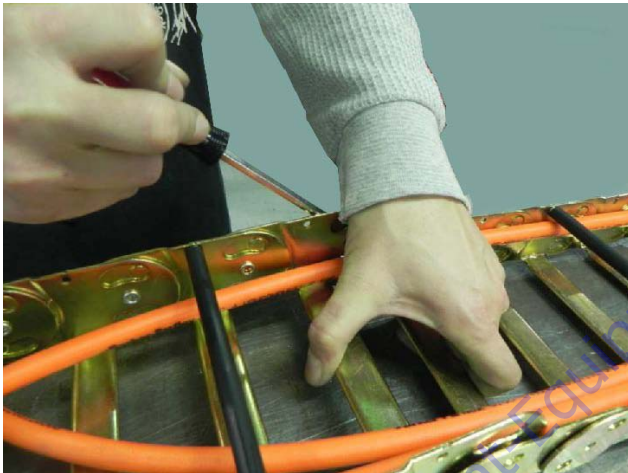
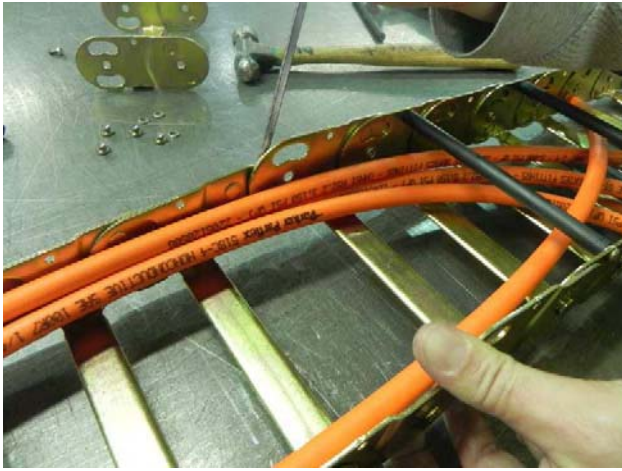
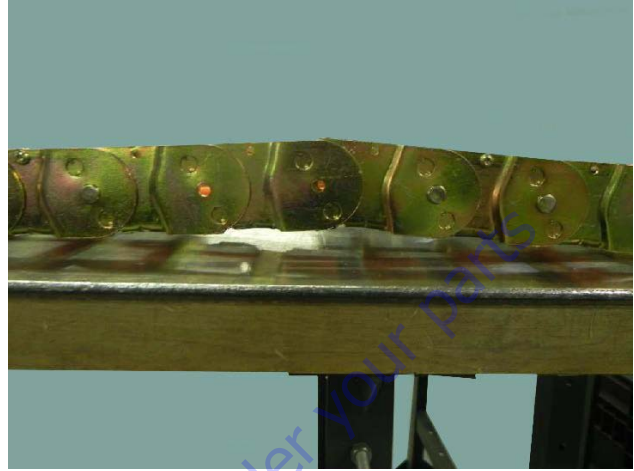


SECTION 4 - BOOM & PLATFORM

2. Spread apart the half-shear (female) end of the new link and slide the peanut end of the track section into it. A screwdriver may be necessary to do this.

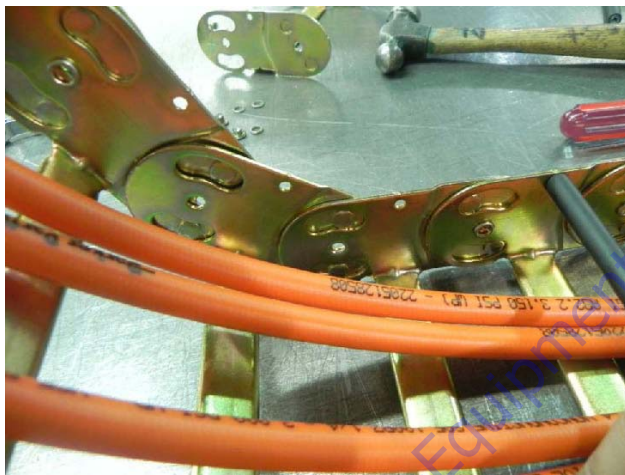


3. After the new link is installed in the powertrack the round half-shears will not fit properly in the peanut cut-outs yet.



4. Pull the moving end out over the track so that the new connection is positioned in the curve of the powertrack.

In this position the round half-shears will rotate into the peanut cut outs.



6. Push pin through center hole then slide washer on pin.



5. The parts shown below will be used to connect the new link to the powertrack.



SECTION 4 - BOOM & PLATFORM

7. Install the snap ring in the groove on the pin. Repeat the pin installation steps for all center holes that have the rivets removed.

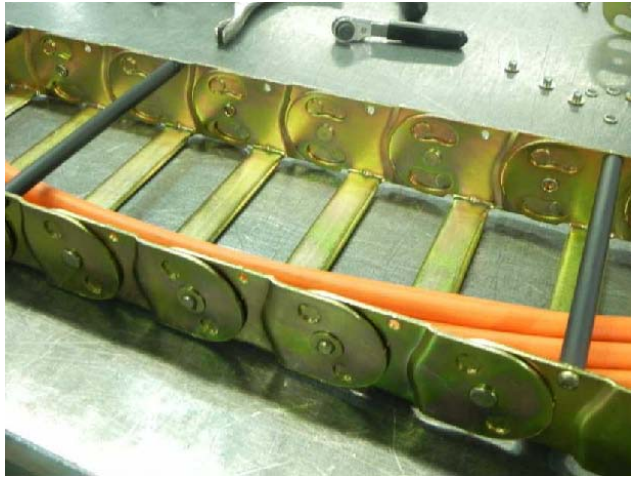


NOTE: When installing snap rings make sure they are seated in pin groove and closed properly.

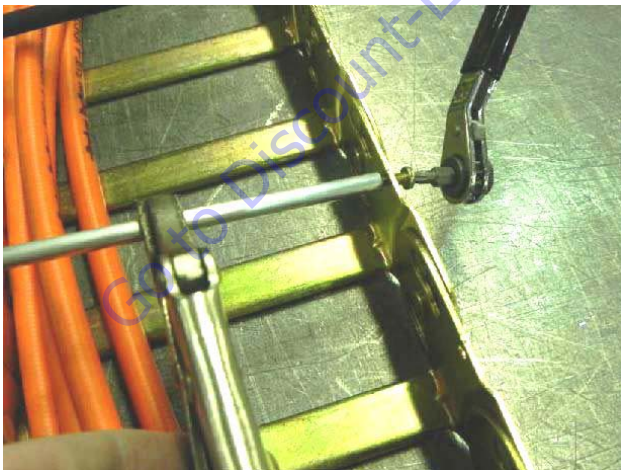
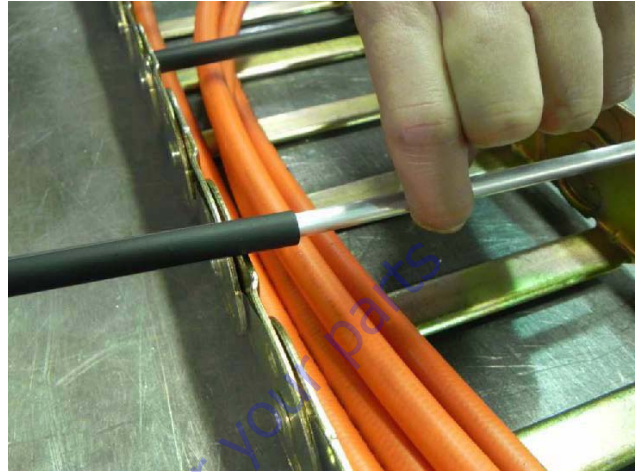


8. Hold new aluminum round bar tightly, then install new 8-32 x 0.500 self-threading torx head screw into one end.

NOTE: Maximum tightening torque is 18-20 in-lbs.



9. Pull up on the other end of the round bar and slide the new poly roller onto the bar.



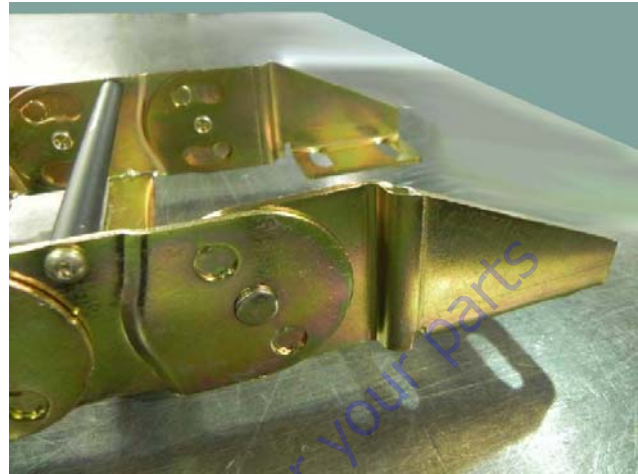
10. Install a new 8-32 x 0.500 self threading screw on the other side.



NOTE: When tightening screws make sure screw head is seated against link with no space in between the link and under-side of screw head. Maximum tightening torque is 18-20 in-lbs.



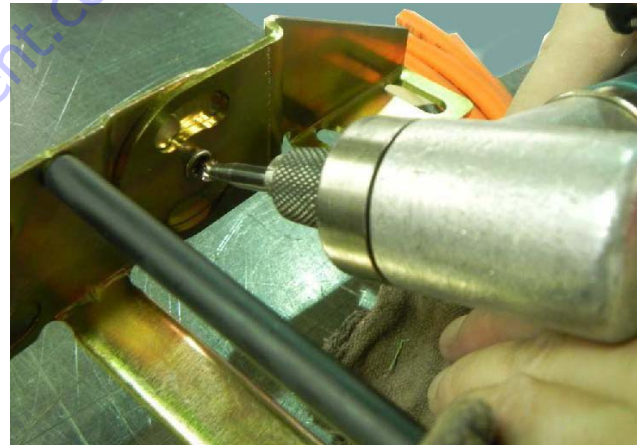
Replacing Fixed End Brackets



1. Remove the rivets the same way as shown under the link removal instructions.

NOTICE

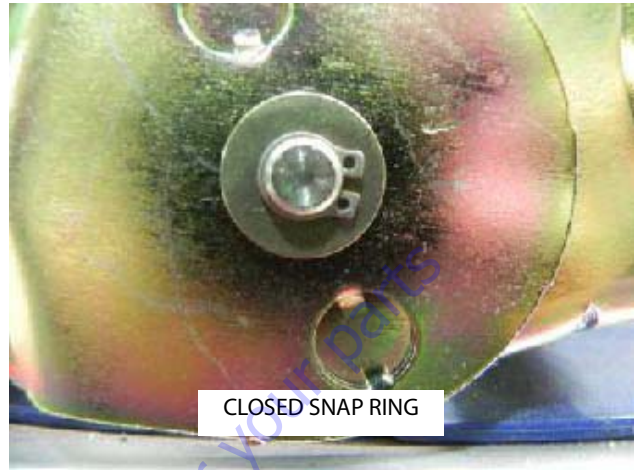
MOVE THE CABLES/HOSES OUT OF THE WAY DURING THE GRINDING PROCESS TO PROTECT THEM. KEEP THE HOSES AND CABLES COVERED TO PREVENT ANY DEBRIS FROM GETTING ON THEM.



2. Parts used: Bracket Center Pin and Center Pin Snap Ring.



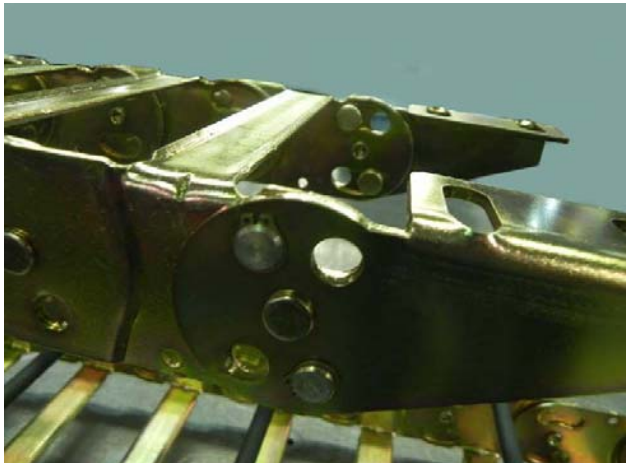
NOTE: When installing snap rings make sure they are seated in pin groove and closed properly.



3. Take the new bracket and install bracket center pin and snap ring. Repeat on the other bracket if replacing it as well.



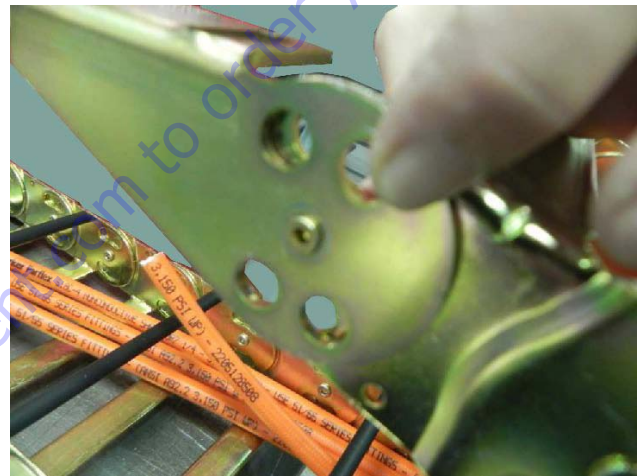
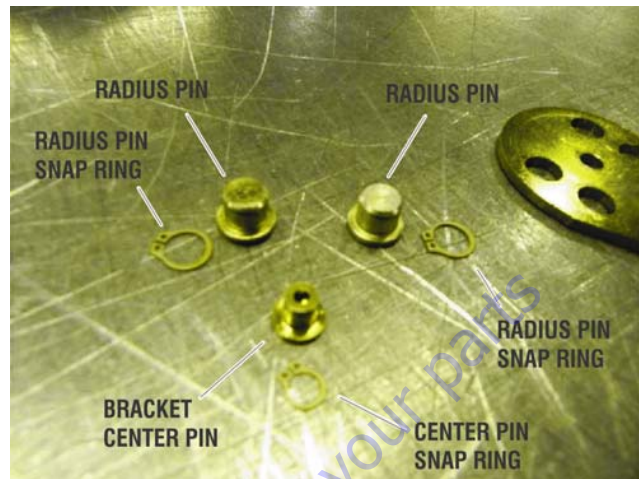
Replacing Moving End Brackets



1. Remove existing pins and center rivet. Remove the rivet the same way as shown in the link removal instructions. Repeat on other bracket if replacing it as well.

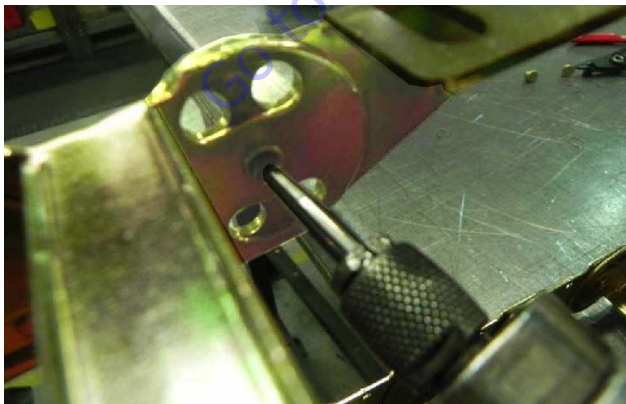


2. Take new bracket and install center pin with snap ring.

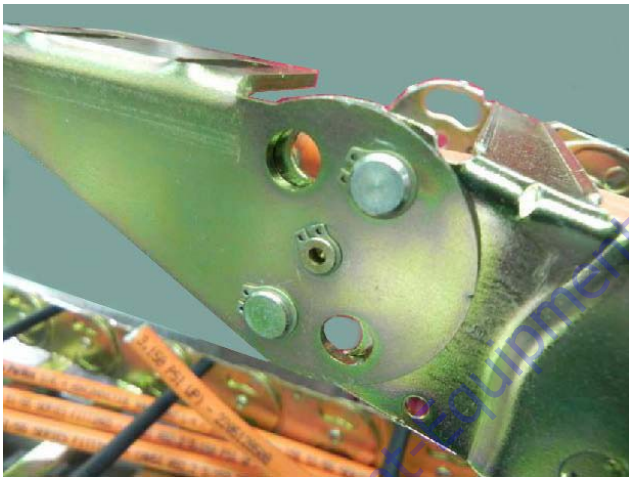
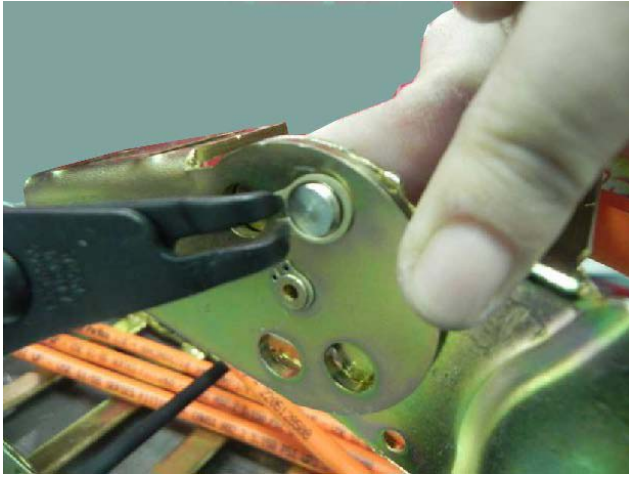


NOTICE

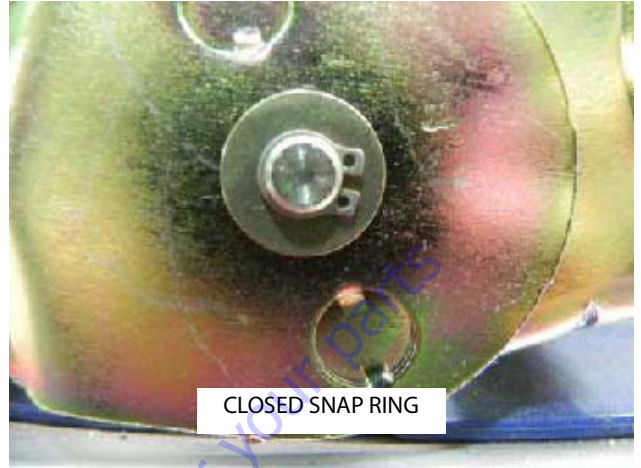
MOVE THE CABLES/HOSES OUT OF THE WAY DURING THE GRINDING PROCESS TO PROTECT THEM. KEEP THE HOSES AND CABLES COVERED TO PREVENT ANY DEBRIS FROM GETTING ON THEM.



3. Install radius pins into their original locations and install snap rings. Repeat with other moving end if replacing as well.



NOTE: When installing snap rings make sure they are seated in pin groove and closed properly.



4. When complete make sure that both brackets rotate correctly.

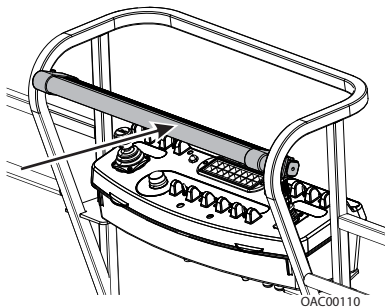


4.13 SKYGUARD

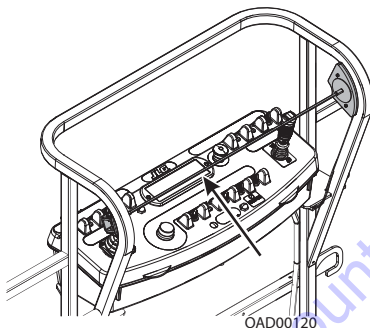
Operation

SkyGuard provides enhanced control panel protection. When the SkyGuard sensor is activated, functions in use at the time of actuation will reverse or cutout. The SkyGuard Function Table provides more details on these functions.

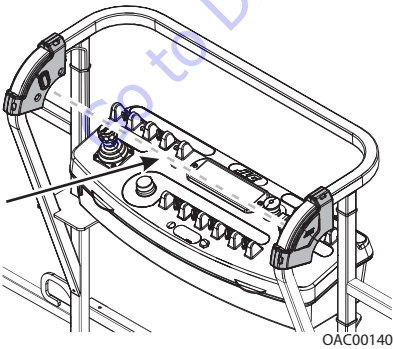
Consult the following illustrations to determine which type of SkyGuard the machine is equipped with. Regardless of the type, SkyGuard function according to the SkyGuard Function Table does not change.



SkyGuard



SkyGuard SkyLine™



SkyGuard SkyEye™

⚠ WARNING

THE MACHINE OPERATOR IS REQUIRED TO PERFORM A DAILY FUNCTION TEST TO ENSURE PROPER OPERATION OF THE SKYGUARD SYSTEM.

Function Test

SKYGUARD ONLY

Perform this function test if **SkyGuard only** is selected in machine setup (refer to Table 6-2).

From the Platform Control Console in an area free from obstructions:

1. Operate the telescope out function, then activate SkyGuard sensor.
2. Once sensor has been activated, ensure telescope out function stops then telescope in function operates for a short duration. Additionally, verify Soft Touch/SkyGuard indicator light flashes and horn sounds. If machine is equipped with SkyGuard beacon, ensure it flashes when sensor activates.
3. With SkyGuard sensor still engaged, press and hold yellow Soft Touch/SkyGuard override button. Operate a function to verify operation can be resumed.
4. Disengage SkyGuard sensor, release controls, and recycle footswitch. Ensure normal operation available.

In Ground Mode:

Operation is allowed regardless of SkyGuard activation.

SOFT TOUCH

If **Soft Touch** is selected in machine setup (refer to Table 6-2), machine will treat the Soft Touch/SkyGuard override switch as if it is a Soft Touch switch.

SKYGUARD NOT SELECTED IN MACHINE SETUP

If the SkyGuard system is not selected in the machine setup (refer to Table 6-2), SkyGuard sensor status will be ignored. No function cutout or reversal will be implemented.

Diagnostics & Troubleshooting

If SkyGuard does not function when the sensor is engaged, first verify the configuration under the MACHINE SETUP: SKYGUARD OPTION menu using the handheld Analyzer. Ensure the selected configuration matches the actual system installed on the machine. If not, select the correct configuration, then verify operation.

Additionally, use the handheld analyzer to navigate to the DIAGNOSTICS: FEATURES → SKYGUARD INPUTS menu to determine additional SkyGuard fault information.

Engage the SkyGuard sensor and observe the Analyzer to determine if the switch/relay closes.

If the status of the switch/relay remains OPEN while the SkyGuard sensor is actively engaged, it is possible the sensor has failed and should be replaced immediately.

If the status of the switch/relay remains CLOSED while the SkyGuard sensor is actively engaged, a power or ground wire may not be making good contact or may be loose or broken. Additionally, there is a low probability that both relays may have failed.

If the switch/relay status is in disagreement, then one may have failed or is not installed correctly. In this case, the machine will be inoperable.

FAULT CODES

Refer to Table 6-16 for more fault code information

- **0039** - SkyGuard switch activation fault
- **2563** - switch disagreement fault

Table 4-2. SkyGuard Function Table

Drive Forward	Drive Reverse	Steer	Swing	Tower Lift Up	Tower Lift Down	Boom Lift Up	Boom Lift Down	Boom Tele Out	Boom Tele In	Jib Lift	Jib Swing	Basket Level	Basket Rotate
R*/C**	R	C	R	R	C	R	C	R	C	C	C	C	C
R= Indicates Reversal is Activated													
C= Indicates Cutout is Activated													
* DOS (Drive Orientation System) Enabled													
** DOS Not Enabled, machine is driving straight without steering, and any other hydraulic function is active													

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SECTION 5. BASIC HYDRAULIC INFORMATION & SCHEMATICS

5.1 LUBRICATING O-RINGS IN THE HYDRAULIC SYSTEM

When assembling connectors in the hydraulic that use o-ring fittings, it is necessary to lubricate all fittings with hydraulic oil prior to assembly. To lubricate the fittings, use one of the following procedures.

NOTE: All o-ring fittings must be pre-lubricated with hydraulic oil prior to assembly.

Cup and Brush

The following is needed to correctly oil the o-ring in this manner:

- A small container for hydraulic oil
- Small paint brush



1. Hold the fitting in one hand while using the brush with the other hand to dip into the container. Remove excess hydraulic oil from the brush so an even film of oil is applied on the o-ring.



2. Holding the fitting over the hydraulic oil container, brush an even film of oil around the entire o-ring in the fitting, making sure the entire o-ring is completely saturated.



3. Turn the o-ring on the other side of the fitting and repeat the previous step, ensuring the entire o-ring is coated with hydraulic oil.



Dip Method

NOTE: This method works best with Face Seal o-rings, but will work for all o-ring fitting types.

The following is needed to correctly oil the o-ring in this manner:

- A small leak proof container
 - Sponge cut to fit inside the container
 - A small amount of hydraulic oil to saturate the sponge.
1. Place the sponge inside the container and add hydraulic oil to the sponge until it is fully saturated.
 2. Dip the fitting into the sponge using firm pressure. Upon lifting the fitting, a small droplet will form and drip from the bottom of the fitting. This should signify an even coating of oil on the fitting.



3. O-ring Boss type fittings will require more pressure in able to immerse more of the fitting into the saturated sponge. This will also cause more oil to be dispersed from the sponge.



Spray Method

This method requires a pump or trigger spray bottle.

1. Fill the spray bottle with hydraulic oil.
2. Hold the fitting over a suitable catch can.
3. Spray the entire o-ring surface with a medium coat of oil.



Brush-on Method

This method requires a sealed bottle brush.

1. Fill the bottle with hydraulic oil.
2. Using slight pressure to the body of the spray bottle, invert the bottle so the brush end is in the downward position.
3. Brush hydraulic oil on the entire o-ring, applying an even coat of oil.



5.2 HYDRAULIC CONNECTION ASSEMBLY AND TORQUE SPECIFICATION

Tapered Thread Types

NPTF = national tapered fuel (Dry Seal) per SAE J476/J512

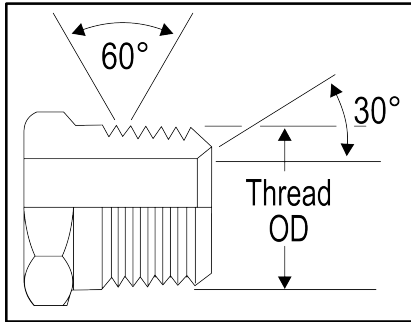


Figure 5-1. NPTF Thread

BSPT = British standard pipe tapered per ISO7-1

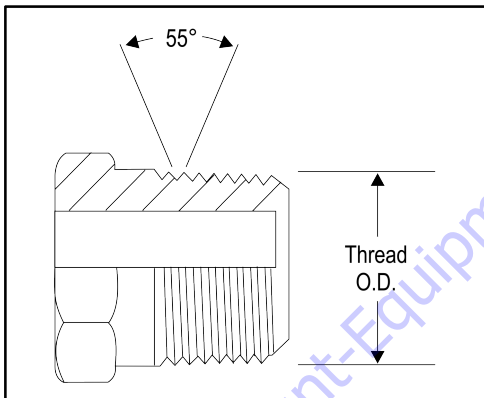


Figure 5-2. BSPT Thread

Straight Thread Types, Tube and Hose Connections

JIC = 37° flare per SAE J514

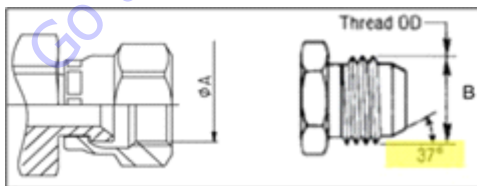


Figure 5-3. JIC Thread

SAE = 45° flare per SAE J512

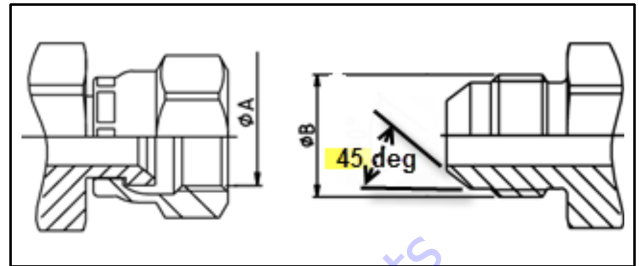


Figure 5-4. SAE Thread

ORFS = o-ring face seal per SAE J1453

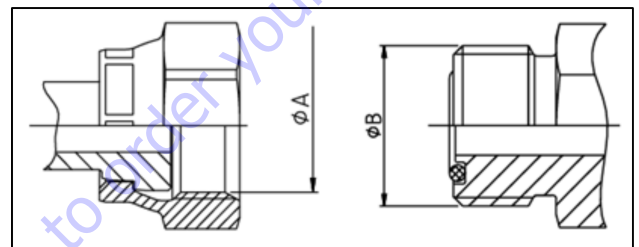


Figure 5-5. ORFS Thread

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

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

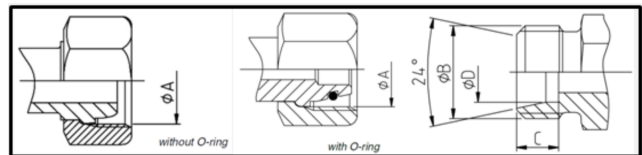


Figure 5-6. MTBL-MBTS Thread

BH = bulkhead connection – JIC, ORFS, MBTL, or MBTS types

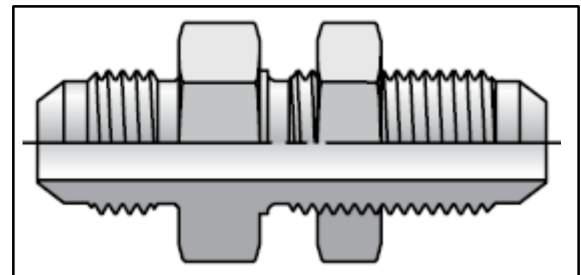


Figure 5-7. Bulkhead Thread

Straight Thread Types, Port Connections

ORB = o-ring boss per SAE J1926, ISO 11926

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

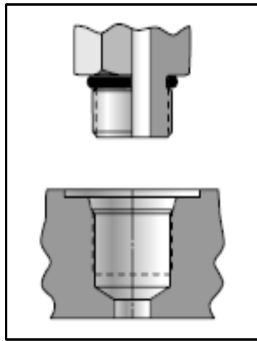


Figure 5-8. ORB-MPP Thread

MFF = metric flat face port per ISO 9974-1

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

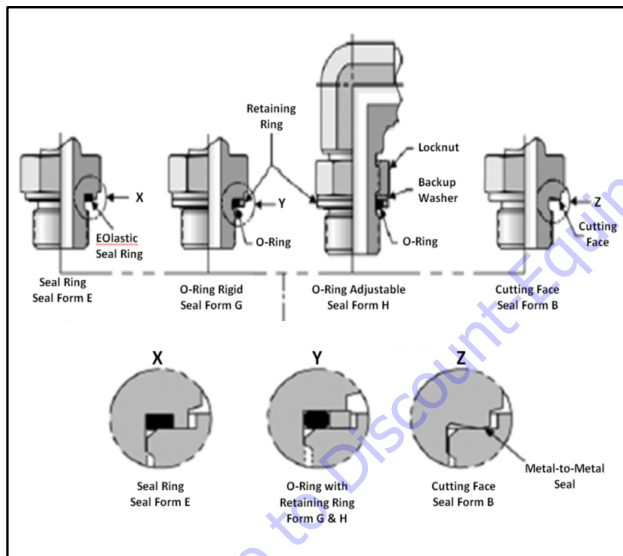


Figure 5-9. MFF-BSP Thread

Flange Connection Types

FL61 = code 61 flange per SAE J518, ISO 6162

FL62 = code 62 flange per SAE J518, ISO 6162

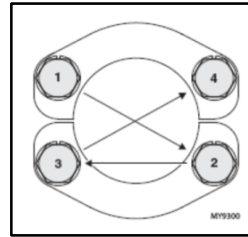


Figure 5-10. FL61-FL62

Tightening Methods

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

Finger Tight = The point where the connector will no longer thread onto the mating part when tightened by hand or fingers. Finger Tight is relative to user strength and will have some variance. The average torque applied by this method is 3 ft-lbs [4 N-m]. Also referred to as 'Hand Tight.'

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

FFWR = Flats from Wrench Resistance; Application of a preload to a connection by tightening to the point of initial wrench resistance and turning the nut a described number of 'flats'. A 'flat' is one side of the hexagonal tube nut and equates to 1/6 of a turn. Also referred to as the 'Flats Method'.

Assembly And Torque Specifications

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

GENERAL TUBE TYPE FITTING ASSEMBLY INSTRUCTIONS

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

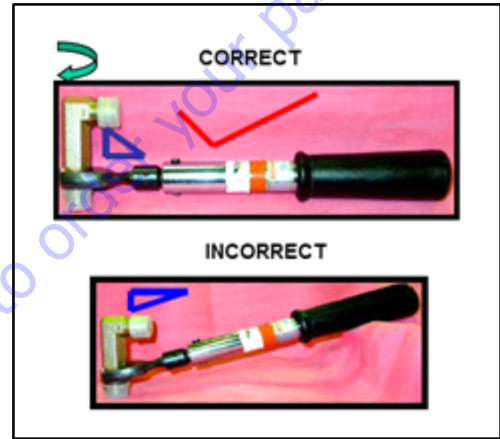


Figure 5-11. Torque Wrench Angle

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

Assembly Instructions for American Standard Pipe Thread Tapered (NPTF) Connections.

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

⚠ CAUTION

OVER TIGHTENING MAY CAUSE DEFORMATION OF THE PIPE FITTING AND DAMAGE TO THE JOINING FITTING, FLANGE OR COMPONENT MAY OCCUR. NEVER BACK OFF (LOOSEN) PIPE THREADED CONNECTORS TO ACHIEVE ALIGN-

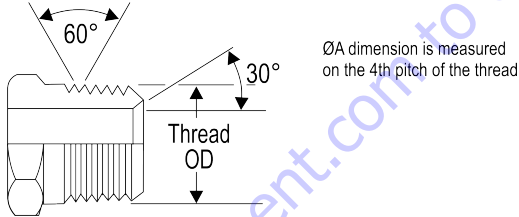
MENT. MEET THE MINIMUM REQUIRED TURNS AND USE THE LAST TURN FOR ALIGNMENT.

5. Rotate male fitting the number of turns per Table 5-1, NPTF Pipe Thread. See FFWR and TFFT Methods for TFFT procedure requirements.

NOTE: TFFT values provided in Table 5-1, NPTF Pipe Thread are applicable for the following material configurations:

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

Table 5-1. NPTF Pipe Thread



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

*ØA thread dimension for reference only.
 ** See FFWR and TFFT Methods for TFFT procedure requirements.

Assembly Instructions for British Standard Pipe Thread Tapered (BSPT) Connections

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

⚠ CAUTION

OVER TIGHTENING MAY CAUSE DEFORMATION OF THE PIPE FITTING AND DAMAGE TO THE JOINING FITTING, FLANGE OR COMPONENT MAY OCCUR. NEVER BACK OFF (LOOSEN) PIPE THREADED CONNECTORS TO ACHIEVE ALIGN-

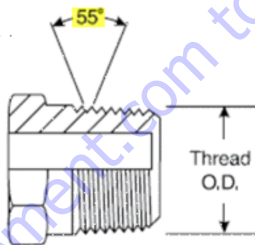
MENT. MEET THE MINIMUM REQUIRED TURNS AND USE THE LAST TURN FOR ALIGNMENT.

5. Rotate male fitting the number of turns per Table 5-2, BSPT Pipe Thread. See FFWR and TFFT Methods for TFFT procedure requirements.

NOTE: TFFT values provided in Table 5-2, BSPT Pipe Thread are applicable for the following material configurations:

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

Table 5-2. BSPT Pipe Thread



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

* ØA thread dimension for reference only.

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

Assembly Instructions for 37° (JIC) Flare Fittings

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

⚠ CAUTION

DO NOT FORCE A MISALIGNED OR SHORT HOSE/TUBE INTO ALIGNMENT. IT PUTS UNDESIRABLE STRAIN ONTO THE JOINT EVENTUALLY LEADING TO LEAKAGE.

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

⚠ CAUTION

THE TORQUE METHOD SHOULD NOT BE USED ON LUBRICATED OR OILY FITTINGS. NO LUBRICATION OR SEALANT IS REQUIRED. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

3. Torque assembly to value listed in Table 5-3, 37° Flare (JIC) Thread - Steel or Table 5-4, 37° Flare (JIC) Thread - Aluminum/Brass while using the Double Wrench Method per Double Wrench Method. Refer to FFWR and TFFT Methods for procedure requirements if using the FFWR method.

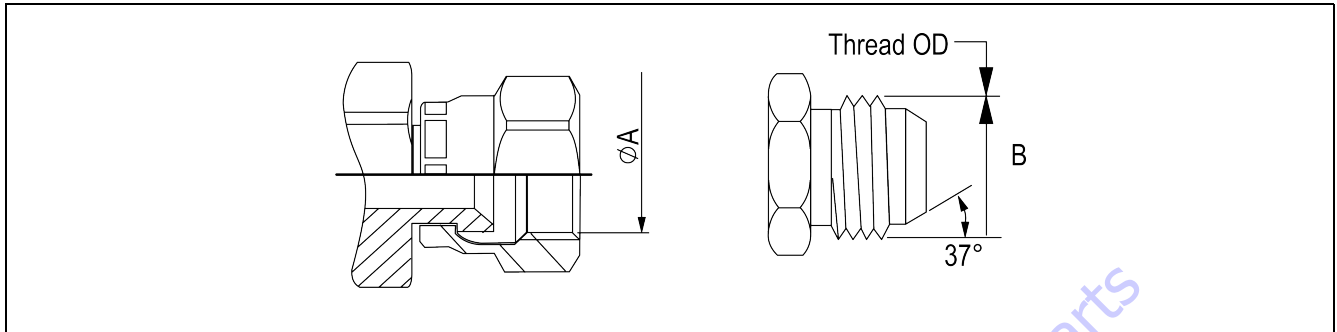
NOTE: *Torque values provided in Table 5-3, 37° Flare (JIC) Thread - Steel and Table 5-4, 37° Flare (JIC) Thread - Aluminum/Brass are segregated based on the material configuration of the connection.*

'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.

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Table 5-3. 37° Flare (JIC) Thread - Steel



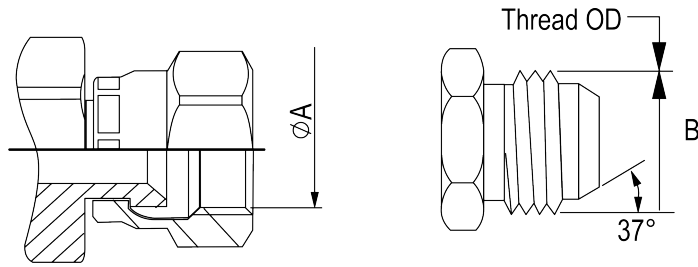
TYPE/FITTING IDENTIFICATION							Torque						Flats from Wrench Resistance (F.F.W.R)**
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]			
			(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.28	7.00	0.31	7.75	6	7	7	8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

* ØA and ØB thread dimensions for reference only.

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

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

Table 5-4. 37° Flare (JIC) Thread - Aluminum/Brass



TYPE/FITTING IDENTIFICATION							Torque						Flats from Wrench Resistance (F.F.W.R)**
MATERIAL	Dash Size	Thread Size (UNF)	ØA*		ØB*		[Ft-Lb]			[N-m]			
			(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max	
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.28	7.00	0.31	7.75	4	4	5	5	6	7	--
	3	3/8-24	0.34	8.60	0.37	9.50	5	6	7	7	8	9	--
	4	7/16-20	0.39	10.00	0.44	11.10	8	9	9	11	12	13	1-1/2 to 1-3/4
	5	1/2-20	0.46	11.60	0.50	12.70	9	10	10	12	13	14	1 to 1-1/2
	6	9/16-18	0.51	13.00	0.56	14.30	14	15	16	19	20	21	1 to 1-1/2
	8	3/4-16	0.69	17.60	0.75	19.10	27	29	30	37	39	41	1-1/2 to 1-3/4
	10	7/8-14	0.81	20.50	0.87	22.20	39	41	43	53	56	58	1 to 1-1/2
	12	11/16-12	0.97	24.60	1.06	27.00	55	57	60	74	78	81	1 to 1-1/2
	14	13/16-12	1.11	28.30	1.19	30.10	65	68	72	88	93	97	1 to 1-1/2
	16	15/16-12	1.23	31.30	1.31	33.30	77	81	84	104	109	114	3/4 to 1
	20	15/8-12	1.54	39.20	1.63	41.30	109	115	120	148	155	163	3/4 to 1
	24	17/8-12	1.80	45.60	1.87	47.60	127	133	139	172	180	189	3/4 to 1
32	21/2-12	2.42	61.50	2.50	63.50	172	181	189	234	245	257	3/4 to 1	

* ØA and ØB thread dimensions for reference only.

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

Assembly Instructions for 45° SAE Flare Fittings

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

⚠ CAUTION

DO NOT FORCE A MISALIGNED OR SHORT HOSE/TUBE INTO ALIGNMENT. IT PUTS UNDESIRABLE STRAIN ONTO THE JOINT EVENTUALLY LEADING TO LEAKAGE.

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

⚠ CAUTION

THE TORQUE METHOD SHOULD NOT BE USED ON LUBRICATED OR OILY FITTINGS. NO LUBRICATION OR SEALANT IS REQUIRED. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

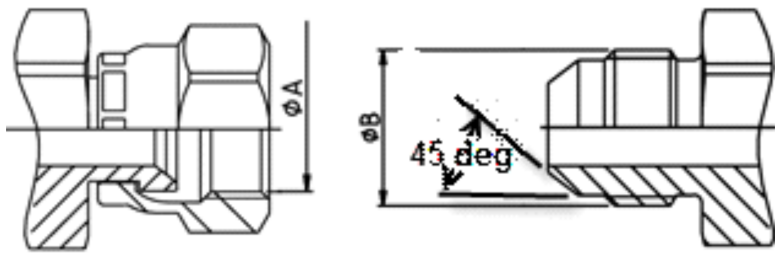
4. Torque fitting to value listed in Table 5-5, 45° Flare (SAE) - Steel and Table 5-6, 45° Flare (SAE) - Aluminum/Brass while using the Double Wrench Method outlined in this section. Refer to FFWR and TFFT Methods for procedure requirements if using the TFFT method.

NOTE: *Torque values provided in Table 5-5, 45° Flare (SAE) - Steel and Table 5-6, 45° Flare (SAE) - 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 5-5. 45° Flare (SAE) - Steel

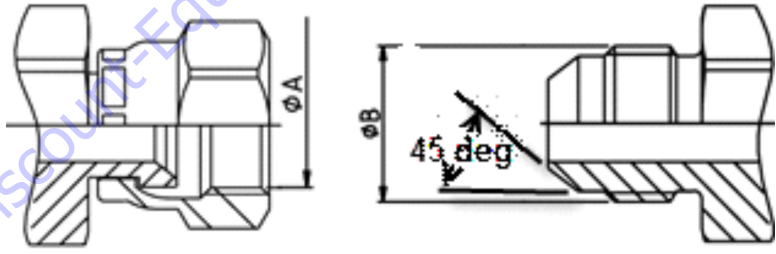


TYPE/FITTING IDENTIFICATION							Torque						Turns From Finger Tight (TFFT)**
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]			
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max	
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	4	7/16-20	0.39	9.90	0.44	11.10	13	14	14	18	19	19	1/4 to 1/2
	6	5/8-18	0.56	14.30	0.63	15.90	22	23	24	30	31	33	1/4 to 1/2
	8	3/4-16	0.69	17.50	0.75	19.10	42	44	46	57	60	62	1/4 to 1/2
	10	7/8-14	0.81	20.60	0.87	22.20	60	63	66	81	85	89	1/4 to 1/2
	12	1 1/16-14	0.98	25.00	1.06	27.00	84	88	92	114	119	125	1/4 to 1/2

*ØA and ØB thread dimensions for reference only.

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

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



TYPE/FITTING IDENTIFICATION							Torque						Turns From Finger Tight (TFFT)**
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	1/4 to 1/2
	6	5/8-18	0.56	14.30	0.63	15.90	14	15	15	19	20	20	1/4 to 1/2
	8	3/4-16	0.69	17.50	0.75	19.10	27	29	30	37	39	41	1/4 to 1/2
	10	7/8-14	0.81	20.60	0.87	22.20	39	41	43	53	56	58	1/4 to 1/2
	12	1 1/16-14	0.98	25.00	1.06	27.00	55	58	61	75	79	83	1/4 to 1/2

*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.



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.

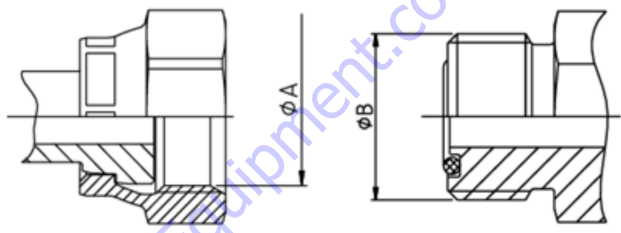
5. Torque nut to value listed in Table 5-7, O-ring Face Seal (ORFS) - Steel or Table 5-8, O-ring Face Seal (ORFS) - Aluminum/Brass while using the Double Wrench Method. Refer to FFWR and TFFT Methods for procedure requirements if using the FFWR method.

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

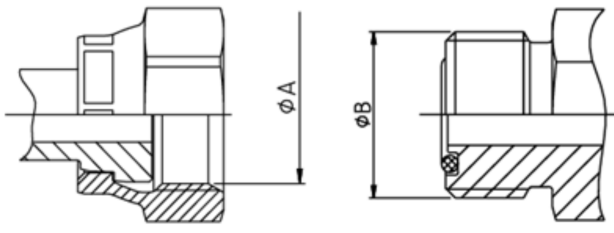


TYPE/FITTING IDENTIFICATION							Torque						Flats from Wrench Resistance (F.F.W.R)**	
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]			Tube Nuts	Swivel & Hose Ends
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max		
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	4	9/16-18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

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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						Flats from Wrench Resistance (F.F.W.R)**			
		(mm)	(Metric)	(mm)	(mm)	(mm)	(mm)	[Ft-Lb]			[N-m]						
								Min	Nom	Max	Min	Nom	Max				
STEEL FITTINGS WITH STEEL MATING COMPONENTS	DIN 24° CONE FLARELESS BITE (MBTL) FITTING	6	M12x1.5	10.50	12.00	7.00	6.20	FFWR is the recommended method of fitting assembly. Torque values are application specific due to variability in the fitting supplier, coating, lubrication, and other physical characteristics of the connection. Refer to the specific procedure in the service manual						1.5 to 1.75			
		8	M14x1.5	12.50	14.00	7.00	8.20							1.5 to 1.75			
		10	M16x1.5	14.50	16.00	7.00	10.20							1.5 to 1.75			
		12	M18x1.5	16.50	18.00	7.00	12.20							1.5 to 1.75			
		15	M22x1.5	20.50	22.00	7.00	15.20							1.5 to 1.75			
		18	M26x1.5	24.50	26.00	7.50	18.20							1.5 to 1.75			
		22	M30x2	27.90	30.00	7.50	22.20							1.5 to 1.75			
		28	M36x2	33.90	36.00	7.50	28.20							1.5 to 1.75			
		35	M45x2	42.90	45.00	10.50	35.30							1.5 to 1.75			
	42	M52x2	49.90	52.00	11.00	42.30	1.5 to 1.75										
	DIN 24° CONE FLARELESS BITE (MBTS) FITTING	TYPE	Tube O.D.	Thread M Size	ØA*	ØB*	C*	ØD*	Torque						Flats from Wrench Resistance (F.F.W.R)**		
			(mm)	(Metric)	(mm)	(mm)	(mm)	(mm)	[Ft-Lb]			[N-m]					
									Min	Nom	Max	Min	Nom	Max			
					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 service manual						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.

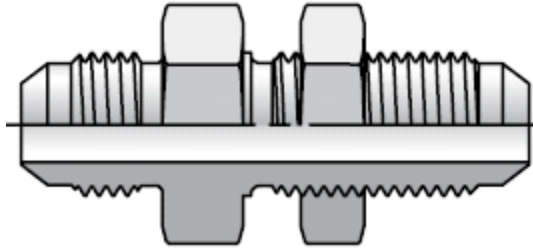
** See FFWR and TFFT Methods for FFWR procedure requirements.

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, Bulkhead Fittings (BH) - INCH and Table 5-11, Bulkhead Fittings (BH) - METRIC while using the Double Wrench Method.

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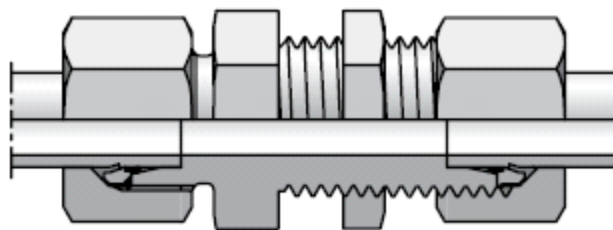
Table 5-10. Bulkhead Fittings (BH) - INCH



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		
	37° FLARE (JIC) BULKHEAD FITTING	TYPE	Dash Size	Thread Size	Torque					
					[Ft-Lb]			[N-m]		
		(UNF)	Min	Nom	Max	Min	Nom	Max		
		3	3/8-24	8	9	9	11	12	12	
		4	7/16-20	13	14	14	18	19	19	
		5	1/2-20	20	21	22	27	28	30	
		6	9/16-18	25	27	28	34	37	38	
		8	3/4-16	50	53	55	68	72	75	
		10	7/8-14	85	90	94	115	122	127	
		12	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	2 1/2-12	310	326	341	420	442	462			

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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					
		(mm)	(metric)	[Ft-Lb]			[N-m]		
				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 Tables 5-17, O-RING BOSS (ORB) 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, O-RING BOSS (ORB) 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 counter bore of the port.

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

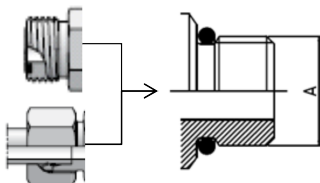
TYPE/FITTING IDENTIFICATION					HEX TYPE PLUGS & STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
					Ft-Lb or (in-lb)			[N-m]		
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	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	1 1/16-12	1.06	27.00	135	142	149	185	193	202
	14	1 3/16-12	1.19	30.10	175	184	193	235	249	262
	16	1 5/16-12	1.31	33.30	200	210	220	270	285	298
	20	1 5/8-12	1.63	41.30	250	263	275	340	357	373
	24	1 7/8-12	1.87	47.60	305	321	336	415	435	456
32	2 1/2-12	2.50	63.50	375	394	413	510	534	560	
TYPE/FITTING IDENTIFICATION					HEX TYPE PLUGS & STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
					Ft-Lb or (in-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	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.

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

Table 5-13. O-ring Boss (ORB) - Table 2 of 6

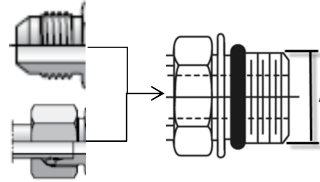


TYPE/FITTING IDENTIFICATION					STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Dash Size	Thread Size (UNF)	ØA* (in) (mm)		Torque					
					Ft-Lb or (in-lb)			[N-m]		
					Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	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 (UNF)	ØA* (in) (mm)		Torque					
					Ft-Lb or (in-lb)			[N-m]		
					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



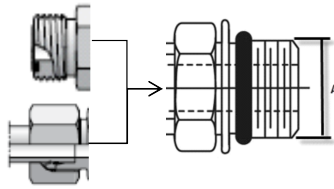
TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size (UNF)	ØA*		Torque					
			(in)	(mm)	Ft-Lb or (in-lb)			[N-m]		
					Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	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	2 1/2-12	2.50	63.50	375	394	413	510	534	560	
TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size (UNF)	ØA*		Torque					
			(in)	(mm)	Ft-Lb or (in-lb)			[N-m]		
					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	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.

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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 or (in-lb)			[N-m]		
					(UNF)	(in)	(mm)	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 or (in-lb)			[N-m]		
					(UNF)	(in)	(mm)	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.

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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



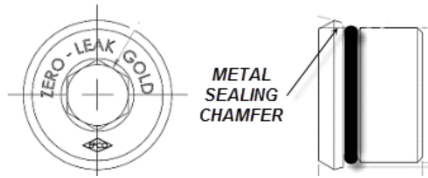
TYPE/FITTING IDENTIFICATION					HOLLOW HEX PLUGS					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
					Ft-Lb or (in-lb)			[N-m]		
			(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(30)	(32)	(33)	3	4	4
	3	3/8-24	0.37	9.52	(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	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	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 or (in-lb)			[N-m]		
			(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom
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	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	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.

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

Table 5-17. O-ring Boss (ORB) - Table 6 of 6



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

* ØA Thread OD dimension for reference only.

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

Assembly Instructions for Adjustable Port End Metric (MFF) Fittings

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

⚠ CAUTION

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

3. Pre-lubricate the O-ring with Hydraulic Oil.
4. For Non-Adjustable Fittings and Plugs, thread the fitting by hand until contact.
5. For Adjustable fittings, refer to Adjustable Stud End Assembly for proper assembly.

6. Torque the fitting or nut to value listed in Table 5-18, Table 5-19, Table 5-20, Metric Flat Face Port (MFF) - L Series and Table 5-21, Table 5-22, Table 5-23, Metric Flat Face Port (MFF) - S Series 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, Metric Flat Face Port (MFF) - L Series and Table 5-21, Table 5-22, and Table 5-23, Metric Flat Face Port (MFF) - S Series 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

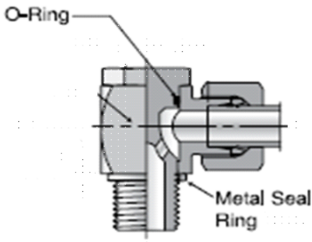
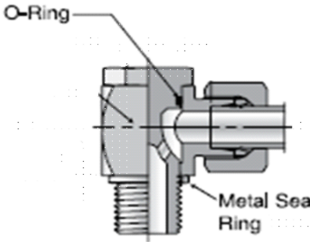
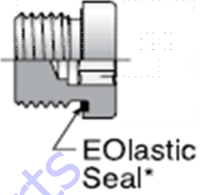
TYPE/FITTING IDENTIFICATION			FORM A (SEALING WASHER) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM B (CUTTING FACE) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
	(metric)	(mm)	[Ft-Lb]		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

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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

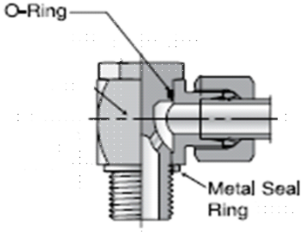
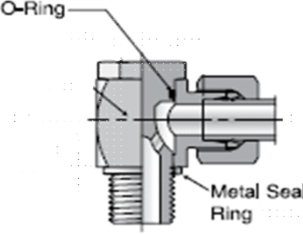
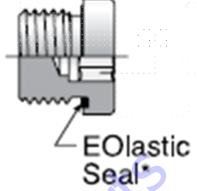
TYPE/FITTING IDENTIFICATION			FORM A (SEALING WASHER) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end						FORM B (CUTTING FACE) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
	(metric)	(mm)	[Ft-Lb]			[N-m]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

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

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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	--	--	--	--	--	--						
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 preinstalled, 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, Metric Pipe Parallel O-ring Boss (MPP) 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, Metric Pipe Parallel O-ring Boss (MPP) 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)

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, British Standard Parallel Pipe Port (BSPP) - L Series and Table 5-28, Table 5-29, Table 5-30, British Standard Parallel Pipe Port (BSPP) - S Series 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, British Standard Parallel Pipe Port (BSPP) - L Series and Table 5-28, Table 5-29, Table 5-30, British Standard Parallel Pipe Port (BSPP) - S Series 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.

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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
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.

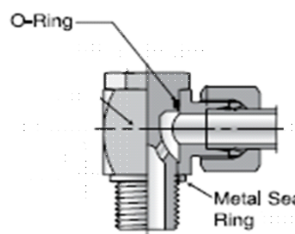
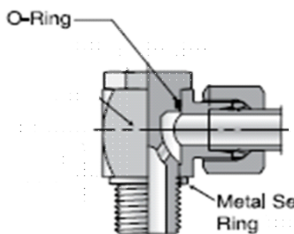
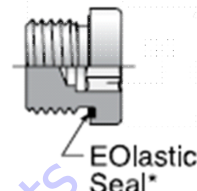
SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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		
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						Torque						Torque							
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]				
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max		
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G1/8A	6	13	14	14	18	19	19	13	14	14	18	19	19	10	11	11	13	15	15		
	G1/4A	8	30	32	33	40	43	45	33	35	36	45	47	49	22	23	24	30	31	33		
	G1/4A	10	30	32	33	40	43	45	33	35	36	45	47	49	22	23	24	30	31	33		
	G3/8A	12	48	51	53	65	69	72	52	55	57	70	75	77	44	46	48	60	62	65		
	G1/2A	15	66	70	73	90	95	99	89	94	98	120	127	133	59	62	65	80	84	88		
	G1/2A	18	66	70	73	90	95	99	89	94	98	120	127	133	59	62	65	80	84	88		
	G3/4A	22	92	97	101	125	132	137	170	179	187	230	243	254	103	108	113	140	146	153		
	G1A	28	--	--	--	--	--	--	236	248	260	320	336	353	148	156	163	200	212	221		
	G1-1/4A	35	--	--	--	--	--	--	398	418	438	540	567	594	295	313.5	332	400	425	450		
	G1-1/2A	42	--	--	--	--	--	--	516	542	568	700	735	770	332	349	365	450	473	495		
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.

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	26	28	29	35	38	39	41	43	45	55	58	61
	G 1/4A	8	26	28	29	35	38	39	41	43	45	55	58	61
	G 3/8A	10	33	35	36	45	47	49	66	70	73	90	95	99
	G 3/8A	12	33	35	36	45	47	49	66	70	73	90	95	99
	G 1/2A	14	48	51	53	65	69	72	111	117	122	150	159	165
	G 1/2A	16	48	51	53	65	69	72	96	101	106	130	137	144
	G 3/4A	20	66	70	73	90	95	99	199	209	219	270	283	297
	G 1A	25	111	117	122	150	159	165	251	264	276	340	358	374
	G 1-1/4A	30	177	186	195	240	252	264	398	418	438	540	567	594
	G 1-1/2A	38	214	225	235	290	305	319	516	542	568	700	735	770
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.

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	41	43	45	55	58	61	26	28	29	35	38	39
	G 1/4A	8	41	43	45	55	58	61	26	28	29	35	38	39
	G 3/8A	10	59	62	65	80	84	88	52	55	57	70	75	77
	G 3/8A	12	59	62	65	80	84	88	52	55	57	70	75	77
	G 1/2A	14	85	90	94	115	122	127	66	70	73	90	95	99
	G 1/2A	16	85	90	94	115	122	127	66	70	73	90	95	99
	G 3/4A	20	133	140	146	180	190	198	133	140	146	180	190	198
	G 1A	25	229	241	252	310	327	342	229	241	252	310	327	342
	G 1-1/4A	30	332	349	365	450	473	495	332	349	365	450	473	495
	G 1-1/2A	38	398	418	438	540	567	594	398	418	438	540	567	594
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

Diagram illustrating the Form E fitting configuration, showing the Cutting Face Seal Type 'B' and the Metal-to-Metal Seal.

Diagram illustrating the Form G/H fitting configuration, showing the O-Ring with Retaining Ring Types 'G' & 'H', Retaining Ring, Locknut, and Back-Up Washer.

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

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

Table 5-30. British Standard Parallel Pipe Port (BSPP) - 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						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]		
			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						
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						

O-Ring
Metal Seal Ring

O-Ring
Metal Seal Ring

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.

* 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 5-31, Flange Code (FL61 & FL62) - Inch Fasteners and Table 5-32, Flange Code (FL61 & FL62) - Metric Fasteners.

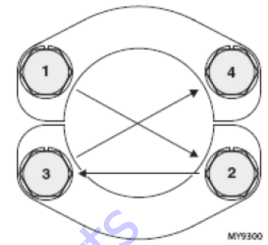
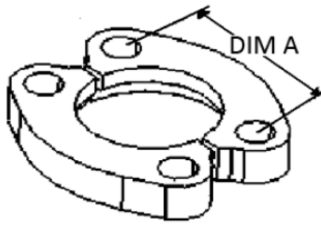
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SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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					
		(in)	(mm)	(in)	(mm)		[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
							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
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.



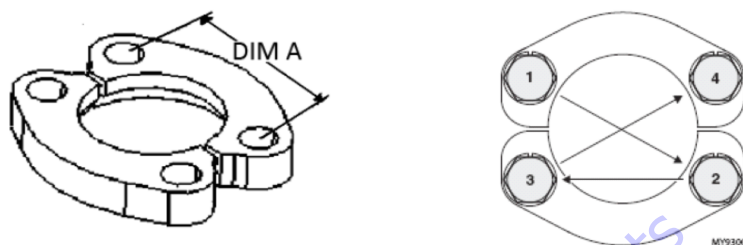
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SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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					
		(in)	(mm)	(in)	(mm)		[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
						(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	
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.

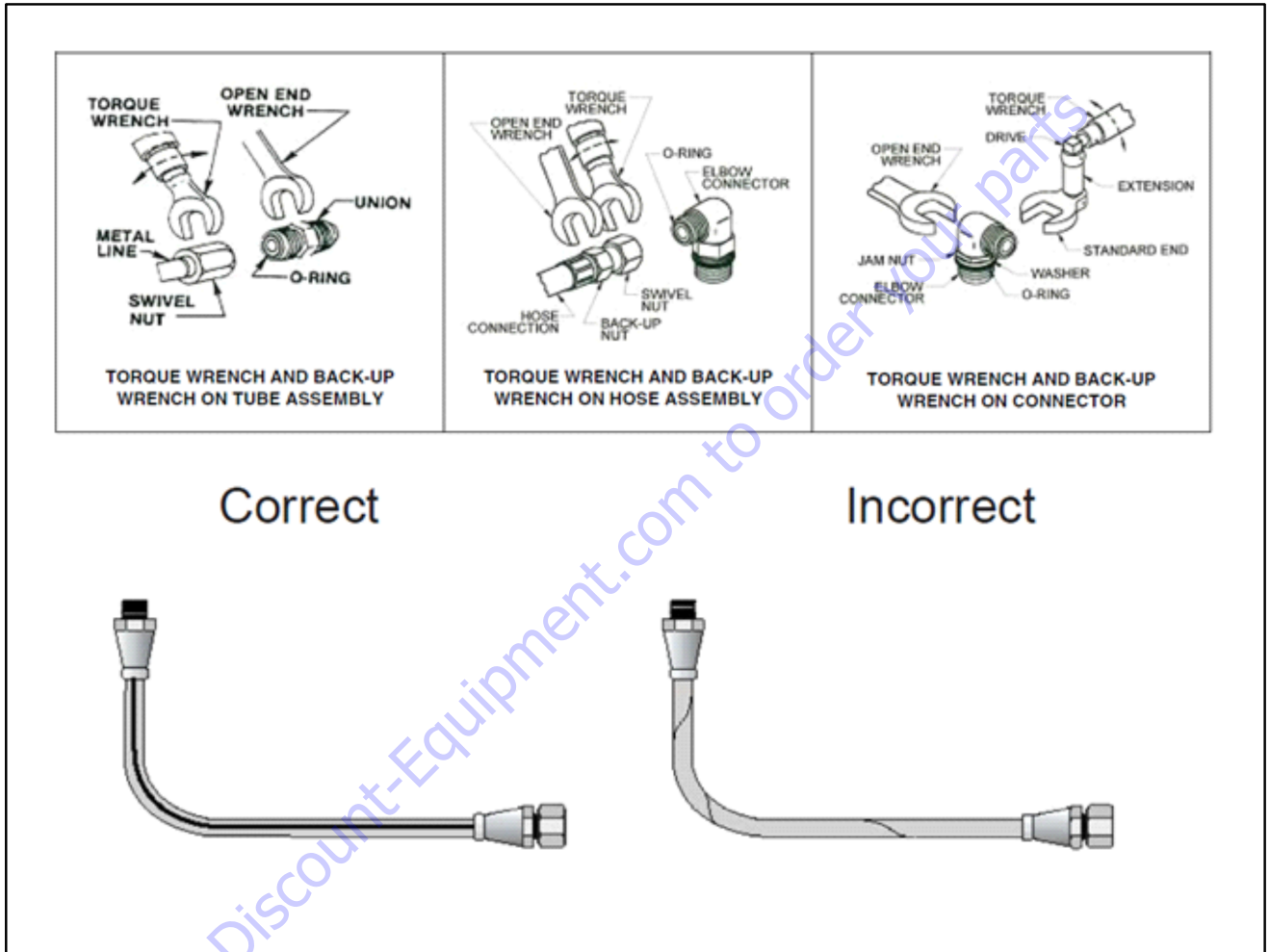


Figure 5-12. Double Wrench Method

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.

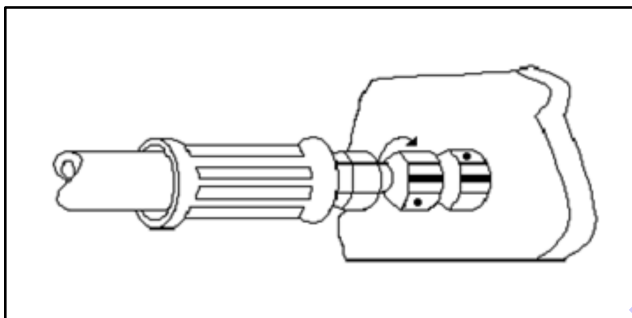


Figure 5-13. FFWR Method

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.

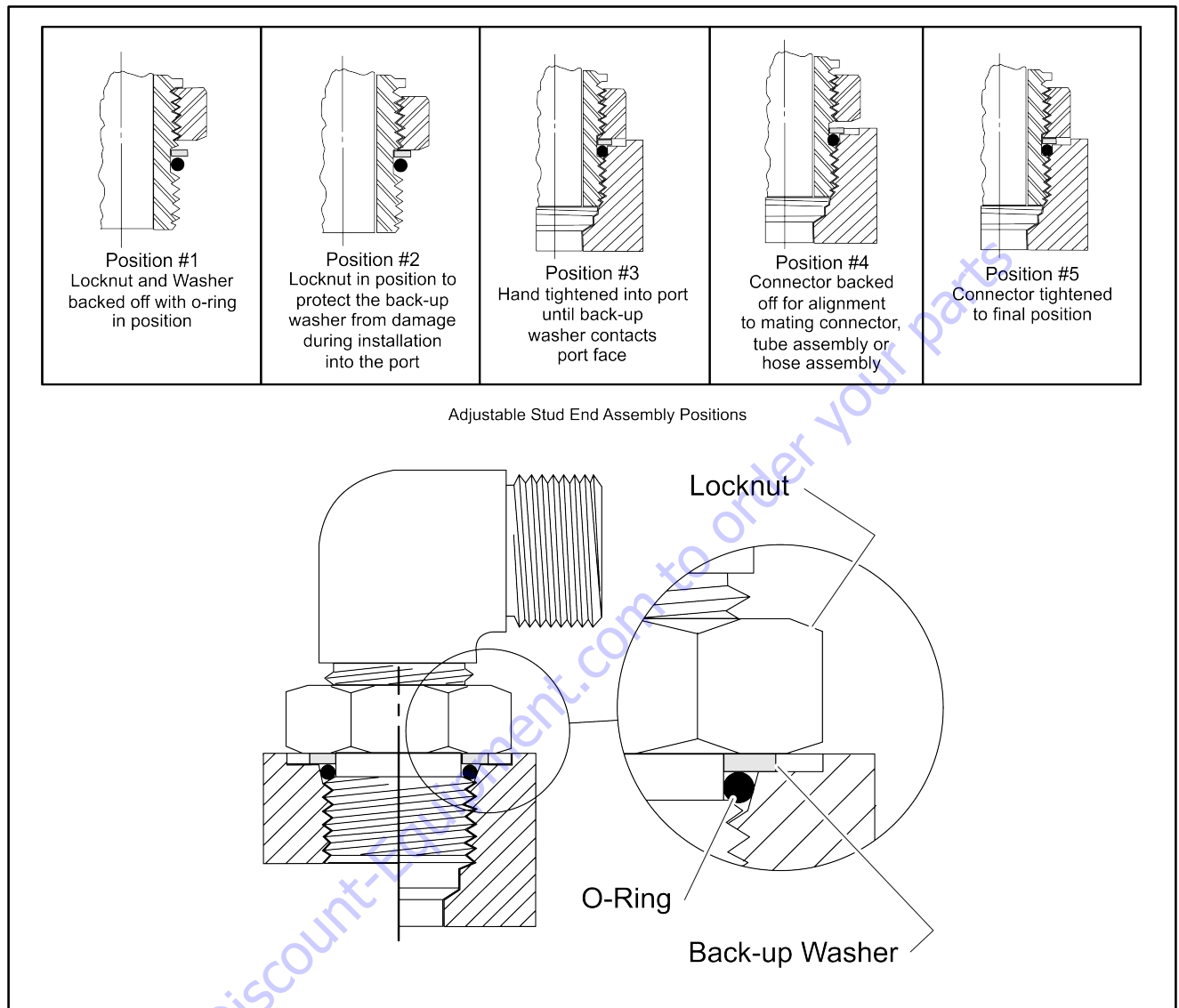


Figure 5-14. Adjustable Stud End Assembly

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

Platform Level Cylinder

DISASSEMBLY

NOTICE

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

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

WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove counterbalance valve from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

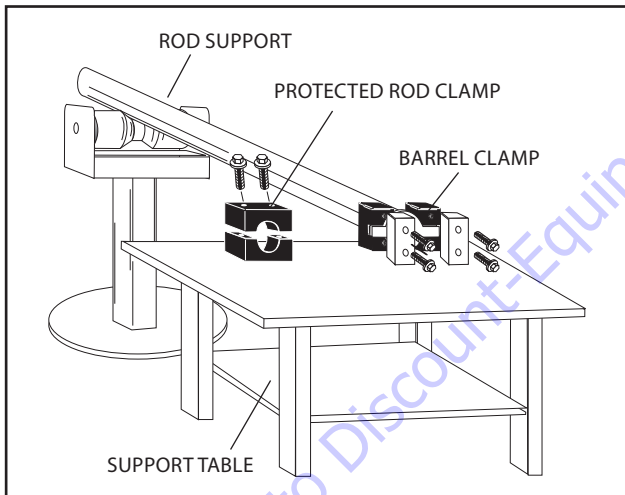


Figure 5-15. Cylinder Barrel Support

5. Using a pin-face spanner wrench, unscrew the cylinder head from the barrel.

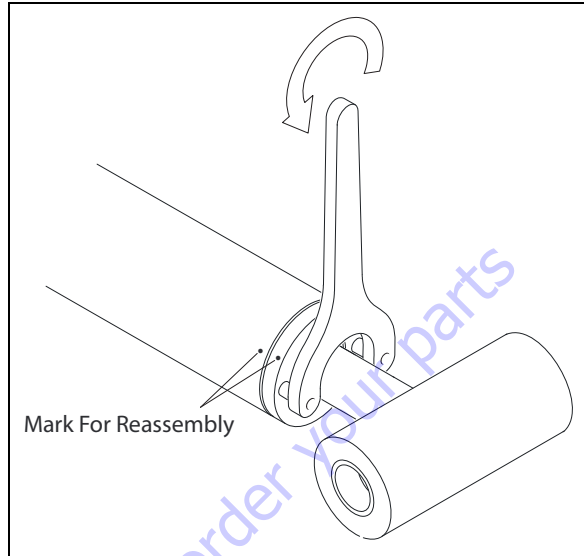


Figure 5-16. Cylinder Head Removal

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

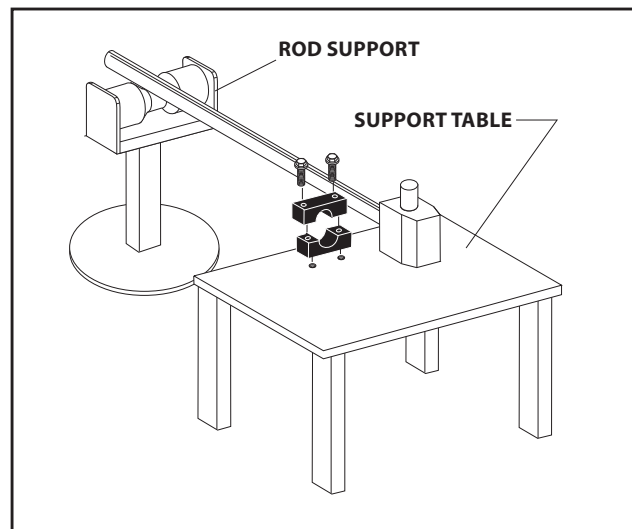
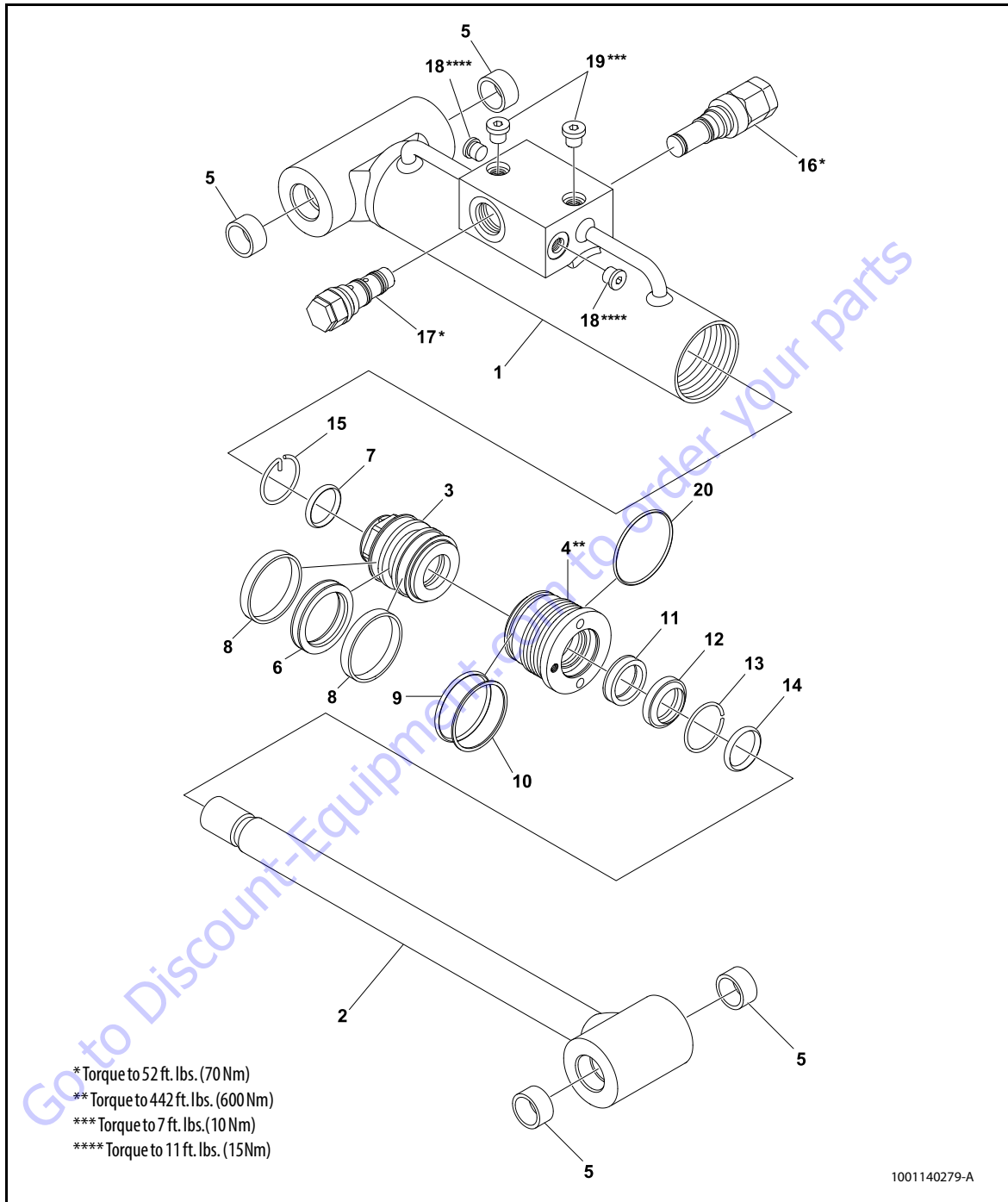
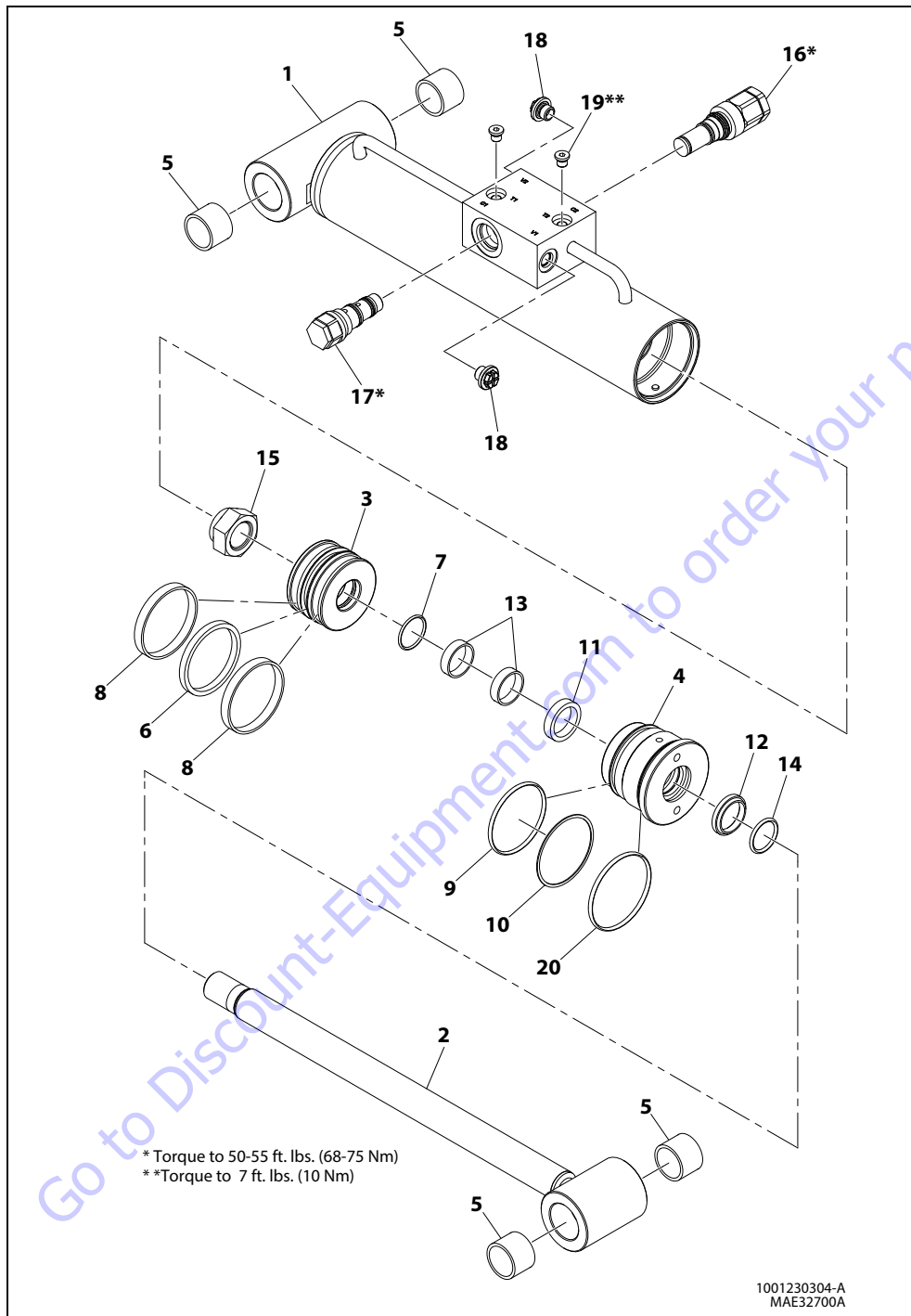


Figure 5-17. Cylinder Rod Support



- | | | | | |
|-----------|----------------|-----------------|--------------------------|--------------------------|
| 1. Barrel | 5. Bushing | 9. O-ring | 13. Retaining Ring | 17. Counterbalance Valve |
| 2. Rod | 6. Piston Seal | 10. Backup Ring | 14. O-ring | 18. Plug |
| 3. Piston | 7. O-ring | 11. Rod Seal | 15. Retainer | 19. Plug |
| 4. Head | 8. Wear Ring | 12. Wiper Seal | 16. Counterbalance Valve | 20. O-ring |

Figure 5-18. Platform Level Cylinder - USA Built Machine



- | | | | |
|------------|-----------------|----------------|--------------------------|
| 1. Barrel | 6. Piston Seal | 11. Rod Seal | 16. Counterbalance Valve |
| 2. Rod | 7. O-ring | 12. Wiper Seal | 17. Counterbalance Valve |
| 3. Piston | 8. Wear Ring | 13. Wear Ring | 18. Plug |
| 4. Head | 9. O-ring | 14. O-ring | 19. Plug |
| 5. Bushing | 10. Backup Ring | 15. Locknut | 20. O-ring |

Figure 5-19. Platform Level Cylinder - China Built Machine

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Remove the retainer which attach the piston to the rod. Refer Figure 5-18.
10. Loosen and remove locknut which attaches the piston to the rod. Refer Figure 5-19.
11. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.
12. Remove and discard the piston o-rings, seals and wear rings.
13. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, retaining rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
 - a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
 - b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
 - c. Lubricate inside of steel bushing prior to bearing installation.
 - d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.

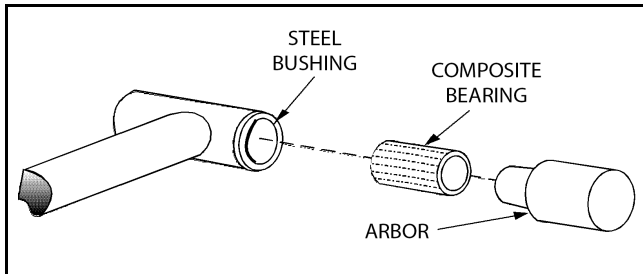


Figure 5-20. Composite Bearing Installation

12. If applicable, inspect port block fittings and holding valve. Replace as necessary.
13. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
14. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

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

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

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

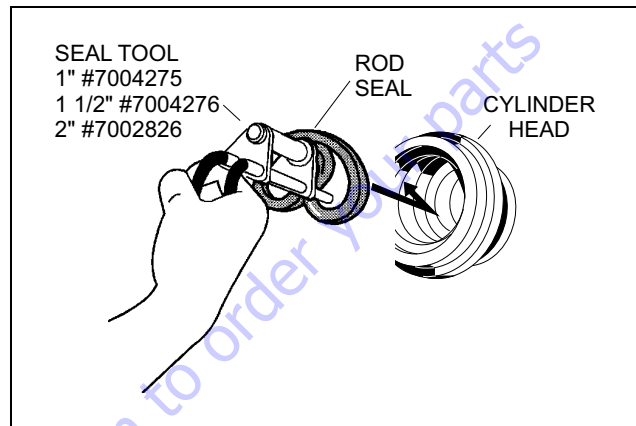


Figure 5-21. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

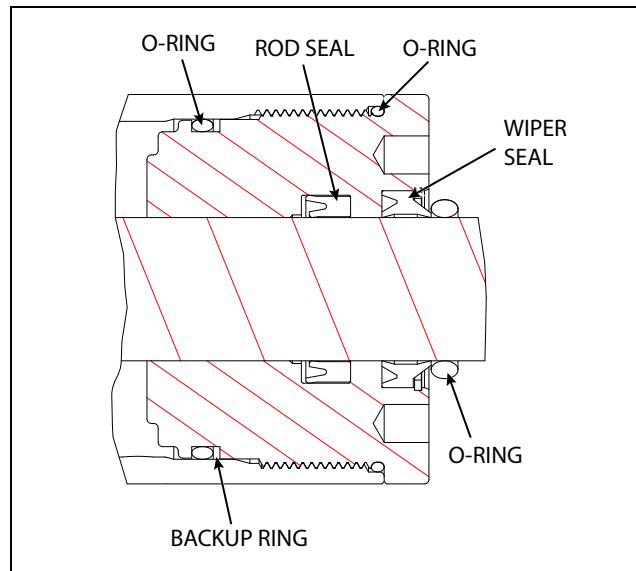


Figure 5-22. Cylinder Head Seal Installation

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

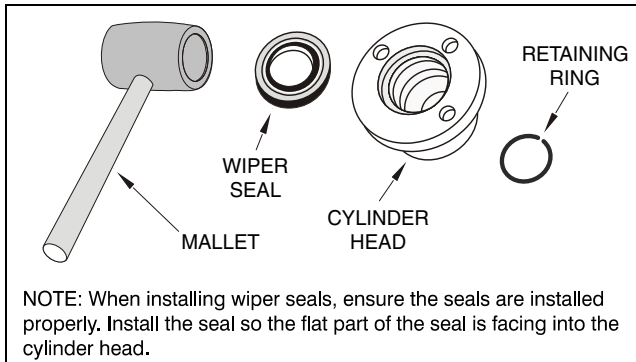


Figure 5-23. Wiper Seal Installation

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

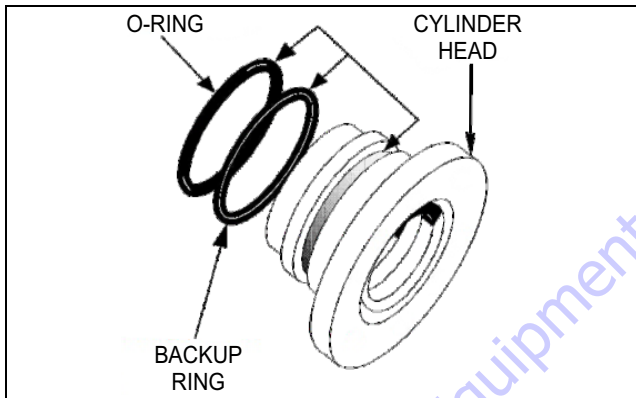


Figure 5-24. Installation of Head Seal Kit

4. Install o-ring onto the cylinder rod. Carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.
5. Place a new o-ring and backup rings in the inner piston diameter groove.
6. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
7. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
8. Thread piston onto rod until it abuts and install the retainer. Refer Figure 5-18.
9. Tread piston onto rod until it abuts and install the lock nut. Refer Figure 5-19.

10. Remove the cylinder rod from the holding fixture.
11. Place new piston seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

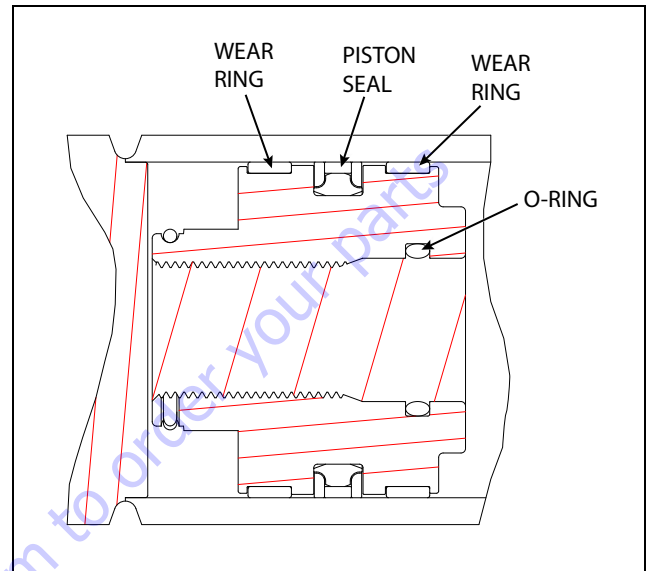


Figure 5-25. Piston Seal Kit Installation

12. Position the cylinder barrel in a suitable holding fixture.

NOTICE

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

13. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
14. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
15. Screw the cylinder head gland into the barrel using a spanner wrench.
16. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the re-installation of any holding valve or valves.
17. Install the counterbalance valves in the rod port block. Torque as shown in Figure 5-18. and Figure 5-19.

Jib Lift Cylinder

DISASSEMBLY

NOTICE

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

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

WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove counterbalance valve from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

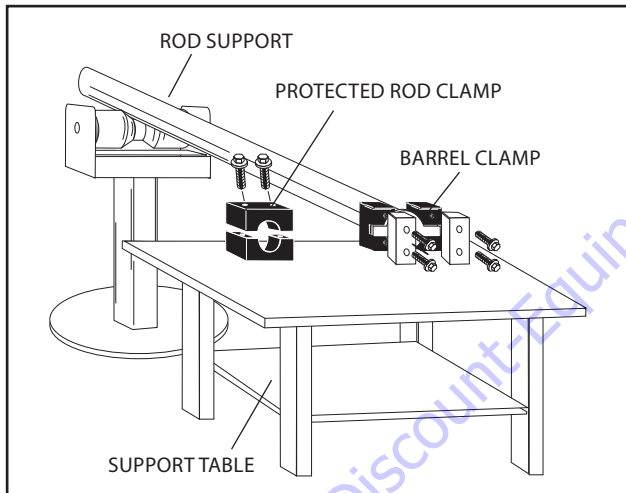


Figure 5-26. Cylinder Barrel Support

5. Using a pin-face spanner wrench, unscrew the cylinder head from the barrel.

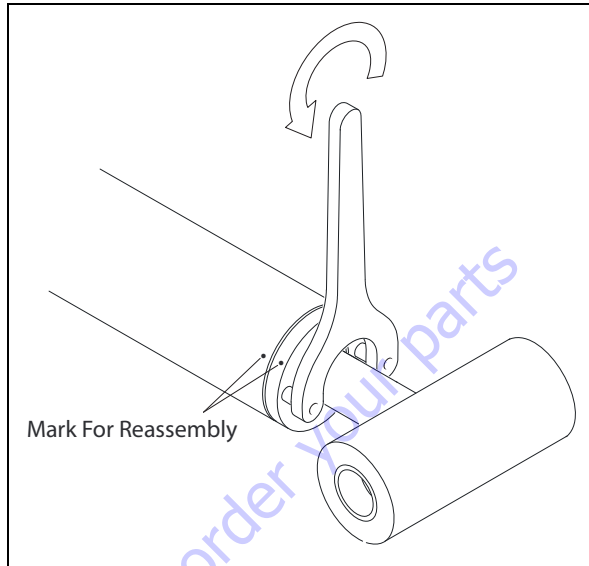


Figure 5-27. Cylinder Head Removal

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

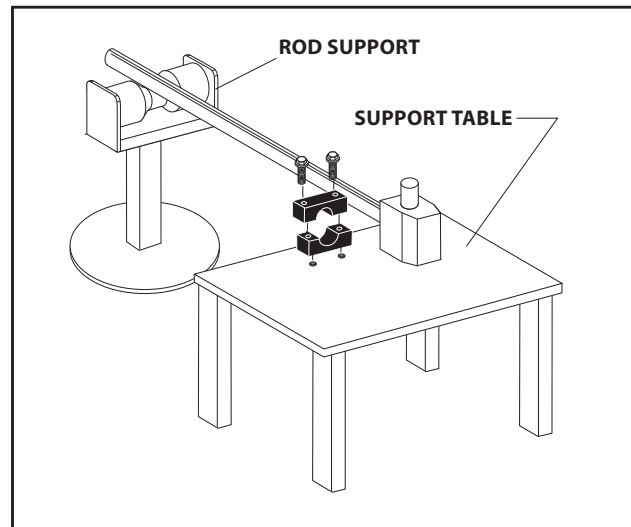
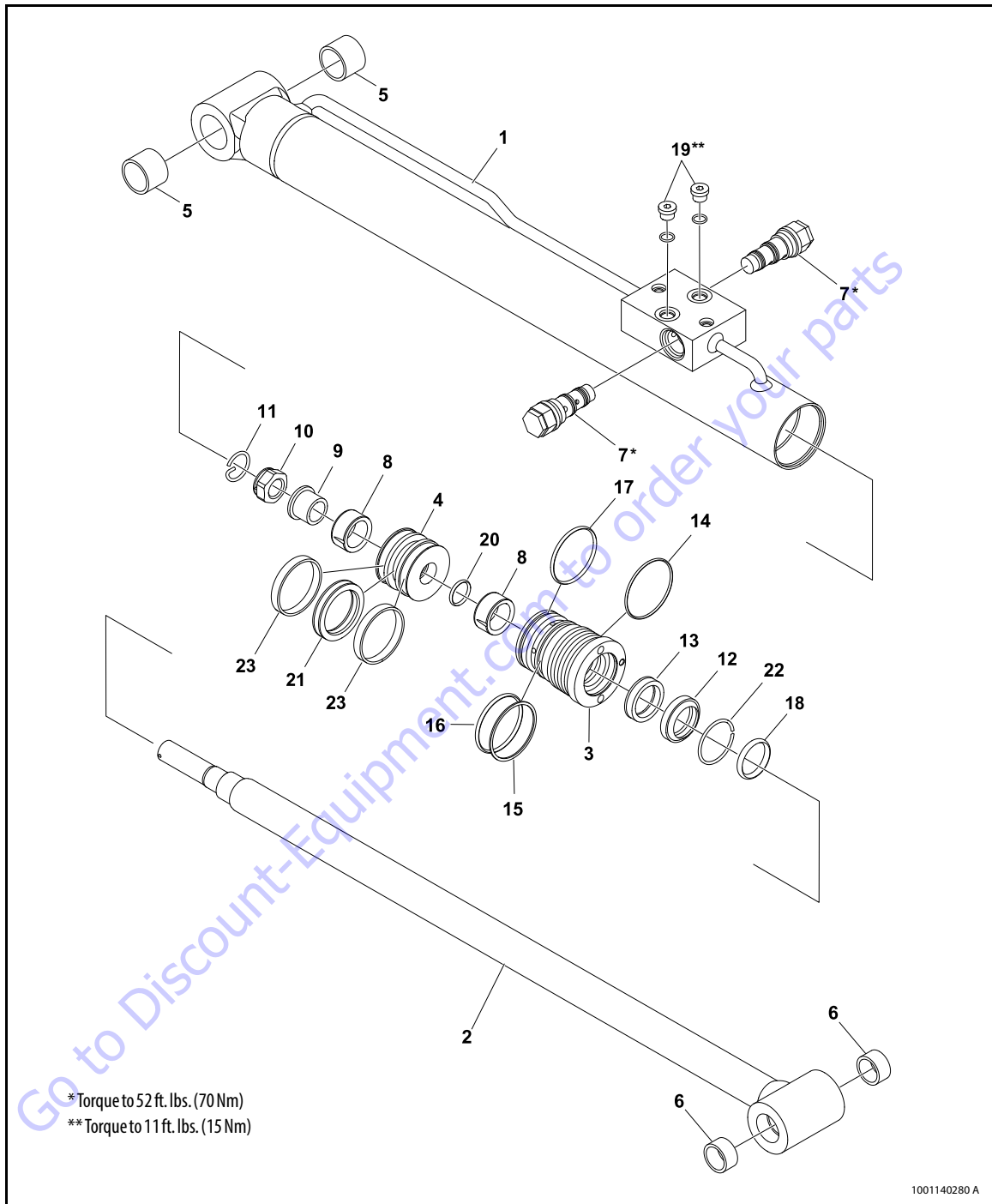
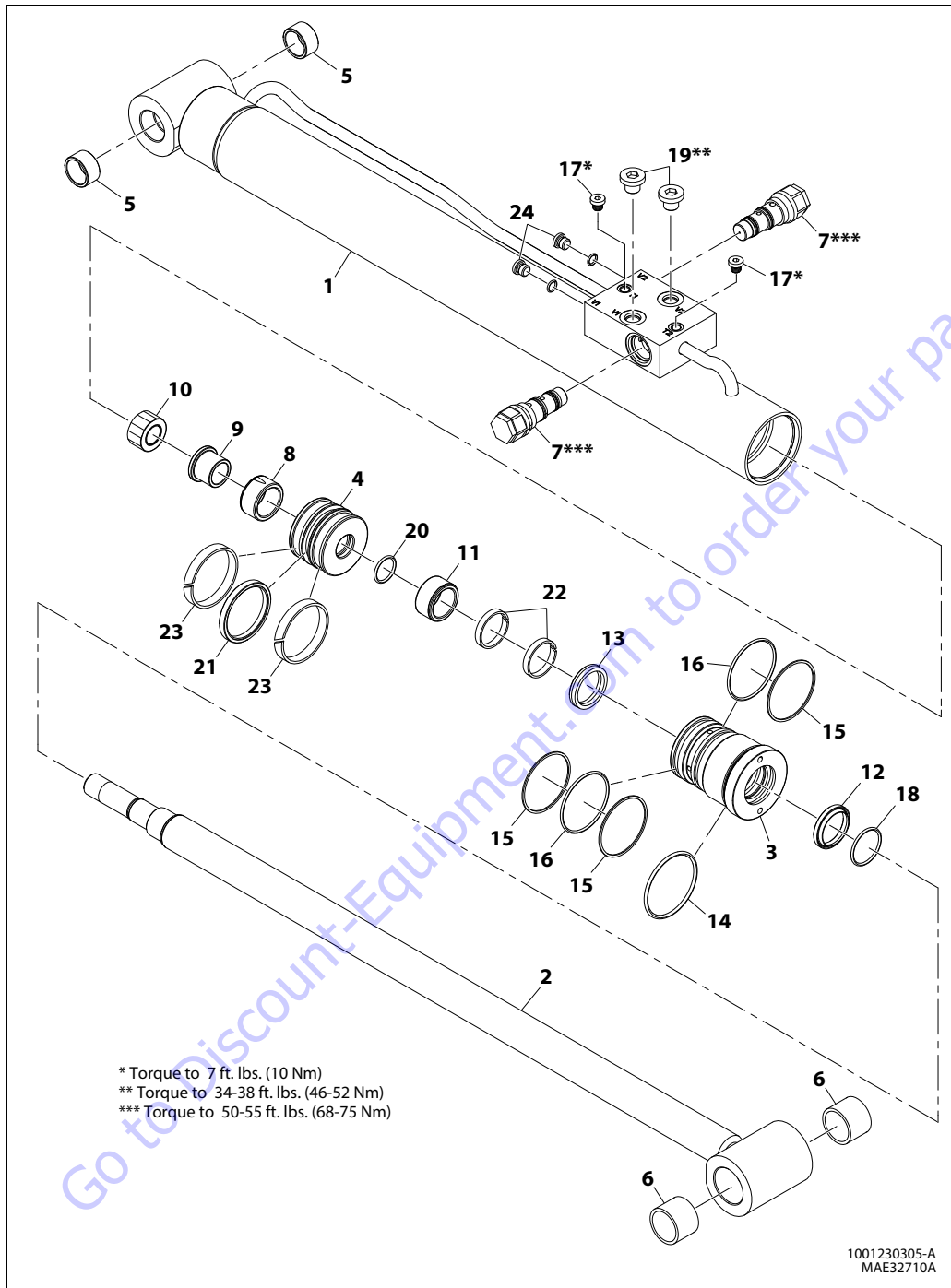


Figure 5-28. Cylinder Rod Support



- | | | | | |
|------------|-------------------------|-----------------|------------|--------------------|
| 1. Barrel | 6. Bushing | 11. Retainer | 16. O-ring | 21. Piston Seal |
| 2. Rod | 7. Counterbalance Valve | 12. Wiper Seal | 17. O-ring | 22. Retaining Ring |
| 3. Head | 8. Bushing | 13. Rod Seal | 18. O-ring | 23. Wear Ring |
| 4. Piston | 9. Sleeve | 14. O-ring | 19. Plug | |
| 5. Bushing | 10. Locknut | 15. Backup Ring | 20. O-ring | |

Figure 5-29. Jib Lift Cylinder (USA Built Machine)



- | | | | | | |
|-----------|-------------------------|----------------|-----------------|------------|-----------------|
| 1. Barrel | 5. Bushing | 9. Sleeve | 13. Rod Seal | 17. Plug | 21. Piston Seal |
| 2. Rod | 6. Bushing | 10. Locknut | 14. O-ring | 18. O-ring | 22. Wear Ring |
| 3. Head | 7. Counterbalance Valve | 11. Plug | 15. Backup Ring | 19. Plug | 23. Wear Ring |
| 4. Piston | 8. Bushing | 12. Wiper Seal | 16. O-ring | 20. O-ring | 24. Plug |

Figure 5-30. Jib Lift Cylinder (China Built Machine)

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Remove the retainer which attach the piston to the rod. Refer Figure 5-29.
10. Loosen and remove locknut which attaches the piston to the rod. Refer Figure 5-30.
11. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.
12. Remove and discard the piston o-rings, seals and wear rings.
13. Remove bushings from the rod.
14. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, retaining rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
 - a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
 - b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
 - c. Lubricate inside of steel bushing prior to bearing installation.
 - d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.

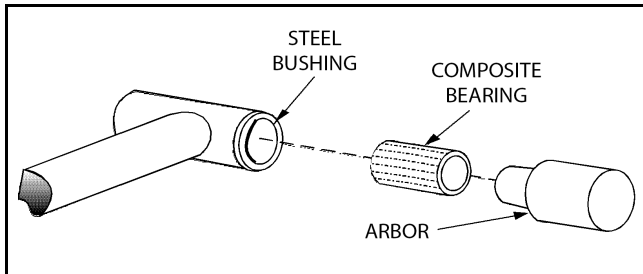


Figure 5-31. Composite Bearing Installation

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

ASSEMBLY

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

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

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

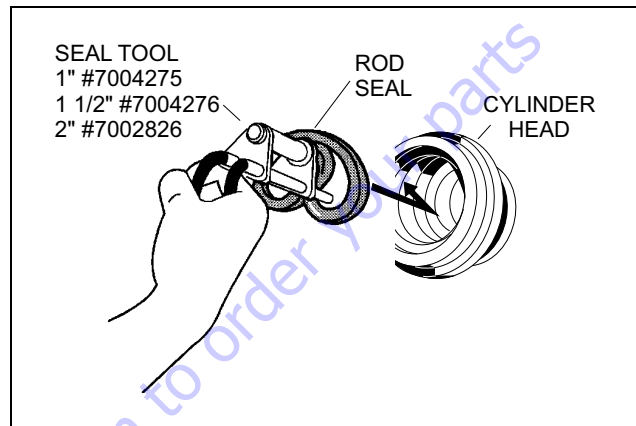


Figure 5-32. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

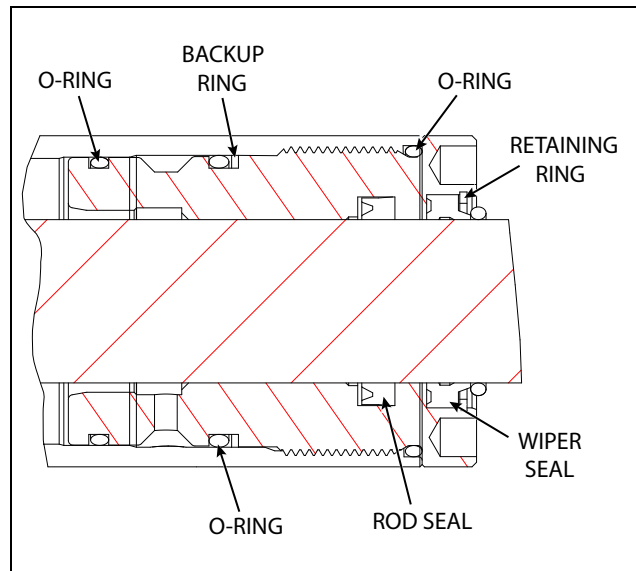


Figure 5-33. Cylinder Head Seal Installation

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

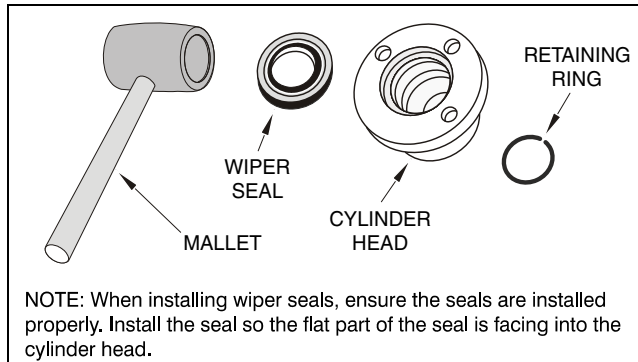


Figure 5-34. Wiper Seal Installation

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

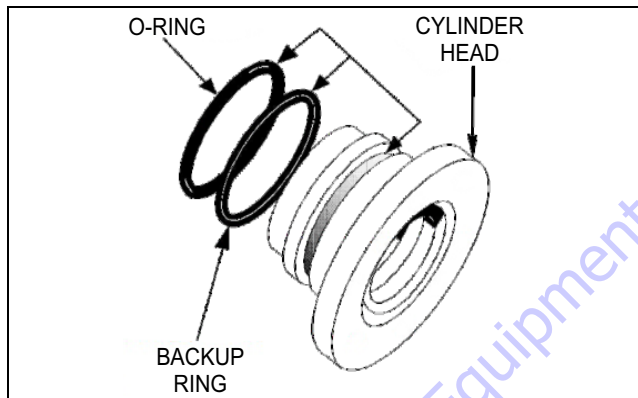


Figure 5-35. Installation of Head Seal Kit

4. Install o-ring onto the cylinder rod. Carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.
5. Push the spacer onto the rod.
6. Place a new o-ring and backup rings in the inner piston diameter groove.
7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
9. Thread piston onto rod until it abuts the spacer end and install the retainer. Refer Figure 5-29.
10. Thread piston onto rod until it abuts the spacer end and install the Locknut. Refer Figure 5-30.

11. Remove the cylinder rod from the holding fixture.
12. Place new piston seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

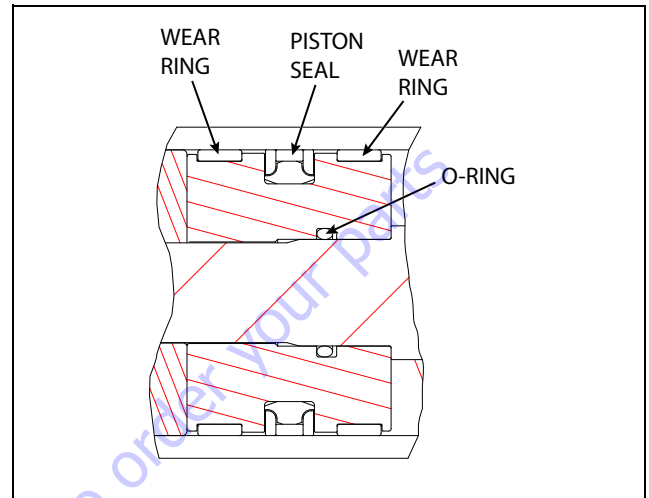


Figure 5-36. Piston Seal Kit Installation

13. Position the cylinder barrel in a suitable holding fixture.

NOTICE

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

14. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
15. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
16. Screw the cylinder head gland into the barrel using a spanner wrench.
17. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the re-installation of any holding valve or valves.
18. Install the counterbalance valves in the rod port block. Torque as shown in Figure 5-29. and Figure 5-30.

Lower Lift Cylinder

DISASSEMBLY

NOTICE

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

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

WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove cartridge holding valve from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

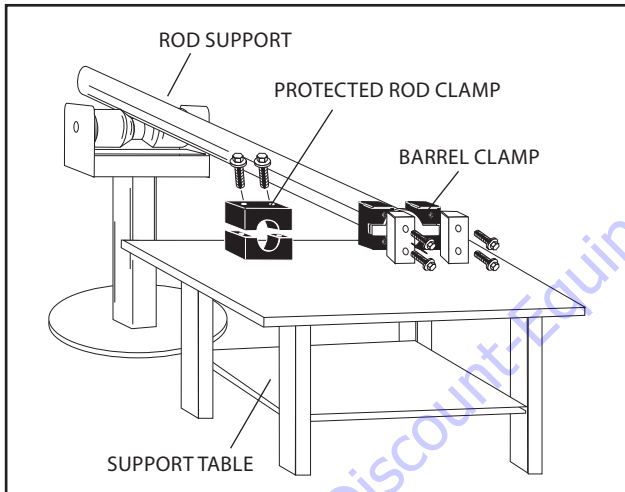


Figure 5-37. Cylinder Barrel Support

5. Remove cylinder head as mention below:
 - a. Using a pin-face spanner wrench, unscrew the cylinder head from the barrel. Refer Figure 5-42.

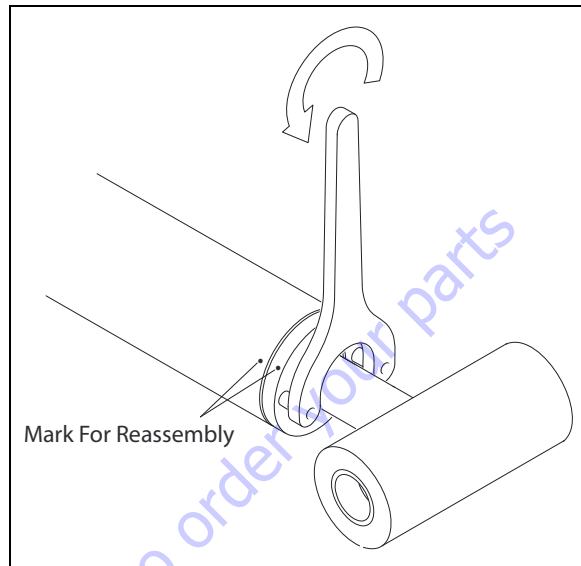


Figure 5-38. Cylinder Head Removal

- b. Unscrew cylinder head with hook spanner wrench. Refer Figure 5-41.

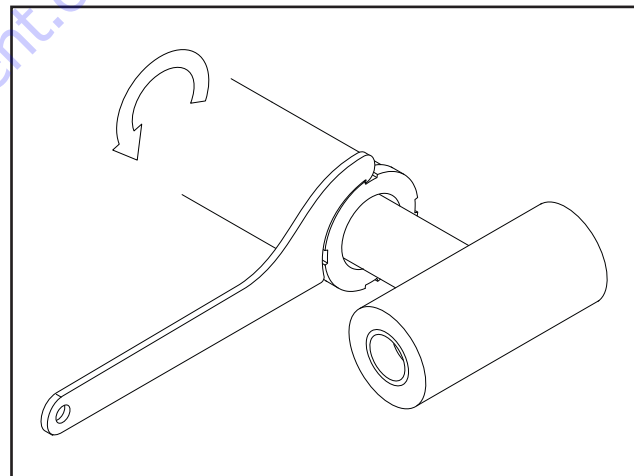


Figure 5-39. Cylinder Head Removal

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

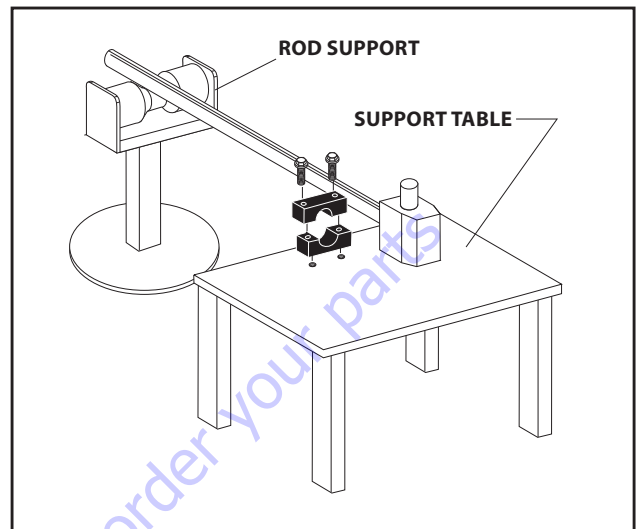
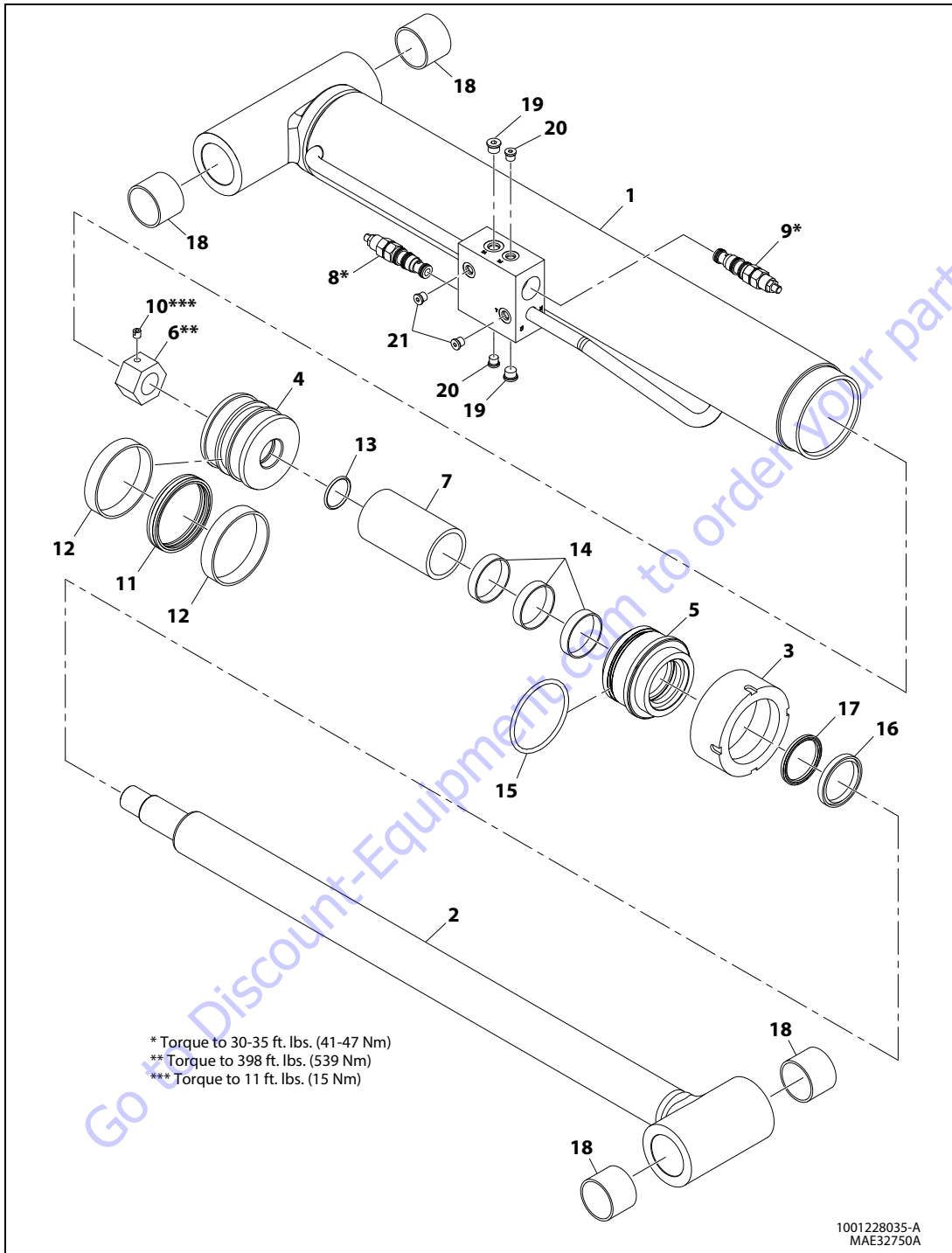
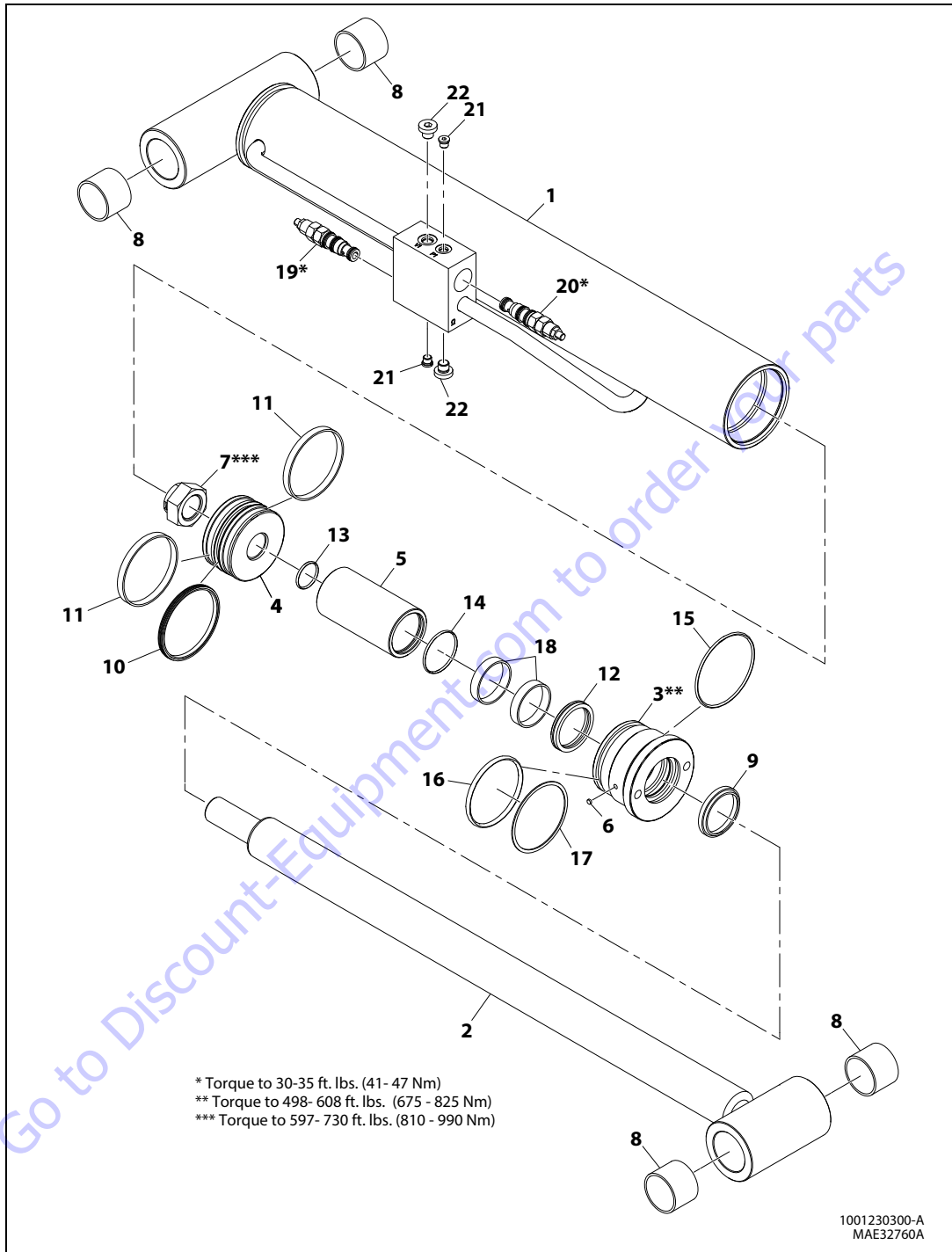


Figure 5-40. Cylinder Rod Support



- | | | | | |
|-----------|--------------------|-----------------|----------------|----------|
| 1. Barrel | 6. Locknut | 11. Piston Seal | 16. Rod Seal | 21. Plug |
| 2. Rod | 7. Spacer | 12. Wear Ring | 17. Wiper Seal | |
| 3. Head | 8. Cartridge Valve | 13. O-ring | 18. Bushing | |
| 4. Piston | 9. Cartridge Valve | 14. Wear Ring | 19. Plug | |
| 5. Head | 10. Setscrew | 15. O-ring | 20. Plug | |

Figure 5-41. Lower Lift Cylinder - USA Built Machine



- | | | | | |
|-----------|------------------|----------------|--------------------------|----------|
| 1. Barrel | 6. Locking Piece | 11. Wear Ring | 16. O-ring | 21. Plug |
| 2. Rod | 7. Locknut | 12. Wiper Seal | 17. Backup Ring | 22. Plug |
| 3. Head | 8. Bushing | 13. O-ring | 18. Wear Ring | |
| 4. Piston | 9. Rod Seal | 14. O-ring | 19. Counterbalance Valve | |
| 5. Spacer | 10. Piston Seal | 15. O-ring | 20. Counterbalance Valve | |

Figure 5-42. Lower Lift Cylinder - China Built Machine

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Piston removal for Figure 5-41. as mention below:
 - a. Unscrew the setscrew from the locknut.
 - b. Loosen and remove locknut which attach the piston to the rod.
 - c. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.
10. Piston removal for Figure 5-42. as mention below:
 - a. Loosen and remove locknut which attaches the piston to the rod.
 - b. Screw the piston counterclockwise and remove the piston from cylinder rod.
11. Remove and discard the piston o-rings, seals and wear rings.
12. Remove bushings from the rod.
13. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, wear rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
 - a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
 - b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
 - c. Lubricate inside of steel bushing prior to bearing installation.
 - d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.

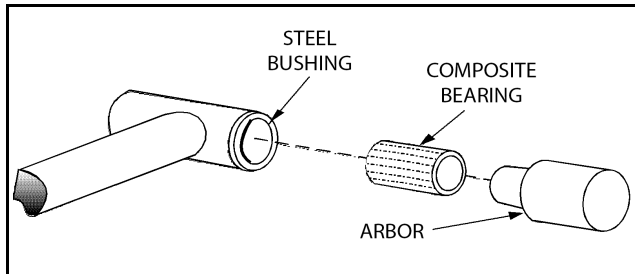


Figure 5-43. Composite Bearing Installation

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

ASSEMBLY

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

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

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

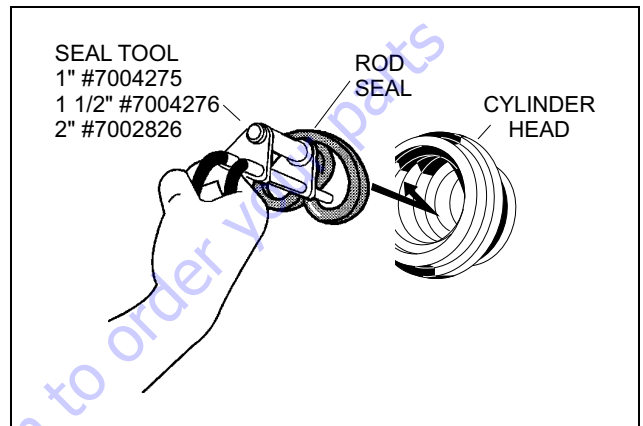


Figure 5-44. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

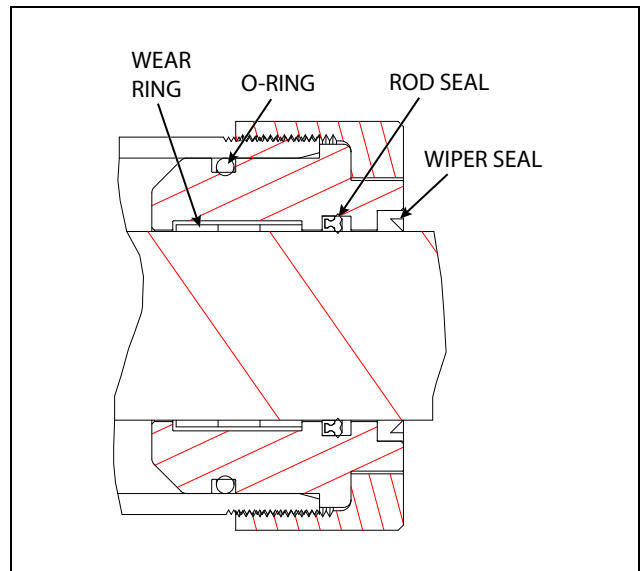


Figure 5-45. Cylinder Head Seal Installation

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

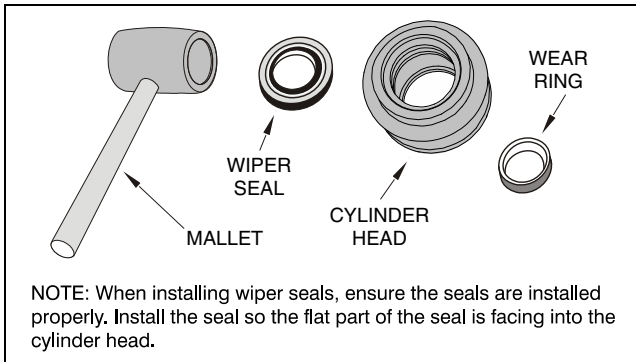


Figure 5-46. Wiper Seal Installation

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

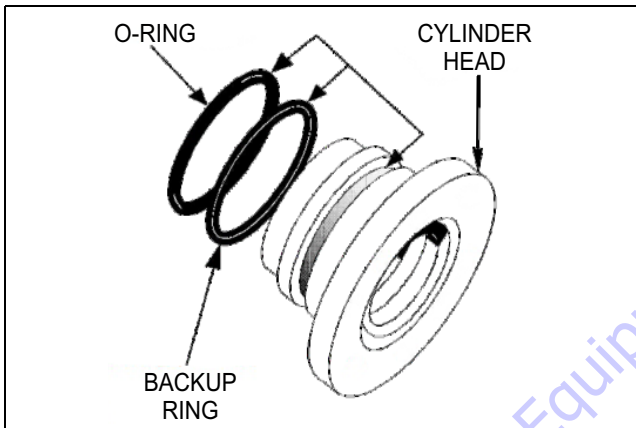


Figure 5-47. Installation of Head Seal Kit

4. Place the cylinder cap over the rod and carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.
5. Push the spacer onto the rod.
6. Place a new o-ring and backup rings in the inner piston diameter groove.
7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
9. Thread piston onto rod until it abuts the spacer end.

10. Secure piston as mentioned below:
 - a. Install the locknut and setscrew on the piston and attach the piston on the rod. Refer Figure 5-41.
 - b. Install locknut onto the piston and attach the piston on the rod. Refer Figure 5-42.
11. Remove the cylinder rod from the holding fixture.
12. Place new piston seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

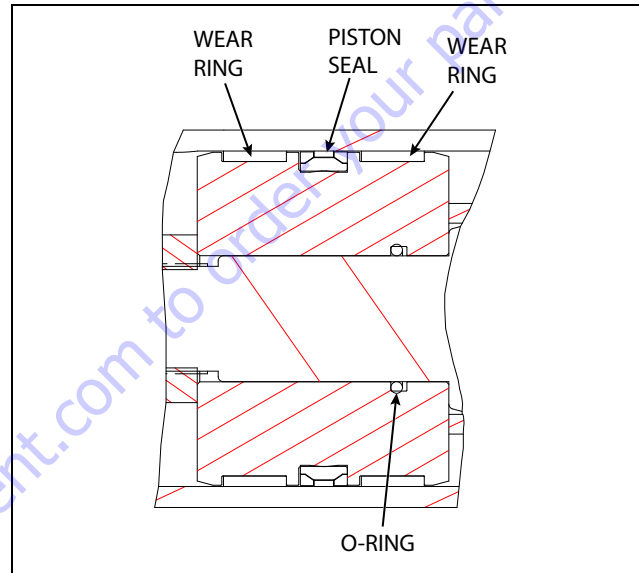


Figure 5-48. Piston Seal Kit Installation

13. Position the cylinder barrel in a suitable holding fixture.

NOTICE

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

14. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
15. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
16. Screw the cylinder head into barrel using hook spanner wrench and pin-face spanner wrench. as shown in Figure 5-41. and Figure 5-42.
17. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the re-installation of any holding valve or valves.
18. Install the cartridge holding valves in the rod port block. Torque to 30-35 ft. lbs. (40-47 Nm).

Mid Lift Cylinder

DISASSEMBLY

NOTICE

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

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

WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove cartridge holding valve from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

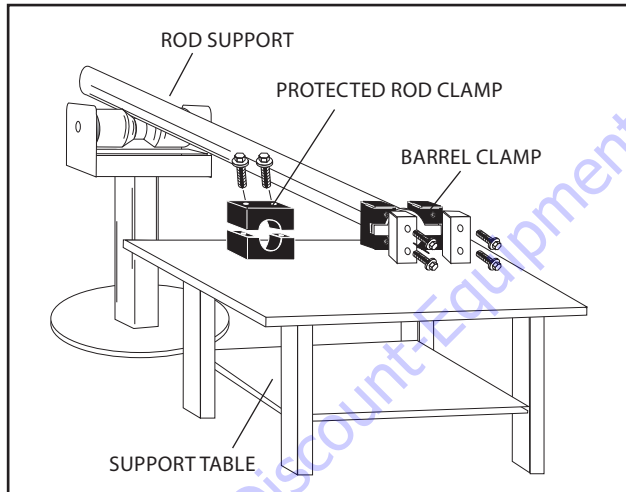


Figure 5-49. Cylinder Barrel Support

5. Remove cylinder head as mention below:
 - a. Unscrew cylinder head with hook spanner wrench. Refer Figure 5-53.

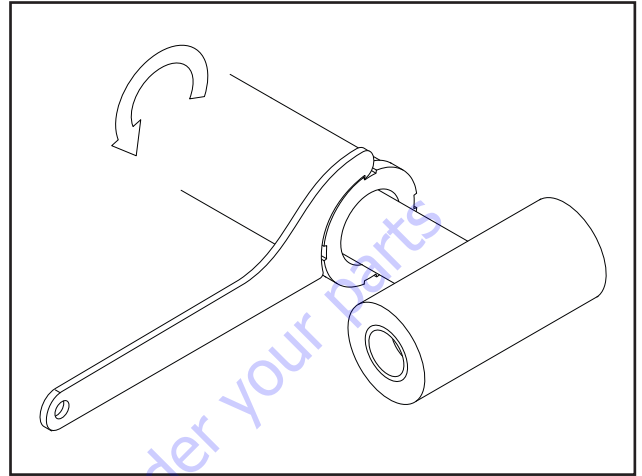


Figure 5-50. Cylinder Head Removal

- b. Using a pin-face spanner wrench, unscrew the cylinder head from the barrel. Refer Figure 5-54.

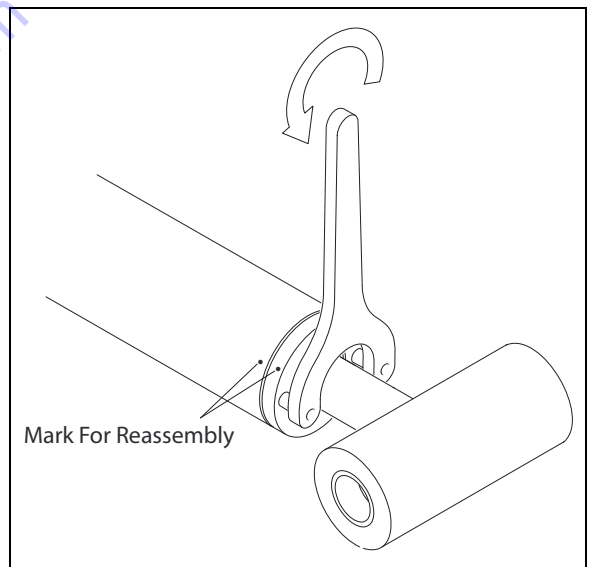


Figure 5-51. Cylinder Head Removal

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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

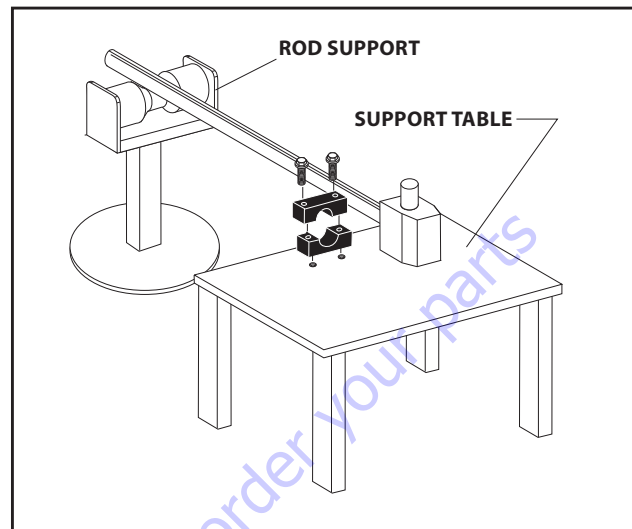
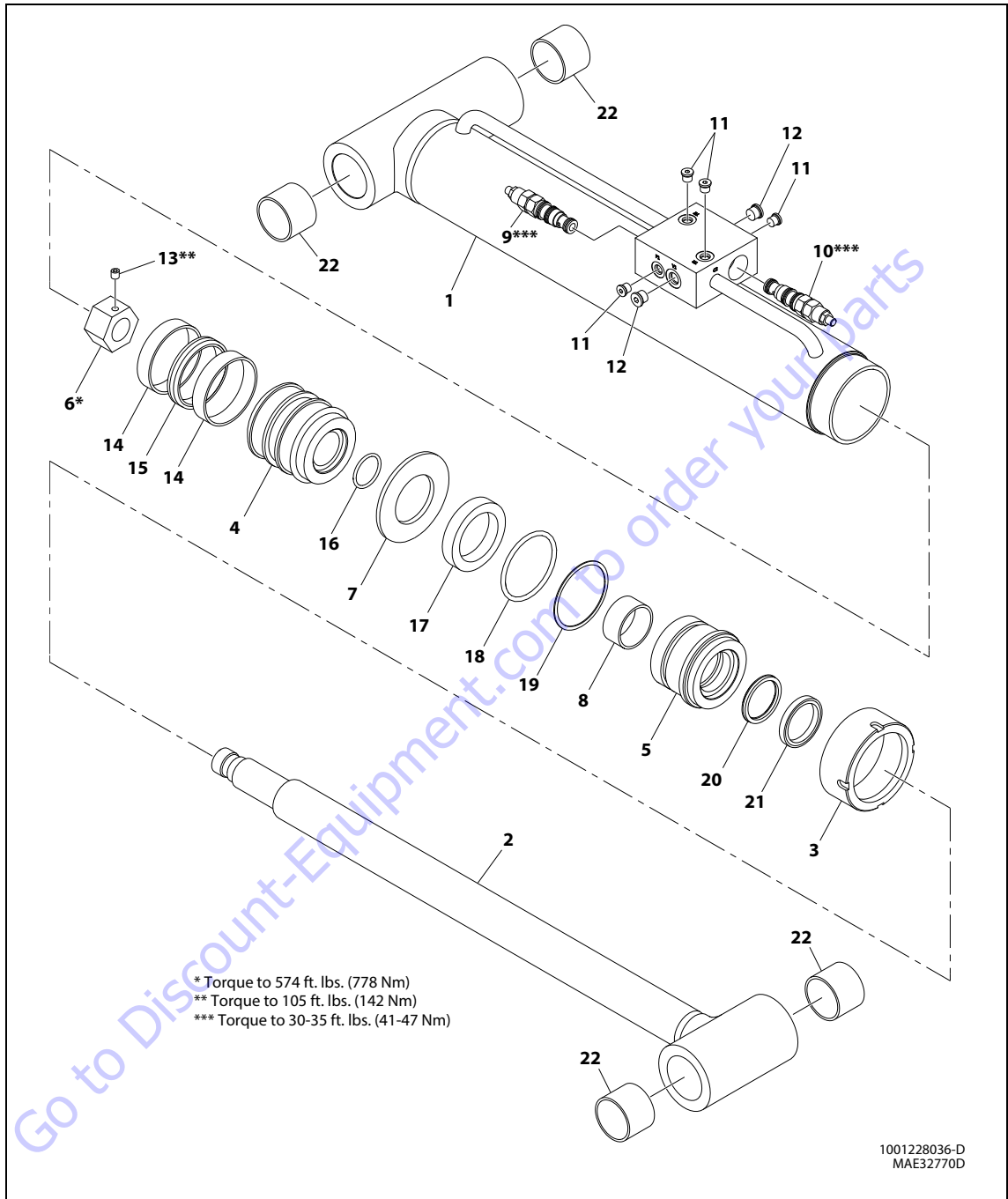
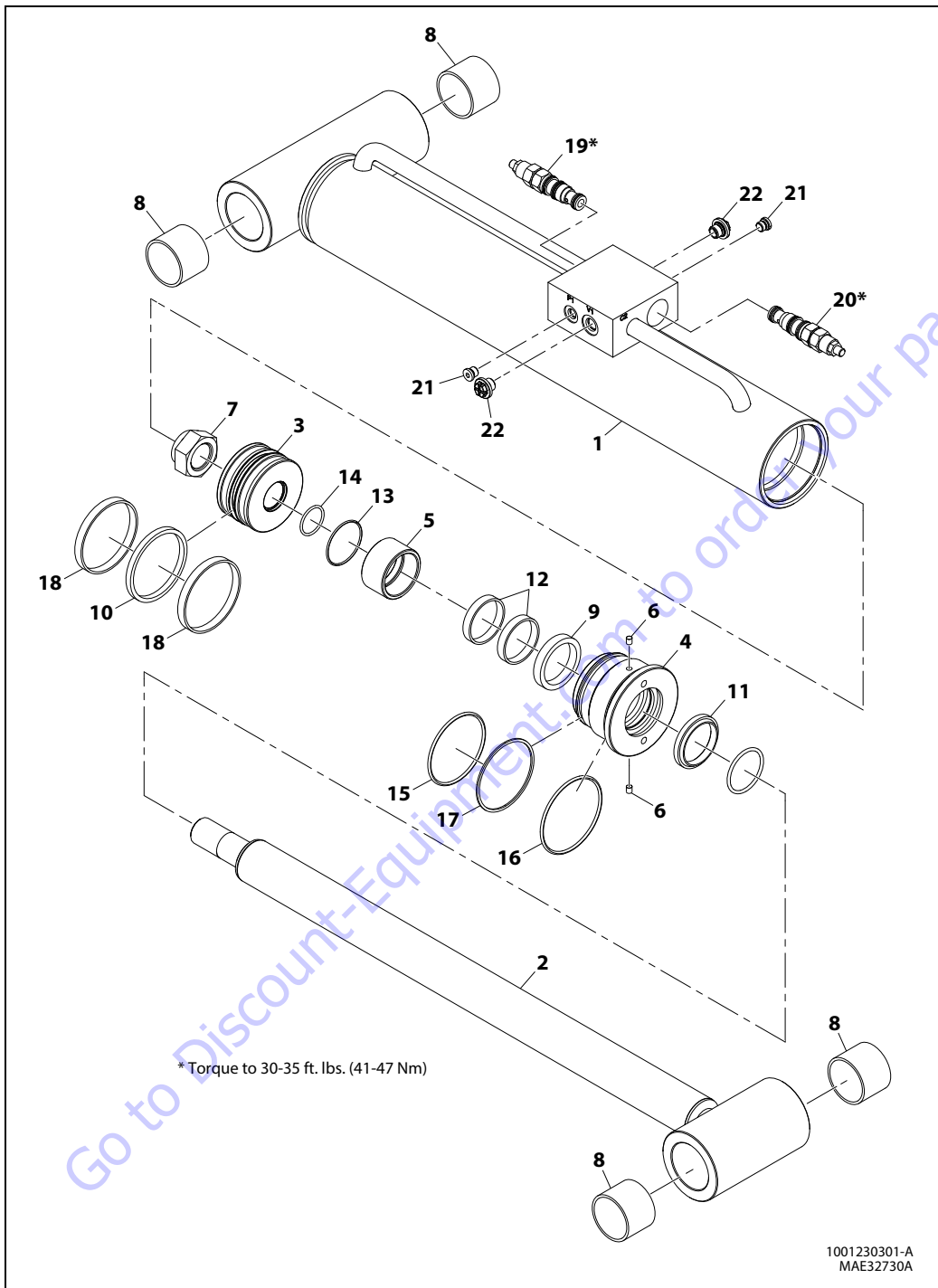


Figure 5-52. Cylinder Rod Support



- | | | | | | |
|-------------|------------|---------------------|-----------------|-----------------|----------------|
| 1. Barrel | 5. Head | 9. Cartridge Valve | 13. Setscrew | 17. Wear Ring | 21. Wiper Seal |
| 2. Rod | 6. Locknut | 10. Cartridge Valve | 14. Wear Ring | 18. O-ring | 22. Bushing |
| 3. Retainer | 7. Washer | 11. Plug | 15. Piston Seal | 19. Backup Ring | |
| 4. Piston | 8. Spacer | 12. Plug | 16. O-ring | 20. Rod Seal | |

Figure 5-53. Mid Lift Cylinder - USA Built Machine



- | | | | | | |
|-----------|------------------|-----------------|------------|--------------------------|----------|
| 1. Barrel | 5. Spacer | 9. Rod Seal | 13. O-ring | 17. Backup Ring | 21. Plug |
| 2. Rod | 6. Locking Piece | 10. Piston Seal | 14. O-ring | 18. Wear Ring | 22. Plug |
| 3. Piston | 7. Locknut | 11. Wiper Seal | 15. O-ring | 19. Counterbalance Valve | |
| 4. Head | 8. Bushing | 12. Wear Ring | 16. O-ring | 20. Counterbalance Valve | |

Figure 5-54. Mid Lift Cylinder - China Built Machine

1. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
2. Piston removal for Figure 5-53. as mention below:
 - a. Unscrew the setscrew from the locknut.
 - b. Loosen and remove locknut which attach the piston to the rod.
 - c. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.
3. Piston removal for Figure 5-54. as mention below:
 - a. Loosen and removal locknut which attaches the piston to the rod.
 - b. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.
4. Remove and discard the piston o-rings, seals and wear rings.
5. Remove the spacer and washer from the rod.
6. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, retaining rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
 - a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
 - b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
 - c. Lubricate inside of steel bushing prior to bearing installation.
 - d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.

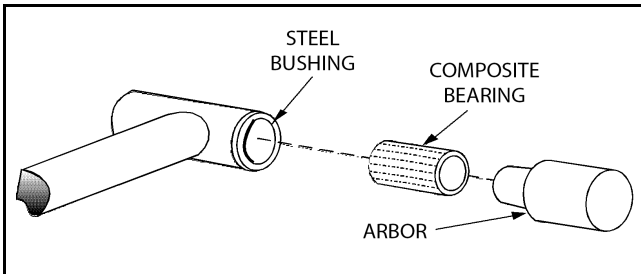


Figure 5-55. Composite Bearing Installation

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

ASSEMBLY

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

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

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

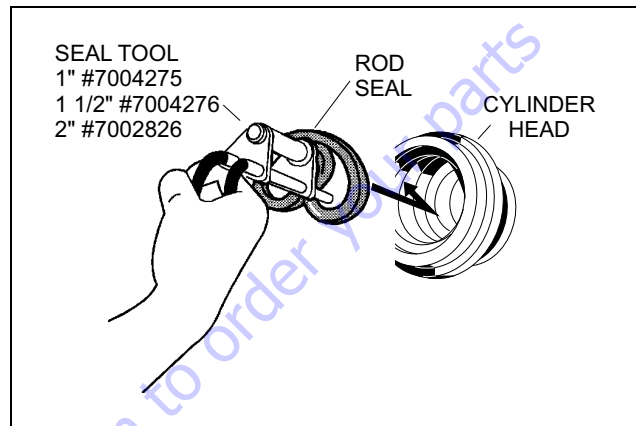


Figure 5-56. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

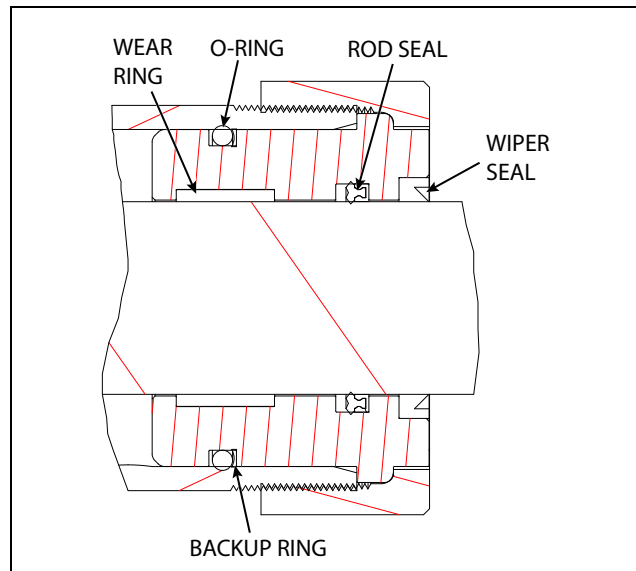


Figure 5-57. Cylinder Head Seal Installation

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

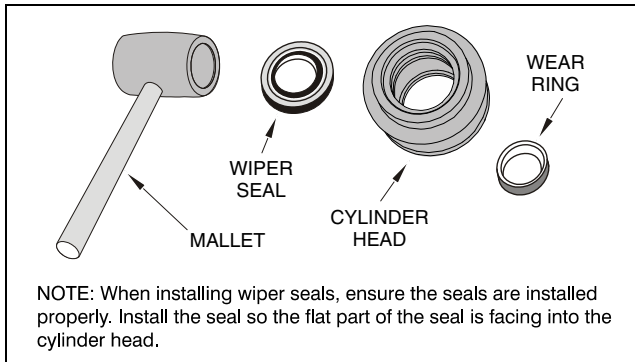


Figure 5-58. Wiper Seal Installation

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

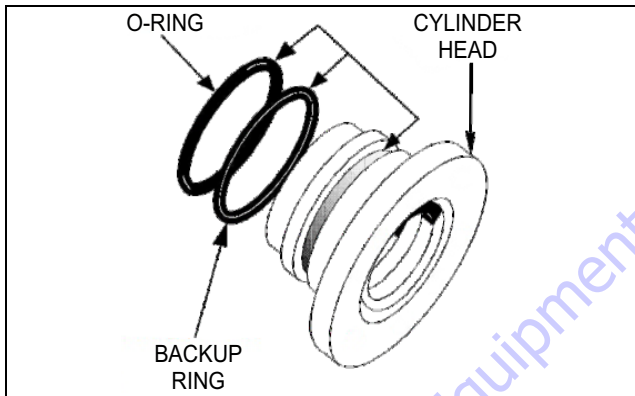


Figure 5-59. Installation of Head Seal Kit

4. Place the cylinder cap over the rod and carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.
5. Push the spacer and washer onto the rod.
6. Place a new o-ring and backup rings in the inner piston diameter groove.
7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
9. Thread piston onto rod until it abuts the spacer end.
10. Secure piston as mentioned below:
 - a. Install the locknut and setscrew on the piston and attach the piston on the rod. Refer Figure 5-53.
 - b. Install locknut onto the piston and attach the piston on the rod. Refer Figure 5-54.

11. Remove the cylinder rod from the holding fixture.
12. Place new piston seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

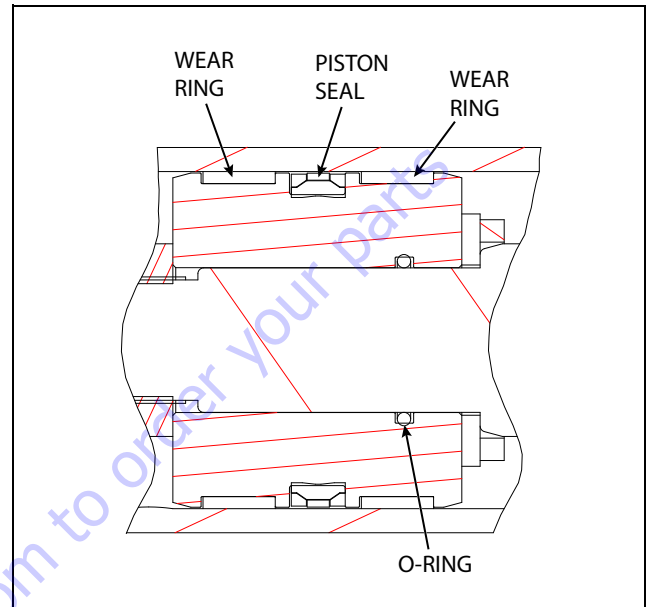


Figure 5-60. Piston Seal Kit Installation

13. Position the cylinder barrel in a suitable holding fixture.

NOTICE

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

14. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
15. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
16. Screw the cylinder head into barrel using hook spanner wrench and pin-face spanner wrench. Refer Figure 5-53. and Figure 5-54.
17. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the re-installation of any holding valve or valves.
18. Install the cartridge holding valves in the rod port block. Torque to 30-35 ft. lbs. (40-47 Nm).

Upper Lift Cylinder

DISASSEMBLY

NOTICE

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

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

WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove cartridge holding valve from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

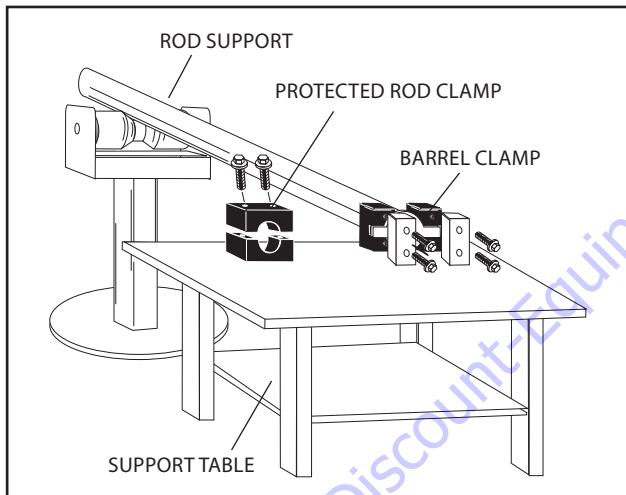


Figure 5-61. Cylinder Barrel Support

5. Remove cylinder head as mention below:
 - a. Using a pin-face spanner wrench, unscrew the cylinder head from the barrel. Refer Figure 5-66.

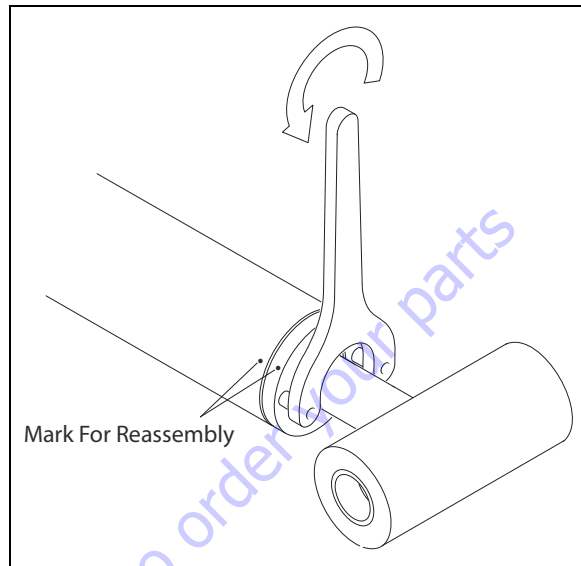


Figure 5-62. Cylinder Head Removal

- b. Unscrew cylinder head with hook spanner wrench. Refer Figure 5-65.

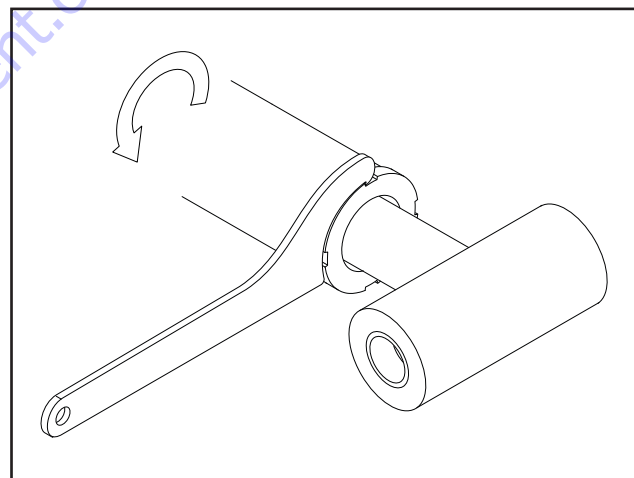


Figure 5-63. Cylinder Head Removal

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

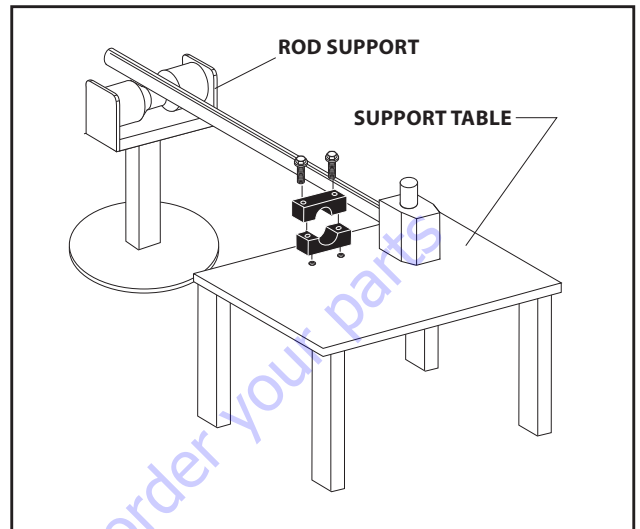
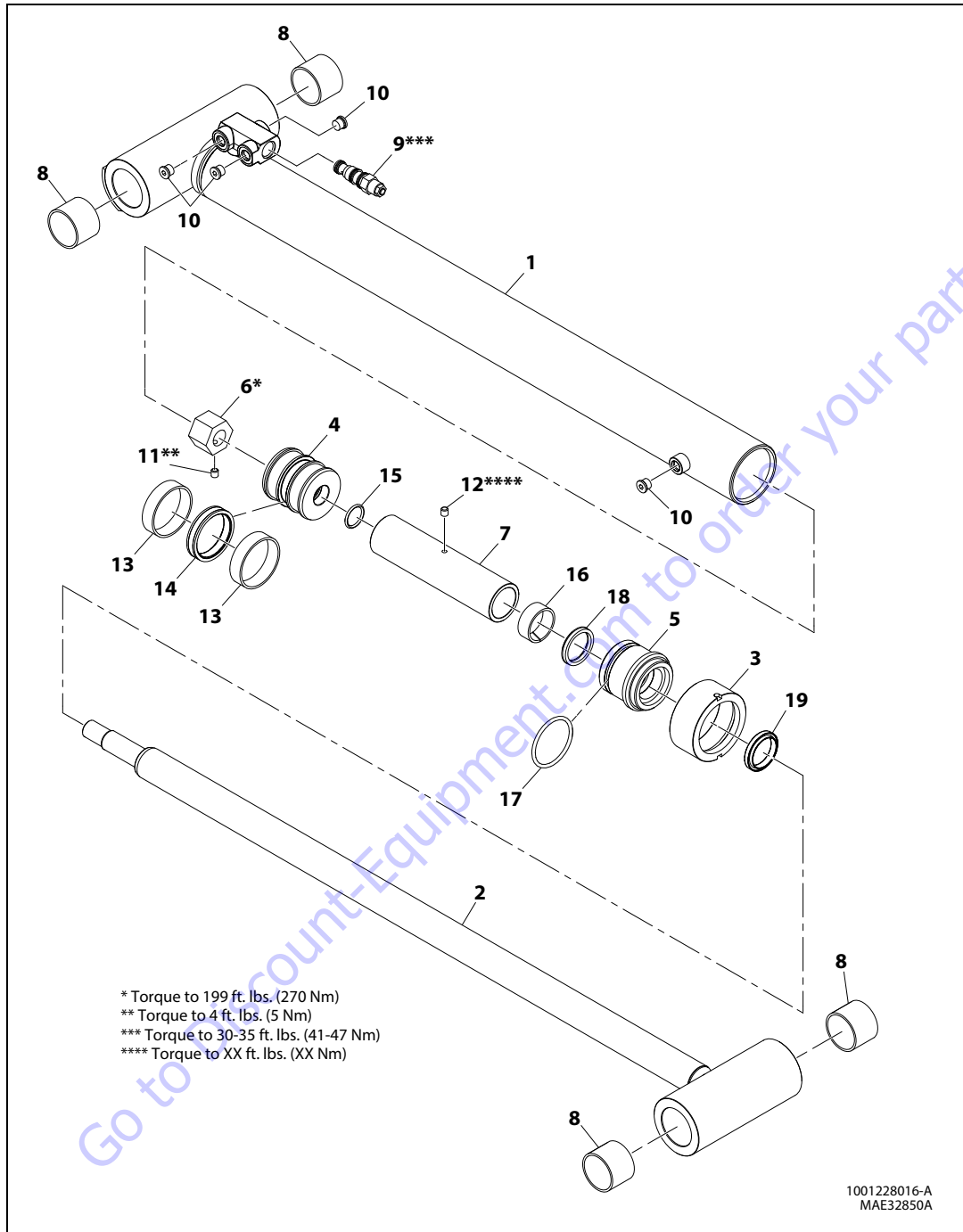
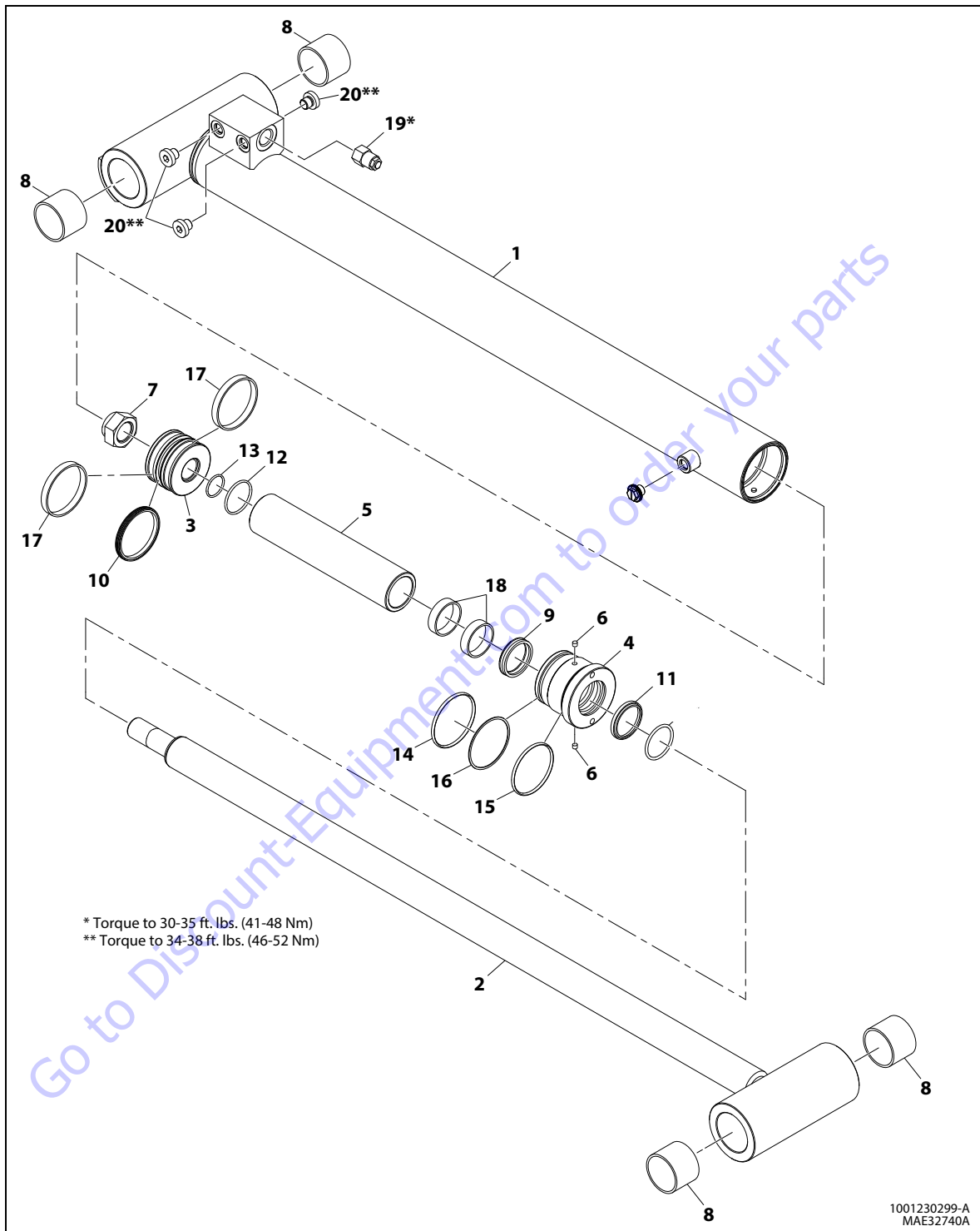


Figure 5-64. Cylinder Rod Support



- | | | | | |
|-------------|------------|--------------------|-----------------|----------------|
| 1. Barrel | 5. Head | 9. Cartridge Valve | 13. Wear Ring | 17. O-ring |
| 2. Rod | 6. Locknut | 10. Plug | 14. Piston Seal | 18. Rod Seal |
| 3. Retainer | 7. Spacer | 11. Setscrew | 15. O-ring | 19. Wiper Seal |
| 4. Piston | 8. Bushing | 12. Setscrew | 16. Wear Ring | |

Figure 5-65. Upper Lift Cylinder - USA Built Machine



- | | | | | |
|-----------|------------------|-----------------|-----------------|--------------------------|
| 1. Barrel | 5. Spacer | 9. Rod Seal | 13. O-ring | 17. Wear Ring |
| 2. Rod | 6. Locking Piece | 10. Piston Seal | 14. O-ring | 18. Wear Ring |
| 3. Piston | 7. Locknut | 11. Wiper Seal | 15. O-ring | 19. Counterbalance Valve |
| 4. Head | 8. Bushing | 12. O-ring | 16. Backup Ring | 20. Plug |

Figure 5-66. Upper Lift Cylinder - China Built Machine

1. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
2. Unscrew the setscrew from the locknut, if applicable.
3. Loosen and remove locknut which attach the piston to the rod.
4. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.
5. Remove and discard the piston o-rings, seals and wear rings.
6. Loosen and remove capscrew which attaches spacer to the rod. Remove Spacer from the rod.
7. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, retaining rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
 - a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
 - b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
 - c. Lubricate inside of steel bushing prior to bearing installation.
 - d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.

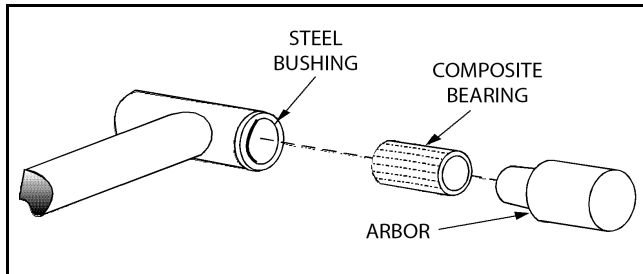


Figure 5-67. Composite Bearing Installation

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

ASSEMBLY

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

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

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

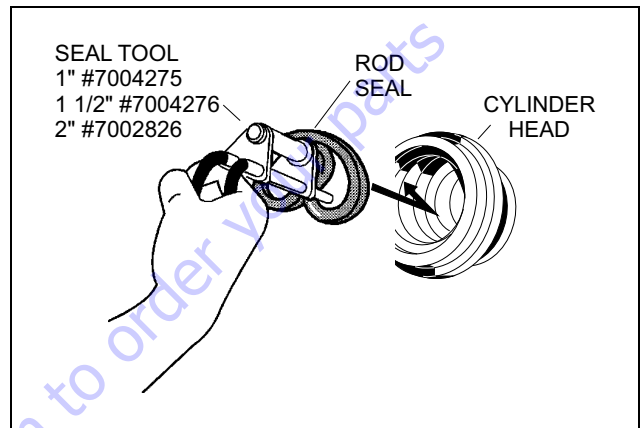


Figure 5-68. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

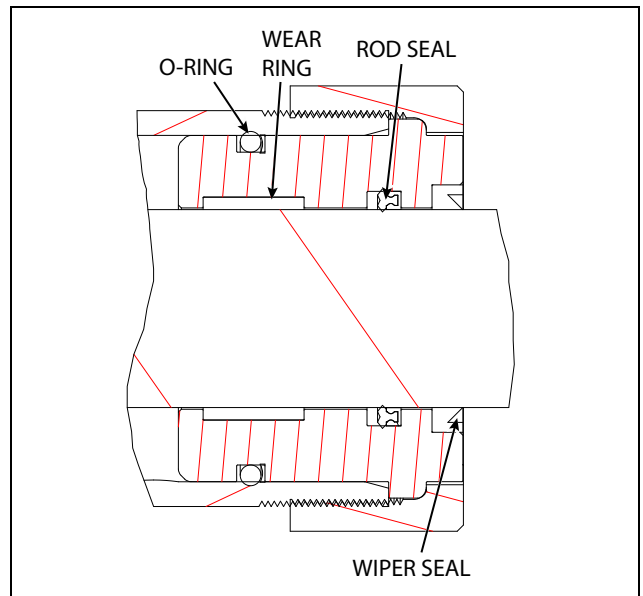


Figure 5-69. Cylinder Head Seal Installation

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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

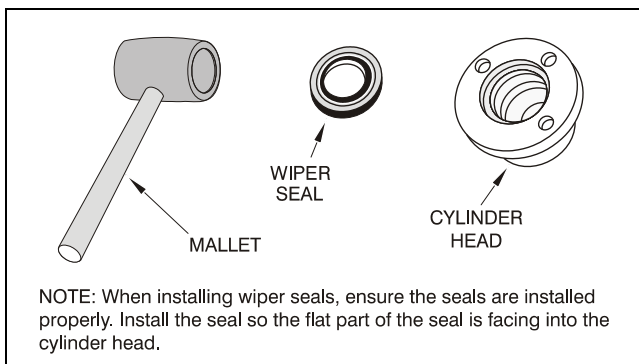


Figure 5-70. Wiper Seal Installation

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

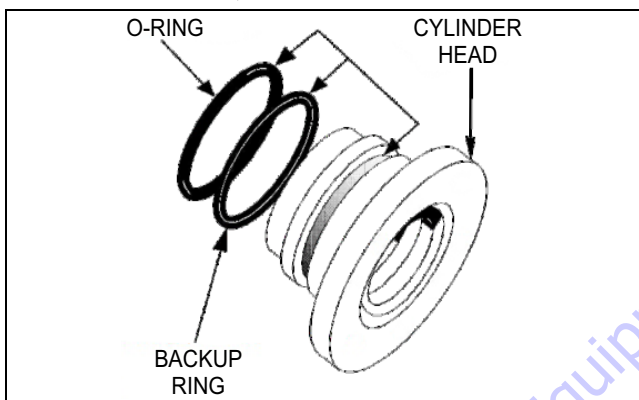


Figure 5-71. Installation of Head Seal Kit

- Place the cylinder cap over the rod and carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.
- Push the spacer onto the rod and use capscrew to attach spacer to the rod.
- Place a new o-ring and backup rings in the inner piston diameter groove.
- Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
- Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
- Thread piston onto rod until it abuts the spacer end.
- Install the locknut and setscrew on the piston and attach the piston on the rod, if applicable.
- Install locknut on the piston and attach piston on the rod.

- Remove the cylinder rod from the holding fixture.
- Place new piston seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

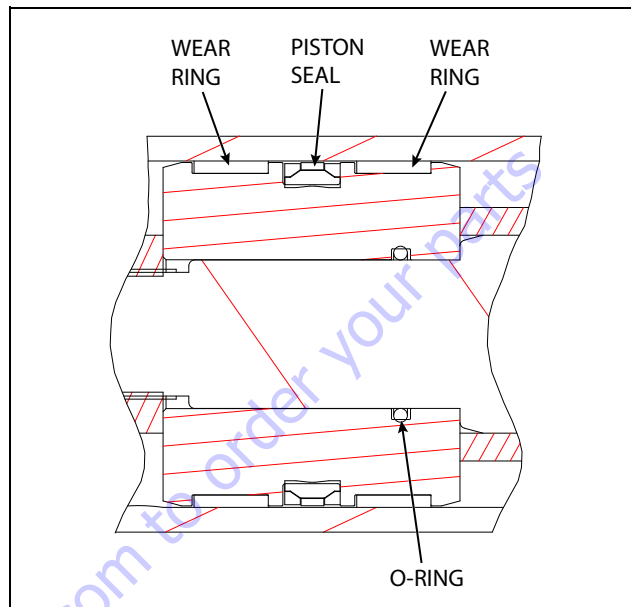


Figure 5-72. Piston Seal Kit Installation

- Position the cylinder barrel in a suitable holding fixture.

NOTICE

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

- With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
- Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
- Screw the cylinder head into barrel using hook spanner wrench and pin-face spanner wrench. Refer Figure 5-65. and Figure 5-66.
- After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the re-installation of any holding valve or valves.
- Install the cartridge holding valves in the rod port block. Torque to 30-35 ft. lbs. (40-47 Nm).

Master Cylinder

DISASSEMBLY

NOTICE

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

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

WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Place the cylinder barrel into a suitable holding fixture.

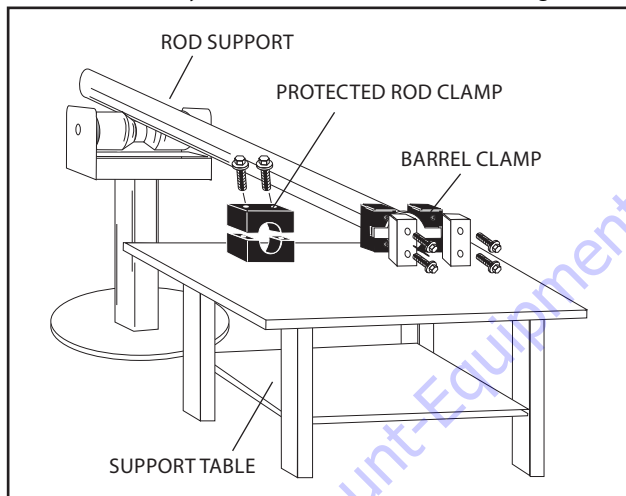


Figure 5-73. Cylinder Barrel Support

4. Using a pin-face spanner wrench, unscrew the cylinder head from the barrel.

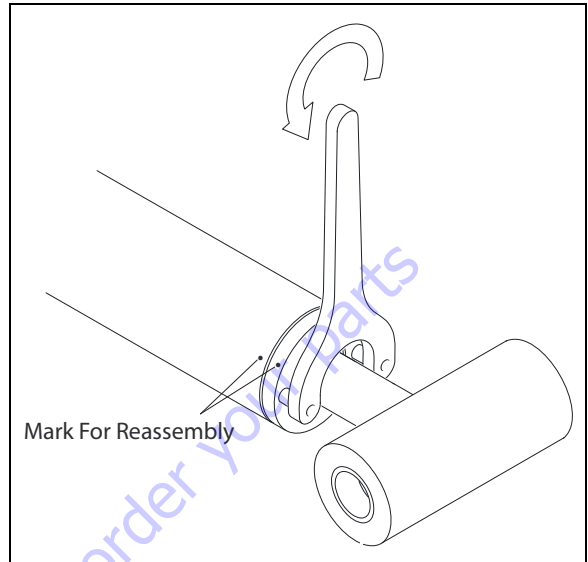


Figure 5-74. Cylinder Head Removal

5. 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.

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

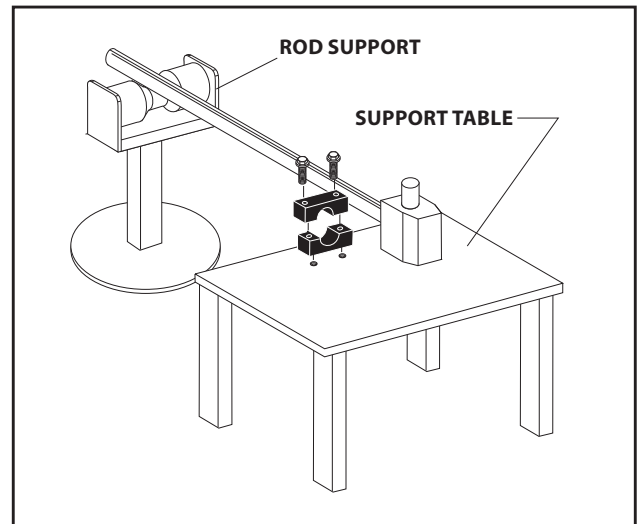
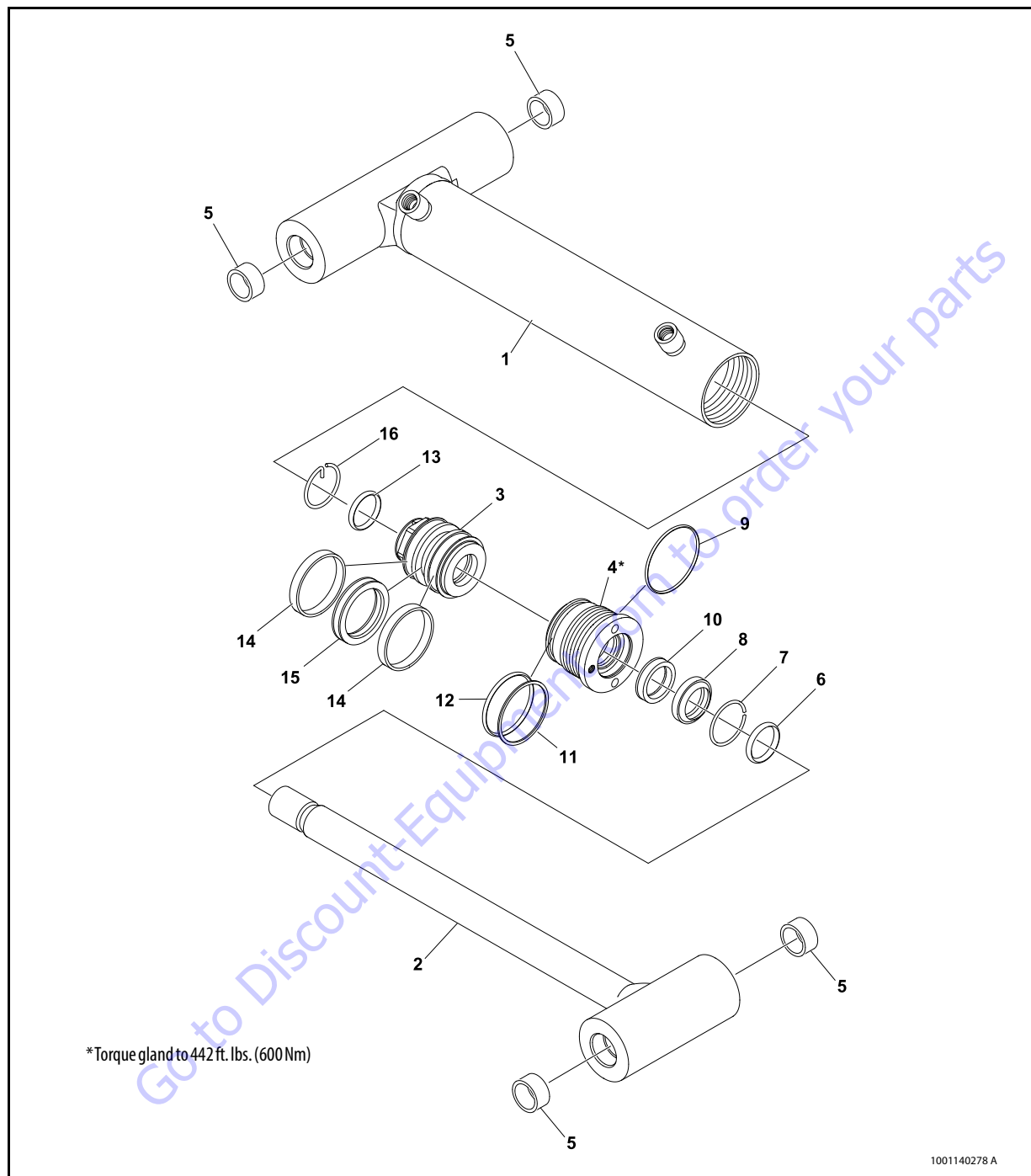
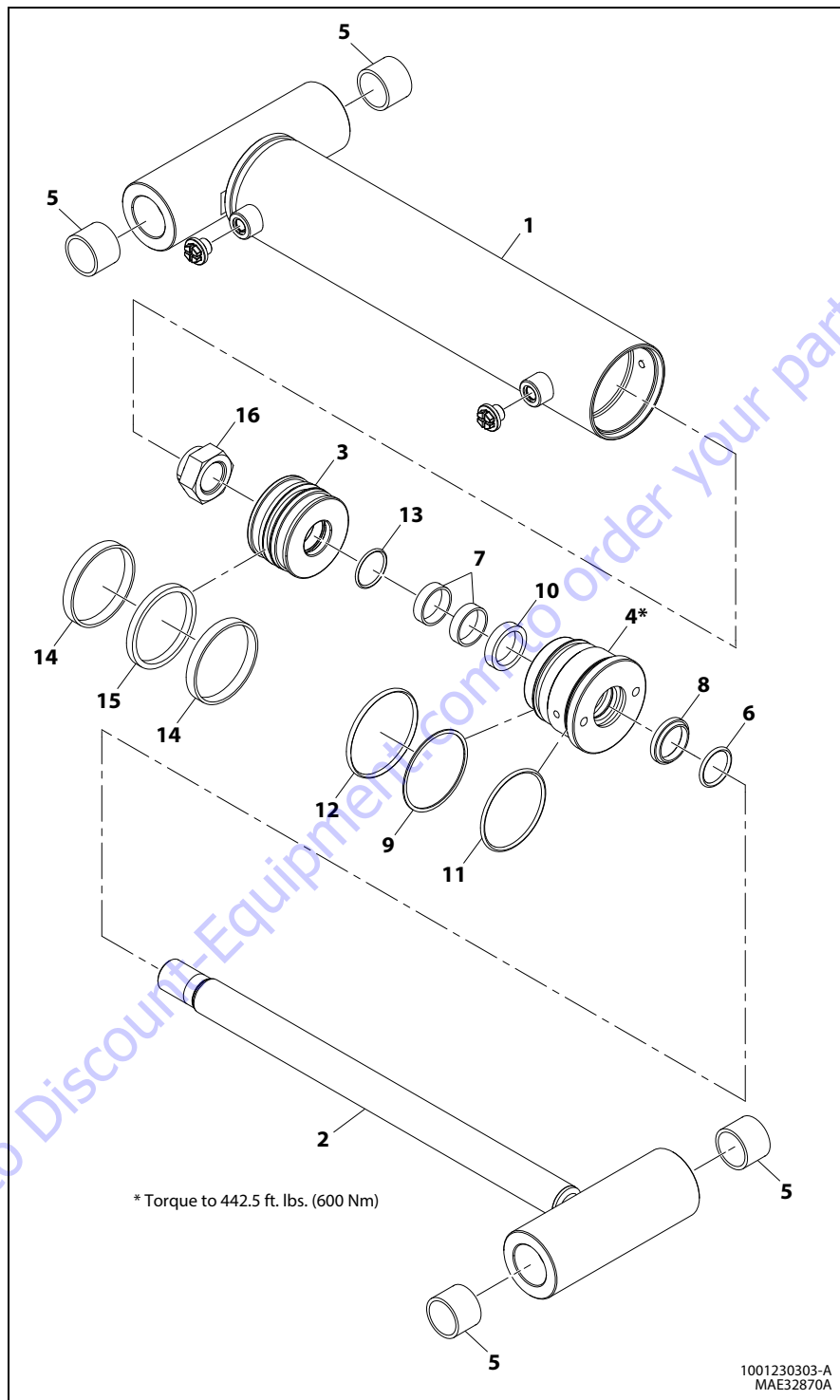


Figure 5-75. Cylinder Rod Support



- | | | | |
|-----------|-------------------|-----------------|-----------------|
| 1. Barrel | 5. Bushing | 9. O-ring | 13. O-ring |
| 2. Rod | 6. O-ring | 10. Rod Seal | 14. Wear Ring |
| 3. Head | 7. Retaining Ring | 11. Backup Ring | 15. Piston Seal |
| 4. Piston | 8. Wiper Seal | 12. O-ring | 16. Retainer |

Figure 5-76. Master Cylinder - USA Built Machine



- | | | | |
|-----------|---------------|-----------------|-----------------|
| 1. Barrel | 5. Bushing | 9. O-ring | 13. O-ring |
| 2. Rod | 6. O-ring | 10. Rod Seal | 14. Wear Ring |
| 3. Piston | 7. Wear Ring | 11. Backup Ring | 15. Piston Seal |
| 4. Head | 8. Wiper Seal | 12. O-ring | 16. Locknut |

Figure 5-77. Master Cylinder - China Built Machine

7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
8. Piston removal for Figure 5-76. as mention below:
 - a. Remove the retainer from the cylinder rod.
 - b. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.
9. Piston removal for Figure 5-77. as mention below:
 - a. Loosen and remove locknut which attaches the piston to the rod.
 - b. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.
10. Remove and discard the piston o-rings, seals and wear rings.
11. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, retaining rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
 - a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
 - b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
 - c. Lubricate inside of steel bushing prior to bearing installation.
 - d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.

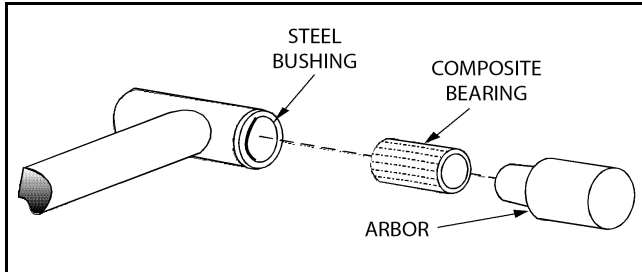


Figure 5-78. Composite Bearing Installation

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

ASSEMBLY

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

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

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

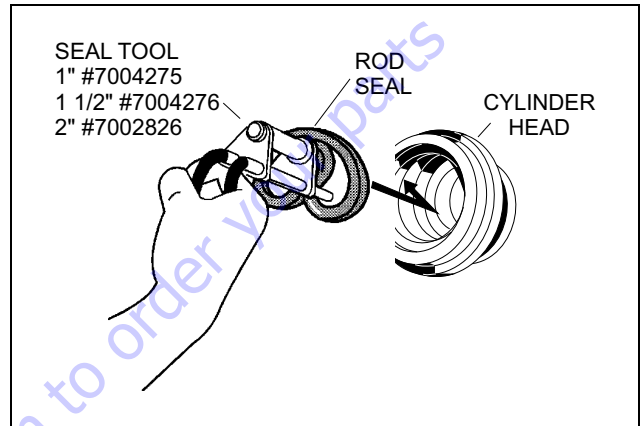


Figure 5-79. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

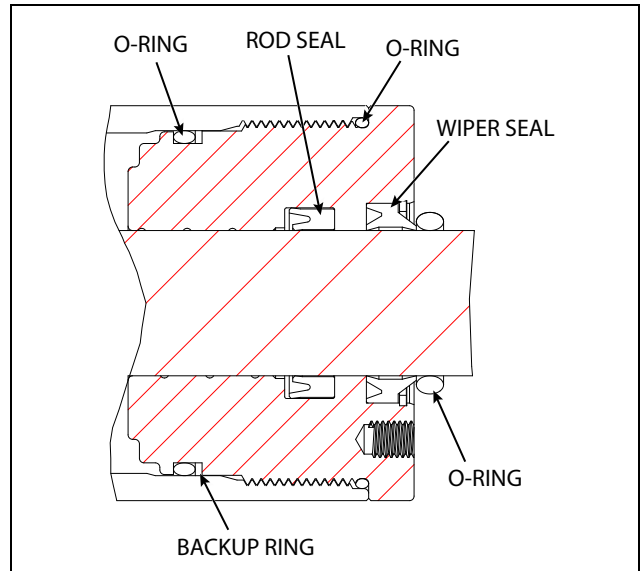


Figure 5-80. Cylinder Head Seal Installation

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

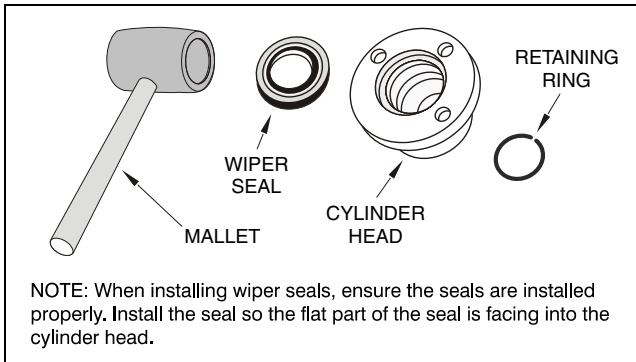


Figure 5-81. Wiper Seal Installation

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

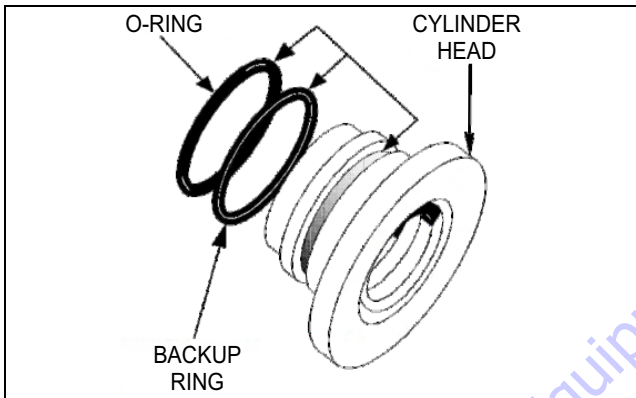


Figure 5-82. Installation of Head Seal Kit

4. Install o-ring onto the cylinder rod. Carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.
5. Place a new o-ring in the inner piston diameter groove.
6. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
7. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
8. Thread piston onto rod until it abuts the spacer end and install the retainer.
9. Remove the cylinder rod from the holding fixture.

10. Place new piston seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

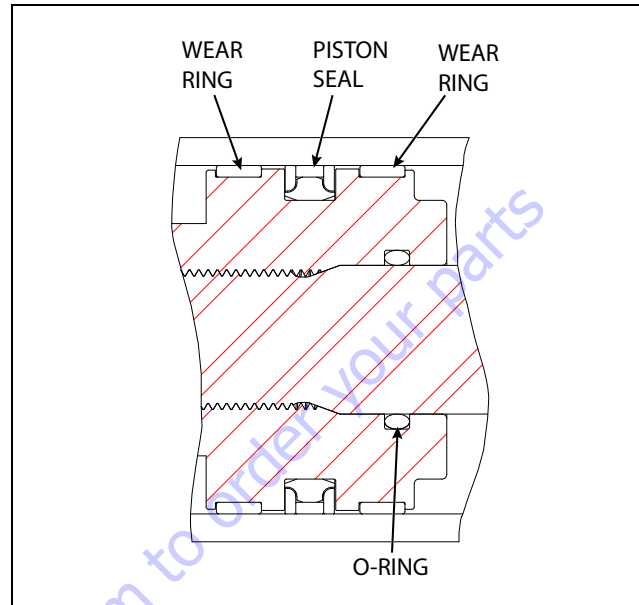


Figure 5-83. Piston Seal Kit Installation

11. Position the cylinder barrel in a suitable holding fixture.

NOTICE

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

12. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
13. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
14. Screw the cylinder head gland into the barrel using a pin-face spanner wrench. Torque gland to 442 ft. lbs. (600 Nm).
15. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the re-installation of any holding valve or valves.

Steer Cylinder

DISASSEMBLY

NOTICE

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

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

WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Place the cylinder barrel into a suitable holding fixture.

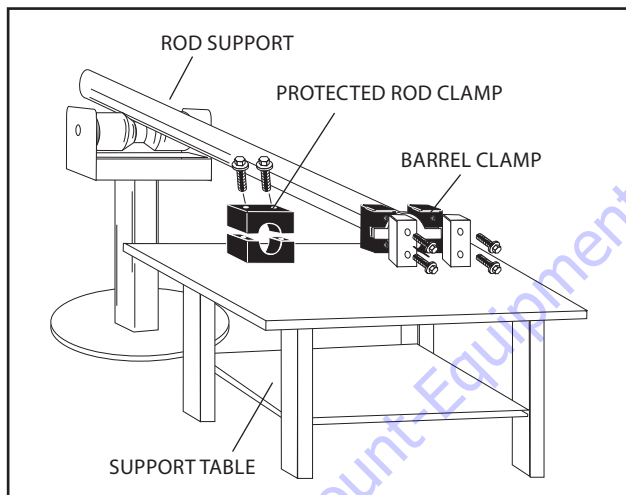


Figure 5-84. Cylinder Barrel Support

4. Using a hook spanner, loosen and remove spanner nut from cylinder barrel.

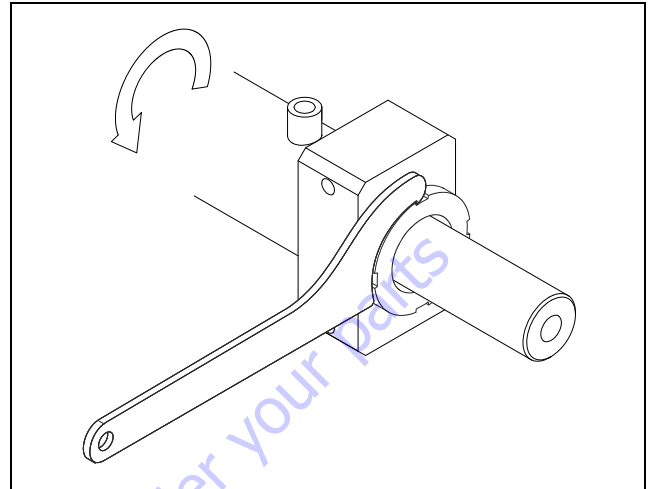


Figure 5-85. Spanner Nut Removal

5. 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.

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

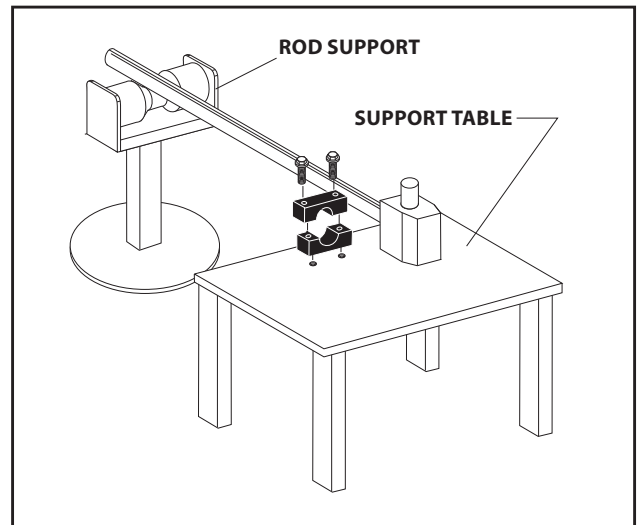
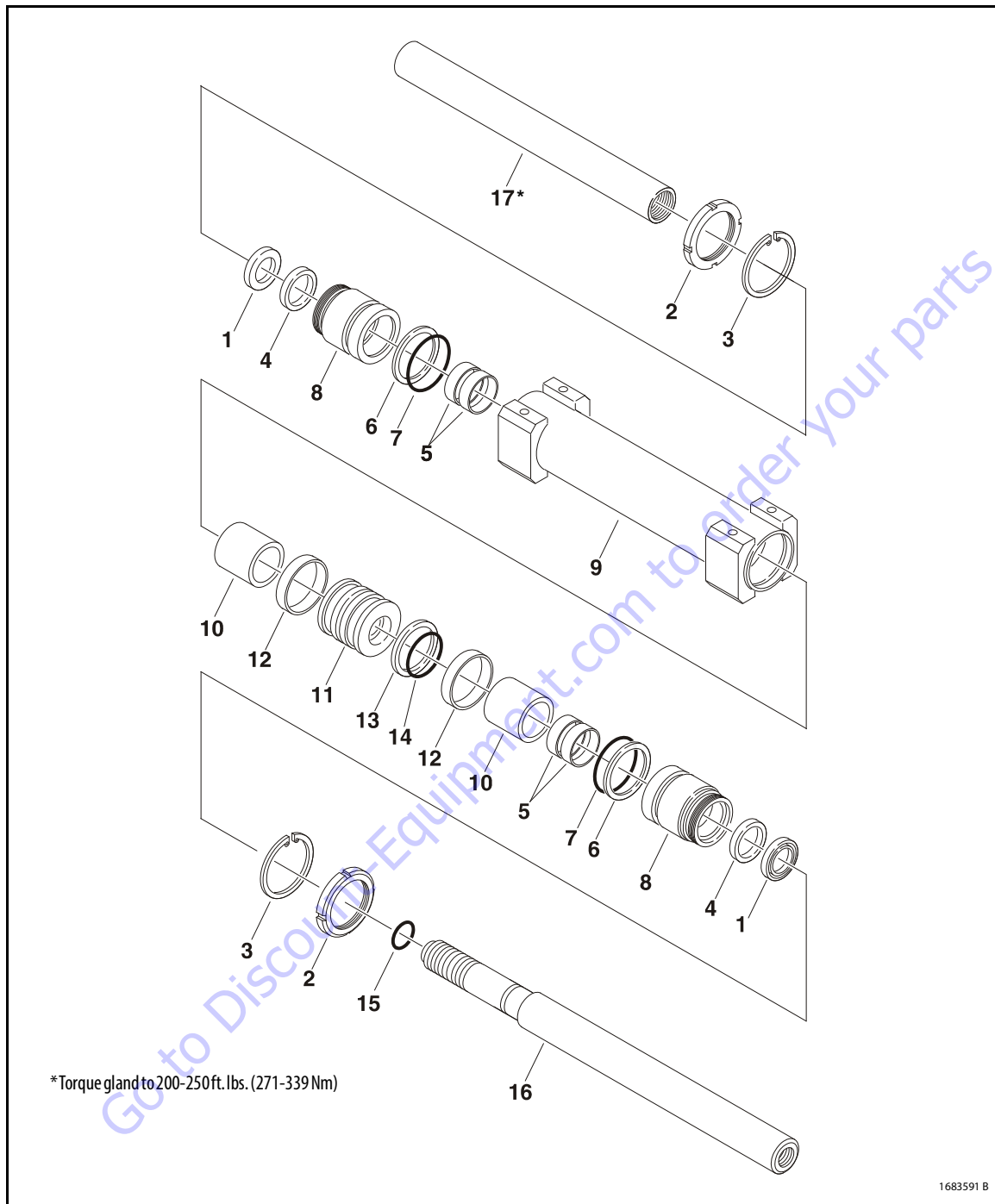


Figure 5-86. Cylinder Rod Support



- | | | | |
|-------------------|----------------|---------------|------------|
| 1. Wiper | 6. Backup Ring | 10. Tube | 14. O-ring |
| 2. Spanner Nut | 7. O-ring | 11. Piston | 15. O-ring |
| 3. Retaining Ring | 8. Guide | 12. Wear Ring | 16. Rod |
| 4. Lip Seal | 9. Barrel | 13. Seal | 17. Rod |
| 5. Wear Ring | | | |

Figure 5-87. Steer Cylinder

7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
8. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.
9. Remove and discard the piston o-rings, seals and wear rings.
10. Remove bushings from the rod.
11. Remove the rod from the holding fixture. Remove the cylinder guide gland, Discard the wear ring, backup rings, o-rings, retaining rings, lip seal, and wiper seal.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder Guide inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in guide for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder guide outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. Inspect piston tube for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
12. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
13. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

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

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

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

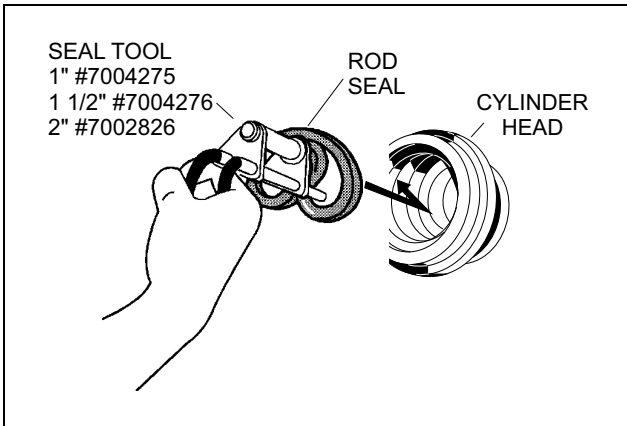


Figure 5-88. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

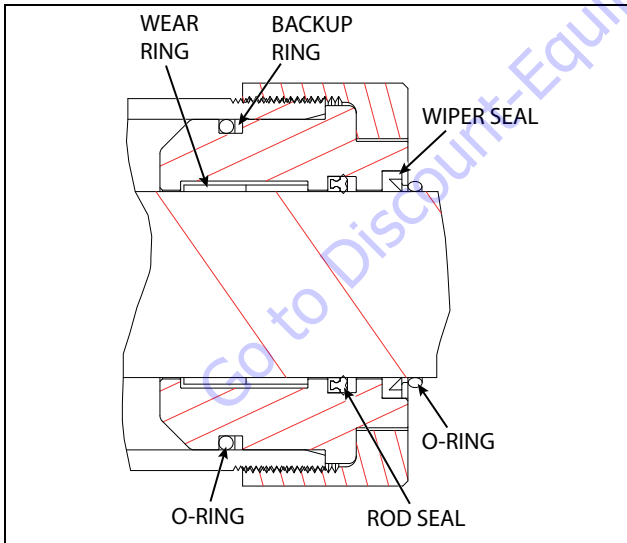


Figure 5-89. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder guide gland groove. Install the new retaining ring into the applicable cylinder guide gland groove.

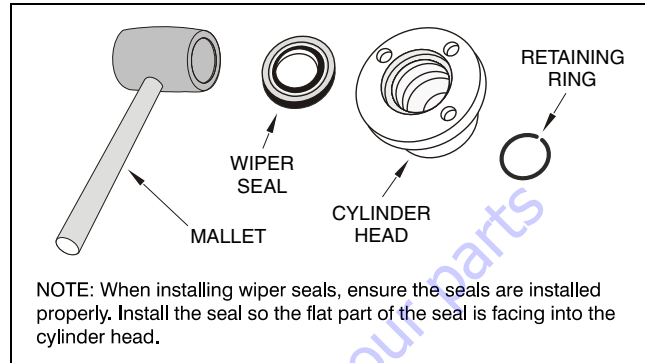


Figure 5-90. Wiper Seal Installation

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

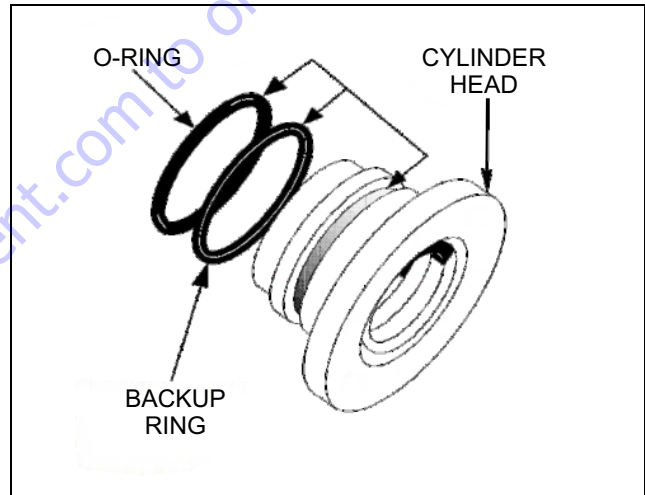


Figure 5-91. Installation of Head Seal Kit

4. Install the guide gland on the rod, ensuring that the wiper and lip seals are not damaged or dislodged. Push the guide along the rod to the rod end.
5. Push the piston tube onto the rod.
6. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
7. Place a new o-ring in the inner piston diameter groove.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
9. Thread piston onto rod until it abuts the piston tube end.
10. Install the piston tube onto the rod.
11. Remove the cylinder rod from the holding fixture.

12. Place new piston seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

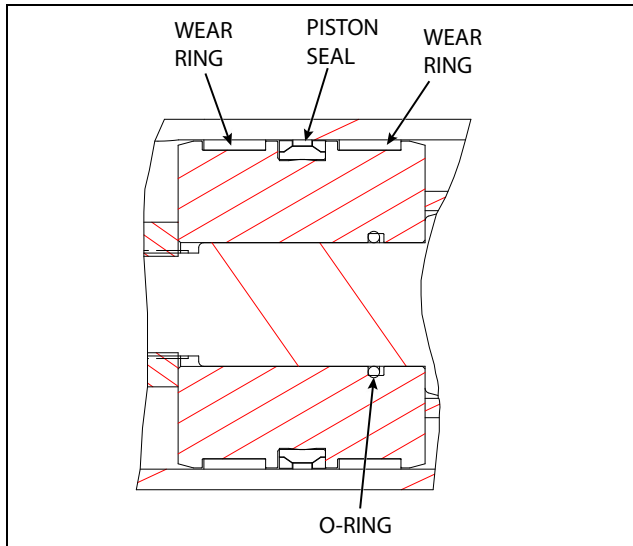


Figure 5-92. Piston Seal Kit Installation

13. Position the cylinder barrel in a suitable holding fixture.

NOTICE

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

14. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal are not damaged or dislodged.
15. Screw both the cylinder rod ends and torque to 200-250 ft lbs. (271-339 Nm).
16. Continue pushing the rod into the barrel until the cylinder guide gland can be inserted into the barrel cylinder.
17. Using a hook spanner, install spanner nut into the cylinder barrel.
18. 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.

Telescope Cylinder

DISASSEMBLY

NOTICE

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

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

WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove counterbalance valve and fittings from the cylinder port block. Remove wear pads from the cylinder.
4. Place the cylinder barrel into a suitable holding fixture.

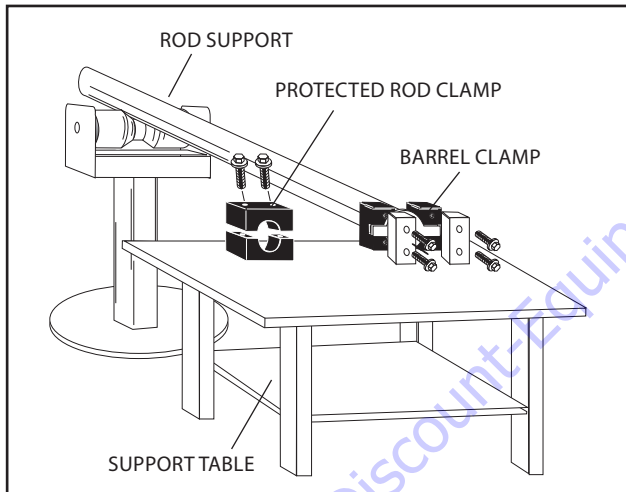


Figure 5-93. Cylinder Barrel Support

5. Remove cylinder head as mention below:
 - a. Mark cylinder head and barrel with a center punch for easy realignment. Unscrew the cylinder cap from the barrel. Refer Figure 5-97.

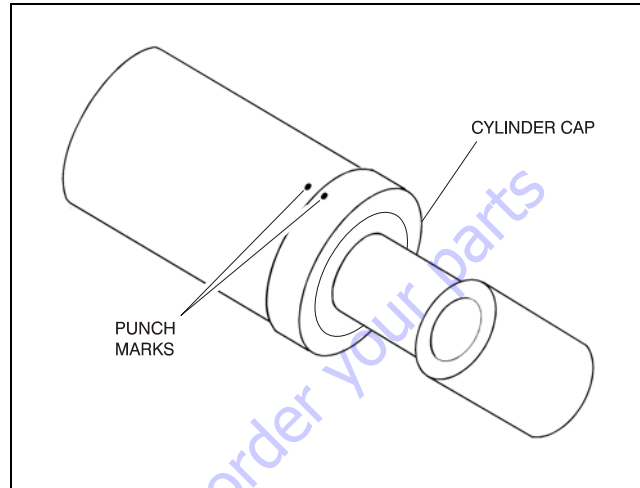


Figure 5-94. Cylinder Cap Removal

- b. Using a pin-face spanner wrench, unscrew the cylinder head from the barrel. Refer Figure 5-98.

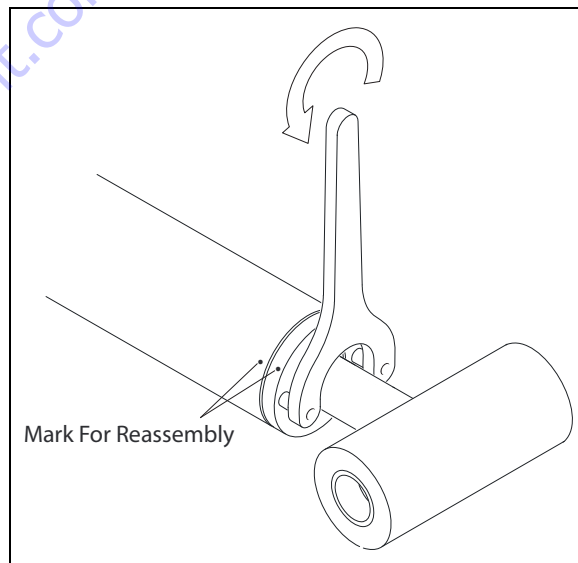


Figure 5-95. Cylinder Head Removal

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

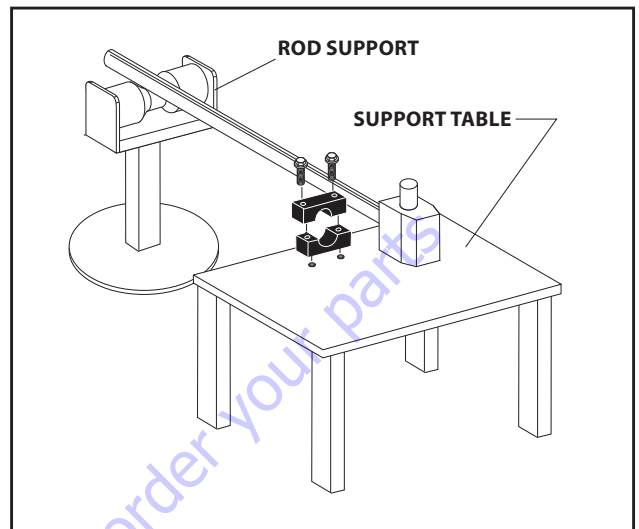
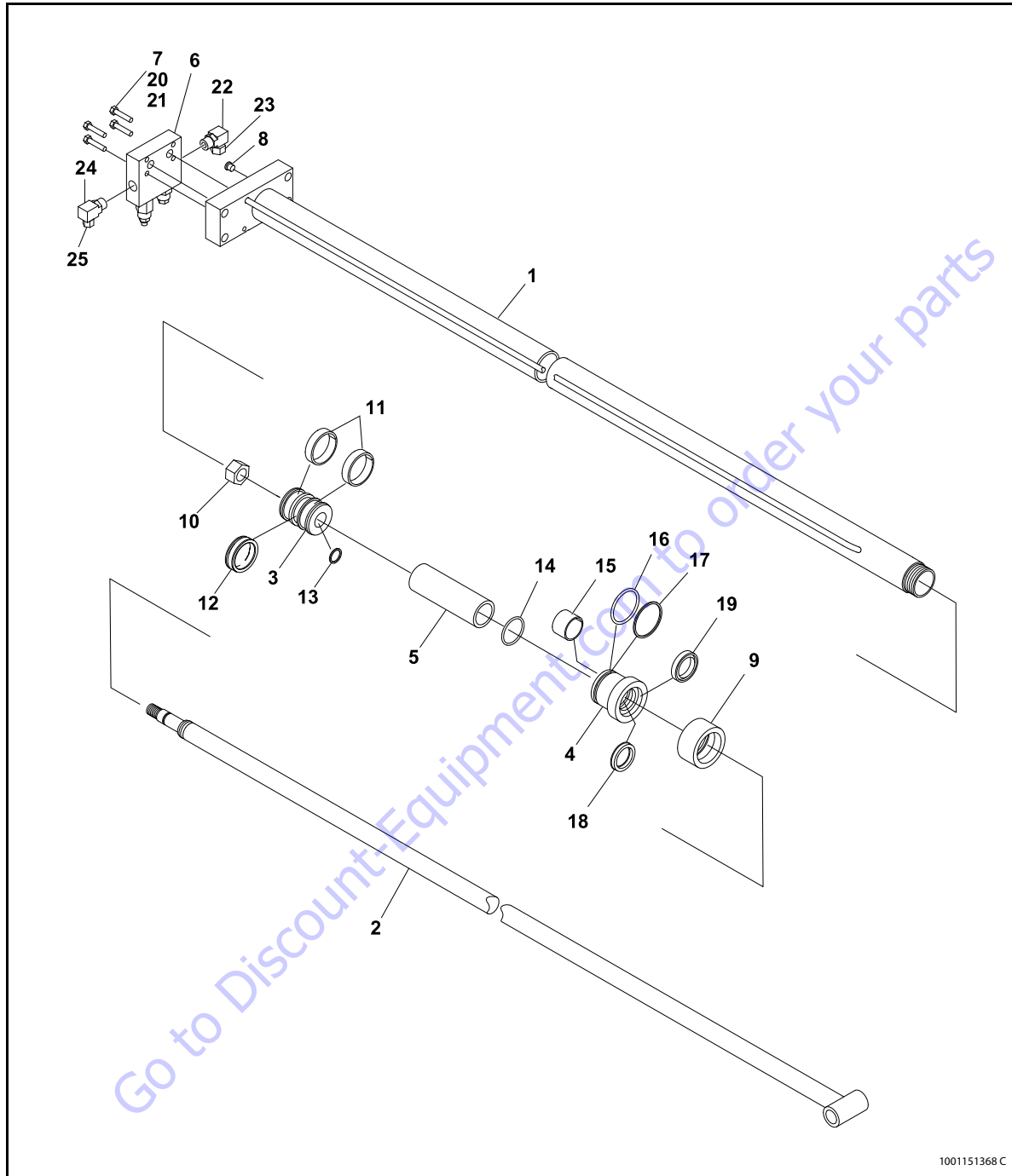


Figure 5-96. Cylinder Rod Support

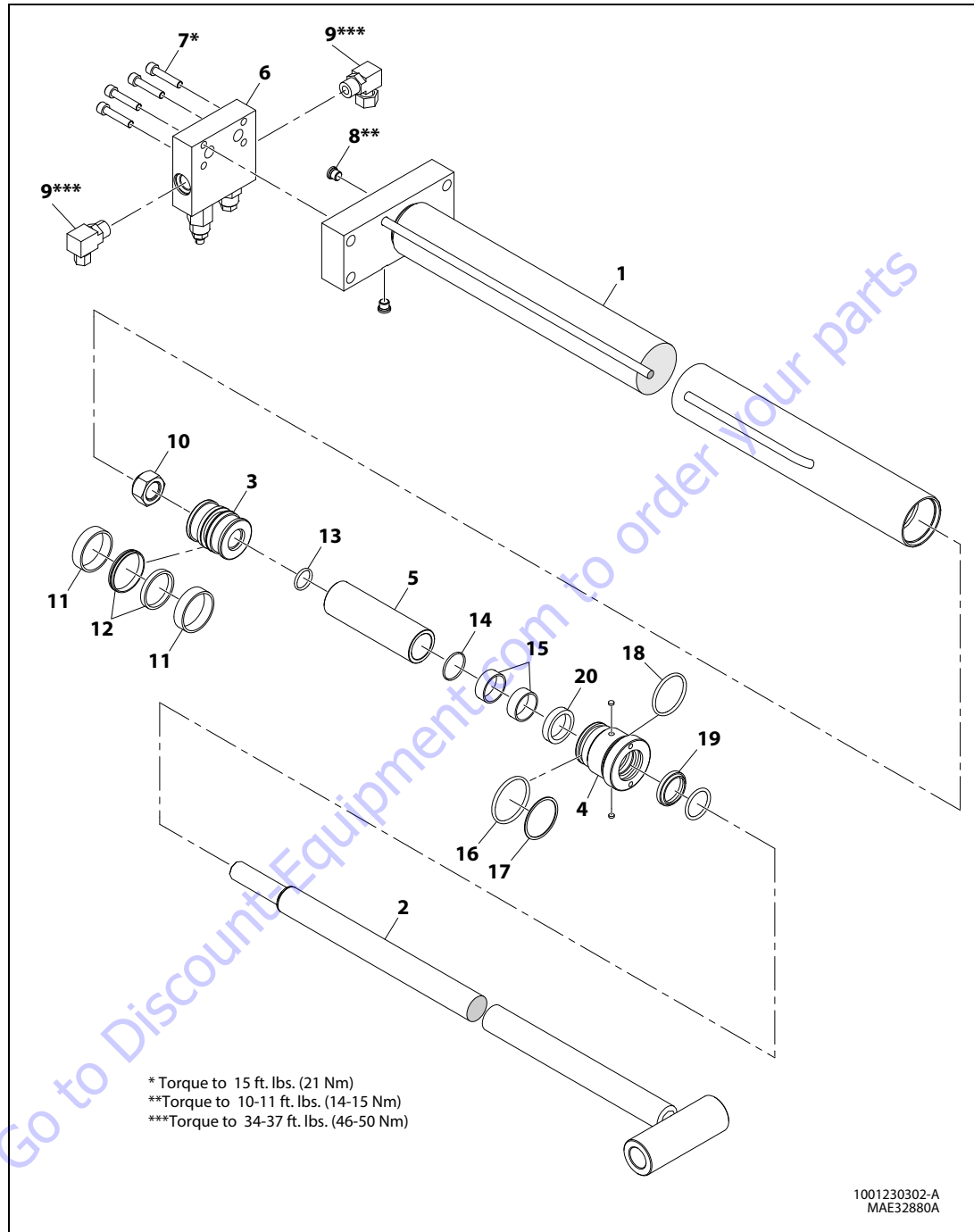
SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS



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- | | | | | |
|-----------|-------------------------|---------------|---|--------------------|
| 1. Barrel | 6. Counterbalance Valve | 11. Wear Ring | 16. O-ring | 21. Locking Primer |
| 2. Rod | 7. Bolt | 12. Cap Seal | 17. Backup Ring | 22. Fitting |
| 3. Piston | 8. Plug | 13. O-ring | 18. Rod Seal | 23. Cap Fitting |
| 4. Head | 9. End Cap | 14. O-ring | 19. Wiper Seal | 24. Fitting |
| 5. Spacer | 10. Locknut | 15. Wear Ring | 20. Medium Strength
Threadlocking Compound | 25. Cap Fitting |

Figure 5-97. Telescope Cylinder - USA Built Machine



- | | | | | |
|-----------|----------------------------------|--------------|--------------|----------------|
| 1. Barrel | 5. Spacer | 9. Fitting | 13. O-ring | 17. BackupRing |
| 2. Rod | 6. Counterbalance Valve Assembly | 10. Locknut | 14. O-ring | 18. O-ring |
| 3. Piston | 7. Bolt | 11. WearRing | 15. WearRing | 19. WiperSeal |
| 4. Head | 8. Plug | 12. CapSeal | 16. O-ring | 20. RodSeal |

Figure 5-98. Telescope Cylinder - China Built Machine

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Loosen and remove nut which attaches the piston to the rod.
10. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.
11. Remove and discard the piston o-rings, cap seals and wear rings.
12. Remove piston spacer from the rod.
13. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, wear rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
 - a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
 - b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
 - c. Lubricate inside of steel bushing prior to bearing installation.
 - d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.

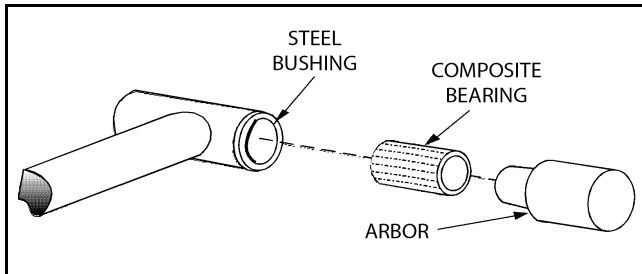


Figure 5-99. Composite Bearing Installation

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

ASSEMBLY

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

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

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

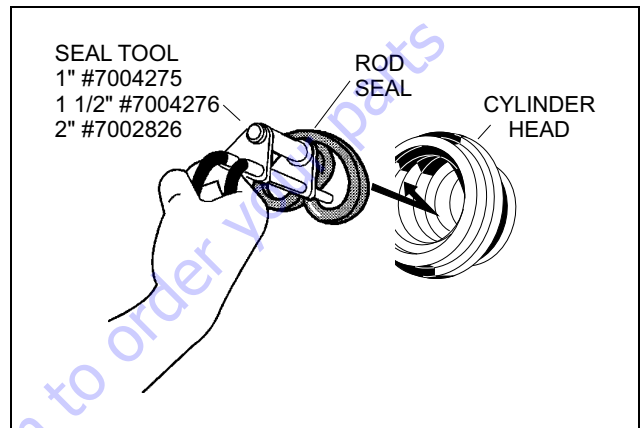


Figure 5-100. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

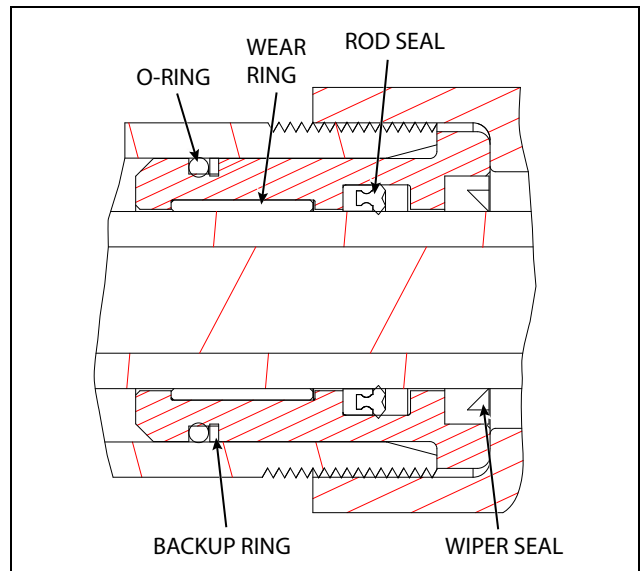


Figure 5-101. Cylinder Head Seal Installation

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

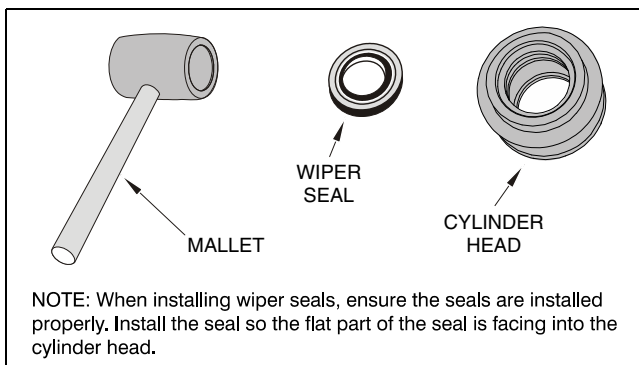


Figure 5-102. Wiper Seal Installation

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

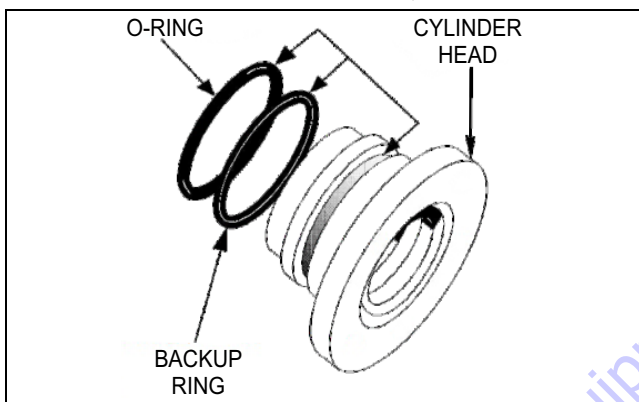


Figure 5-103. Installation of Head Seal Kit

4. Place the cylinder cap over the rod and carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.
5. Push the spacer onto the rod.
6. Place a new o-ring in the inner piston diameter groove.
7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
9. Thread piston onto rod until it abuts the spacer end and install the retainer.
10. Remove the cylinder rod from the holding fixture.

11. Place new cap seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

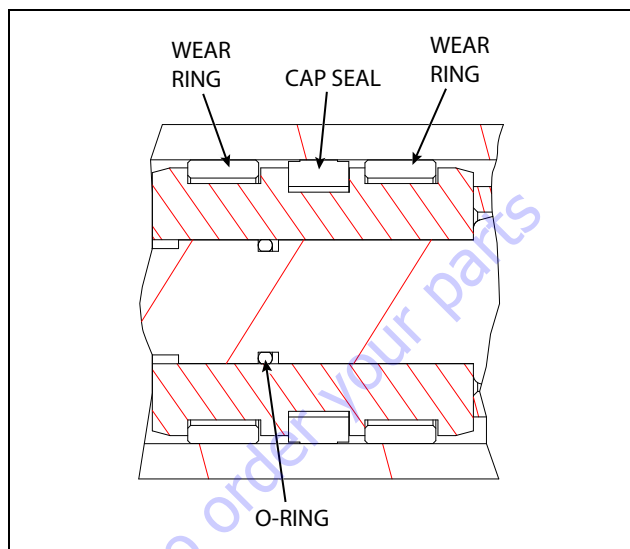


Figure 5-104. Piston Seal Kit Installation

12. Position the cylinder barrel in a suitable holding fixture.

NOTICE

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

13. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
14. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
15. Install cylinder head as mention below:
 - a. Secure the cylinder head gland and the cylinder cap. Refer Figure 5-97.
 - b. Screw the cylinder head into the barrel using a pin-face spanner wrench. Refer Figure 5-98.
16. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the re-installation of any holding valve or valves.
17. Install the counterbalance valves in the rod port block.
18. Install wear pad onto the cylinder.

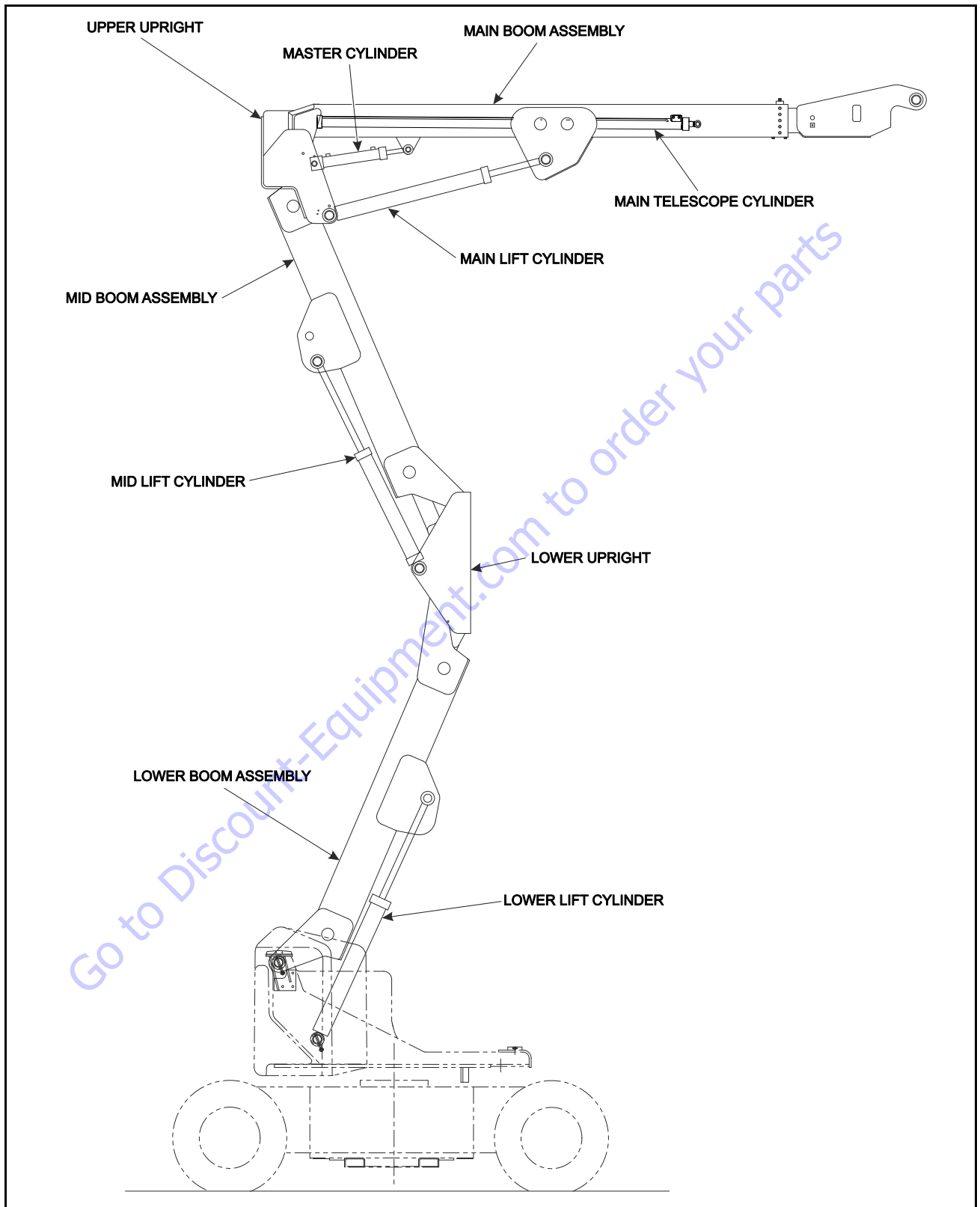


Figure 5-105. Components Boom

5.4 CYLINDER REMOVAL AND INSTALLATION

Main Boom Lift Cylinder Removal

NOTE: The Main Boom weighs approximately 450 lb (204kg).

1. Place the machine on a flat and level surface. Place the Main Boom in a horizontal position. Place Lower and Mid Booms 5 degree above horizontal. Support the platform end of main boom with suitable lifting device. Shut down machine and prop boom.
2. Tag and disconnect hydraulic lines from the main lift cylinder. Use suitable container to collect any residual hydraulic fluid. Cap hydraulic lines and ports.

NOTE: The Main Boom Lift Cylinder weighs approximately 97 lb (44kg).

3. Secure the main boom lift cylinder with suitable lifting device.
4. Remove the hardware securing the cylinder rod attach pin #1 to the boom. Using a suitable brass drift, drive out the cylinder rod attach pin #1.

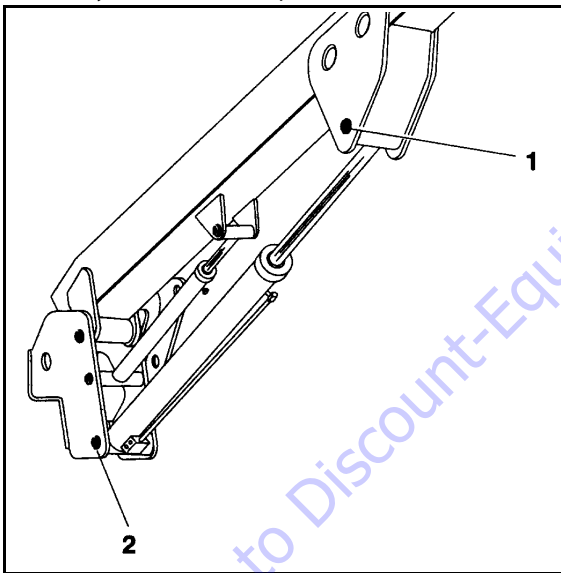


Figure 5-106. Main Boom Lift Cylinder Removal

5. Remove the hardware securing the barrel end attach pin #2. Using a suitable brass drift, drive out the barrel end attach pin #2.
6. Carefully remove the main lift cylinder from the boom and place in a suitable operating surface.

Main Boom Lift Cylinder Installation

NOTE: Coat I.D. of bushings with specified lubricant prior to installing pins.

NOTE: The Main Boom Lift Cylinder weighs approximately 97 lb (44kg).

1. Using suitable lifting device, place the Main Lift Cylinder in the position and align with mounting holes on upright.
2. Using a suitable drift, drive the barrel end attach pin #2 through the mounting holes in the lift cylinder and upright. Secure in place with pin retaining hardware.
3. Remove cylinder port plugs and hydraulic line caps and correctly attach lines to cylinder ports.
4. With function speed switch at its slowest setting, extend the cylinder rod until attach pin hole aligns with those in boom. Using a suitable drift, drive the cylinder rod attach pin #1 through the aligned holes. Secure the pin in place with pin retaining hardware.
5. Remove the lifting device from the main lift cylinder.
6. Cycle cylinder completely to check for proper functioning. Place boom in stowed position. Check hydraulic fluid level and adjust accordingly.

Mid Boom Lift Cylinder Removal

NOTE: The Upright weighs approximately 92 lb (42kg) and Main Boom weighs approximately 450 lb (204kg).

1. Place machine on flat and level surface. Place the Main Boom in a horizontal position. Place the Mid Boom in a 10 degree elevated position. Support Main Boom with a prop. Support upright with suitable lifting device.

NOTE: The Mid Lift Cylinder weighs approximately 60 lb (27.2 kg).

2. Using slings, restrain the lower lift cylinder.
3. Remove the hardware securing the cylinder rod attach pin #3 to the boom. Using an appropriate brass drift, drive out the cylinder rod attach pin #3.

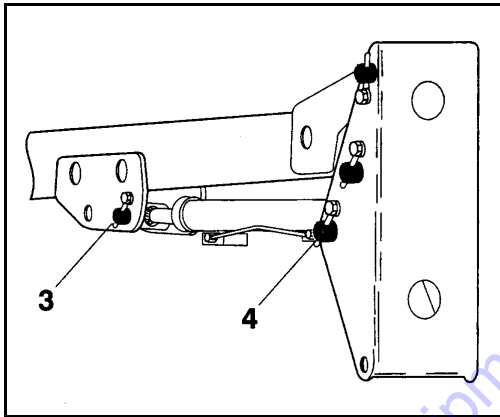


Figure 5-107. Mid Boom Lift Cylinder Removal

4. Tag and disconnect hydraulic lines from the main lift cylinder. Use suitable container to collect any residual hydraulic fluid. Cap hydraulic lines and ports.
5. Remove the hardware securing the barrel end attach pin #4 to the boom. Using an appropriate brass drift, drive out the cylinder barrel pin #4.
6. Remove the lifting device from the mid lift cylinder.
7. Carefully remove cylinder from boom. Place in a suitable operating surface.

Mid Boom Lift Cylinder Installation

NOTE: Coat I.D. of bushings with specified lubricant prior to installing pins.

NOTE: The Mid Lift Cylinder weighs approximately 60 lb (27.2 kg).

1. With the booms positioned and supported, place cylinder in position and secure in place using slings.
2. Install the cylinder barrel pin #4, being sure to align the hole in the cylinder barrel pin with the retaining pin screw hole. When holes align, install hardware.
3. Correctly install hydraulic lines to cylinder as previously tagged. Extend cylinder rod slowly until attach pin hole aligns with those in boom.
4. Using a suitable brass drift, drive the cylinder rod attach pin #3 through the aligned holes. Secure the pin in place using retaining hardware.
5. Remove boom prop and suitable lifting device.
6. Take the lift cylinder through one complete cycle to assure correct functioning. Place boom in stowed position. Check hydraulic fluid and adjust accordingly.

Lower Boom Lift Cylinder Removal

NOTE: The Lower Lift Cylinder weighs approximately 130 lb (59kg).

1. Place machine on flat and level surface. Place the Main Boom in a horizontal position. Place the Mid and Lower Booms in a 10 degree elevated position. Support Main Boom with a prop. Support upright with suitable lifting device.
2. Using slings, restrain the lower lift cylinder.
3. Remove the hardware securing the cylinder rod attach pin #5 to the boom. Using an appropriate brass drift, drive out the cylinder rod attach pin #5.

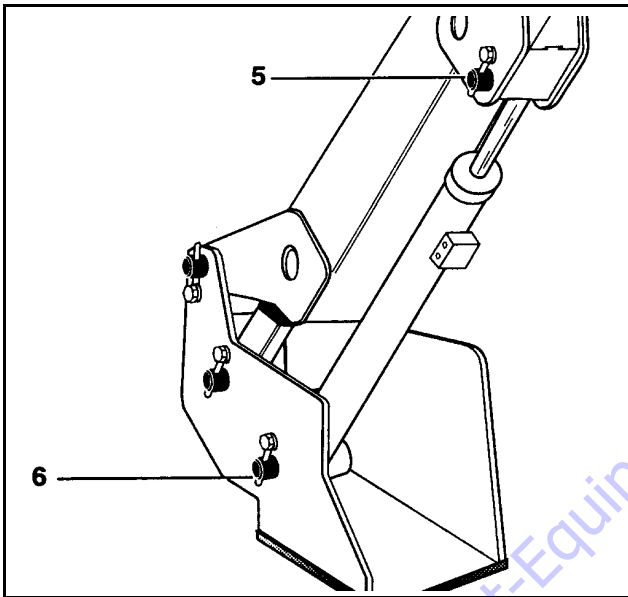


Figure 5-108. Lower Boom Lift Cylinder Removal

4. Tag and disconnect hydraulic lines from the upper lift cylinder. Use suitable container to collect any residual hydraulic fluid. Cap hydraulic lines and ports.
5. Remove the hardware securing the barrel end attach pin #6 to the boom. Using an appropriate brass drift, drive out the cylinder barrel pin #6.
6. Carefully remove cylinder from boom. Place in a suitable operating surface.

Lower Boom Lift Cylinder Installation

NOTE: Coat I.D. of bushings with specified lubricant prior to installing pins.

NOTE: The Lower Lift Cylinder weighs approximately 130lb (59kg).

1. With the booms positioned and supported, place cylinder in position and secure in place using slings.
2. Install the cylinder barrel pin #6, being sure to align the hole in the cylinder barrel pin with the retaining pin screw hole. When holes align, install hardware.
3. Correctly install hydraulic lines to cylinder as previously tagged. Extend cylinder rod slowly until attach pin hole aligns with those in boom.
4. Using a suitable brass drift, drive the cylinder rod attach pin #5 through the aligned holes. Secure the pin in place using retaining hardware.
5. Remove boom prop and suitable lifting device.
6. Take the lift cylinder through one complete cycle to assure correct functioning. Place boom in stowed position. Check hydraulic fluid and adjust accordingly.

Main Boom Telescope Cylinder Removal

1. Place machine on flat and level surface, with Main Boom in the horizontal position.
2. Extend Main Boom until fly attach pin #1 is accessible on fly.

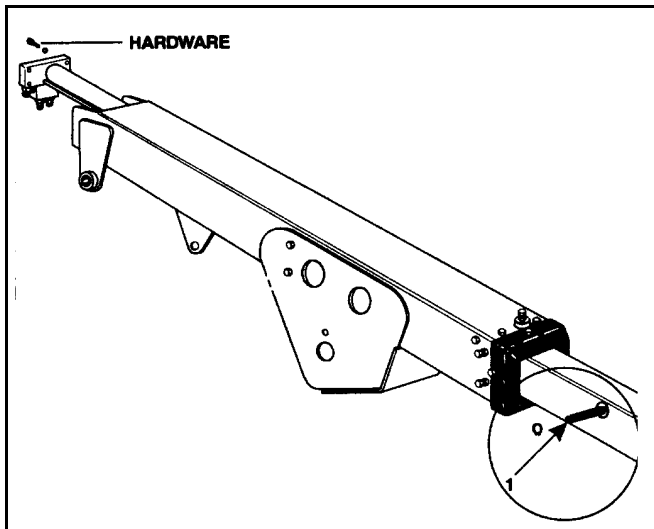


Figure 5-109. Main Telescope Cylinder Removal

NOTE: The Main Boom weighs approximately 450 lb (204kg).

3. Support platform end of the Main Boom end with a prop. Support Main Upright end with suitable lifting device.
4. Tag, disconnect hydraulic lines to telescope cylinder. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
5. Remove the retaining rings that retain the telescope cylinder rod to the fly boom.
6. Using a suitable brass drift, carefully drive the telescope cylinder rod pin #1 from the fly boom.
7. Remove the four (4) bolts securing the telescope cylinder barrel end to the base boom.

NOTE: Care should be taken when removing the telescope cylinder, do not leave cylinder rest on powertrack which could cause damage to powertrack.

8. Using a suitable brass drift, carefully drive the telescope cylinder pin from the base boom.
9. Attach a suitable sling to the telescope cylinder. Using a suitable lifting device attached to the sling carefully pull the telescope cylinder from the boom assembly.

NOTE: The Main Telescope Cylinder weighs approximately 130 lb (46.8kg).

10. Using another lifting device, support the rod end of the cylinder and remove the cylinder from the boom assembly.
11. Carefully lift the cylinder clear of the boom assembly and lower to the ground or suitably supported operating surface.

Main Boom Telescope Cylinder Installation

1. Attach a hydraulic power supply to the telescope cylinder ports. Using suitable supports or lifting devices at each end of the cylinder, extend the rod so that the cylinder pin attach holes are the same distance apart as the boom pin attach holes.

NOTE: The Main Boom weighs approximately 450 lb (204kg).

2. Using suitable lifting equipment, carefully lower the cylinder to the boom assembly.

NOTE: The Main Telescope Cylinder weighs approximately 130 lb (46.8kg).

3. Using another lifting device, support the rod end of the cylinder and install the cylinder into the boom assembly.
4. Remove lifting devices from the telescope cylinder.
5. Carefully install the telescope cylinder rod pin #1 through the fly boom and secure it with the retaining rings.
6. Carefully install the telescope cylinder barrel end to base, securing cylinder to the base boom with four (4) bolts and hardware.
7. Remove applicable hydraulic line and port caps and correctly connect the hydraulic lines to the telescope cylinder. Ensure all hoses are correctly routed.
8. Remove boom prop and suitable lifting device. Activate hydraulic system.
9. Using all applicable safety precautions, operate the boom functions. Check for correct operation and hydraulic leaks. Secure as necessary.
10. Check fluid level of hydraulic tank and add as necessary.

5.5 LOWER LIFT CYLINDER BLEEDING PROCEDURE

NOTE: Bleeding procedure should only be necessary if rebuilding or replacing lift cylinder.

1. Check oil level in the hydraulic oil tank (all booms must be retracted).
2. Lay an oil drip pan under the rod end port block and crack bleeder open from the fitting in the port block.
3. From the platform, turn the speed control knob to the slow position.
4. Lift up very slowly. This will force any air out of the circuit. If the lower boom is not extending, turn the speed control up very slowly until the lower boom starts to move.
5. Raise the lower boom approximately 30.5 cm (1 foot), then close bleeder while the boom is still moving.
6. Lift down all the way.
7. Repeat this procedure until all air has been purged from the circuit. Re-check the hydraulic oil level.
8. To test, cycle the lower lift function 3-4 times to see if both cylinders stop at the same time when fully extended.

5.6 PRESSURE SETTING PROCEDURES

NOTE: Cold temperatures have a significant impact on pressure readings. JLG Industries Inc. recommends operating the machine until hydraulic system has warmed to normal operating temperatures prior to checking pressures. We also recommend using a calibrated gauge. Pressure readings are acceptable if within +/- 5% of specified pressures.

Main Relief

1. Install pressure gauge at port "G" on Steer Valve.
2. Activate and bottom out either Main or Lower Lift Up. Adjust Main Relief to value given in Figure 5-112., Steer Valve Pressure Adjustment.

Main Lift Down Relief

1. With pressure gauge at "G" port on main valve, activate and bottom out Main Lift Down.
2. Adjust Main Lift Relief to value given in Figure 5-115., Main Valve Pressure Adjustment.

Lower Lift Down Relief

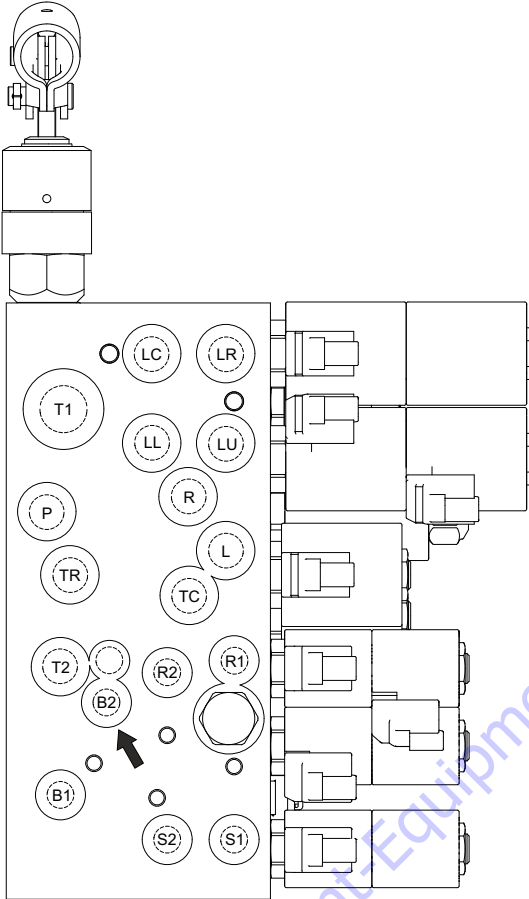
1. With pressure gauge at "G" port on main valve, activate and bottom out Mid/Lower Lift Down.
2. Adjust Mid/Lower Lift Relief to value given in Figure 5-115., Main Valve Pressure Adjustment.

Telescope Relief

1. With pressure gauge at "G" port on main valve, activate and bottom out Telescope In.
2. Adjust Telescope Relief to value given in Figure 5-115., Main Valve Pressure Adjustment.

Platform Level Up Relief

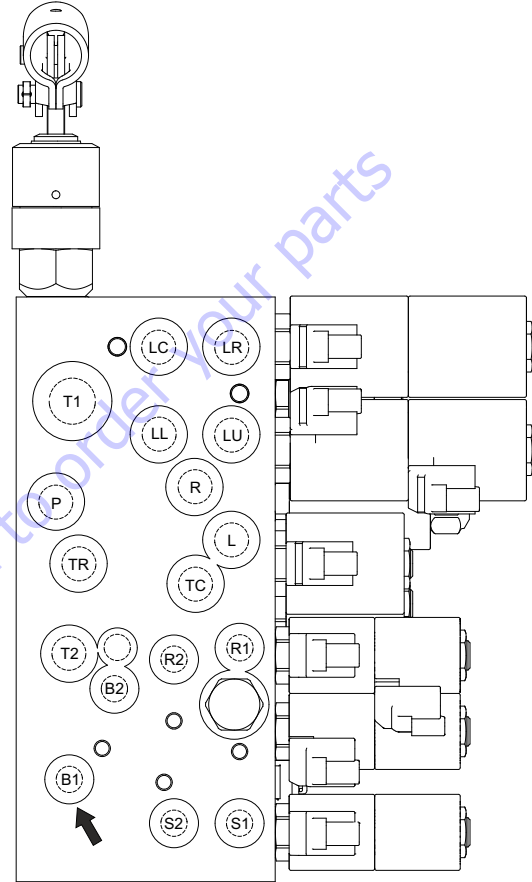
1. Install the pressure gauge at the "B2" port on the back of the Main Control Valve, activate and bottom out Platform Level Up.



2. Adjust Platform Level Up Relief to value given in Figure 5-115., Main Valve Pressure Adjustment.

Platform Level Down Relief

1. Install the pressure gauge at the "B1" port on the back of the Main Control Valve, activate and bottom out Platform Level Down.



2. Adjust Platform Level Down Relief to value given in Figure 5-115., Main Valve Pressure Adjustment.

Steer Relief

1. With pressure gauge at "G" port on steer/brake valve, activate and bottom out Steer Left or Right.
2. Adjust Steer Relief to value given in Figure 5-112., Steer Valve Pressure Adjustment.
3. Shut down hydraulic system and remove pressure gauge.

Jib Lift (Up and Down) Relief

1. Install the pressure gauge at the at the "G" port on the Main Control valve, activate and bottom out jib up or down.

Releveling Valve Relief

1. Install a pressure gauge at port "G" on the main valve.
2. Adjust the lower lift down pressure relief to the value given in Figure 5-115., Main Valve Pressure Adjustment.
3. With the lower boom lowered all the way, pull the red releveling knob and activate lower lift down.

4. Adjust the releveling pressure relief to the value given in Figure 5-115., Main Valve Pressure Adjustment. Turning clockwise increases the pressure and turning counter-clockwise decreases pressure. The relief valve is located directly below the red releveling knob.

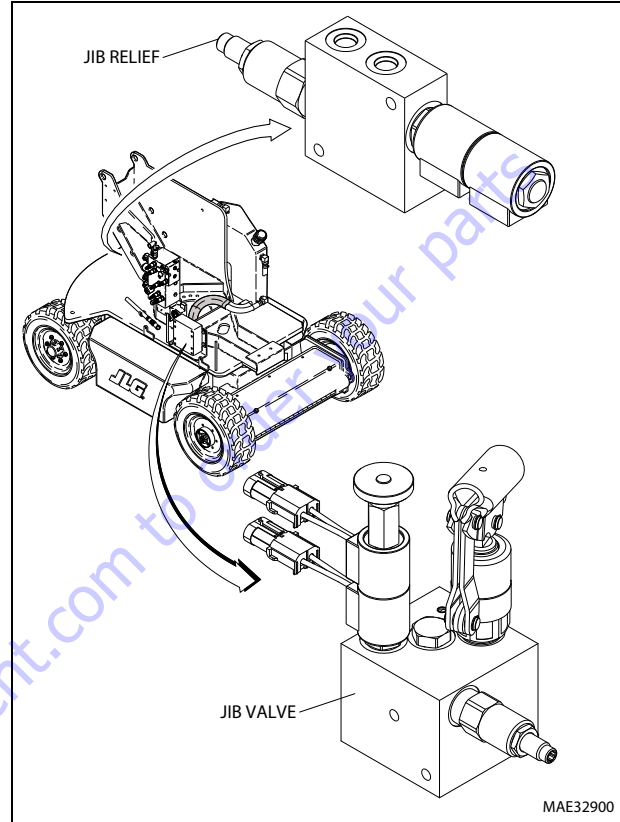


Figure 5-110. Jib Valve Location

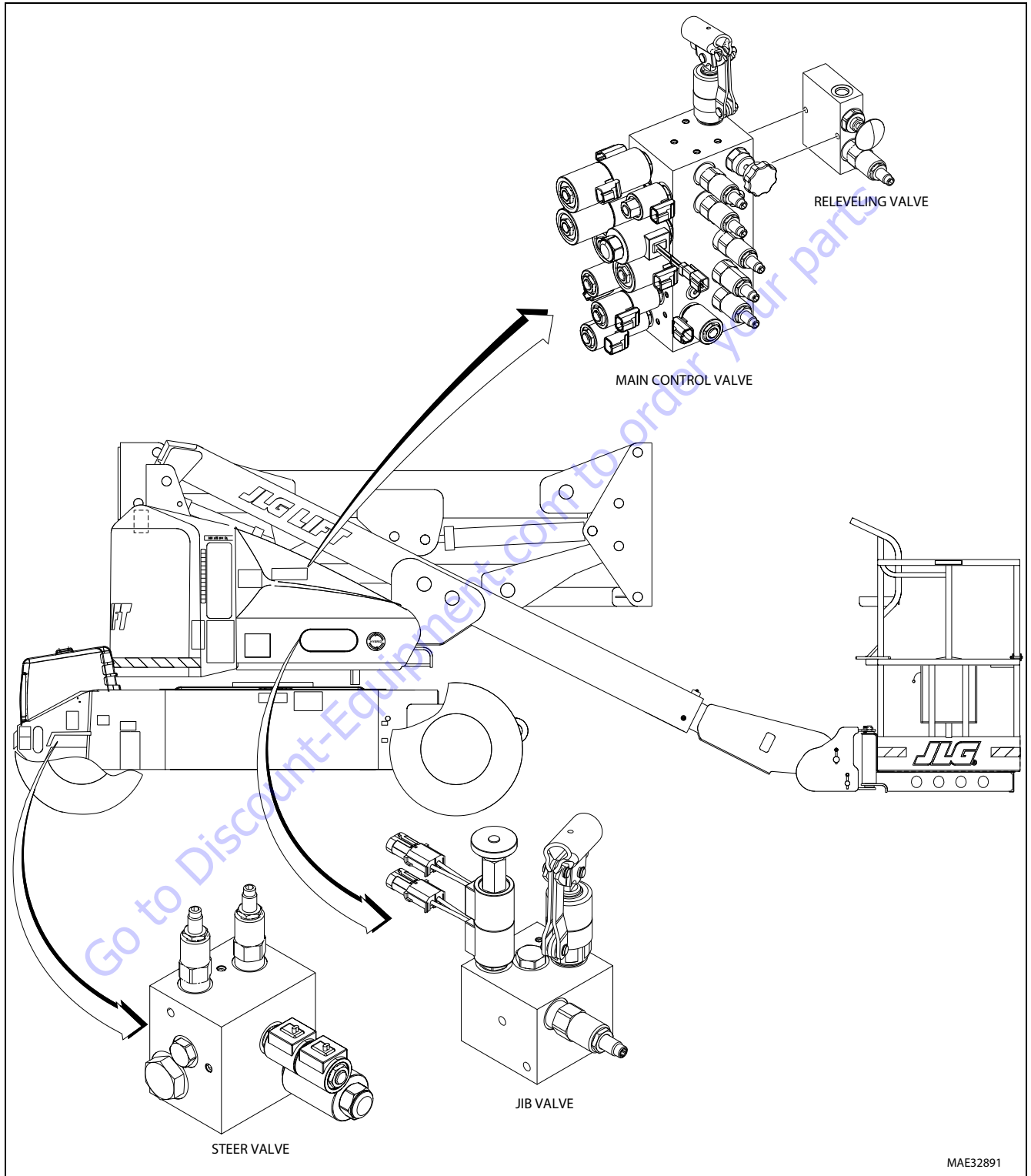


Figure 5-111. Hydraulic Component Location

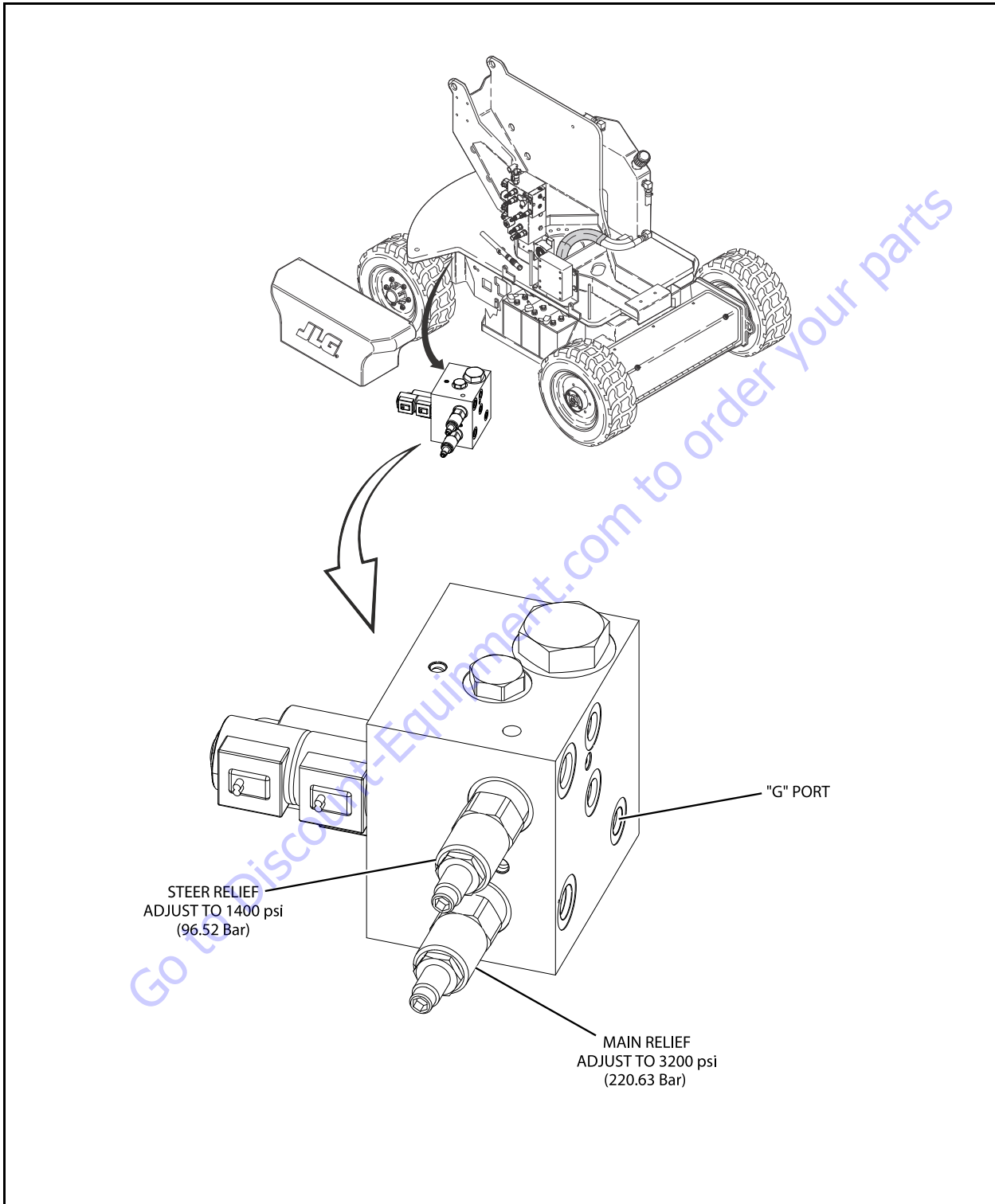


Figure 5-112. Steer Valve Pressure Adjustment

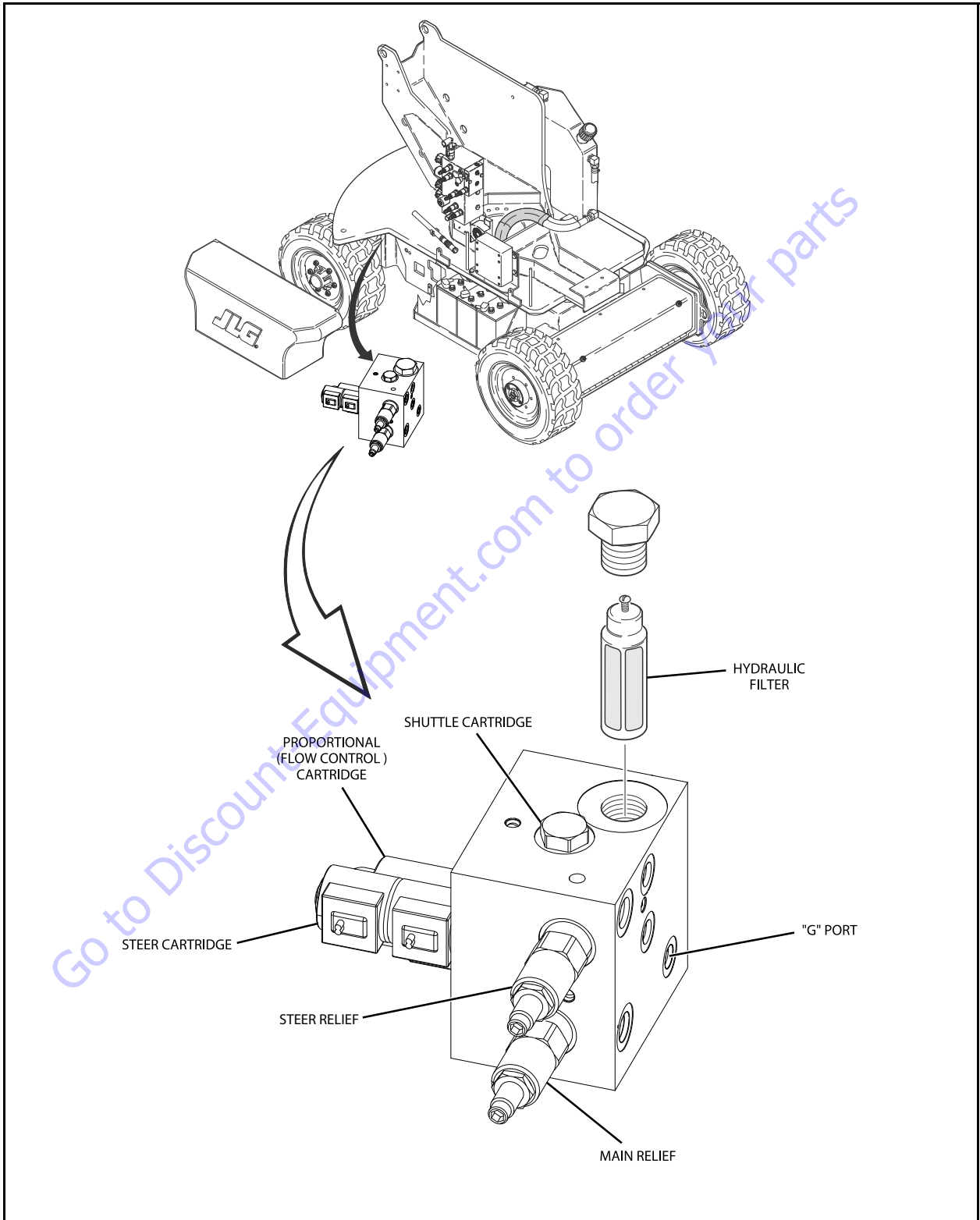
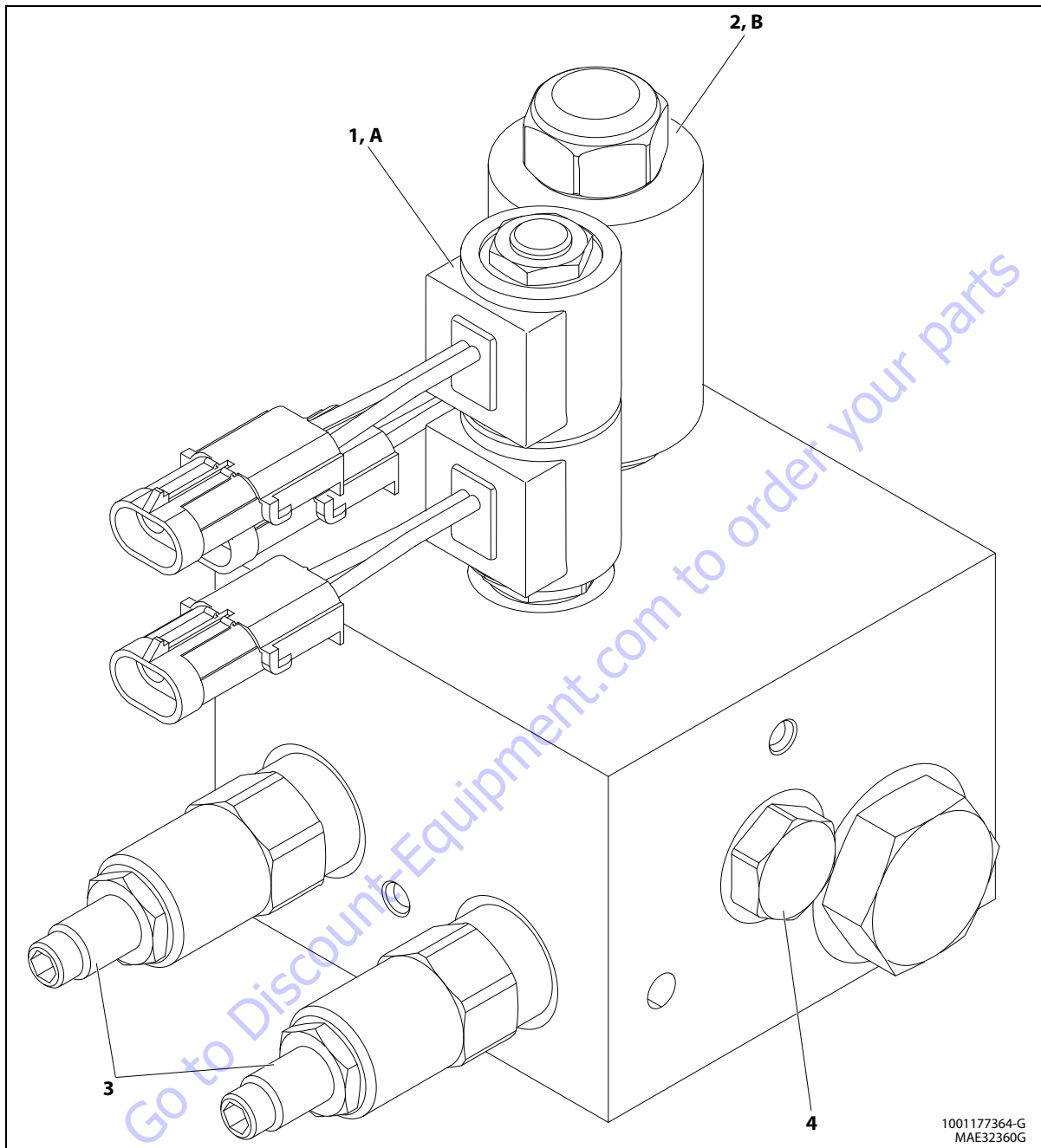


Figure 5-113. Steer Valve Component



1001177364-G
MAE32360G

Table 5-33. Cartridge Torque Values

	Ft. Lbs.	Nm
1	35-40	47-54
2	25	34
3	25-30	34-41
4	20	27

Table 5-34. Coil Torque/Resistance Values

	Torque		Resistance
	Ft. Lbs.	Nm	Ohm (Ω)
A	4-5	5-7	9.8 @ 20°C
B	10-12	13-16	5 @ 20°C

Figure 5-114. Steer Valve Torque Specification

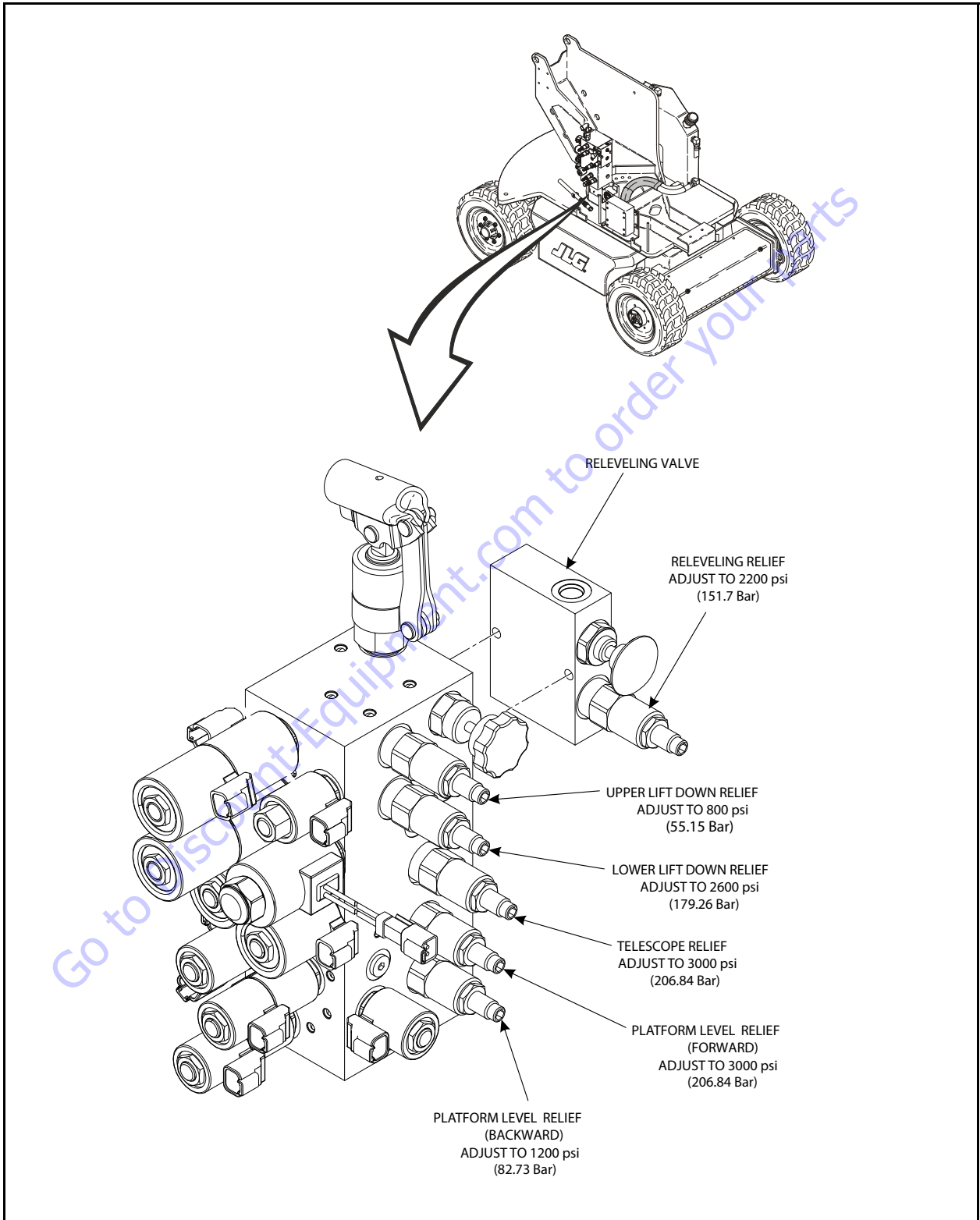


Figure 5-115. Main Valve Pressure Adjustment

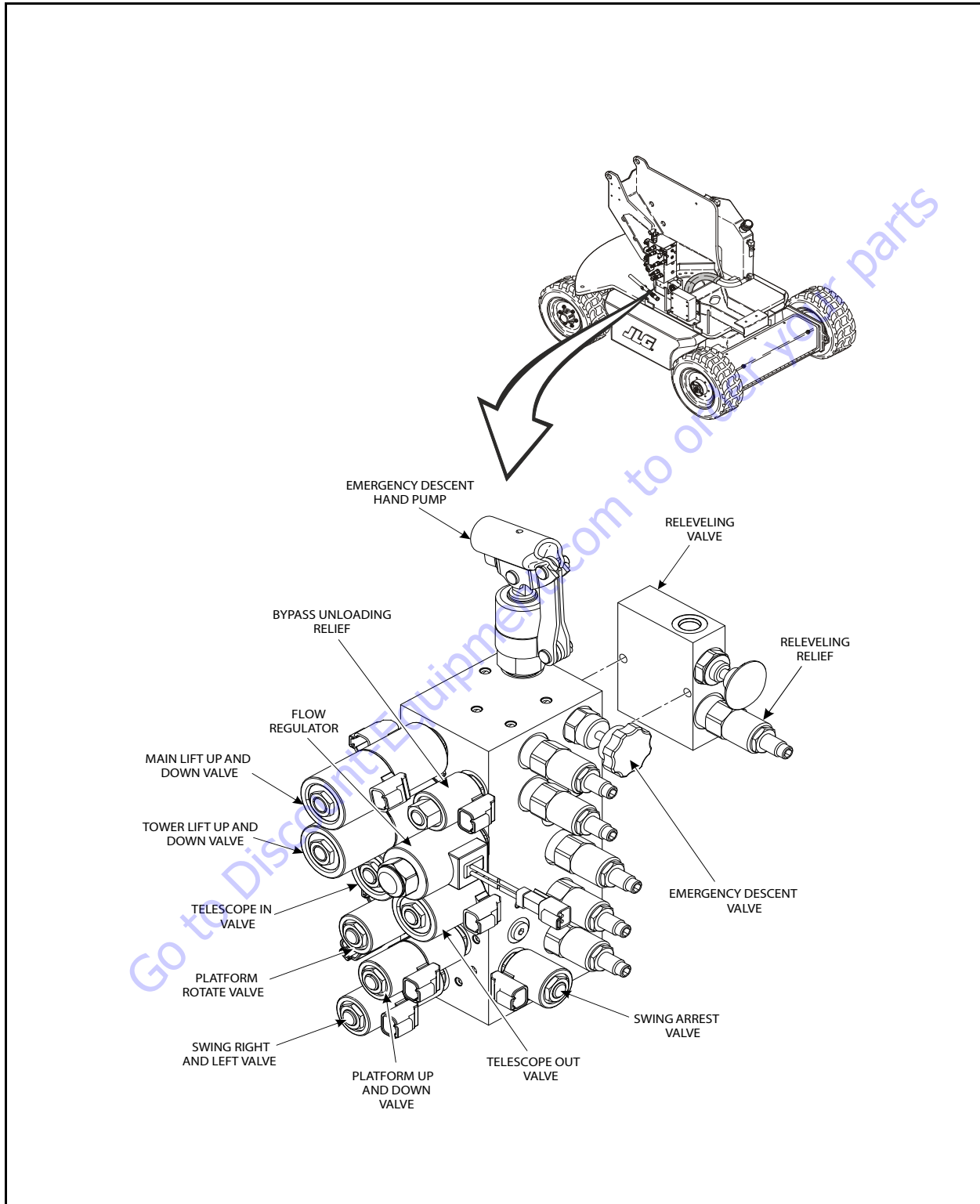
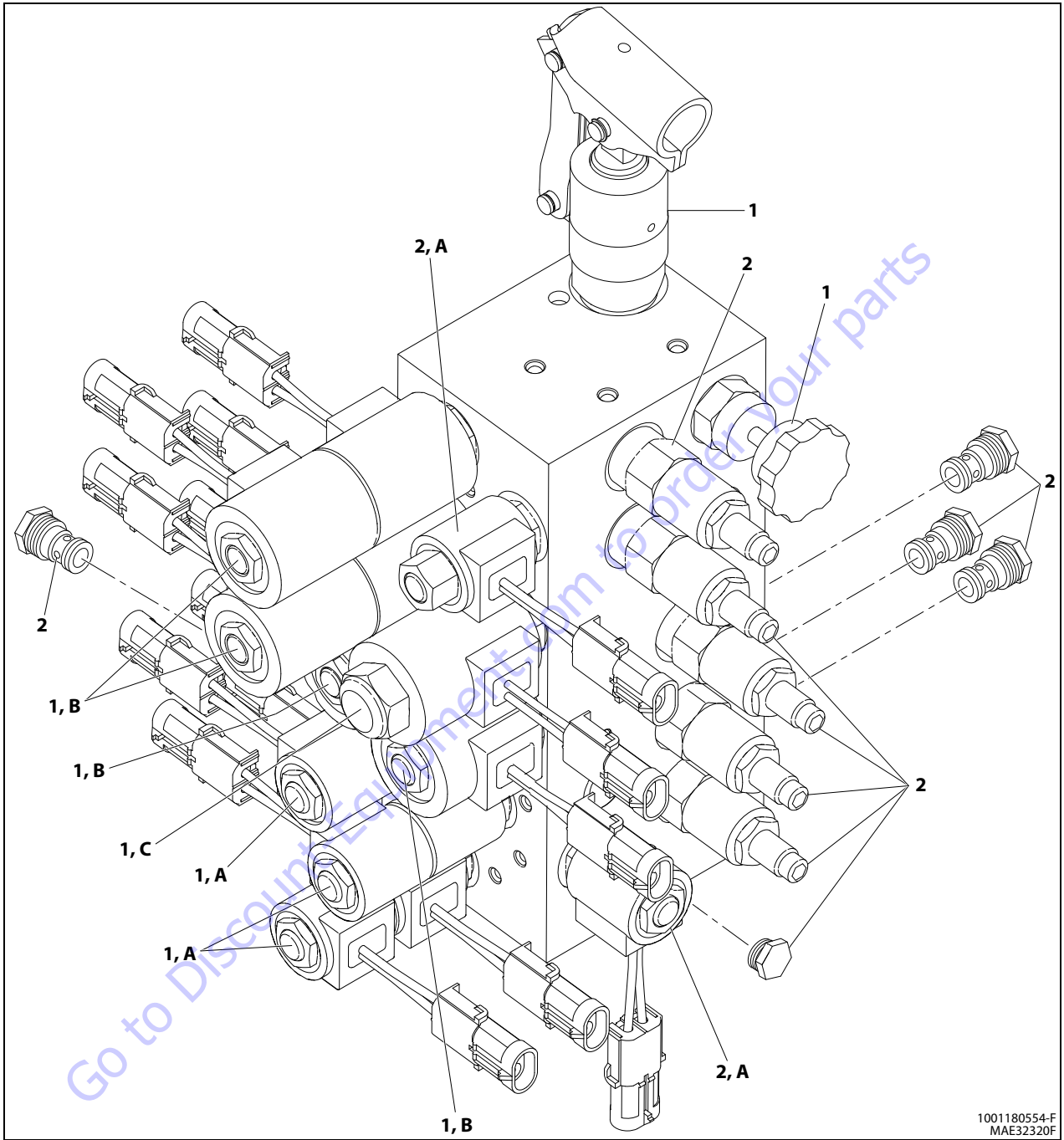


Figure 5-116. Main Valve Components



1001180554-F
MAE32320F

Table 5-35. Cartridge Torque Values

	Ft. Lbs.	Nm
1	25	34
2	20	27

Table 5-36. Coil Torque Values

	Torque		Resistance
	Ft. Lbs.	Nm	Ohm (Ω)
A	10-12	13-16	5 @ 20°C
B	7-10	9-13	7.2 @ 20°C
C	4-5	5-7	9.8 @ 20°C

Figure 5-117. Main Control Valve Torque Specification

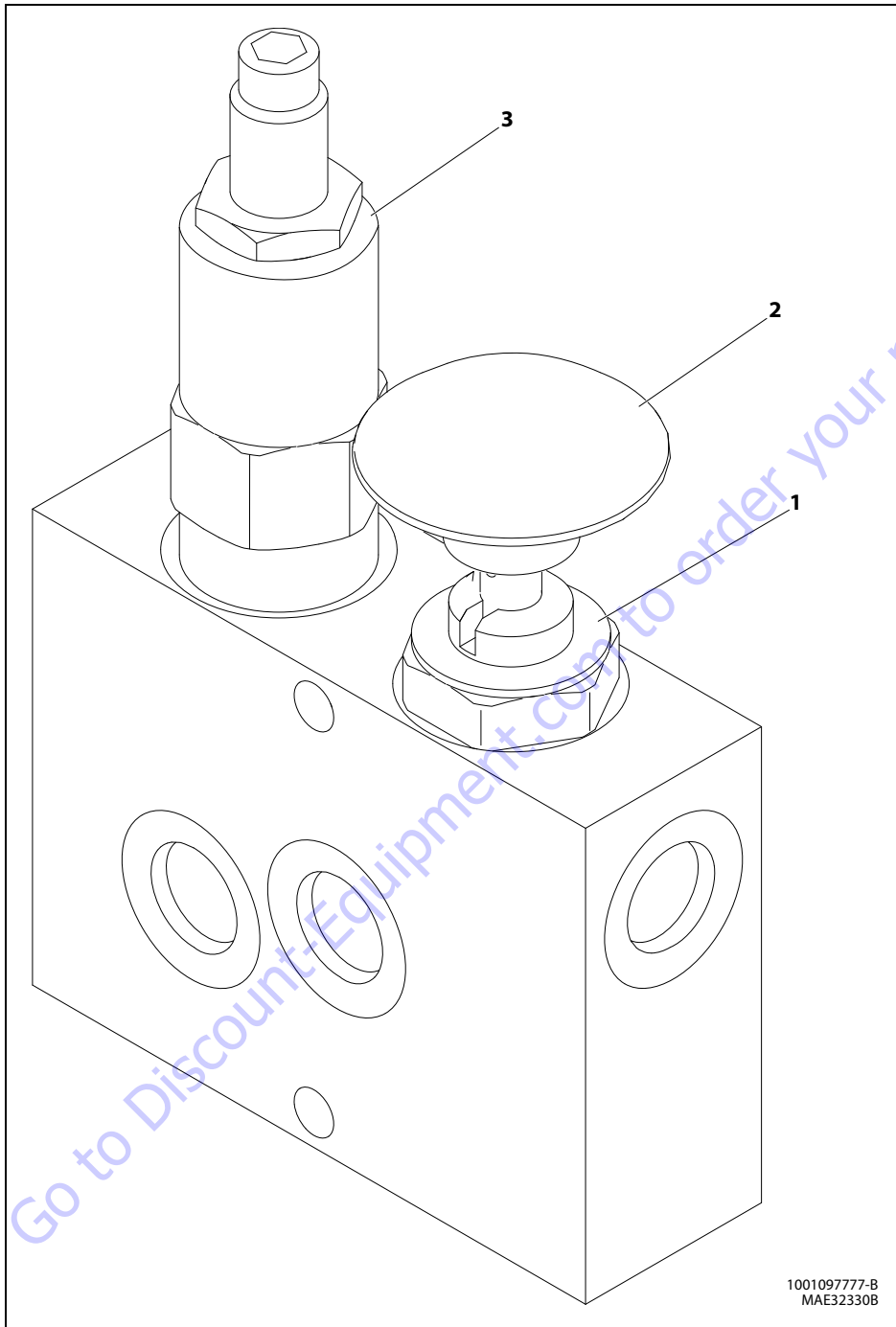


Table 5-37. Cartridge Torque Values

	Ft. Lbs.	Nm
3	20	27

Figure 5-118. Releveling Valve Torque Specification

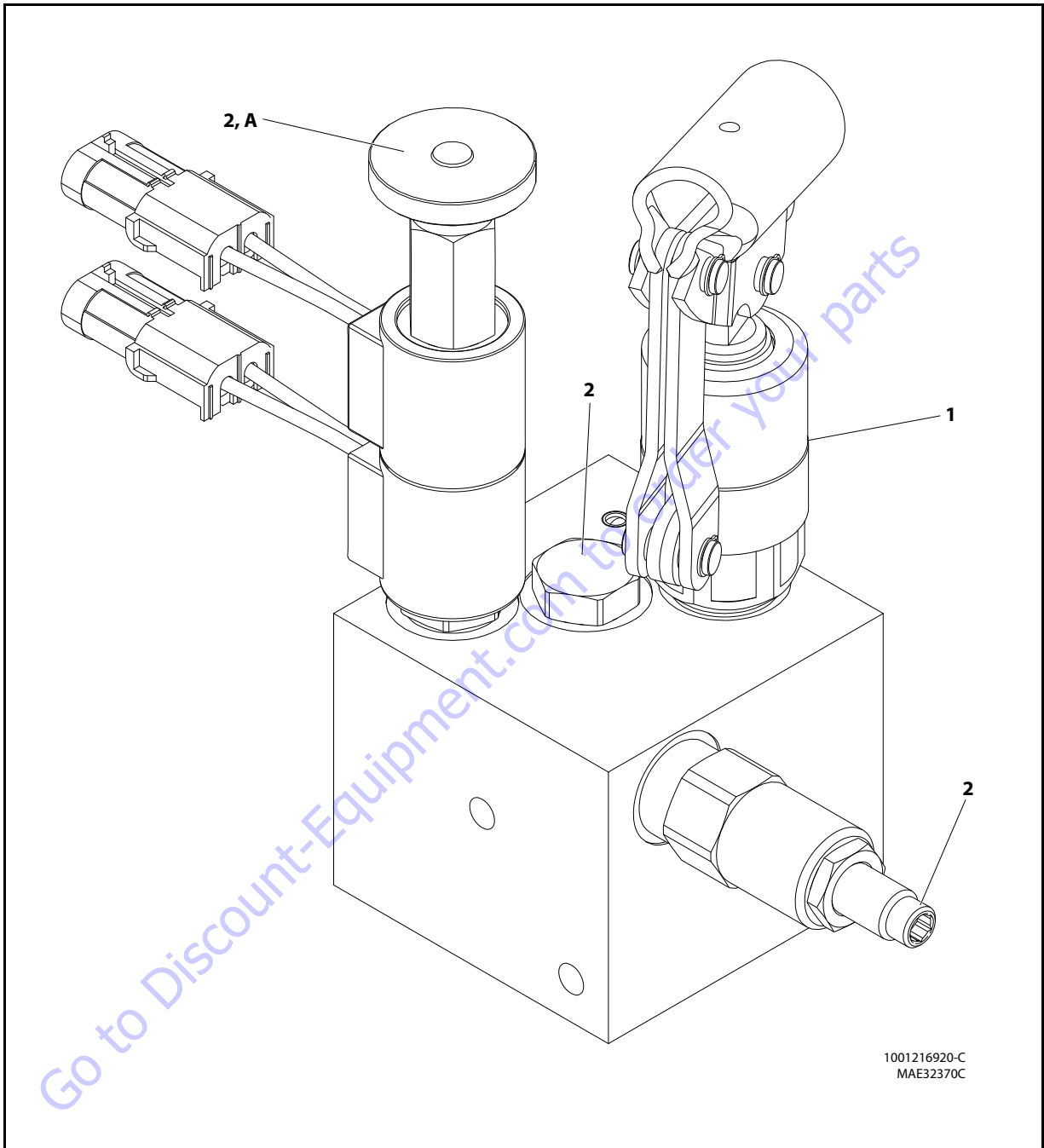


Table 5-38. Cartridge Torque Values

	Ft. Lbs.	Nm
1	25	34
2	20	27

Table 5-39. Coil Resistance Value

	Ohm
A	9.8@20°C

Figure 5-119. Jib Valve Torque Specification

5.7 HYDRAULIC SCHEMATIC

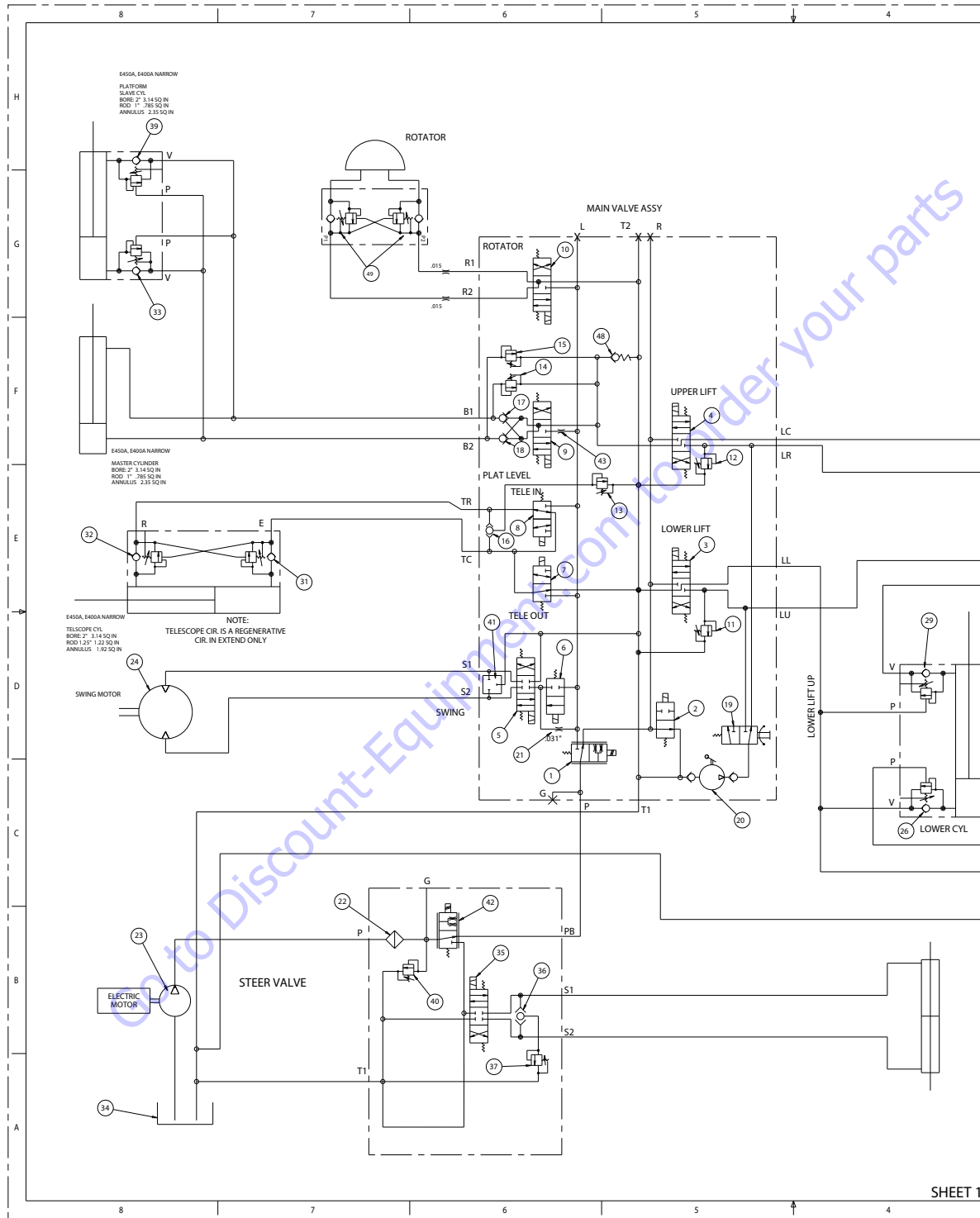


Figure 5-120. Hydraulic Schematic - Sheet 1 of 7

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

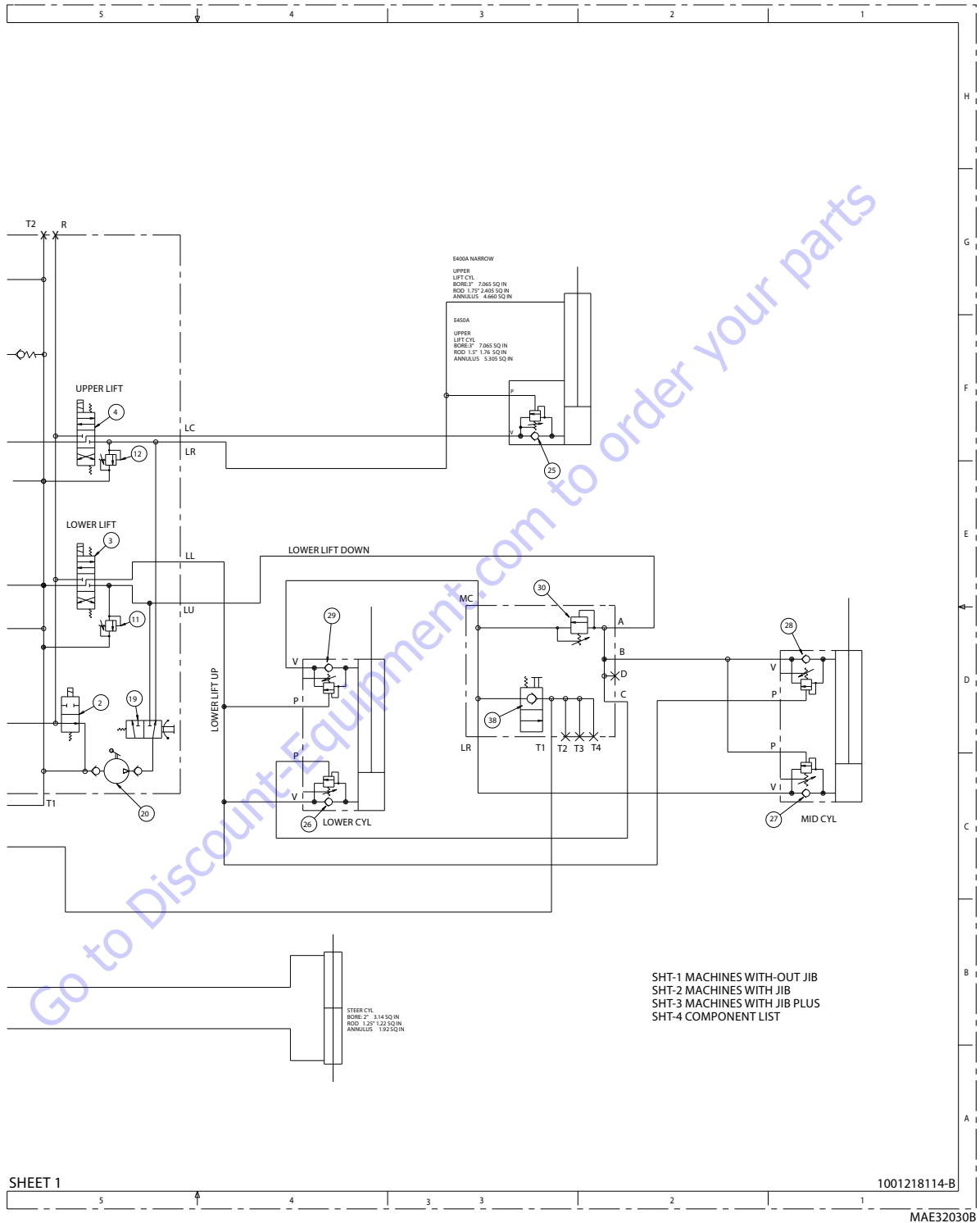


Figure 5-121. Hydraulic Schematic - Sheet 2 of 7

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

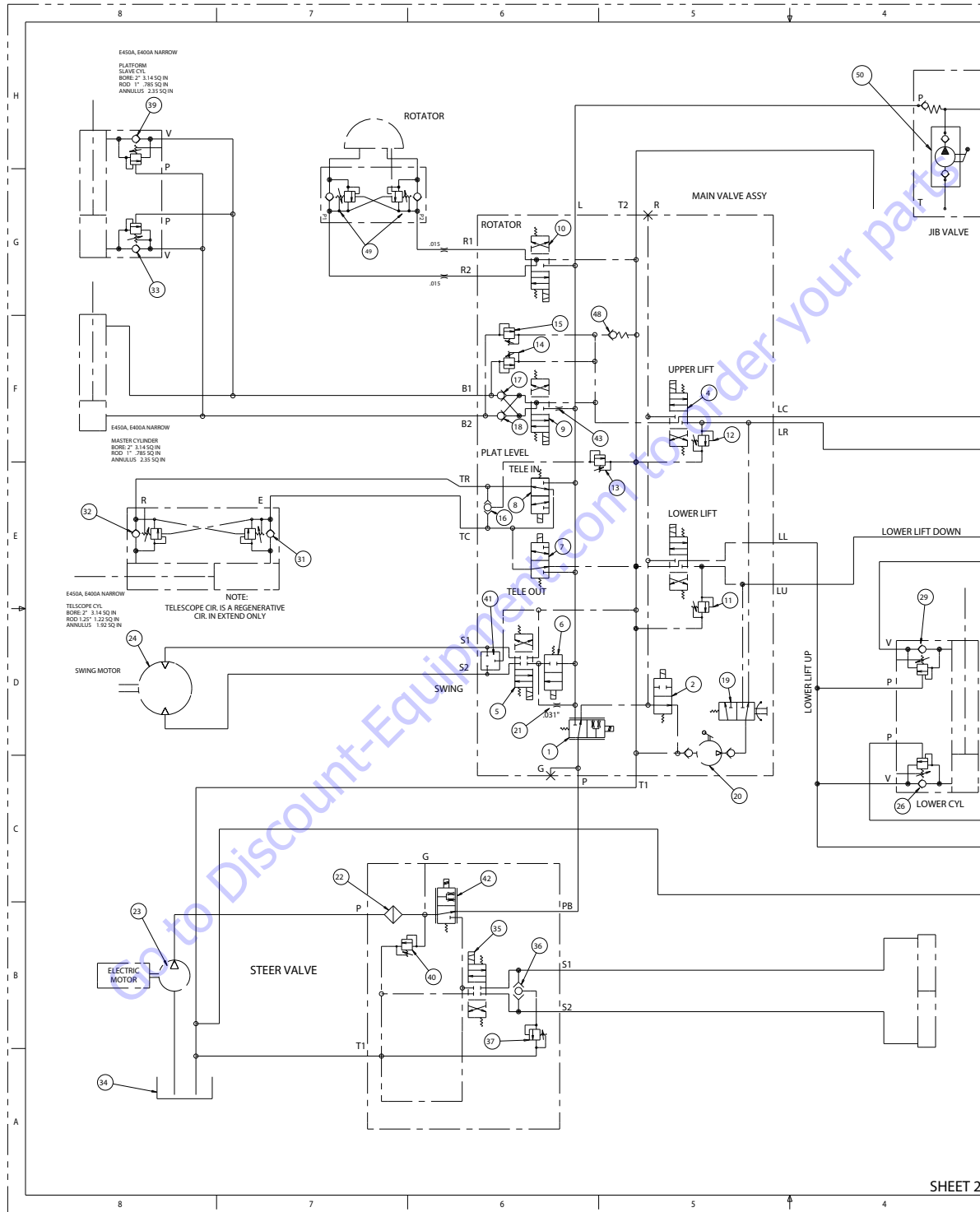


Figure 5-122. Hydraulic Schematic - Sheet 3 of 7

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

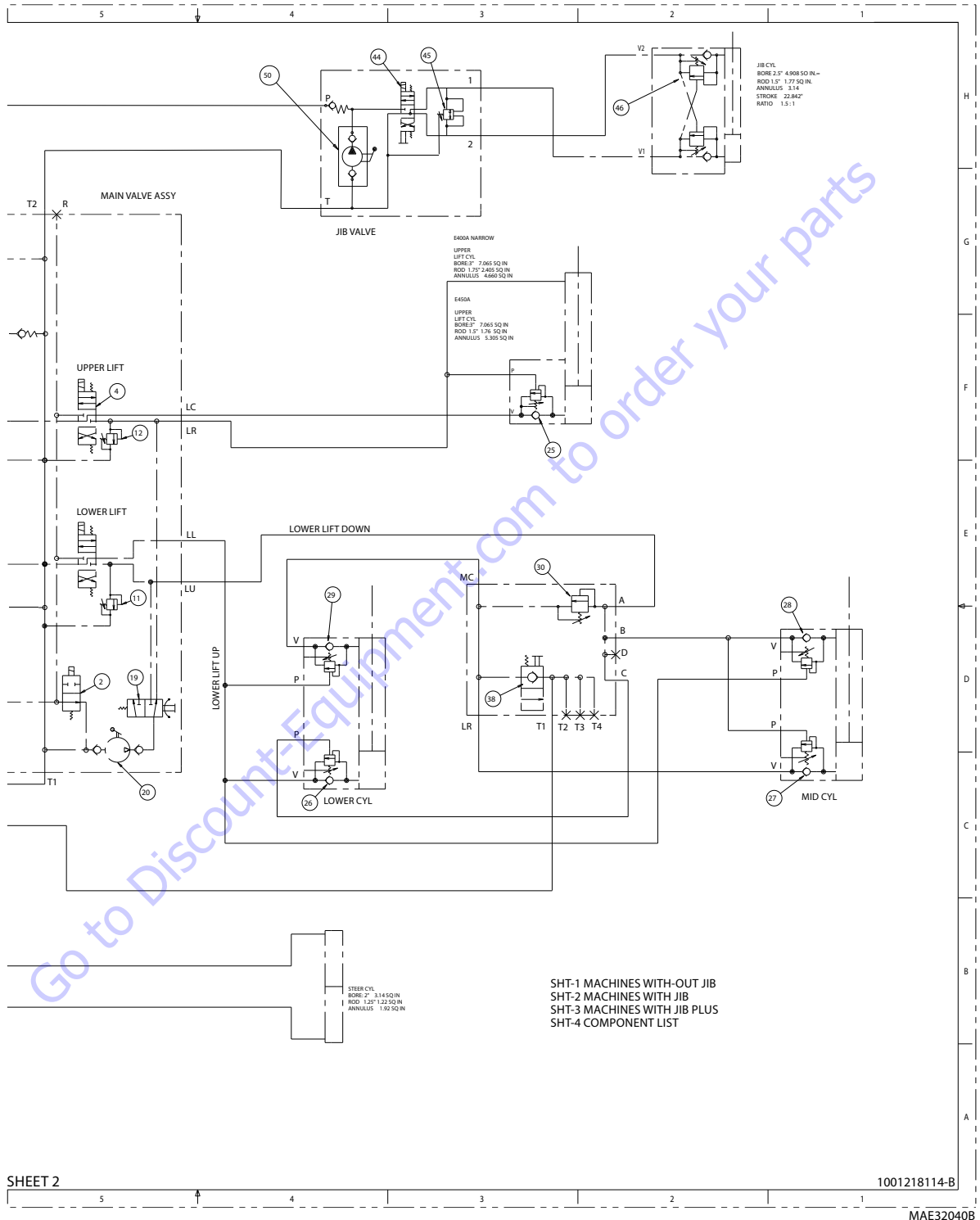
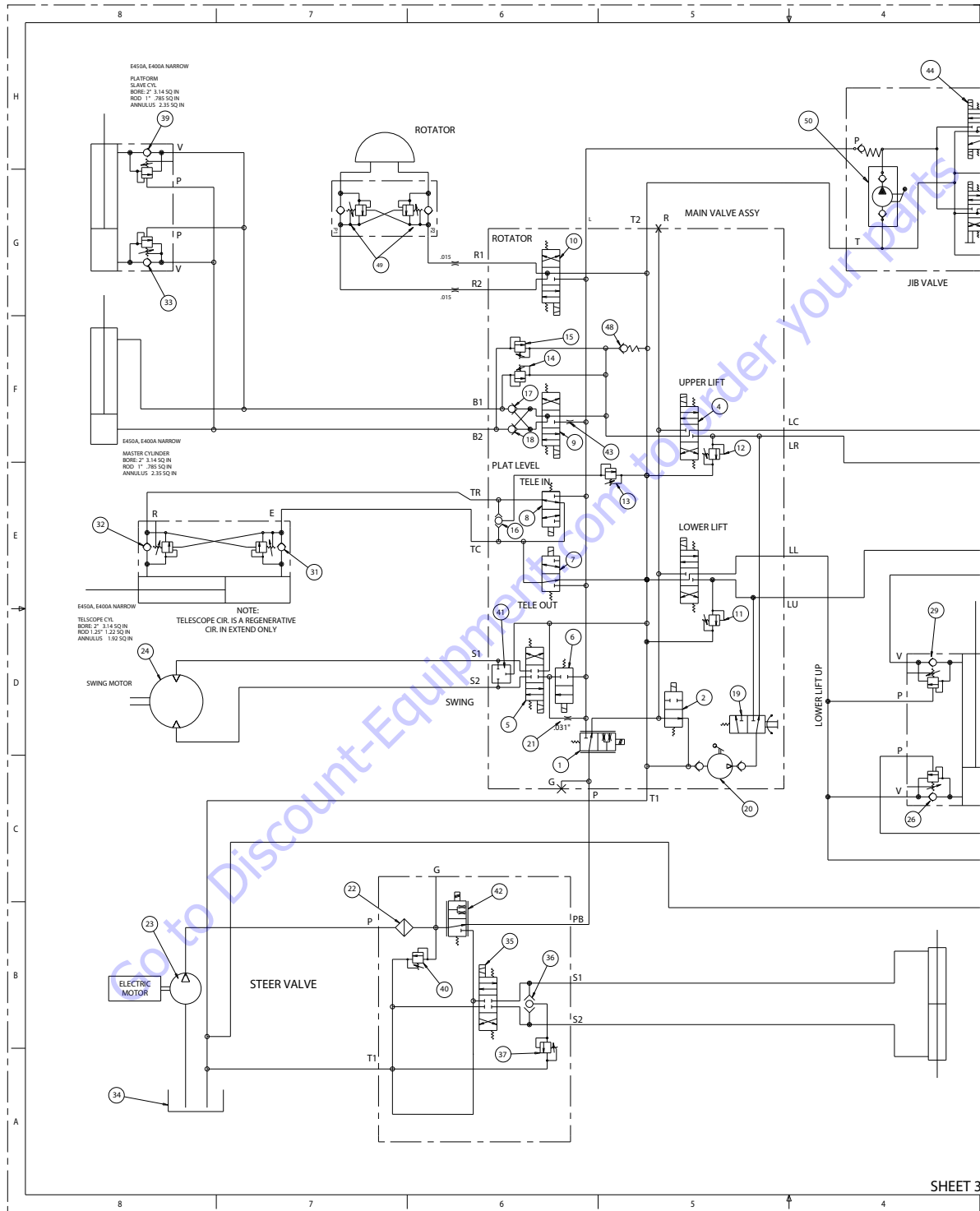


Figure 5-123. Hydraulic Schematic - Sheet 4 of 7

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS



SHEET 3

Figure 5-124. Hydraulic Schematic - Sheet 5 of 7

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

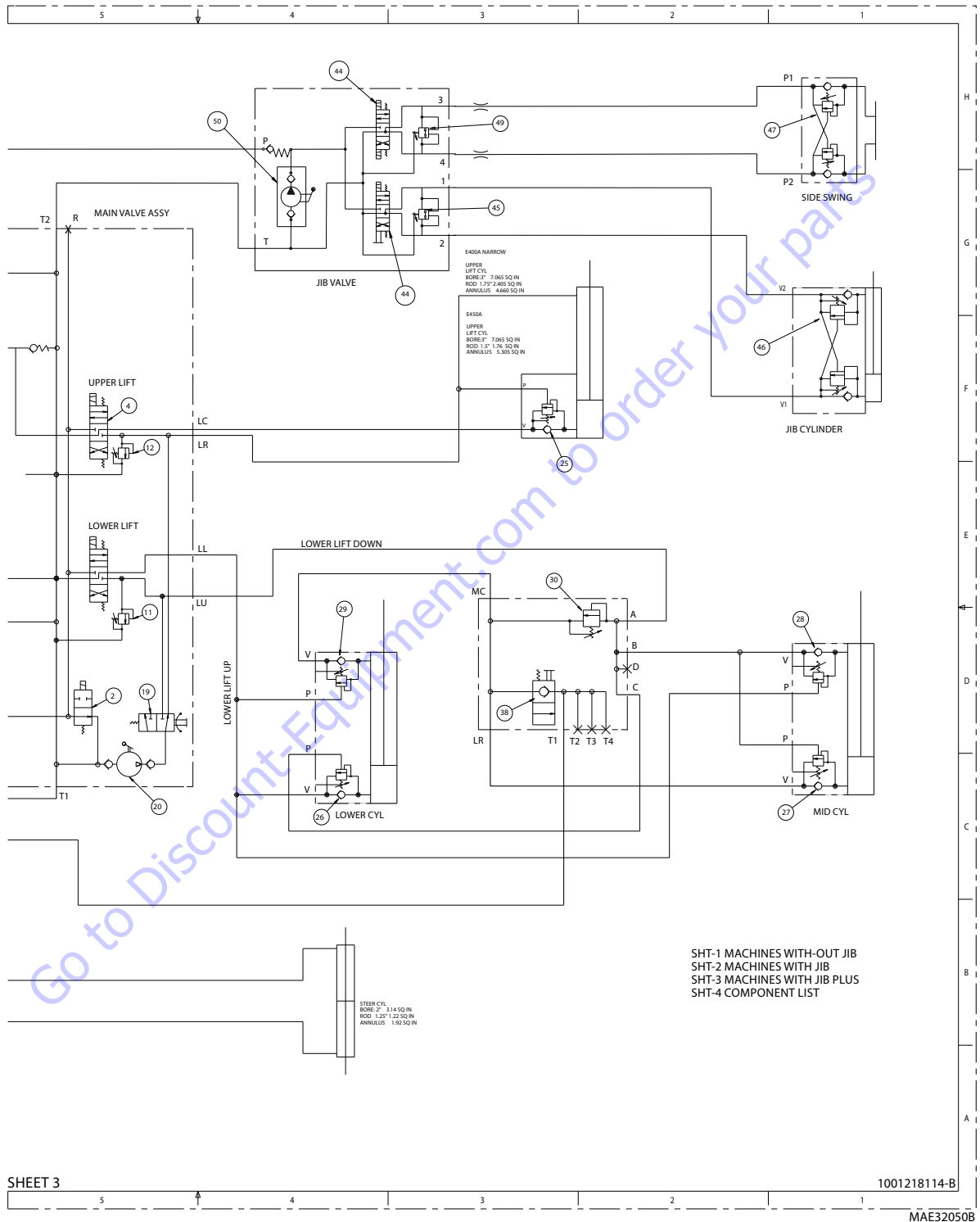


Figure 5-125. Hydraulic Schematic - Sheet 6 of 7

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

COMPONENT LIST	
1.	PROPORTIONAL FLOW REGULATOR, PRESSURE COMPENSATED, PV70-3001B-0-N-12DW
2.	2-POS, 2-WAY POPPET VALVE, NORMALLY OPEN, SV08-21-0-N-12DW (BYPASS UNLOADING)
3.	3-POS, 4-WAY VALVE, SV10-4722E-0-N-12DW, (LOWER LIFT)
4.	3-POS, 4-WAY VALVE, SV10-4722E-0-N-12DW, (UPPER LIFT)
5.	3-POS, 4-WAY VALVE, SV08-47C-0-N-12DW, (SWING)
6.	2-POS, 2-WAY SPOOL VALVE, NORMALLY CLOSED SV08-24-0-N-12DW
7.	2-POS, 3-WAY VALVE, SV10-33-0-N-12DW, (TELESCOPE OUT)
8.	2-POS, 3-WAY VALVE, SV10-33-0-N-12DW, (TELESCOPE IN)
9.	3-POS, 4-WAY VALVE, SV08-47D-0-N-12DW, (PLATFORM LEVEL)
10.	3-POS, 4-WAY VALVE, SV08-47D-0-N-12DW, (ROTATOR)
11.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-N-33/26 (LOWER LIFT DOWN) SET AT 2600 PSI
12.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-N-18/8.0 (UPPER LIFT DOWN) SET AT 800 PSI
13.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-N-33/30 (TELESCOPE) SET AT 3000 PSI
14.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-N-33/12 (PLATFORM LEVEL BACKWARD ROD END) SET AT 1200 PSI
15.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-N-33/30 (PLATFORM LEVEL FORWARD PISTON END) SET AT 3000 PSI
16.	SHUTTLE VALVE, LS08-30-0-N, (TELESCOPE)
17.	PILOT OPERATED CHECK, PC08-30-0-N, (PLATFORM LEVEL, ROD SIDE)
18.	PILOT OPERATED CHECK, PC08-30-0-N, (PLATFORM LEVEL, PISTON SIDE)
19.	ROTARY 2-POS, 3-WAY VALVE, MR10-31-0-N, W/6113160 (EMERGENCY DESCENT)
20.	MANUAL HAND PUMP, HP10-21A-0-N-A (0.47 IN3)
21.	0.031" ORIFICE PLUG
22.	FILTER, HIGH PRESSURE, 10@2 ABSOLUTE G1761
23.	ELECTRIC MOTOR, PUMP ASSEMBLY, 48VDC
24.	MOTOR, GEROTOR TYPE, FIXED 3.2 CU. IN., (SWING)
25.	COUNTERBALANCE CARTRIDGE, 10:1 @@ 3000 PSI, NON-VENTED SPRING
26.	COUNTERBALANCE CARTRIDGE, 1:1 @@ 3500 PSI, VENTED SPRING, SEALED PILOT
27.	COUNTERBALANCE CARTRIDGE, 1:1 @@ 3500 PSI, VENTED SPRING, SEALED PILOT
28.	COUNTERBALANCE CARTRIDGE, 5:1 @@ 4000 PSI, VENTED SPRING, SEALED PILOT
29.	COUNTERBALANCE CARTRIDGE, 5:1 @@ 4000 PSI, VENTED SPRING, SEALED PILOT
30.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-NC-18/22, (LEVELING RELIEF VALVE) SET AT 2200 PSI CRACKING PRESSURE
31.	COUNTERBALANCE CARTRIDGE, 10:1 @@ 2500 PSI, NON-VENTED SPRING
32.	COUNTERBALANCE CARTRIDGE, 5:1 @@ 2500 PSI, VENTED SPRING, SEALED PILOT
33.	COUNTERBALANCE CARTRIDGE, PILOT RATIO: 7:1 (2500 PSI HOLDING, 3300 PSI THERMAL) NON-VENTED SPRING, SEALED PILOT
34.	HYDRAULIC TANK
35.	3-POS, 4-WAY VALVE, SV08-47C-0-N-12DW, (STEER)
36.	SHUTTLE VALVE, LS08-30-0-N (STEER)
37.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-NC-33/14 (STEER) SET AT 1400 PSI
38.	MANUAL, SPRING RETURN, PULL TO OPEN POPPET CARTRIDGE (MP10-20-J)
39.	COUNTERBALANCE CARTRIDGE, PILOT RATIO 10:1 (500 PSI HOLDING, 1200 PSI THERMAL) VENTED SPRING, SEALED PILOT
40.	RELIEF VALVE, DIRECT ACTING, RV58-20A-0-NC-46/32 (SYSTEM RELIEF) SET AT 3200 PSI
41.	CARTRIDGE PLUG CP08-30-0-N
42.	PROPORTIONAL FLOW REGULATOR, PRESSURE COMPENSATED, PV70-30B-0-N-12DW
43.	0.028 ORFICED PLUG
44.	3-POS, 4-WAY VALVE, SV08-47D-0-N-12DW, (JIB)
45.	RELIEF VALVE CRO8A-O-N-30/19 SET AT 2200 PSI
46.	COUNTERBALANCE CARTRIDGE, 7:1 @ 2500 PSI
47.	COUNTERBALANCE CARTRIDGE, 3:1 @ 3000 PSI, NON-VENTED SPRING
48.	CHECK VALVE CV08-20-0-N-60 (SET AT 60 PSI)
49.	RELIEF VALVE, CRO8A-O-N-30/30 SET AT 3000 PSI
50.	PUMP, HP10-21A-0-N-30

SHT-1 MACHINES WITH-OUT JIB
SHT-2 MACHINES WITH JIB
SHT-3 MACHINES WITH JIB PLUS
SHT-4 COMPONENT LIST

SHEET 4

1001218114-B

MAE32060B

Figure 5-126. Hydraulic Schematic - Sheet 7 of 7

PARTS FINDER

**Search Website
by Part Number**



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

Search Manuals

Enter your information to search for a parts manual or lookup a part.

* Brand:

* Model:

* Serial:

* Part Name:

* Quantity:

SEARCH

**Can't Find Part or
Manual? Request Help
by Manufacturer,
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Parts Order Form

Please fill in the following information to request help finding a part or manual.

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Model:

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Click on this link: <http://www.discount-equipment.com/category/5443-parts/> and choose one of the options to help get the right parts and equipment you are looking for. Please have the machine model and serial number available in order to help us get you the correct parts. If you don't find the part on the website or on once of the online manuals, please fill out the request form and one of our experienced staff members will get back to you with a quote for the right part that your machine needs.

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

SECTION 6. JLG CONTROL SYSTEM

6.1 JLG CONTROL SYSTEM ANALYZER KIT
INSTRUCTIONS

Introduction

NOTICE

WHEN INSTALLING A NEW POWER MODULE CONTROLLER ON THE MACHINE, IT WILL BE NECESSARY TO PROGRAM THE CONTROLLER FOR THE PROPER MACHINE CONFIGURATION, INCLUDING OPTIONS.

NOTICE

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

The JLG designed Control System is a 48 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 and max-speed for all boom, drive, and steering functions.

The main lift, swing, and drive are controlled by individual joysticks, with steering being controlled by a rocker switch built into the top the drive joystick. To activate Drive, Lift, and Swing simply pull up on the slide lock location on the joystick and move the handle into the direction desired.

The motor controller will control current output, as programmed for smooth operation and maximum cycle time. Ground control speeds for all boom functions can also be programmed into the motor controller. The motor controller also features an adjustable time limit for positive traction.

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 an hour meter, beacon light, function cutout, and ground alarm. These options may be added later but must be programmed into the motor controller when installed.

The Control System may be accessed in one of two ways: Utilizing a custom designed, hand held analyzer (Analyzer Kit, JLG part no. 2901443) which will display two lines of information at a time, by scrolling through the program.

NOTE: Each module has a label with the JLG part number and a serial number which contains a date code.

The following instructions are for using the hand held analyzer.

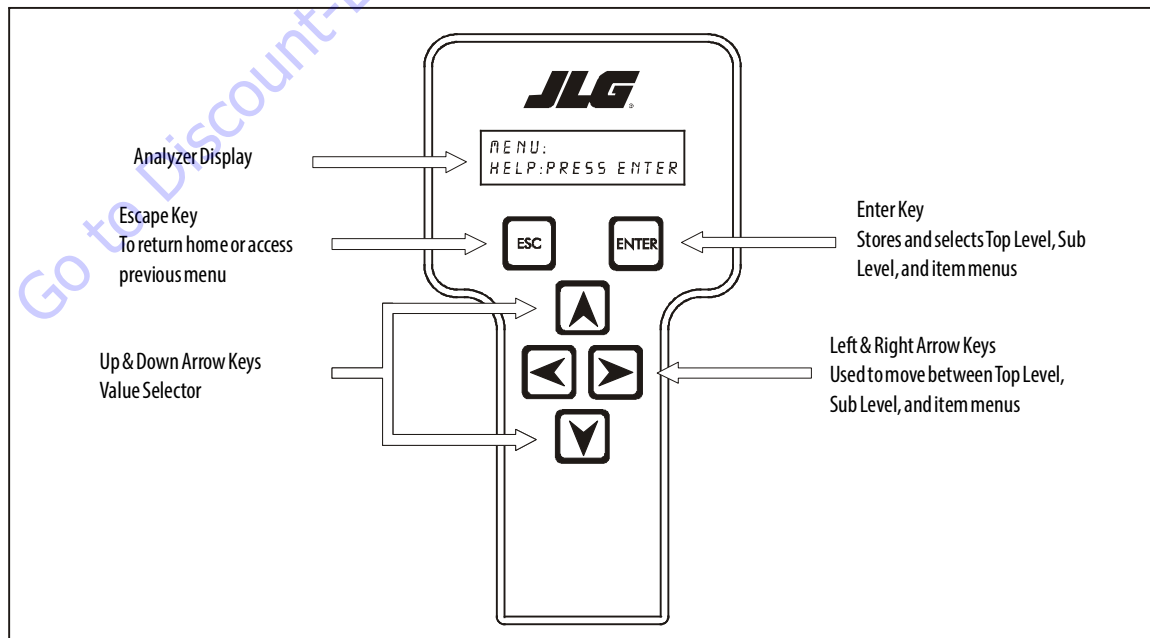


Figure 6-1. Hand Held Analyzer

To Connect the JLG Control System Analyzer

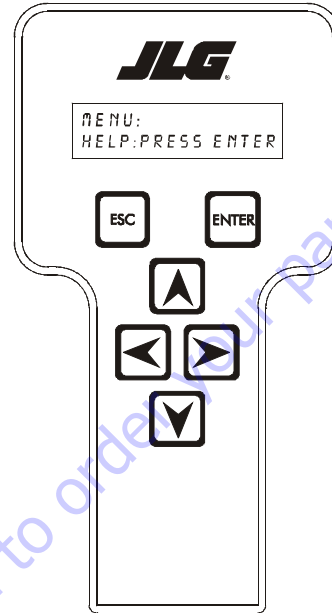
1. Connect the four pin end of the cable supplied with the analyzer, to the motor controller module located in the platform box or at the power module and connect the remaining end of the cable to the analyzer.

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 the Analyzer


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



MENU:
HELP: PRESS ENTER


At this point, using the **RIGHT**  and **LEFT**  arrow keys, you can move between the top level menu items. To


select a displayed menu item, press **ENTER** . To cancel a

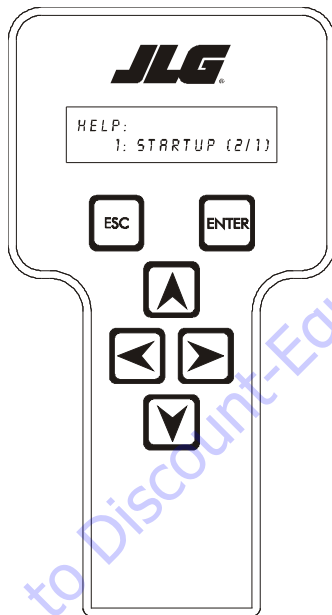
selected menu item, press **ESCAPE** ; then you will be able to scroll using the right and left arrow keys to select a different menu item.

The top level menus are as follows:

- HELP
- DIAGNOSTICS
- SYSTEM TEST
- ACCESS LEVEL
- PERSONALITIES
- MACHINE SETUP
- LEVEL VEHICLE (level 1 only)
- CALIBRATIONS (view only)

If you press **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 will read: **GROUND OK**.

If **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 **ESCAPE** , 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:

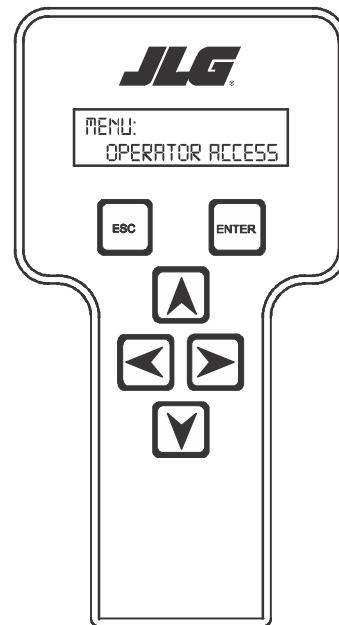
- DRIVE
- BOOM
- SYSTEM
- DATALOG
- VERSIONS

Pressing **ENTER**  with any of the above displayed menus, will display 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**  key.

Changing the Access Level of the Hand Held Analyzer

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




MENU:
OPERATOR ACCESS

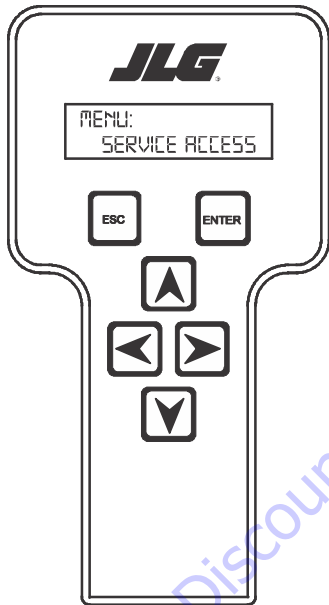
Press **ENTER**  to select the **ACCESS LEVEL** menu.

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

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

Use the **UP**  or **DOWN**  arrow key to enter the second digit of the password which is 33271.

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



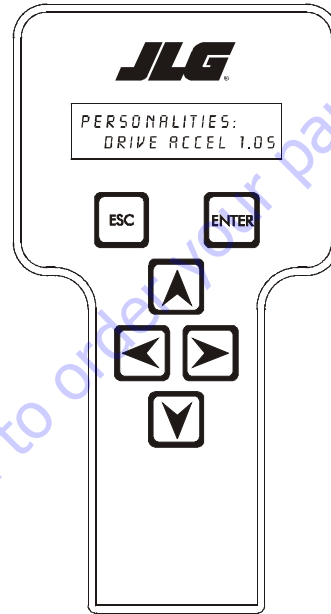
**MENU:
SERVICE ACCESS**

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

Adjusting Parameters Using the Hand Held Analyzer


Once you have gained access to level 1, and a personality item


is selected, press the **UP**  or **DOWN**  arrow keys to adjust its value, for example:





**PERSONALITIES:
DRIVE ACCEL 1.0s**

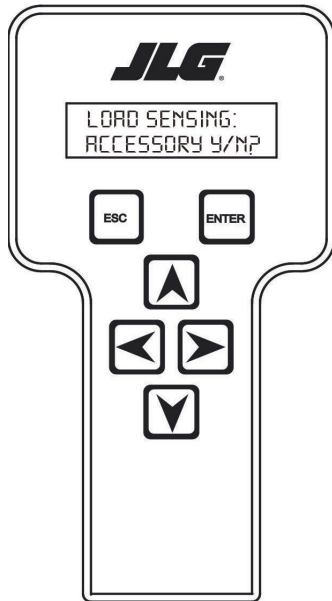
There will be a minimum and maximum for the value to ensure efficient operation. The Value will not increase if the **UP**

 arrow is pressed when at the maximum value nor will

the value decrease if the **DOWN**  arrow is pressed and the value is at the minimum value for any particular personality. If the value does not change when pressing the up and down arrows, check the access level to ensure you are at Service Access.

Machine Setup

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



GROUND ALARM: LIFT DOWN

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 Table 6-4, Personality Ranges/Defaults, and Table 6-5, Machine Setup Descriptions in this Service Manual for the recommended factory settings.

NOTE: Password 33271 will give you access to Service Access, which will permit you to change all machine personality settings.

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

ELEVATION CUTBACK

NOTICE

CHANGING THIS SETTING MAY ADVERSELY AFFECT THE PERFORMANCE OF YOUR MACHINE.

NOTICE

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

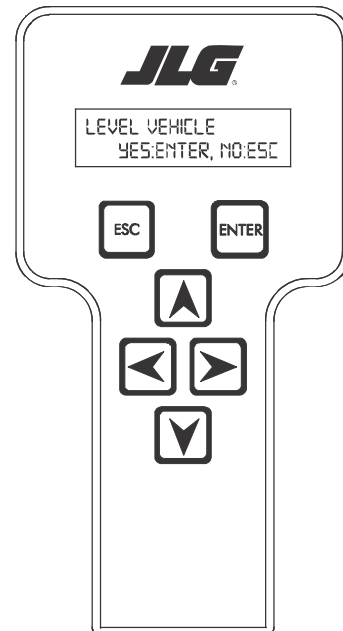
Level Vehicle Description

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 LEVEL VEHICLE EXCEPT ON A LEVEL SURFACE.



LEVEL VEHICLE YES:ENTER, NO:ESC

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

SECTION 6 - JLG CONTROL SYSTEM

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	CUT OUT
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

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SECTION 6 - JLG CONTROL SYSTEM

Table 6-2. Machine Configuration Programming Information - Version P1.10

Configuration Digit	Number	Description	Default Number
<p>NOTE: The machine configuration must be completed before any personality settings can be changed. Changing the personality settings first and then changing the model number of the machine configuration will cause the personality settings to return to default values.</p>			
MODEL NUMBER: 1	1	E300	4- E450
	2	E400	
	3	E400N	
	4	E450	
	5	E600	
MARKET: 2	1	ANSI USA	1
	2	ANSI EXPORT	
	3	CSA	
	4	CE	
	5	AUSTRALIA	
	6	JAPAN	
	7	GB	
BATTERIES: 3*	1	310AH Flooded	2-E400, E450
	2	375AH Flooded	
	3	312AH AGM	
	4	415AH Flooded	
	5	390AH AGM)	
<p>* Certain battery visibilities are dependent on model selection.</p>			

Table 6-2. Machine Configuration Programming Information - Version P1.10

Configuration Digit	Number	Description	Default Number
TILT: 4	1	5 DEGREES+CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also disallows the tower lift up, drive, telescope out and lift up.	4 ANSI USA, ANSI Export, CSA, JAPAN
	2	4 DEGREES+CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also disallows the tower lift up, drive, telescope out and lift up.	
	3	3 DEGREES+CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also disallows the tower lift up, drive, telescope out and lift up.	
	4	5 DEGREES + DRV CUT: Reduces the maximum speed of all boom functions to creep when titled more than 5 degrees and above elevation; also reduces drive speed to creep when drive reversal is allowed, drive is disallowed otherwise.	
	5	4 DEGREES+ DRV CUT: Reduces the maximum speed of all boom functions to creep when titled more than 4 degrees and above elevation; also reduces drive speed to creep when drive reversal is allowed, drive is disallowed otherwise.	
	6	3 DEGREES+ DRV CUT: Reduces the maximum speed of all boom functions to creep when titled more than 3 degrees and above elevation; also reduces drive speed to creep when drive reversal is allowed, drive is disallowed otherwise.	
GROUND ALARM: 5	1	NO: No ground alarm installed.	4
	2	DRIVE: Travel alarm sounds when the drive function is active.	
	3	DESCENT: Descent alarm sounds when lift down is active.	
	4	MOTION: Motion alarm sounds when any function is active.	
ALARM/HORN 6	1	SEPERATE: Ambient alarm installed	2
	2	COMBINED: Single Horn / Alarm installed	
JIB: 7	1	NO: No jib installed.	2
	2	YES: Jib installed which has up and down movements only.	
JIBSWING: 8	1	NO: No jibswing installed.	2
	2	YES: Jib installed which has side to side movements.	

SECTION 6 - JLG CONTROL SYSTEM

Table 6-2. Machine Configuration Programming Information - Version P1.10

Configuration Digit	Number	Description	Default Number
SKYGUARD: 9	1	NO: No Sky Guard system installed.	2
	2	YES: Sky Guard system installed.	
SOFT TOUCH: 10	1	NO: No Soft Touch system installed.	1
	2	YES: Soft Touch system installed.	
H&T LIGHTS: 11	1	NO: No head and tail lights installed.	1
	2	YES: head and tail lights installed	
LOAD SYSTEM: 12*	1	NO: No load sensor installed.	1
	2	WARN ONLY: Functions in creep, overload lamp lit, platform alarm beeps(5 sec ON, 2 sec OFF).	
	3	CUTOUT PLATFORM: All functions cutout, overload lamp lit, platform alarm beeps(5 SECON, 2 SEC OFF).	
	4	CUTOUT ALL: All functions cutout, flash overload light (500 mS on, 500 mS off), platform alarm beeps(5 SECON, 2 SEC OFF).	
* Only visible under certain market selections. * Certain market selections will limit load system options or alter default setting.			
FUNCTION CUTOUT: 13*	1	NO: No drive cutout.	1
	2	BOOM CUTOUT: Boom function cutout while driving above elevation.	
	3	DRIVE CUTOUT: Drive and steer cutout above elevation.	
* Only visible under certain market selections. * Certain market selections will limit load system options or alter default setting.			
DISPLAY UNITS: 14	1	METRIC	1 CSA, CE, AUS, JAPAN, GB
	2	IMPERIAL	

Table 6-2. Machine Configuration Programming Information - Version P1.10

Configuration Digit	Number	Description	Default Number
ALERT BECON: 15*	1	OFF FOR CREEP.	1
	2	20 FPM FOR CREEP.	
* Only visible if Skyguard is selected.			
TEMP OUTPUT: 16*	1	NO:	1
	2	YES: Low temp cutout system is installed.	
* Certain market selection will display temp cutout options.			
WHEEL DRIVE: 17*	1	4WD: Front wheel assist (4WD) system is installed	2
	2	2WD: Front wheel assist (4WD) system is not installed.	
* Only visible if E600 model is selected.			
CHARGER INTERLOCK: 18	1	DRIVE ONLY: Drive function is disabled when battery charger is plugged in.	1
	2	CUTOUT ALL: Drive and bottom function is disabled when battery charger is plugged in.	
PLAT LVL OVR CUT: 19	1	NO: Platform level functions above elevation.	1
	2	YES: Platform level does not function above elevation.	

1001201628-D

SECTION 6 - JLG CONTROL SYSTEM

Table 6-3. Machine Configuration Programming Settings - Version P1.10

E450	ANSI USA	ANSI Export	CSA	CE	Australia	Japan	GB
Model Number	4	4	4	4	4	4	4
Market	1	2	3	4	5	6	7
Batteries	X	X	X	X	X	X	X
	2	2	2	2	2	2	2
	3	3	3	3	3	3	3
	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
Tilt	1	1	1	X	X	1	X
	2	2	2	X	X	2	X
	3	3	3	3	3	3	3
	4	4	4	X	X	4	X
	5	5	5	X	X	5	X
	6	6	6	6	6	6	6
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
Alarm/Horn	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
Jib Swing	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
Skyguard	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
Head & Tail Lights	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
Load System	X	1	X	1	1	1	1
	X	2	X	X	X	2	X
	X	3	X	X	3	3	X
	X	4	X	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

Table 6-3. Machine Configuration Programming Settings - Version P1.10

E450	ANSI USA	ANSI Export	CSA	CE	Australia	Japan	GB
Display Units	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
Alert Beacon	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
Temp Cutout	X	1	X	1	X	X	1
	X	2	X	2	X	X	2
Wheel Drive	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
Charger Interlock	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
Plat Lvl Ovr Cut	1	1	1	1	1	1	1
	2	2	2	2	2	2	2

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

1001201628-D

6.2 MACHINE PERSONALITY SETTINGS

NOTE: Personality settings can be adjusted within the adjustment range in order to achieve optimum machine performance.

Table 6-4. Personality Ranges/Defaults

FUNCTION	PERSONALITY	RANGE	DEFAULTS
DRIVE	ACCEleration	0.5s to 5.0s	2.0s
	DECEleration	0.3s to 5.0s	3.0s
	DECEleration to stop	0.3s to 2.0s	1.0s
	MAXimum Forward speed	75 to 100%	100%
	REDUCED MAXimum speed MAXimum Reverse Drive	50 to 74%	60%
	ELEVATED MAXimum speed (ANSI)	5 to 15%	7%
	ELEVATED MAXimum speed (CE)	5 to 15%	7%
	CREEP MAXimum speed	5 to 15%	7%
STEER	ACCEleration	0.1 to 5.0s	2.0s
	DECEleration	0.1 to 5.0s	0.3s
	MINimum LEFT speed	20 to 40%	20%
	MAXimum LEFT speed	50 to 90%	60%
	MINimum RIGHT speed	20 to 40%	20%
	MAXimum RIGHT speed	50 to 90%	60%
SWING	ACCEleration	0.1 to 5.0s	2.5s
	DECEleration	0.1 to 5.0s	2.5s
	MINimum LEFT speed	1 to 15%	1%
	MAXimum LEFT speed	36 to 80%	60%
	CREEP Maximum LEFT speed	16 to 35%	20%
	MINimum RIGHT speed	1 to 15%	1%
	MAXimum RIGHT speed	36 to 80%	60%
	CREEP maximum RIGHT speed	16 to 35%	20%

Table 6-4. Personality Ranges/Defaults

FUNCTION	PERSONALITY	RANGE	DEFAULTS
BOOMLIFT	ACCEleration	0.1 to 5.0s	2.5s
	DECEleration	0.1 to 5.0s	2.5s
	MINimum UP speed	1 to 15%	1%
	MAXimum UP speed	36 to 80%	65%
	CREEP maximum UP speed	16 to 35%	30%
	MINimum DOWN speed	1 to 15%	1%
	MAXimum DOWN speed	36 to 80%	40%
	CREEP maximum DOWN speed	16 to 35%	20%
TOWERLIFT	ACCEleration	0.1 to 5.0s	3s
	DECEleration	0.1 to 5.0s	1s
	MINimum UP speed	1 to 15%	15%
	MAXimum UP speed	51 to 100%	85%
	CREEP maximum UP speed	16 to 50%	30%
	MINimum DOWN speed	1 to 15%	15%
	MAXimum DOWN speed	51 to 80%	55%
	CREEP maximum DOWN speed	16 to 50%	30%
TELESCOPE	ACCEleration	0.1 to 5.0s	1.5s
	DECEleration	0.1 to 5.0s	1.5s
	MINimum IN speed	1 to 15%	1%
	MAXimum IN speed	61 to 100%	80%
	CREEP maximum IN speed	16 to 60%	45%
	MINimum OUT speed	1 to 15%	1%
	MAXimum OUT speed	61 to 100%	100%
	CREEP maximum OUT speed	16 to 60%	50%

Table 6-4. Personality Ranges/Defaults

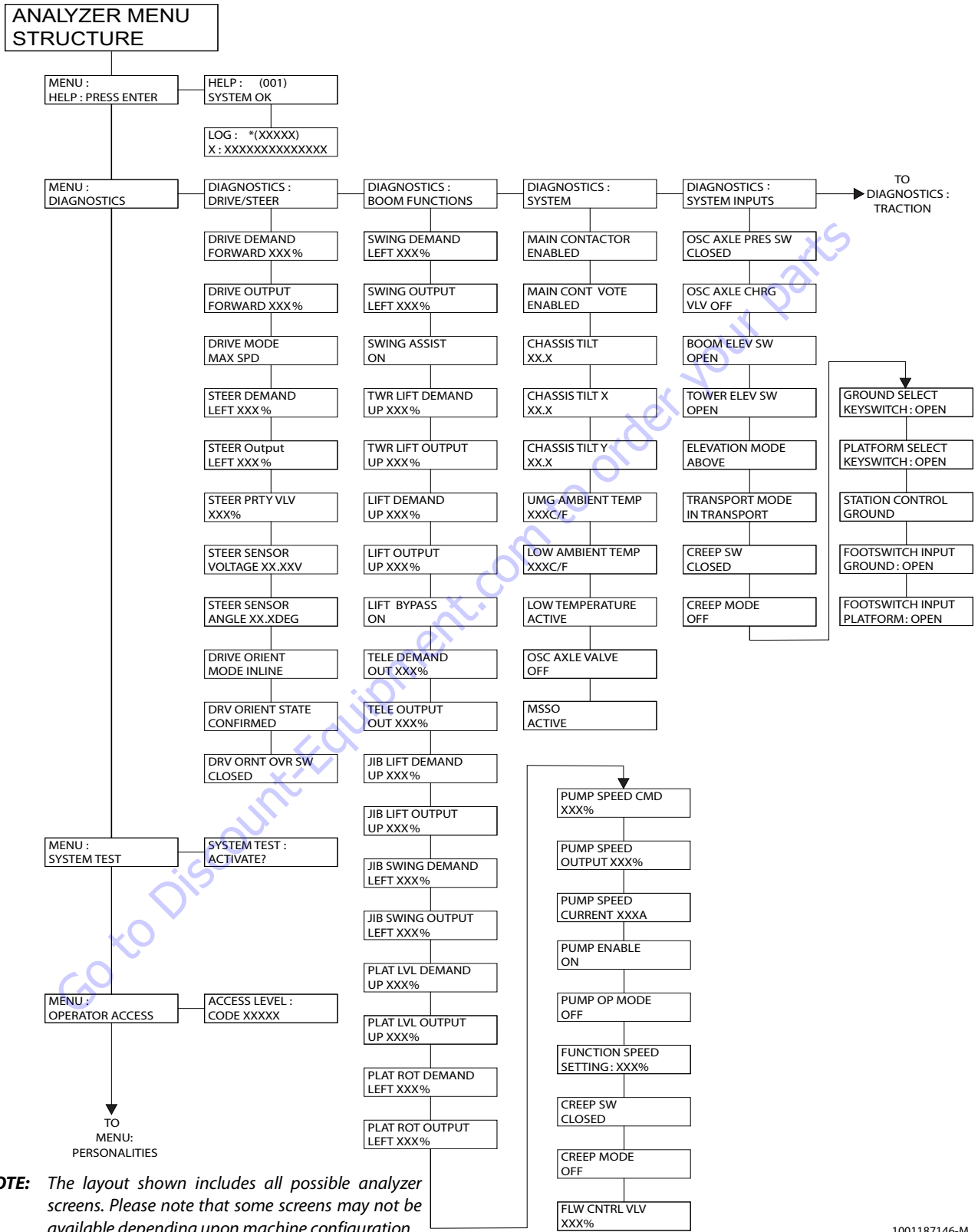
FUNCTION	PERSONALITY	RANGE	DEFAULTS
JIB LIFT	ACCEleration	0.1 to 5.0s	1.2s
	DECEleration	0.1 to 5.0s	0.5s
	MINimum UP speed	1 to 15%	1%
	MAXimum UP speed	41 to 80%	60%
	CREEP maximum UP speed	16 to 35%	35%
	MINimum DOWN speed	1 to 15%	1%
	MAXimum DOWN speed	41 to 80%	45%
	CREEP maximum DOWN speed	16 to 35%	30%
JIB SWING	ACCEleration	0.1 to 5.0s	2.0s
	DECEleration	0.1 to 5.0s	1.0s
	MINimum LEFT speed	1 to 15%	1%
	MAXimum LEFT speed	41 to 75%	50%
	CREEP Maximum LEFT speed	16 to 40%	25%
	MINimum RIGHT speed	1 to 15%	1%
	MAXimum RIGHT speed	41 to 75%	50%
	CREEP maximum RIGHT speed	16 to 40%	25%
PLATFORM LEVEL	ACCEleration	0.1 to 5.0s	1.0s
	DECEleration	0.1 to 5.0s	0.5s
	MINimum UP speed	1 to 15%	1%
	MAXimum UP speed	36 to 60%	40%
	CREEP maximum UP speed	16 to 35%	20%
	MINimum DOWN speed	1 to 15%	1%
	MAXimum DOWN speed	36 to 60%	40%
	CREEP maximum DOWN speed	16 to 35%	20%

SECTION 6 - JLG CONTROL SYSTEM

Table 6-4. Personality Ranges/Defaults

FUNCTION	PERSONALITY	RANGE	DEFAULTS
PLATFORM ROTATE	ACCEleration	0.1 to 5.0s	1.5s
	DECEleration	0.1 to 5.0s	1.5s
	MINimum LEFT speed	1 to 15%	1%
	MAXimum LEFT speed	25 to 50%	30%
	CREEP Maximum LEFT speed	16 to 20%	20%
	MINimum RIGHT speed	1 to 15%	1%
	MAXimum RIGHT speed	25 to 50%	30%
	CREEP maximum RIGHT speed	16 to 20%	20%
GROUND MODE	Swing	36 to 80%	50%
	Tower UP	51 to 100%	80%
	Tower Down	51 to 80%	54%
	Lift UP	36 to 80%	60%
	Lift DOWN	36 to 80%	38%
	Telescope IN	61 to 100%	75%
	Telescope OUT	61 to 100%	90%
	Jib UP	41 to 80%	55%
	Jib DOWN	41 to 80%	42%
	Jib SWING	41 to 75%	45%
	Platform LEVEL	36 to 80%	38%
	Platform ROTATE	25 to 50%	28%
ALARM/HORN	Volume HORN	25 to 100%	100%
	Volume ALARM	25 to 100%	75%
TEMPERATURE CUT	LOW Cutout set	-30 to 0C	-30C
	OFFset	0 to 10C	5C

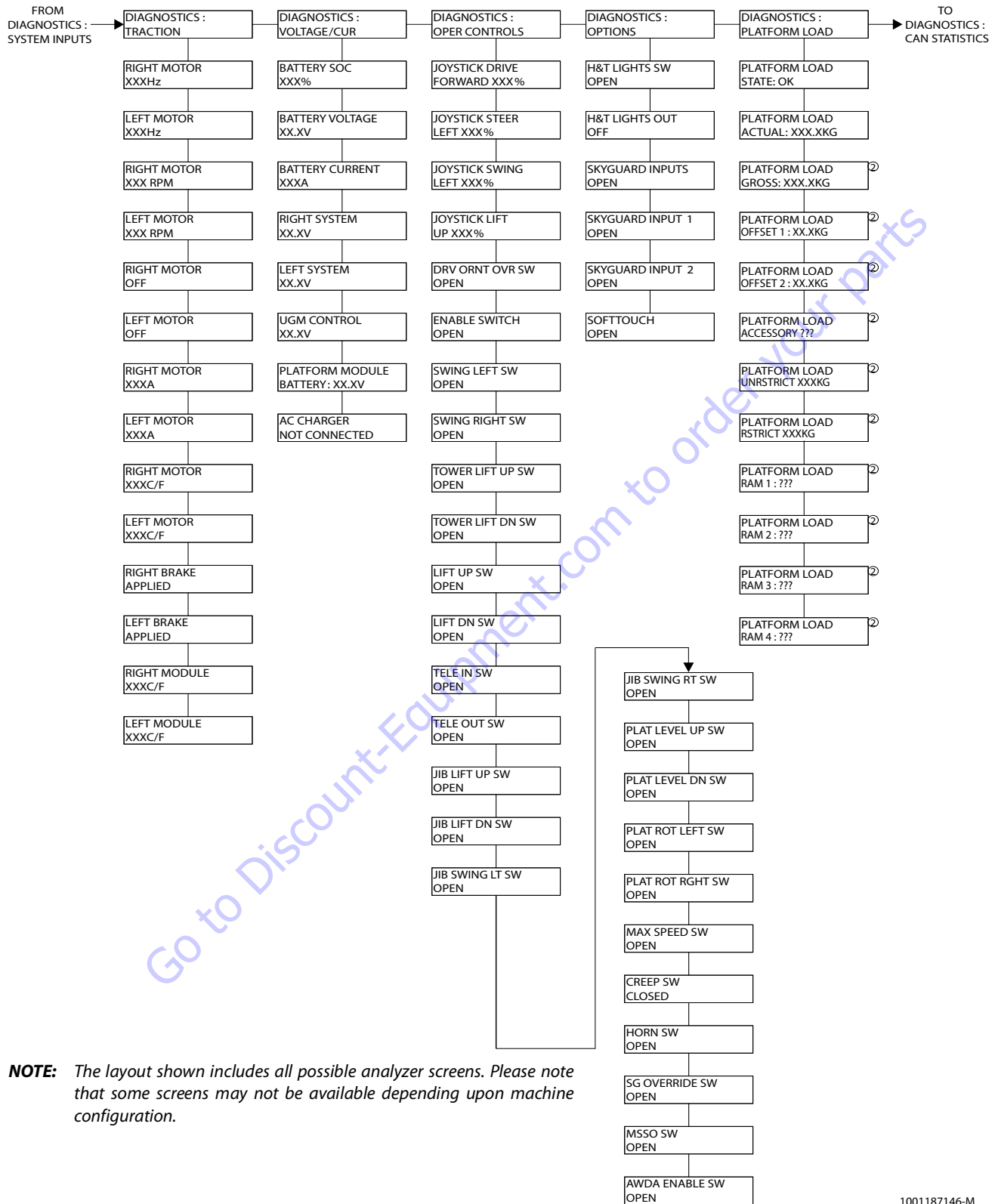
1001250453-A



1001187146-M
MAE31770M

Figure 6-2. Analyzer Software P1.10 - Sheet 1 of 5

SECTION 6 - JLG CONTROL SYSTEM



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

Figure 6-3. Analyzer Software P1.10 - Sheet 2 of 5

1001187146-M
MAE31780M