RGHT XXXXXXX	Number of times Rotate Right is commanded
	DATALOG CYCLES	UGM ON XXXXXXX	Number of times Power is applied
	DATALOG CYCLES	GND OPS XXXXXXX	Number of times machine is in Ground Mode and any function is active (excludes APU/Emergency Descent)
	DATALOG CYCLES	PLAT OPS XXXXXXX	Number of times machine is Enabled from Platform Station (excludes APU/Emergency Descent)
	DATALOG CYCLES	AUX OPS XXXXXXX	Number of times machine Auxiliary Power/Emergency Descent is Enabled
	DATALOG CYCLES	GEN ON XXXXXXX	Number of times Generator Enable Relay is turned On; information logged and stored only if machine configured for generator.
	DATALOG CYCLES	BOOM TR XXXXXXX	Number of times the Boom transitions from Below Elevation to Above Elevation
	DATALOG CYCLES	DUAL CAP XXXXXXX	Number of times the Boom transitions from Restricted to Unrestricted mode (Dual Capacity is configured)
	Cycle counter shall increment up to a limit of 1,000,000, except Steer shall have a limit of 2,000,000 per direction.		
	DATALOG: MAX	UGM TEMP XXXC/	Hottest Temp observed by UGM
		UGM TEMP XXXF	
	DATALOG: MIN	UGM TEMP XXXC/	Coldest Temp observed by UGM
		UGM TEMP XXXF	

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 1st Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
	DATALOG: MAX	UGM VOLT XX.XV	Maximum input voltage observed by UGM
	DATALOG: MACHINE	RENTAL XXXXH XXM	*Stores Machine hours since last memory clear
	DATALOG: ERASE [2]	MACHINE RENTAL?	Erases stored machine rental hours
VERSIONS:	UGM	SOFTWARE PX.X	
	UGM	CNST DATA PX.X	
	UGM	HARDWARE REV X	
	UGM	SN XXXXXX	
	UGM	PN XXXXXXXXX	
	PLATFORM MODULE	SOFTWARE PX.X	
	PLATFORM MODULE	HARDWARE REV X	
	PLATFORM MODULE	SN XXXXXX	
	LSS MODULE	SOFTWARE PX.X	Displayed on if LSS is configured (4-Cell LSS)
	LSS MODULE	HARDWARE REV X	Display if LSS is configured (4-Cell LSS)
	TCU MODULE	SOFTWARE X.Xx	Displayed on if TCU is configured
	TCU MODULE	HARDWARE REV X	Displayed on if TCU is configured
	TCU MODULE	SN XXXXXX	Displayed on if TCU is configured
	ANALYZER	ANALYZER vX.X	

6.8 CALIBRATING TILT SENSOR

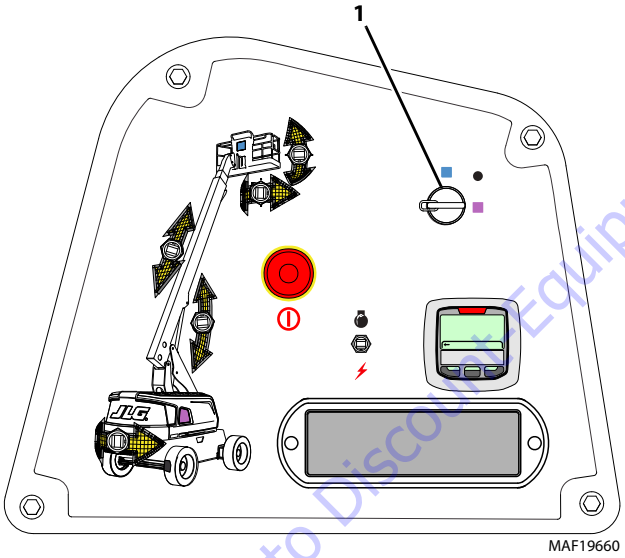
NOTICE

A NEW TILT MODULE WILL ACT AS IF IT IS TILTED ALL OF THE TIME UNTIL THE-FOLLOWING PROCEDURE IS PERFORMED.

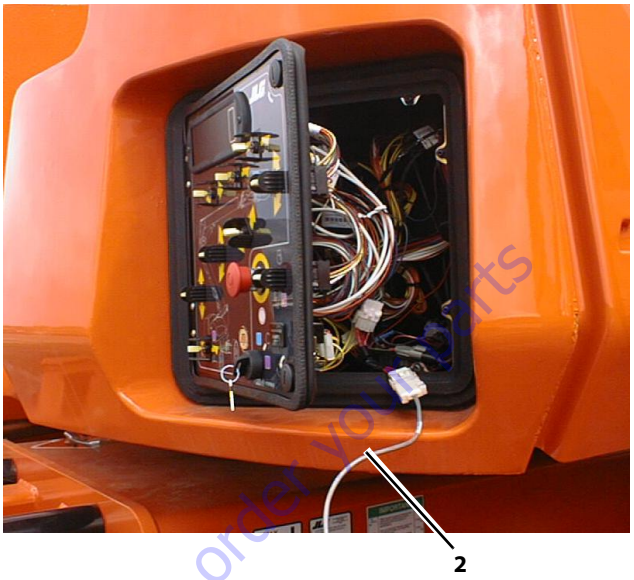
⚠ WARNING

DO NOT CALIBRATE THE LEVEL SENSOR EXCEPT ON A LEVEL SURFACE.

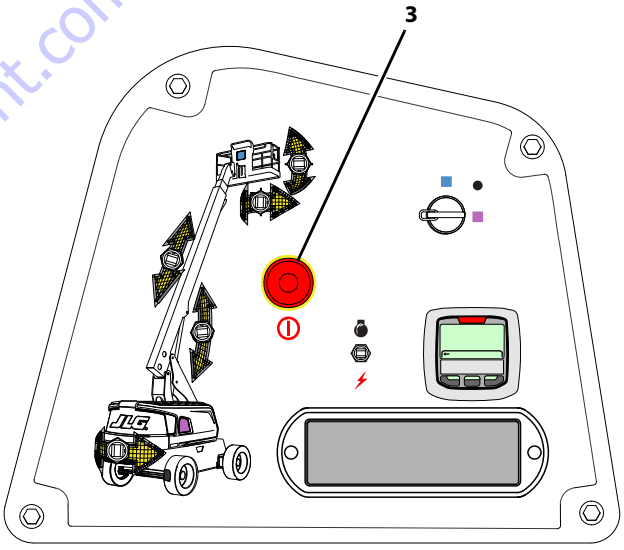
1. Use the following procedure to calibrate the tilt sensor.
2. Before the tilt sensor can be calibrated, the following conditions must be met:
   a. Wheels straight.
   b. Turntable centered.
   c. Boom fully retracted.
   d. Boom angle is less than 45°.
   e. Machine on firm, level ground.
3. Position the Platform/Ground select switch (1) to the Ground position.



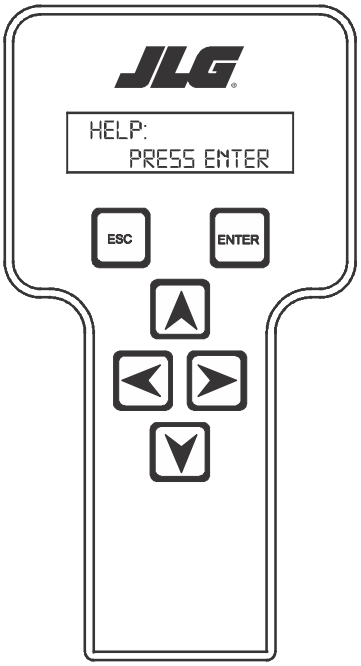
4. Plug the analyzer into the connector (2) inside the Ground control box.



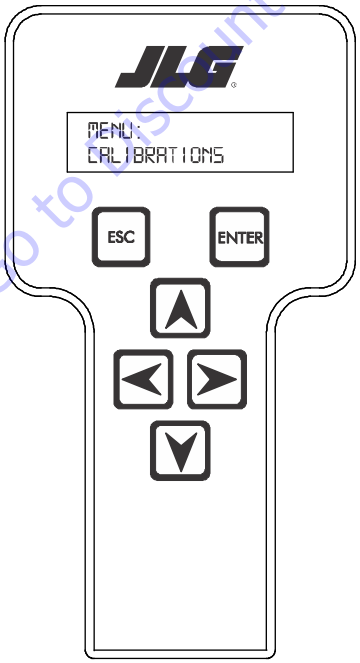
5. Pull out the Emergency Stop switch and Start the engine.



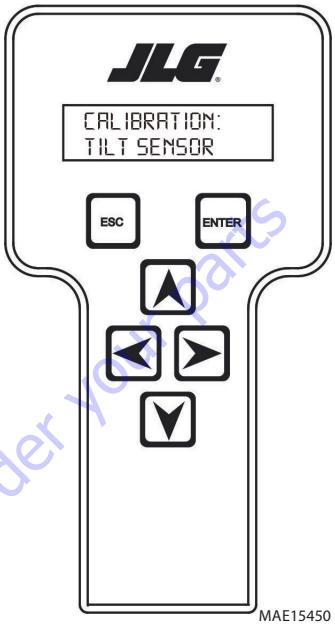
6. The analyzer screen should read:



7. Use the arrow button to reach ACCESS LEVEL. Hit Enter.
8. Enter the Access Code, 33271.
9. Use the right Arrow key to reach CALIBRATIONS. Hit Enter.
10. Using the arrow keys, navigate to Calibrations Menu as shown below and press **ENTER** ENTER.

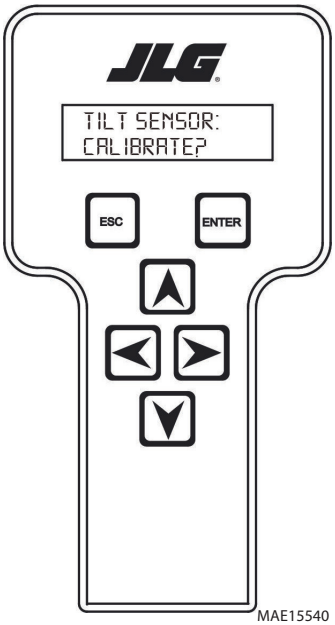


11. Using the arrow keys, navigate to the Tilt Sensor calibration as shown below and press **ENTER** ENTER



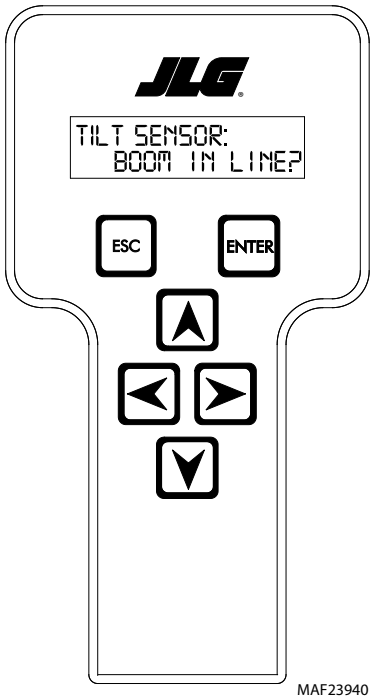
MAE15450

12. Hit Enter. The screen will read.

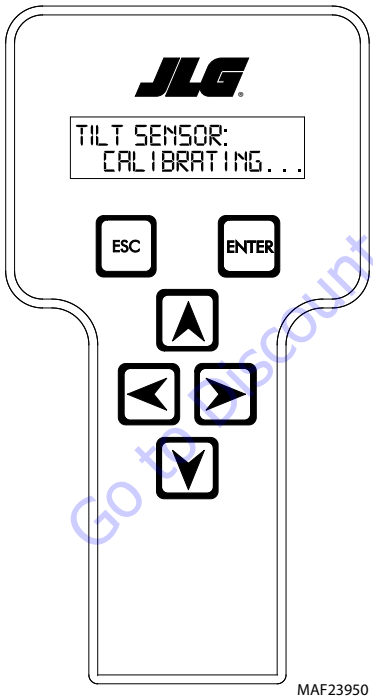


MAE15540

13. UGM will confirm the position of the boom, then the screen will read:

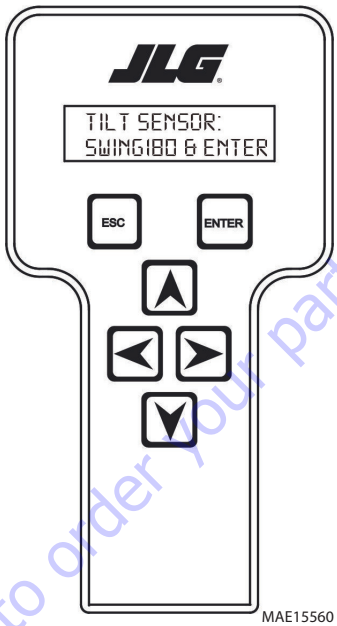


MAF23940



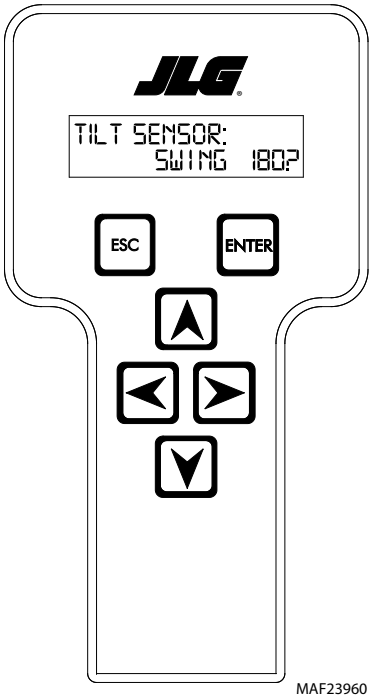
MAF23950

14. When the sensor is calibrated in that position, the screen will read:

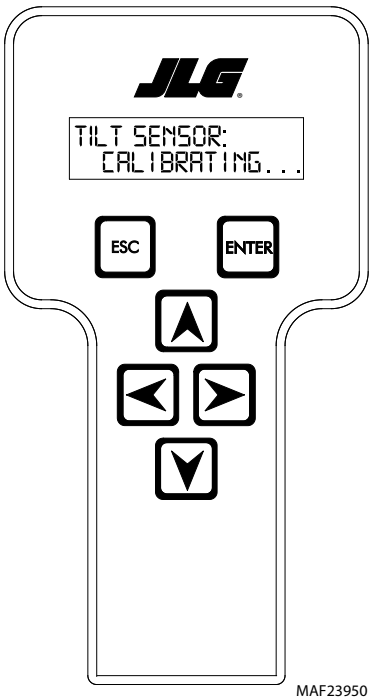


MAE15560

15. Swing the machine 180 degrees, making sure the boom is centered and in the transport position, and **ENTER** ENTER. The screen will read:



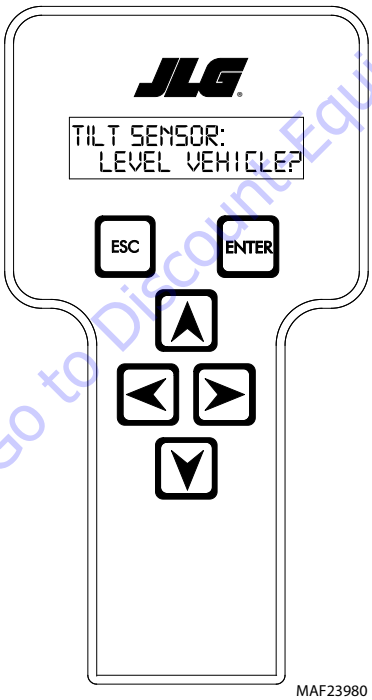
MAF23960



MAF23950

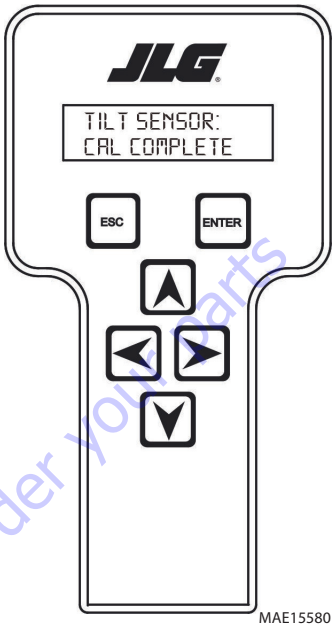
16. Hit Enter. The screen will read.

NOTE: *Screen appears only if the machine is on more then a 3 degree slope.*



MAF23980

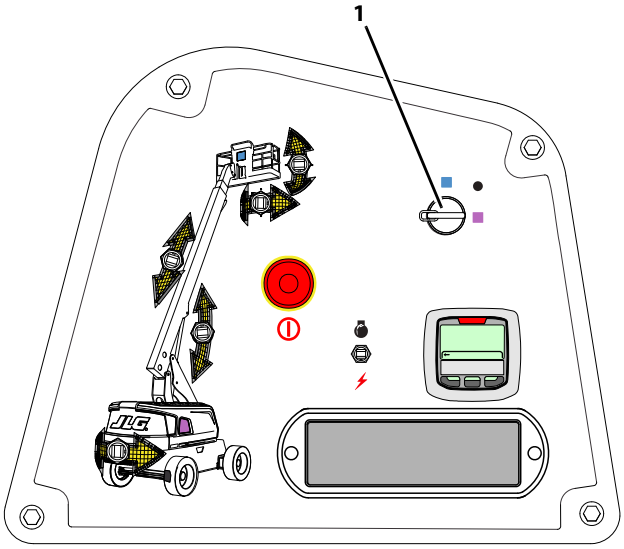
17. When the calibration is complete the screen will read as shown below. Return the machine to the travel position.



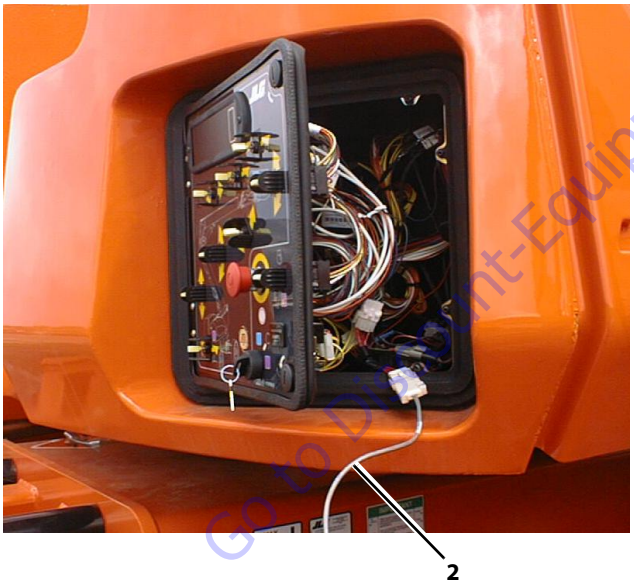
MAE15580

6.9 CALIBRATING BOOM ANGLE

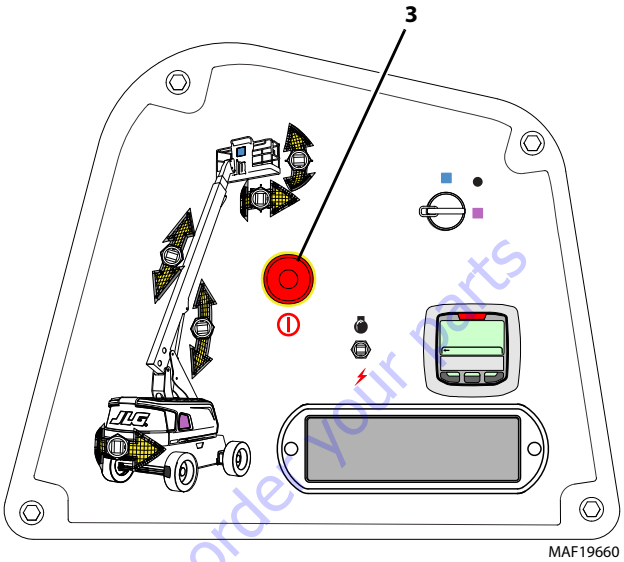
1. Position the Platform/Ground select switch (1) to the Ground position.



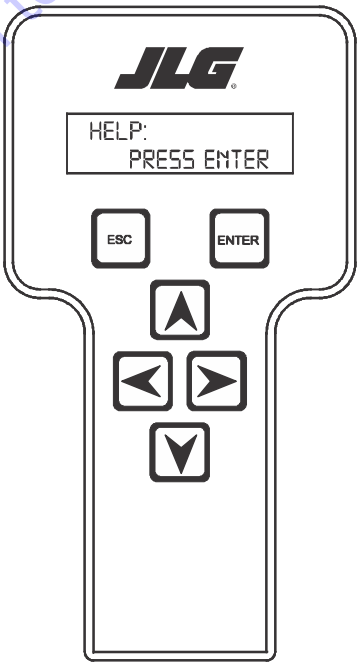
2. Plug the analyzer into the connector (2) inside the Ground control box.



3. Pull out the Emergency Stop switch and Start the engine.

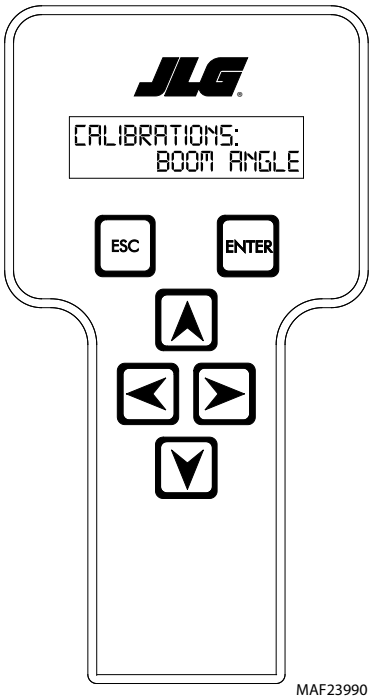


4. The analyzer screen should read:



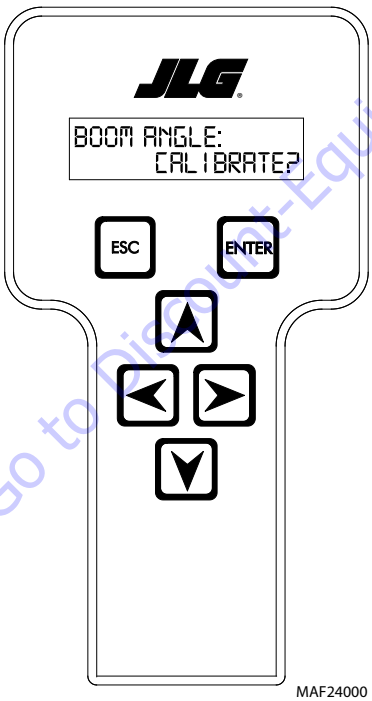
5. Use the arrow button to reach ACCESS LEVEL 2. Hit Enter.
6. Enter the Access Code, 33271.
7. Use the right Arrow key to reach CALIBRATIONS. Hit Enter.

8. Use arrow keys to reach BOOM ANGLE. The Screen will read:



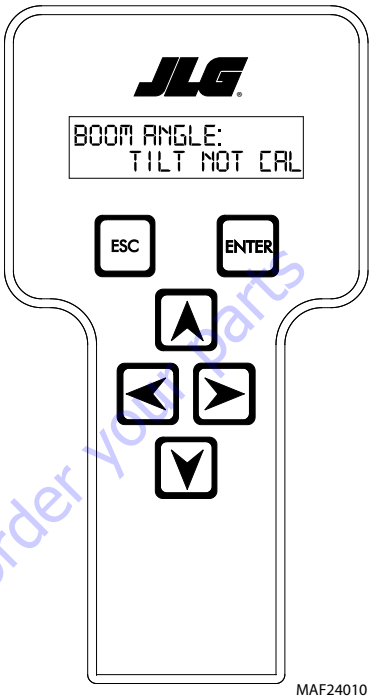
MAF23990

9. Hit Enter. The screen will read.



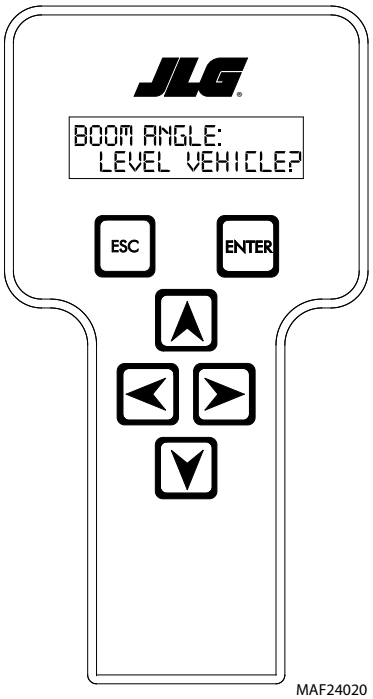
MAF24000

10. UGM will confirm the tilt sensor calibration. The screen will read.



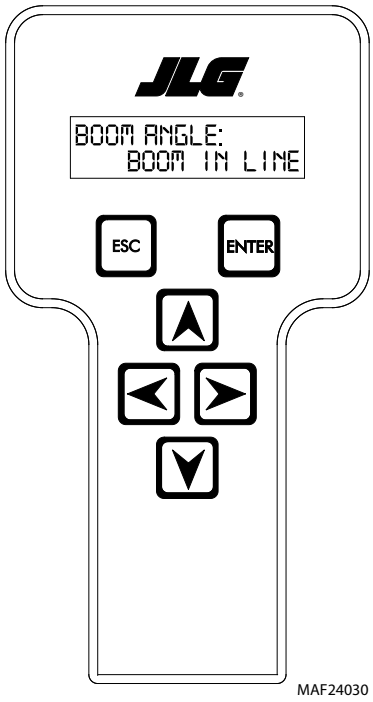
MAF24010

11. Hit Enter. The screen will read.



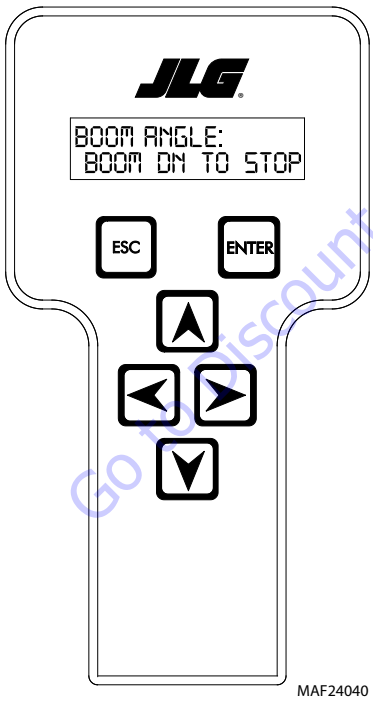
MAF24020

12. UGM will confirm the Boom In-Line position. The screen will read:



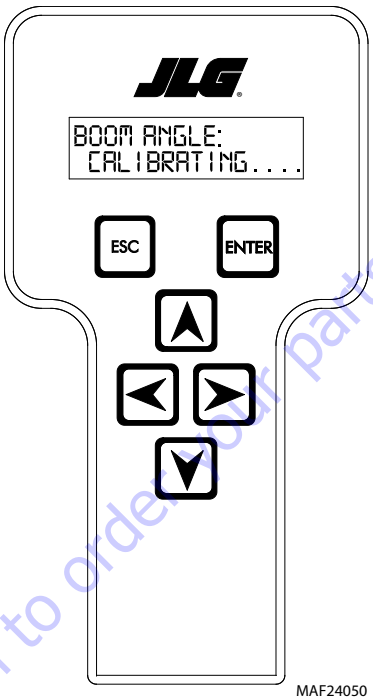
MAF24030

13. Hit Enter. The Screen will read:



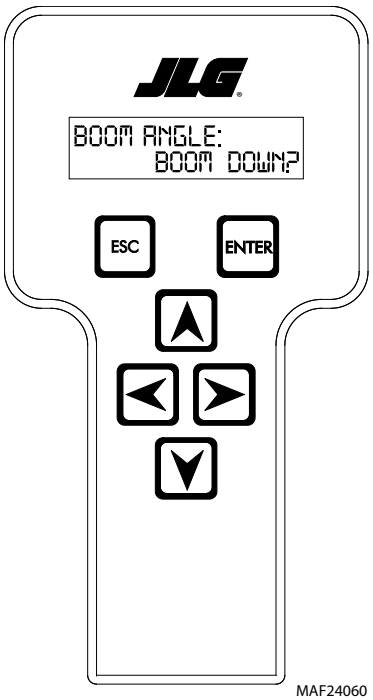
MAF24040

14. When the sensor is calibrated at lower position of the boom. The screen will read:



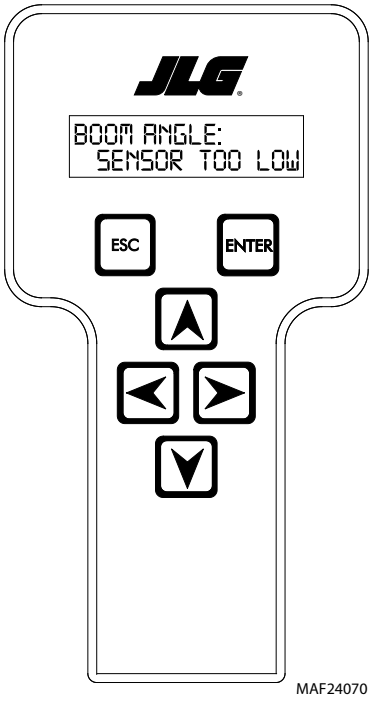
MAF24050

15. Hit Enter. The Screen will read:



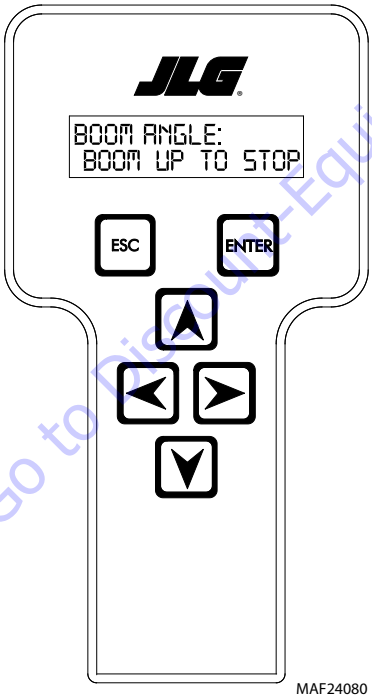
MAF24060

16. Hit Enter. The Screen will read:



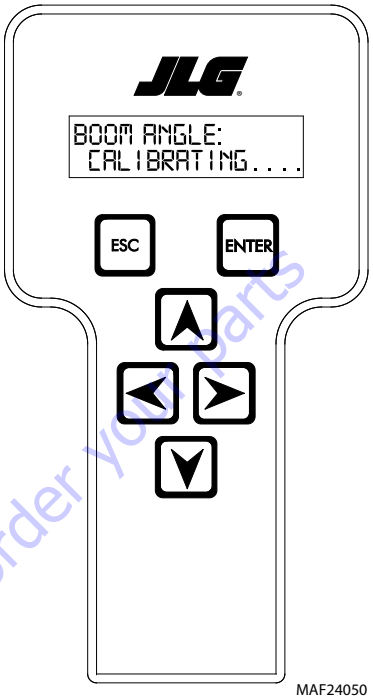
MAF24070

17. UGM will confirm the position of the boom. Press Enter. The screen will read:



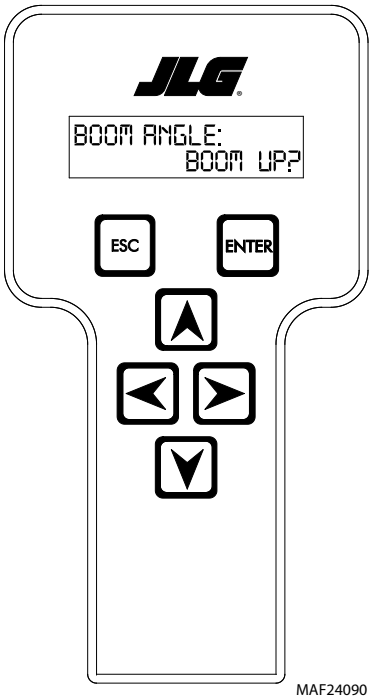
MAF24080

18. When the sensor is calibrated at upper position of the boom. The screen will read:



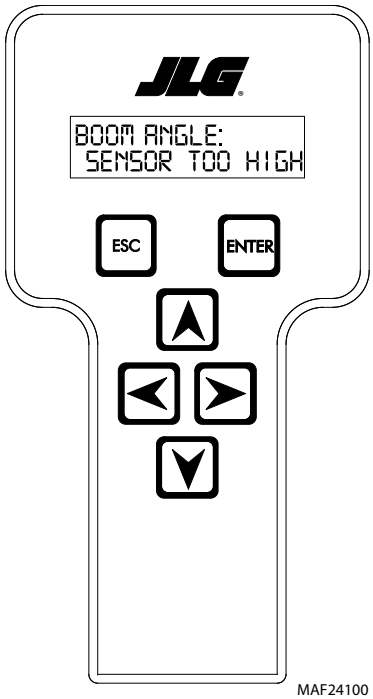
MAF24050

19. UGM will confirm the position of the boom. Press Enter. The screen will read:



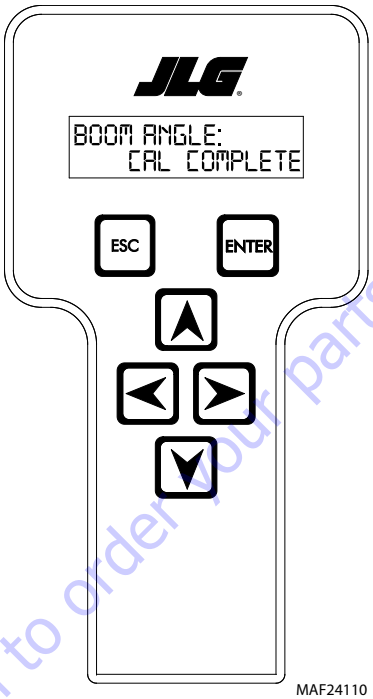
MAF24090

20. Hit Enter. The Screen will read:



MAF24100

21. After few seconds. The screen will read:

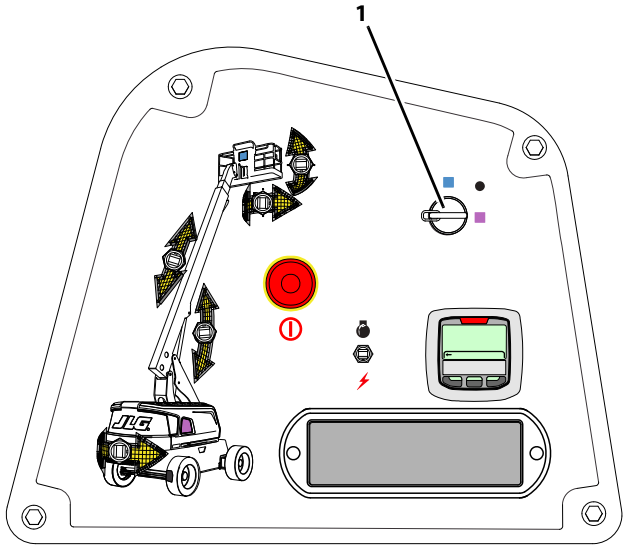


MAF24110

22. Hit ESC twice to go back to CALIBRATIONS.

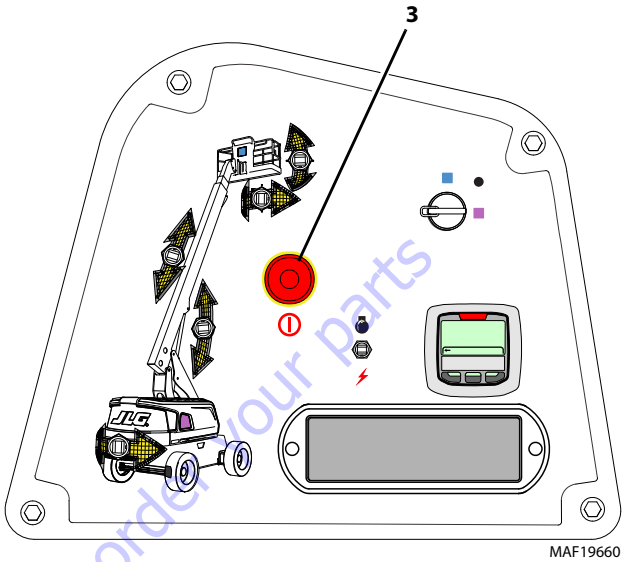
6.10 CALIBRATING LEVEL UP CRKPT

1. Position the Platform/Ground select switch (1) to the Ground position.

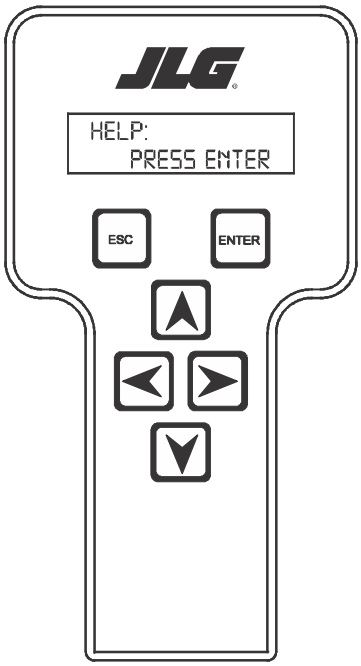


2. Plug the analyzer into the connector (2) inside the Ground control box.

3. Pull out the Emergency Stop switch and Start the engine.

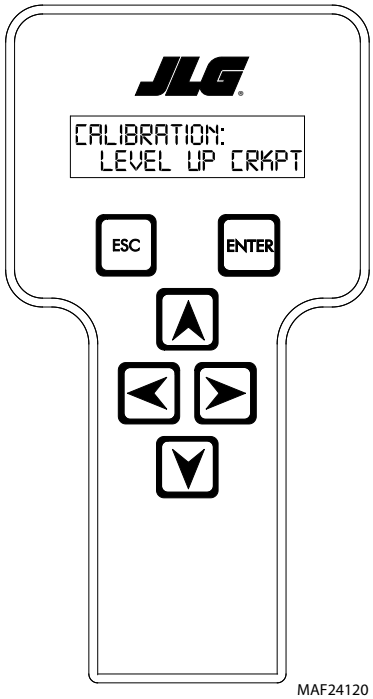


4. The analyzer screen should read:



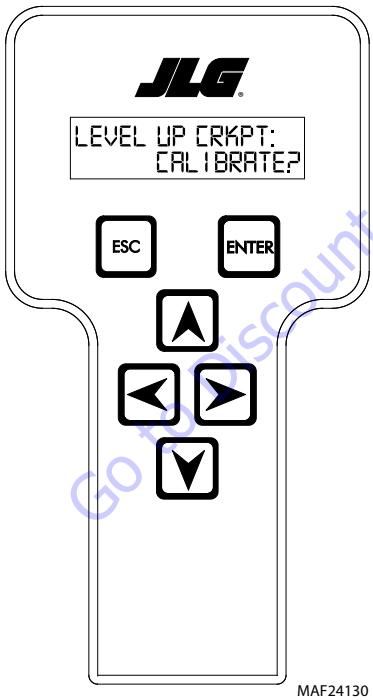
5. Use the arrow button to reach ACCESS LEVEL. Hit Enter.
6. Enter the Access Code, 33271.
7. Use the right Arrow key to reach CALIBRATIONS. Hit Enter.

8. Use the arrow keys to reach LEVEL UP CRKPT. The screen will read.



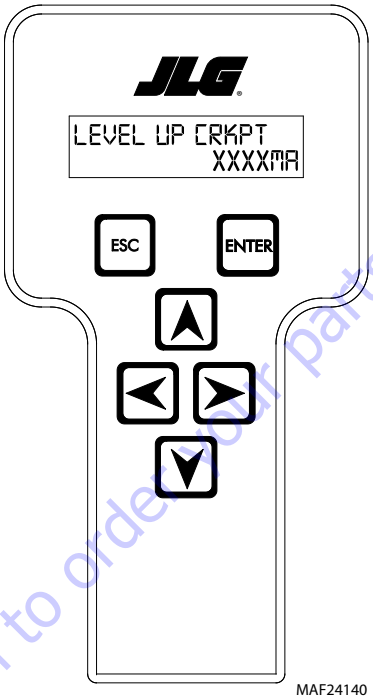
MAF24120

9. Hit Enter. The screen will read.



MAF24130

10. UGM shall set the Level Up Crackpoint default value. The screen will read:



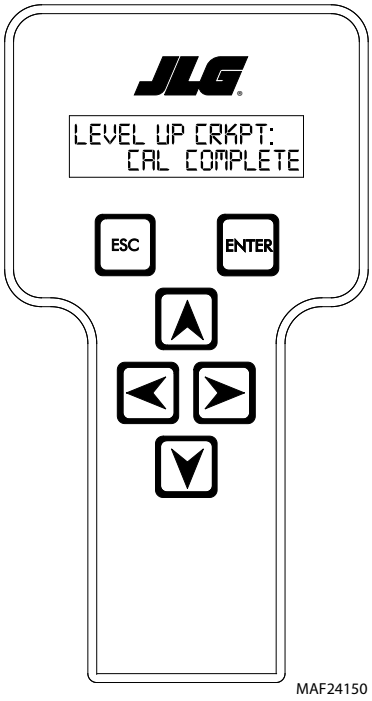
MAF24140

11. Engine RPM will reach to 1400 RPM.

12. Using UP ARROW, increase the value until you see the basket up movement.

NOTE: *Maximum Crack Point value is 1200mA. Calibration will fail if the value is increased to more than 1200mA.*

13. After few seconds. The screen will read:

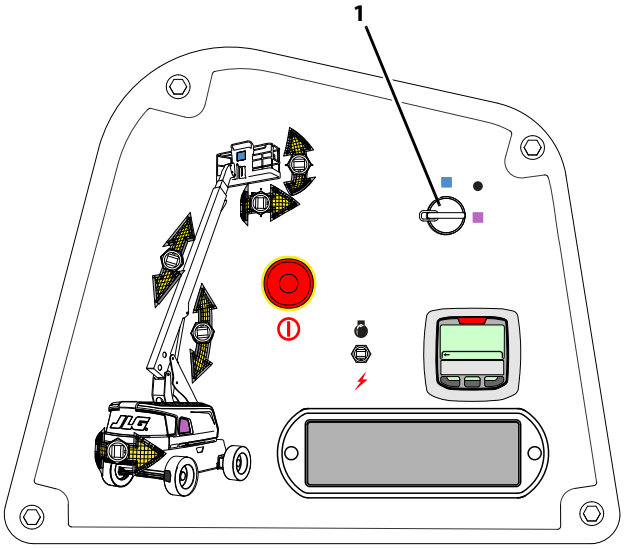


MAF24150

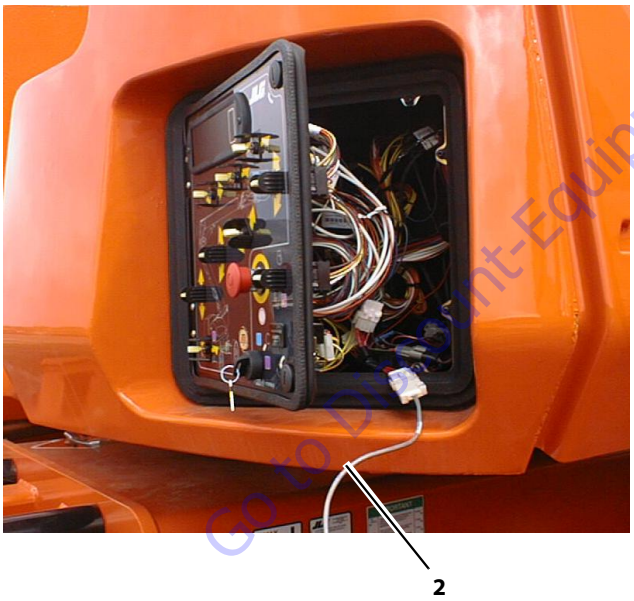
14. Hit ESC twice to go back to CALIBRATIONS.

6.11 CALIBRATING LEVEL DOWN CRACKPOINT

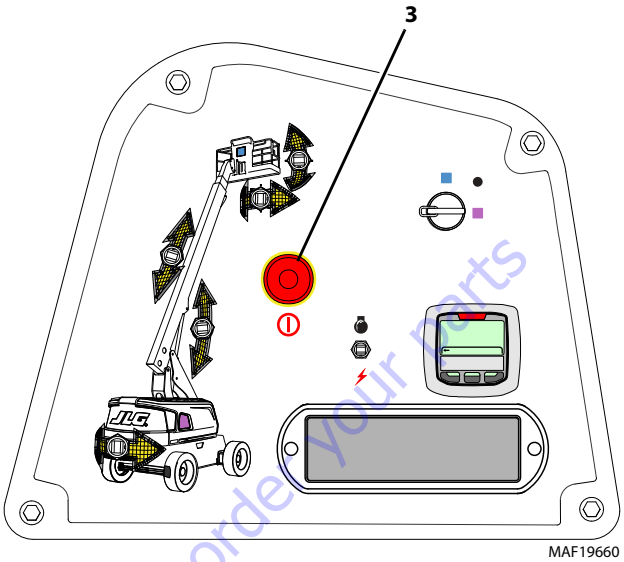
1. Position the Platform/Ground select switch (1) to the Ground position.



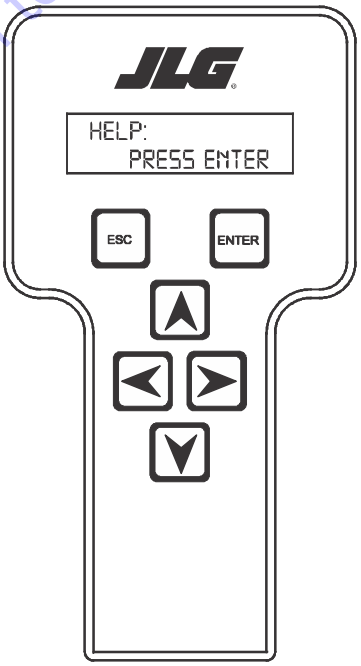
2. Plug the analyzer into the connector (2) inside the Ground control box.



3. Pull out the Emergency Stop switch and Start the engine.

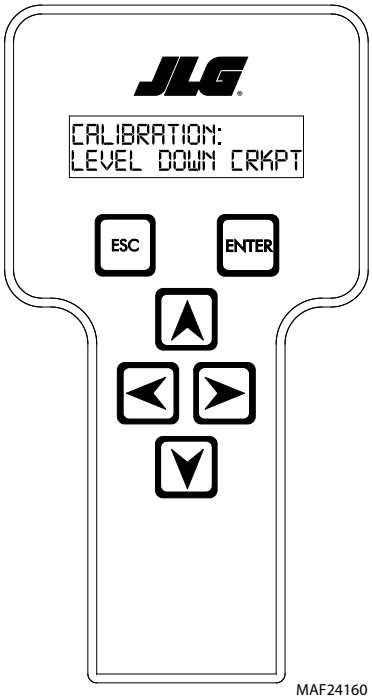


4. The analyzer screen should read:



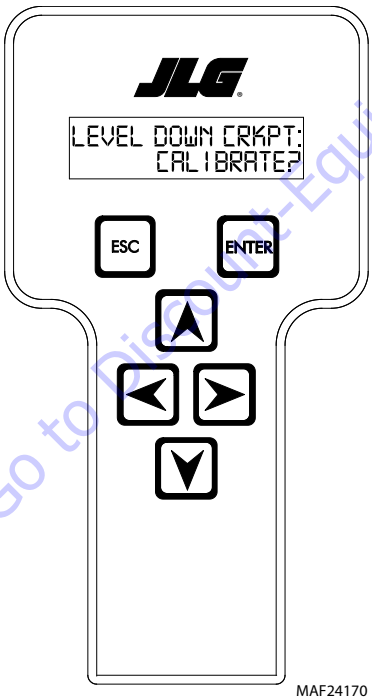
5. Use the arrow button to reach ACCESS LEVEL. Hit Enter.
6. Enter the Access Code, 33271.
7. Use the right Arrow key to reach CALIBRATIONS. Hit Enter.

8. Use the arrow keys to reach LEVEL DOWN CRKPT. The screen will read.



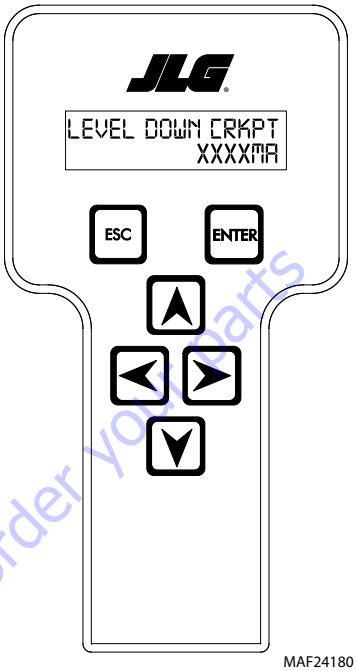
MAF24160

9. Hit Enter. The screen will read.



MAF24170

10. UGM shall set the Level Down Crackpoint default value. The screen will read:



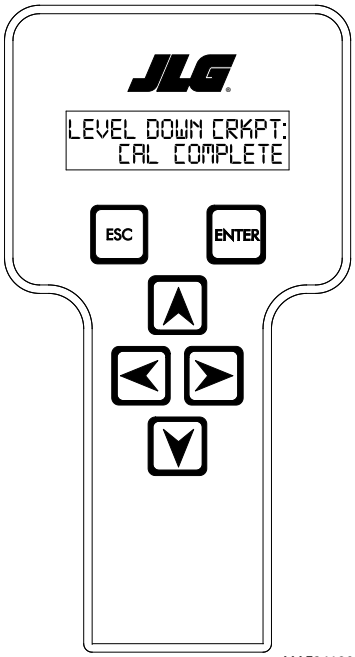
MAF24180

11. Engine RPM will reach to 1400 RPM.

12. Using UP ARROW, increase the value until you see the basket up movement.

NOTE: *Maximum Crack Point value is 1200mA. Calibration will fail if the value is increased to more than 1200mA.*

13. After few seconds. The screen will read:

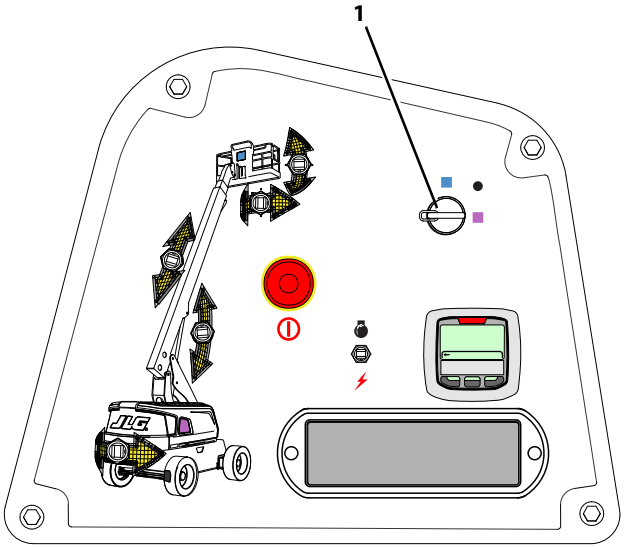


MAF24190

14. Hit ESC twice to go back to CALIBRATIONS.

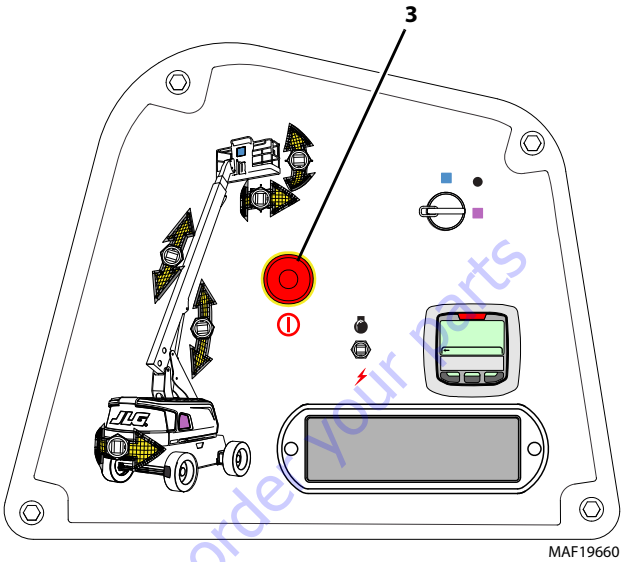
6.12 CALIBRATING PLATFORM ANGLE SENSOR

1. Position the Platform/Ground select switch (1) to the Ground position.

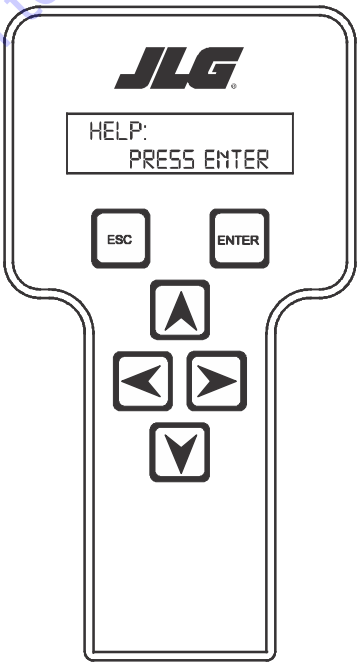


2. Plug the analyzer into the connector (2) inside the Ground control box.

3. Pull out the Emergency Stop switch and Start the engine.

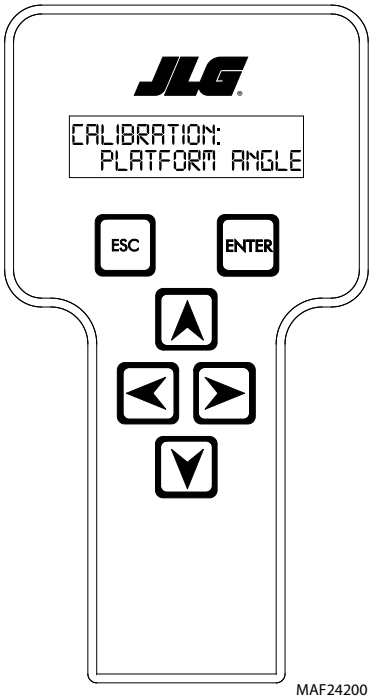


4. The analyzer screen should read:



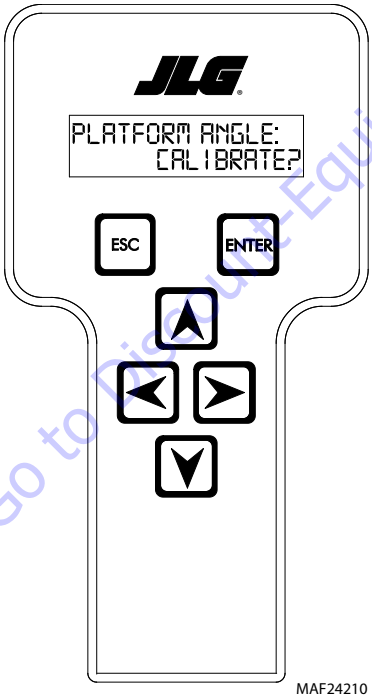
5. Use the arrow button to reach ACCESS LEVEL 2. Hit Enter.
6. Enter the Access Code, 33271.
7. Use the right Arrow key to reach CALIBRATIONS. Hit Enter.

8. Use the arrow keys to reach PLATFORM ANGLE. The screen will read.



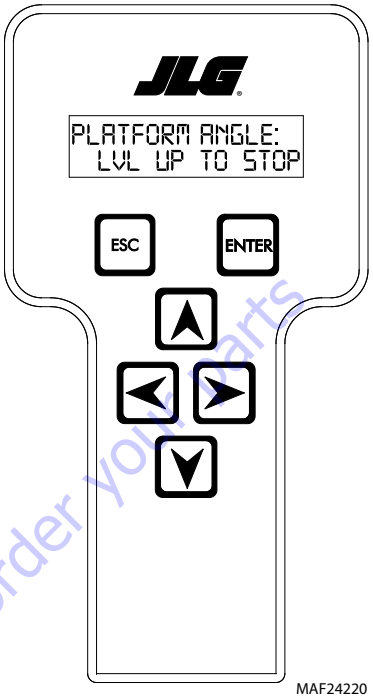
MAF24200

9. Hit Enter. The screen will read:



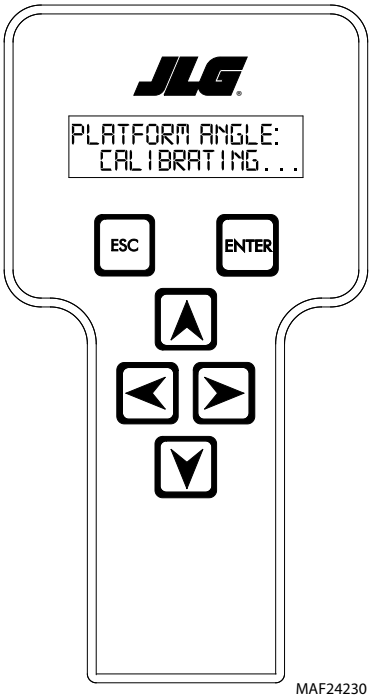
MAF24210

10. Hit Enter. The screen will read:



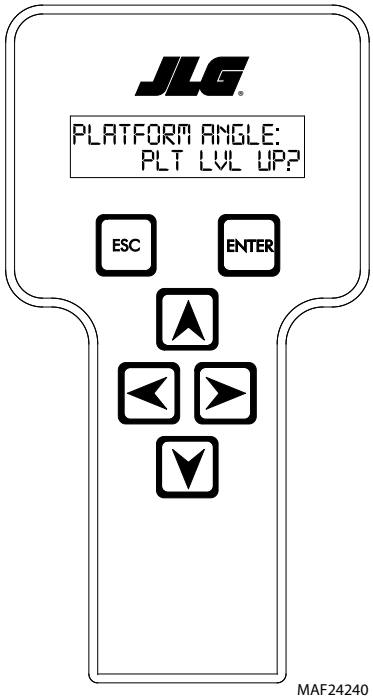
MAF24220

11. Hit Enter. The screen will read:



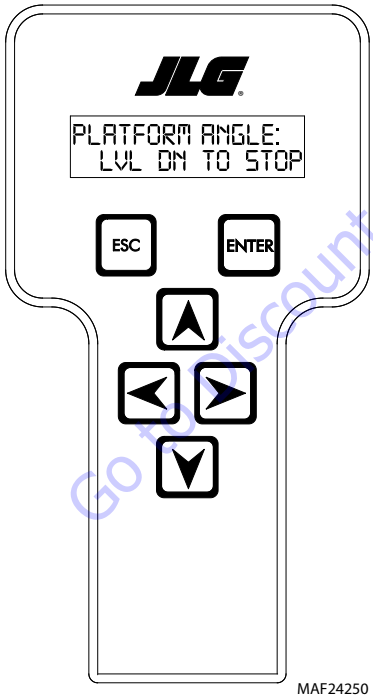
MAF24230

12. UGM will confirm Platform Angle Max sensor readings. The screen will read:



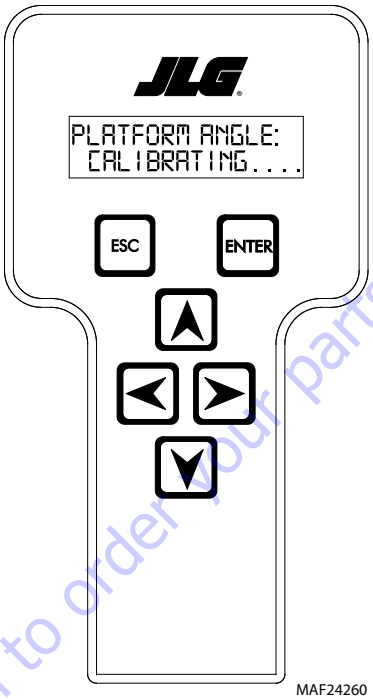
MAF24240

13. Hit Enter. The screen will read:



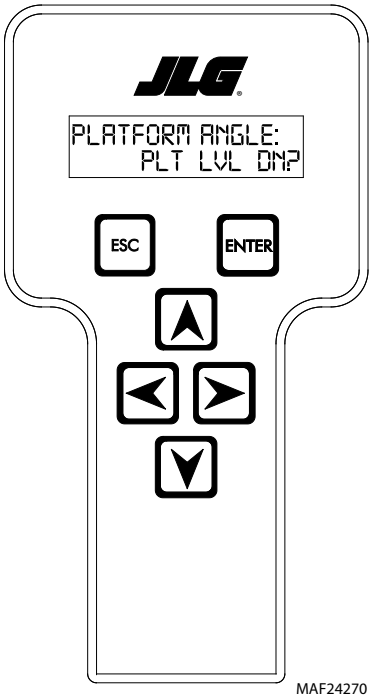
MAF24250

14. After few seconds. The screen will read:



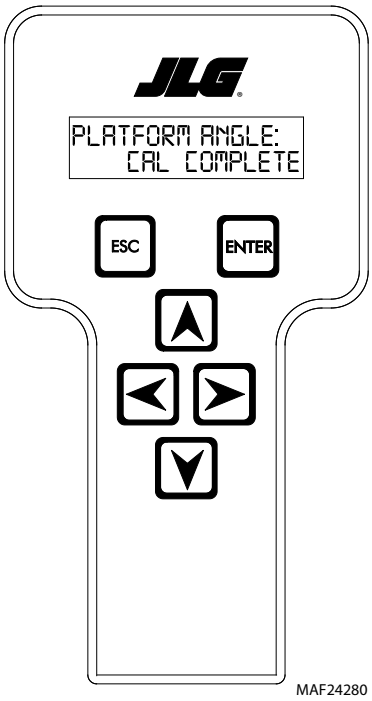
MAF24260

15. UGM will confirm Platform Angle Min sensor readings. The screen will read:



MAF24270

16. After few seconds. The screen will read:



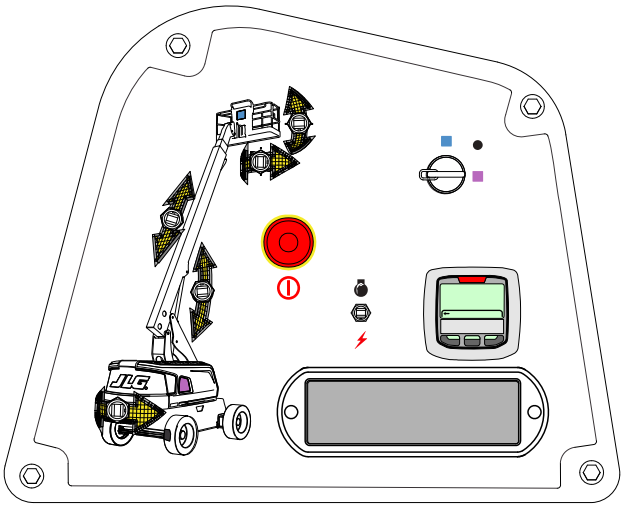
MAF24280

17. Hit ESC twice to go back to CALIBRATIONS.

6.13 CALIBRATING LOAD SENSING

NOTE: *Calibration sub-menu LOAD SENSING is visible only if MACHINE SET-UP sub-menu LOAD SYSTEM is selected to YES.*

1. Position the Platform/Ground select switch to the Platform position.



MAF19660

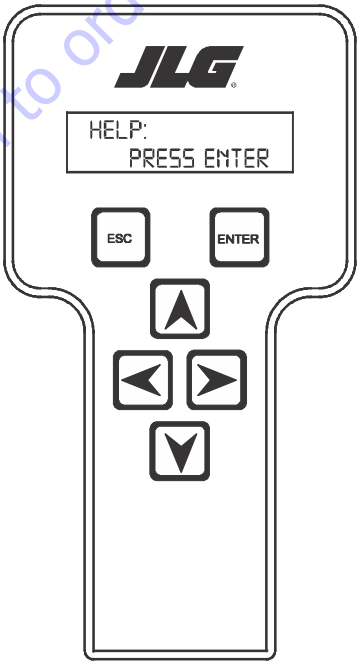
2. Plug the analyzer into the connector at the base of the platform control box.

MAE15680

3. Pull out the Emergency Stop switch and Start the engine.

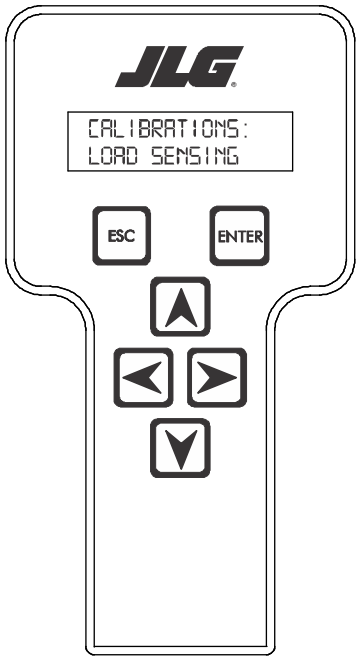
MAE17820

4. The analyzer screen should read:

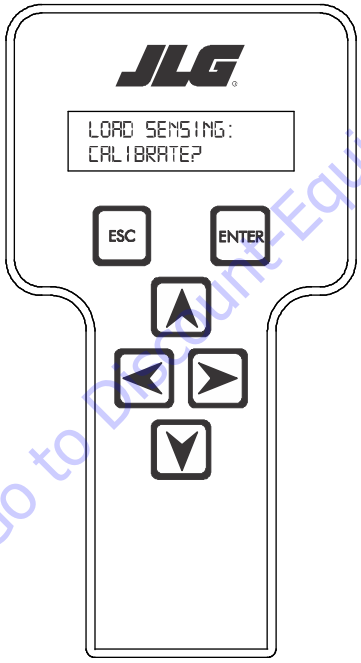


5. Use the arrow button to reach ACCESS LEVEL 2. Hit Enter.
6. Enter the Access Code, 33271.
7. Use the right Arrow key to reach CALIBRATIONS. Hit Enter.

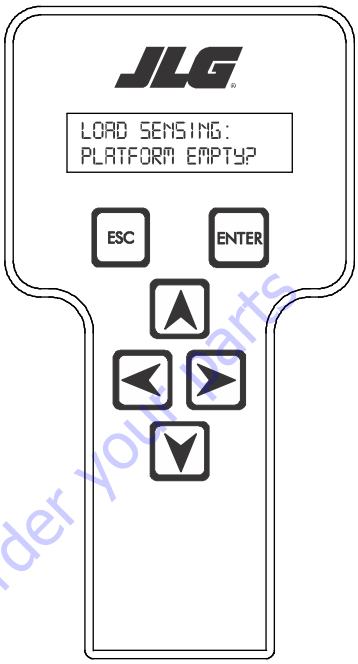
8. Use the arrow keys to reach LOAD SENSING. The screen will read.



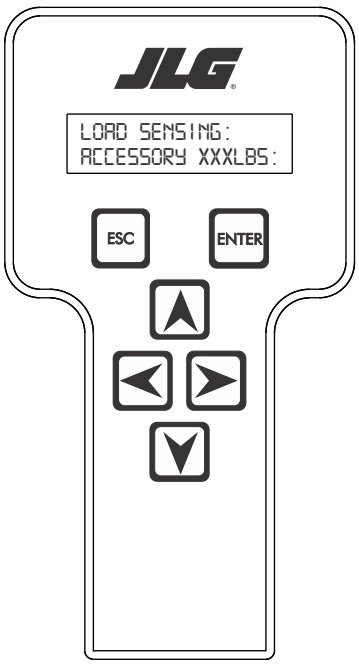
9. Hit Enter. The screen will read:



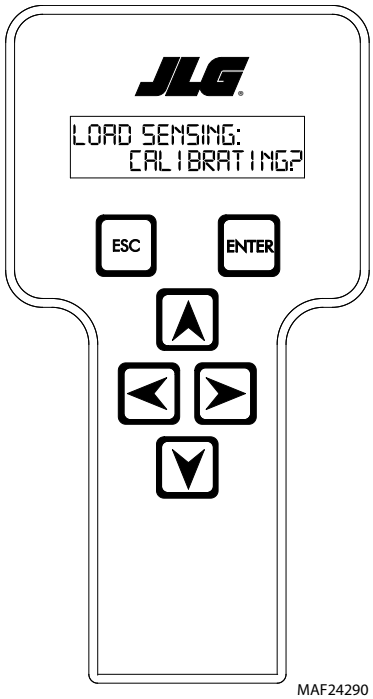
10. Hit Enter. The screen will read:



11. UGM will set the Accessory Weight default value. Press Enter. The screen will read.

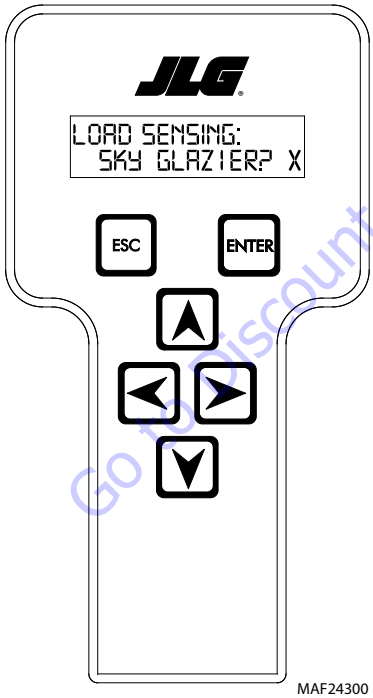


12. Hit Enter. The screen will read:



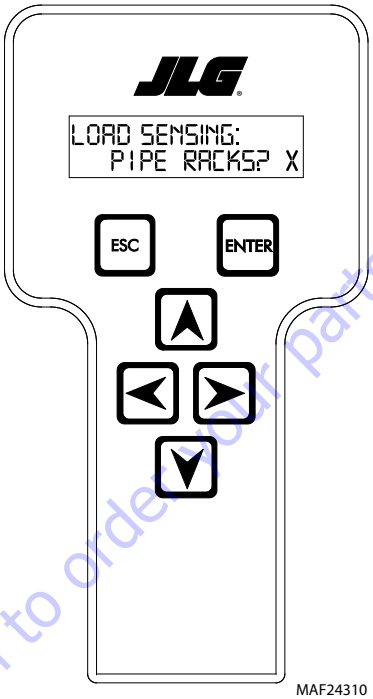
MAF24290

13. UGM will set the Glazier default value. Press Enter. The screen will read:



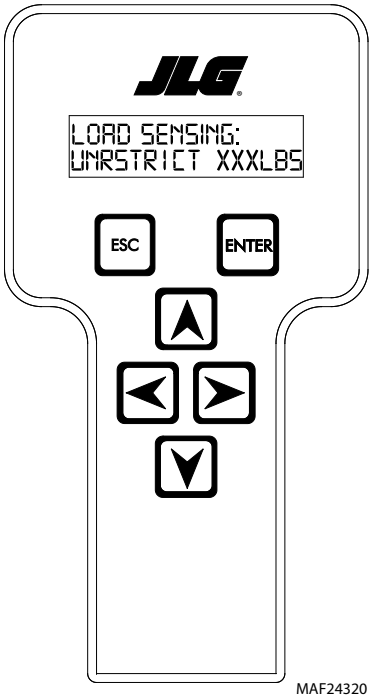
MAF24300

14. UGM will set the Pipe Racks default value. Press Enter. The screen will read:



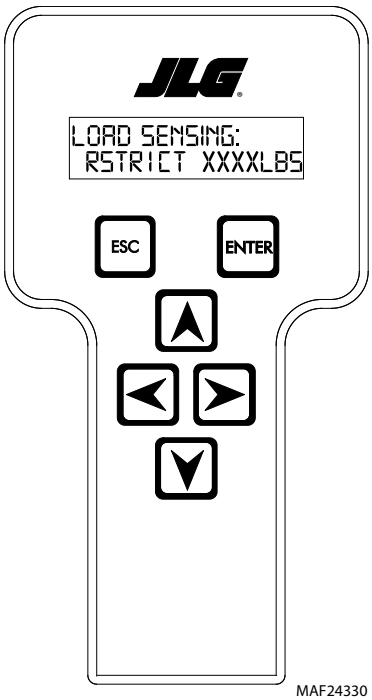
MAF24310

15. UGM will set the Unrestricted Rated Load. Press Enter. The screen will read:



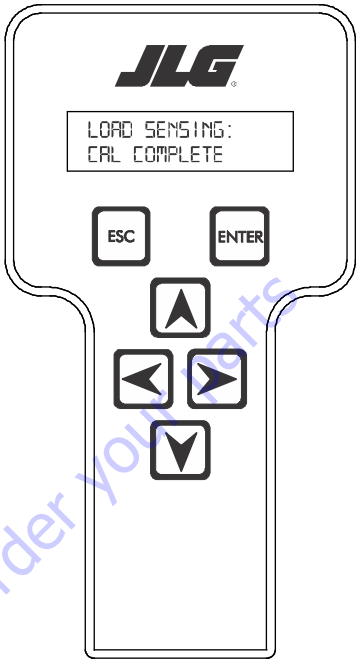
MAF24320

16. UGM will set the Restricted Rated Load. Press Enter. The screen will read:



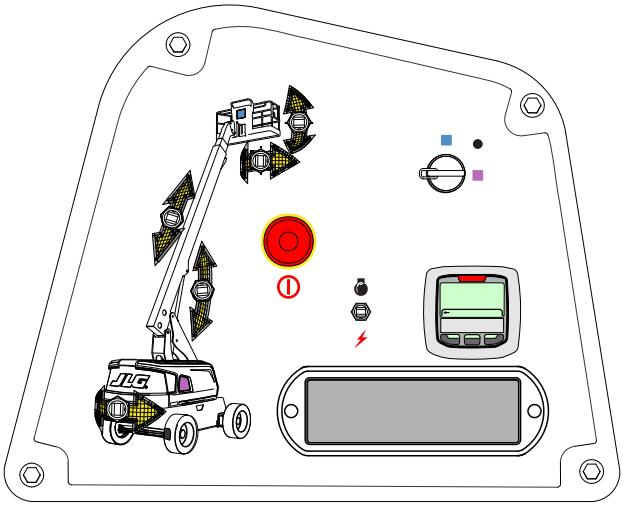
MAF24330

17. After few seconds, the screen will read:



6.14 CALIBRATING MSSO

1. Position the Platform/Ground select switch to the Platform position.



MAF19660

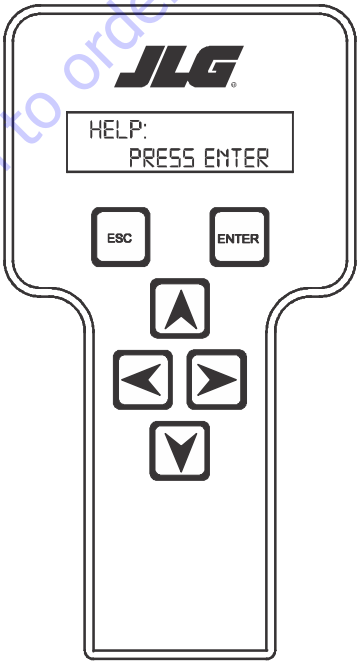
2. Plug the analyzer into the connector at the base of the platform control box.

MAE15680

3. Pull out the Emergency Stop switch and Start the engine.

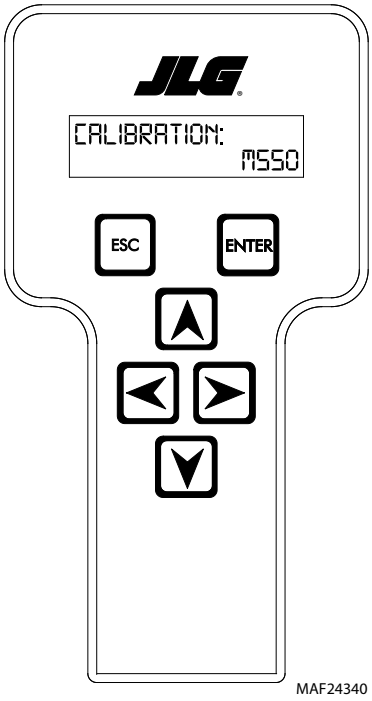
MAE17820

4. The analyzer screen should read:



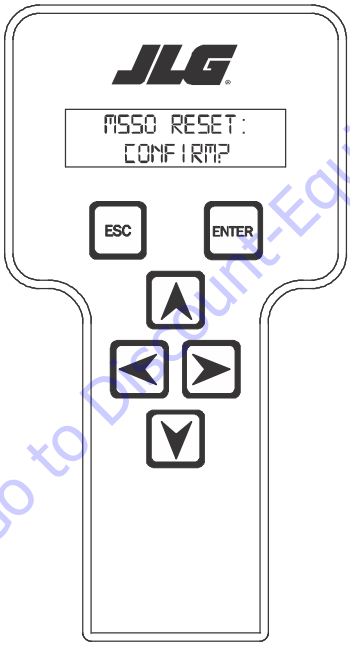
5. Use the arrow button to reach ACCESS LEVEL 2. Hit Enter.
6. Enter the Access Code, 33271.
7. Use the right Arrow key to reach CALIBRATIONS. Hit Enter.

8. Use the arrow keys to reach MSSO. The screen will read:



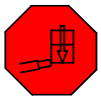
MAF24340

9. Hit Enter. The screen will read:



6.15 LSS SYSTEM

The JLG-designed Load Sensing System (LSS) measures platform load via a sensor mounted in the platform support structure. If the actual platform load exceeds the selected Rated Load, the following will occur:



1. The Overload Visual Warning Indicator will flash at the selected control position (platform or ground).
2. The Platform and Ground Alarms will sound 5 seconds On, and 2 seconds Off.
3. All normal movement will be prevented from the platform control position (optional - ground control functions may be prevented).
4. Further movement is permitted by:
   - **a.** Removing the excess platform load until actual platform load is less than Rated Load.
   - **b.** Operation of the overriding emergency system (Auxiliary Power Unit).
   - **c.** By an authorized person at the ground control position (optional - ground control functions may be prevented).

NOTICE

THE LOAD SENSING SYSTEM MUST BE CALIBRATED WHEN ONE OR MORE OF THE FOLLOWING CONDITIONS OCCUR:

- **d.** LSS Sensor removal or replacement.
- **e.** Addition or removal of certain platform mounted accessories. (Refer to Calibration).
- **f.** Platform is removed, replaced, repaired or shows evidence of impact.

NOTICE

THE LOAD SENSING SYSTEM REQUIRES PERIODIC FUNCTION VERIFICATION NOT TO EXCEED 6 MONTHS FROM PREVIOUS VERIFICATION. REFER TO TESTING & EVALUATION.

All calibration procedures are menu driven through the use of a JLG Analyzer.

Diagnostic Menu

The Diagnostic Menu is another troubleshooting tool for the Load Sensing System. Sensor and status information is presented in real-time for the technician. Several sub-menus exist to organize the data.

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 view the menu.

Press the **LEFT** and **RIGHT** Arrow keys to view the displays and select the various sub-menus. To access a sub-menu, press the ENTER key. Once in a sub-menu, press the **LEFT** and **RIGHT** Arrow keys to view the various displays (just like a Top Level menu). To exit a sub-menu, press the **ESC** key.

Table 6-8, Diagnostic Menu Descriptions details the structure of the Diagnostic Menu, and describes the meaning of each piece of information presented.

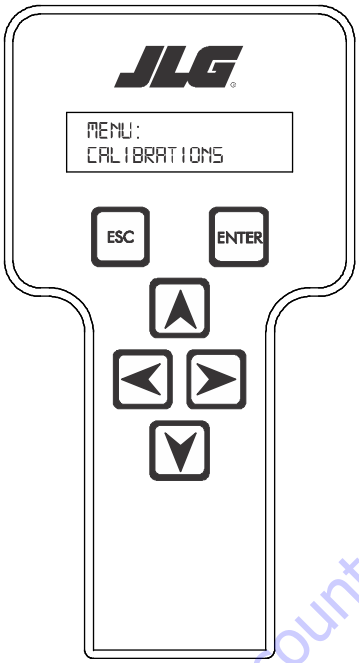
Table 6-8. Diagnostic Menu Descriptions

Diagnostics Menu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 2nd Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
PLATFORM LOAD	STATE:	OK / OVERLOAD	LSS Status.
PLATFORM LOAD	ACTUAL:	XXX.X KG	Calibrated weight of the platform. ???if Platform Load is Unhealthy**.
PLATFORM LOAD (service*)	GROSS:	XXX.X KG	Gross weight of the platform. ???if both Cells are Unhealthy**.
PLATFORM LOAD (service*)	OFFSET 1:	XXX.X KG	Stored offset weight of Cell 1. ???if LSS is not calibrated.
PLATFORM LOAD (service*)	OFFSET 2:	XXX.X KG	Stored offset weight of Cell 1. ???if LSS is not calibrated.
PLATFORM LOAD (service*)	ACCESSORY	XXX.X KG	Stored accessory weight. ???if LSS is not calibrated.
PLATFORM LOAD (service*)	UNRESTRICT	XXX.X KG	UGM will set Unrestricted Rated Load as defined by Machine Configuration.
PLATFORM LOAD (service*)	RESTRICT	XXX.X KG	UGM will set Restricted Rated Load as defined by Machine Configuration.
PLATFORM LOAD (service*)	RAW 1:	XXX.X KG	Gross value from Cell 1. ???if Unhealthy**.
PLATFORM LOAD (service*)	RAW 2:	XXX.X KG	Gross value from Cell 2. ???if Unhealthy**.

* Indicates only visible in service view mode
** Typically indicates a DTC is active

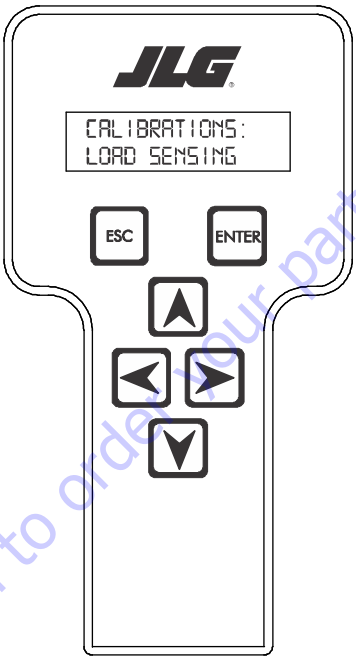
Calibration Procedure

1. Remove everything from the platform, except permanently fixed JLG Accessories, to allow the Load Sensing System to record its' weight during calibration. This includes all tools, debris, and customer-installed devices.
2. Plug the JLG Analyzer into the Machine at the Ground Station and enter Service Access Password 33271.
3. The platform should be approximately level for calibration. Level the platform from ground control (if necessary) to within +/- 5°.
4. To access the Calibration Menu, use the LEFT and RIGHT Arrow keys to select CALIBRATION from the Top Level Menu. The screen will read:

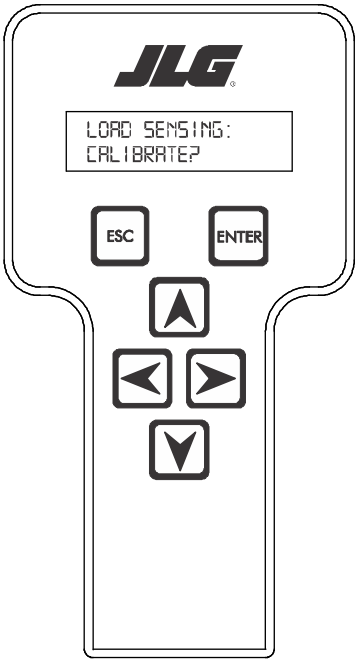


NOTE: *The Calibration Menu is not available in OPERATOR ACCESS.*

5. Press the ENTER key (ENTER) to view the menu. Upon entry to the Calibration Menu, the JLG Control System will link to the Analyzer and the screen will read:



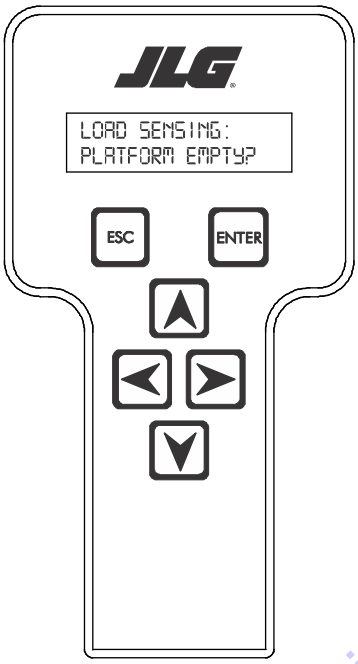
6. Press Enter (ENTER). The Screen will read:



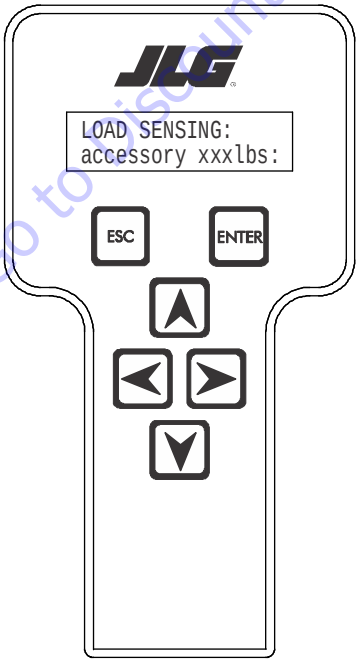
NOTE: *Calibration will auto fail if LSS DTC's are active (443, 444, 4479, 4480, 663, 821, 822, 823, 824, 8218, 8222 -> 8238, 991, 992, 993, 994 or 99285).*

Pressing the ESC [ESC] key after starting calibration and before calibration is complete will display the CAL FAILED message. This will not disturb the prior calibration information.

7. Press ENTER [ENTER]. The analyzer screen will read:



8. If the platform is empty, press ENTER [ENTER]. The screen will read:



NOTE: *Accessory weight will reset to 0 lbs. each time the machine is re-calibrated and will need to be re-entered.*

NOTE: *The Accessory weight will be temporarily stored in the Control System until calibration has been completed successfully.*

Refer to Table 6-9, Accessory Weights. Use the up and down analyzer keys to enter the accessory weight(s) (in lbs). When all the accessory weights are entered, press ENTER [ENTER]. The screen will read:

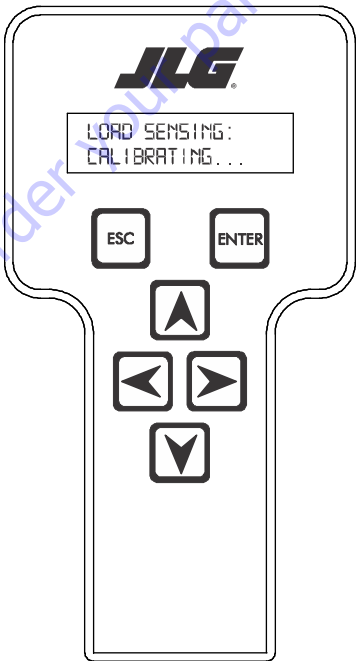


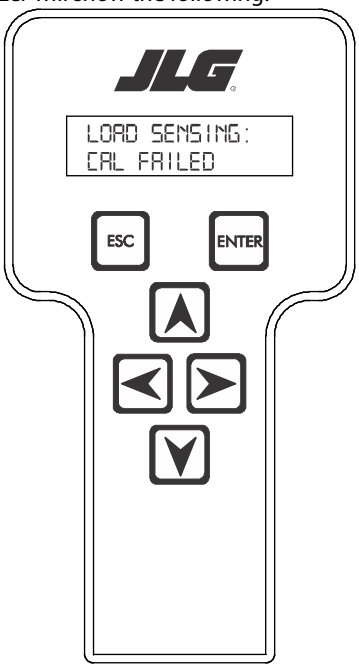
Table 6-9. Accessory Weights

Accessory	Weight
SkyWelder (stick welder)	70 lb. (32 kg)
SkyWelder Prep	Prep only = 15 lb. (7 kg) Full install = 70 lb. (32 kg)
SkyCutter (plasma cutter)	70 lb. (32 kg)
SkyCutter / SkyWelder Combo	140 lb. (64 kg)
Fire Extinguisher	45 lb. (20 kg)
Overhead Soft Touch	80 lb. (36 kg)
Operating Surface	20 lb. (9 kg)

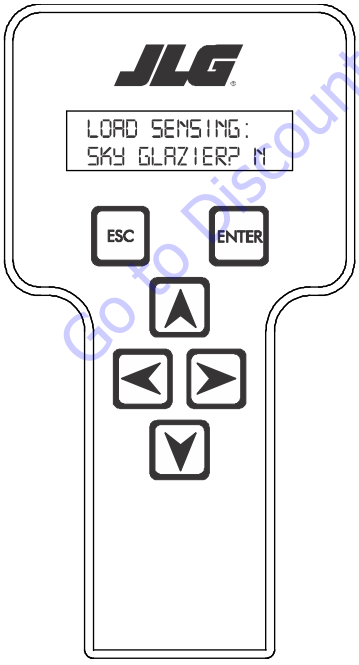
NOTE: *Not all Accessories are available on every JLG model. Some Accessory combinations are prohibited due to excessive weight and/or load restriction. If any installed JLG Accessories are labeled with weight decals but are not listed in the table above, include their weight when entering the ACC WEIGHT value.*

9. The control system will calculate the load cell readings and ensure it is greater than 130 lb (59 kg), but less than 575 lb (261 kg).

If the platform weight is not within the allowed range, the calibration attempt will be unsuccessful and the Analyzer will show the following:



10. Press ENTER (ENTER). The control system will ask for installed accessories. The screen will show the following:



11. Use the analyzer keys to select N for no or Y for yes. Press ENTER (ENTER). The screen will read: