4. Install retract wire ropes into rear end of fly section, route wire ropes through holes in side of fly boom section and pull into slot.

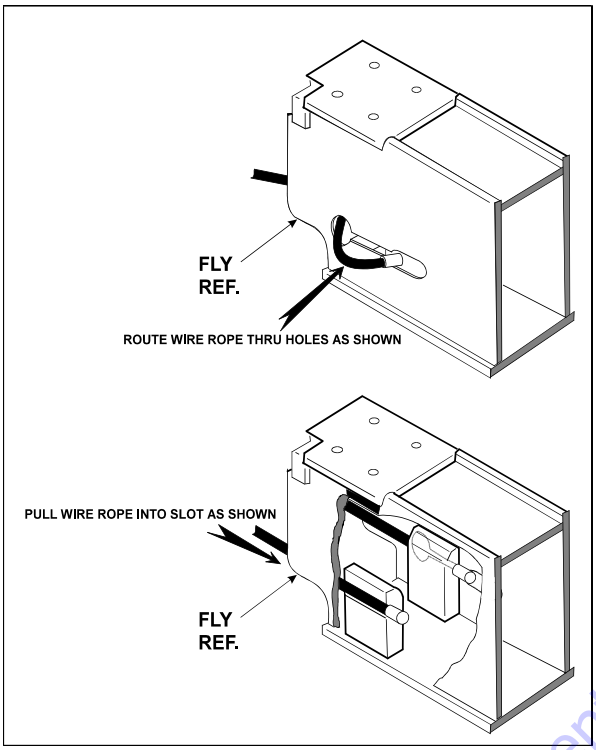



**Figure 4-14. Routing Installation of Retract Wire Ropes**

5. Install side, top and bottom wear pads to the rear end of mid section; shim evenly to the measurements of the inside of mid section.

**NOTICE**

**WHEN ASSEMBLING BOOM SECTIONS, ENSURE THAT THE BOOM SLIDING TRAJECTORIES HAVE BEEN CLEARED OF CHAINS, TOOLS, AND OTHER OBSTRUCTIONS.**

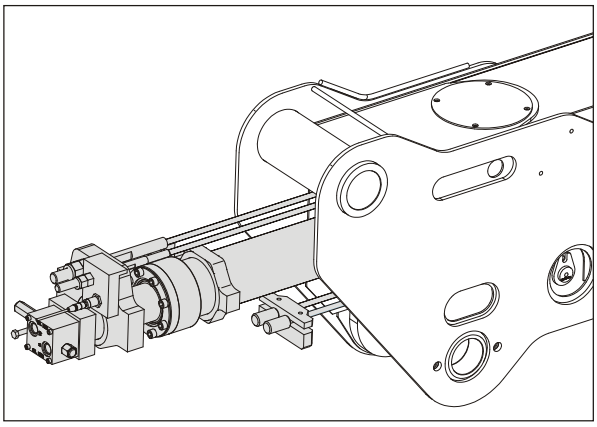
6. Shim the insides of the boom sections for a total of 1/16 inch (0.062) clearance (if the action is centered, there will be 1/32 clearance on each side).
7. Slide fly boom section into the mid boom section. Shim boom, if necessary, for a total of 1/16 inch (0.062) clearance.
8. Install wear pads into the forward position of the mid boom section. Shim boom, if necessary, for a total of 2/10 inch (0.20) clearance.
9. Properly position the retraction wire rope sheaves assemblies at the rear end of the mid boom section; ensure all sheave-to-mounting block attachment holes align. Install the sheave pins and secure them with mounting hardware. Position retract wire ropes onto the sheaves.
10. Install sheave guards to rear end of mid boom section and secure with mounting hardware.
11. Slide mid boom section into the base boom section. Allow the retraction wire ropes to trail between the bottom surfaces of boom sections. Shim boom, if necessary, for a total of 1/16 inch (0.062) clearance.
12. Install wear pads into the forward position of the base boom section. Shim boom, if necessary, for a total of 2/10 inch (0.20) clearance.
13. Install sheave block to bottom of base boom section and adjust block so that retract wire ropes do not come into contact with boom surfaces.
14. Install wire rope threaded ends through attachment holes in the bottom of base boom section. Loosely install nuts and jam nuts onto the threaded ends of wire ropes.
15. Pull the boom sections out to approximately where they were extended to for telescope cylinder removal.
16. Install a new extend sheave on the end of the telescope cylinder.
17. Route new extend cables around the telescope cylinder. Loosely fasten the threaded end of the cables to the rod end of the telescope cylinder with the adjusting nuts and lock nuts. Install the opposite end of the cables in the cable mount block.
18. Use tape or tie straps to fasten the cables to the telescope cylinder assembly. It is important that the tape or straps be strong enough to hold the cable in place yet weak enough to break and fall away when the cables are adjusted.

**NOTICE**

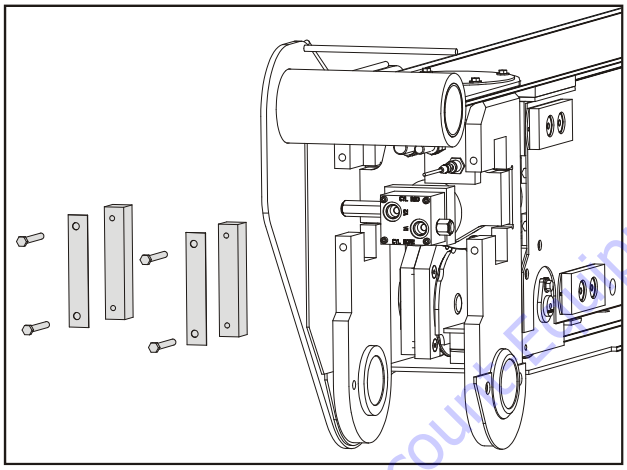
**WHEN PUSHING THE TELESCOPE CYLINDER INTO THE BOOM, IT MAY BE NECESSARY AT SOME POINT TO TURN THE CYLINDER SLIGHTLY IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY INTO THE BOOM. DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.**

***NOTE:*** *The telescope cylinder weighs approximately 600 lbs. (272 kg).*

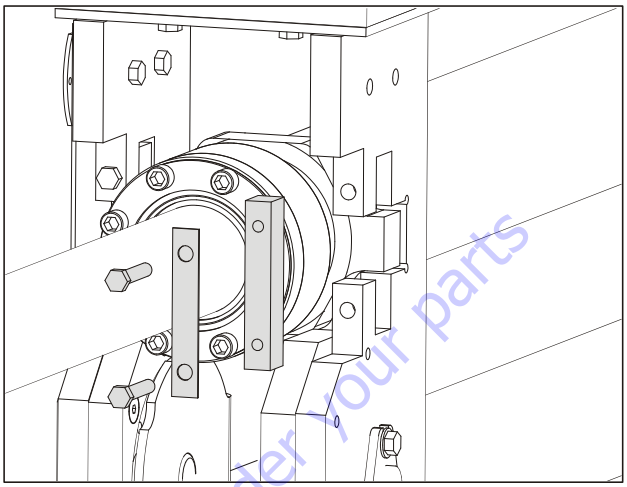
**19.** Using adequate lifting equipment, carefully push the telescope cylinder assembly and cables back into the boom.



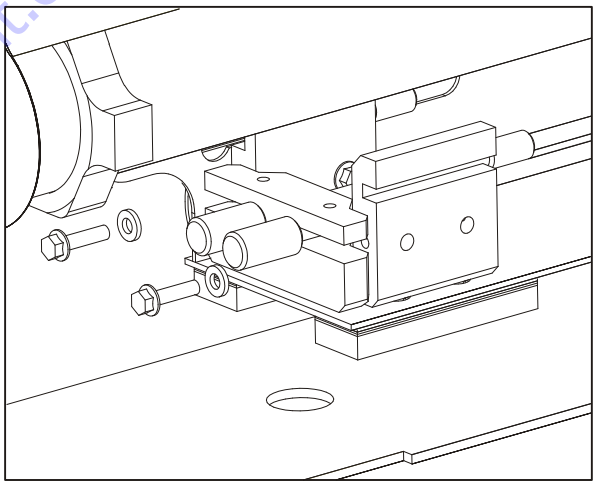
**20.** Apply JLG Threadlocker P/N 0100011 to the bolts and fasten the telescope cylinder rod to the boom base section with the bolts, shims, mounting blocks.



**21.** Apply JLG Threadlocker P/N 0100011 to the bolts and fasten the telescope cylinder barrel to the boom mid section with the bolts, shims, mounting blocks.



**22.** Using a 3/8 drive extension approximately 4 ft. (1.2 m) long, install the bolts and washers securing the cable mount block to the boom fly section. Tape the bolts to the socket at the end of the extension to prevent it from coming out of the socket before it engages the mounting threads.



**23.** Connect all the hydraulic lines to the cylinder as tagged during the removal procedure.

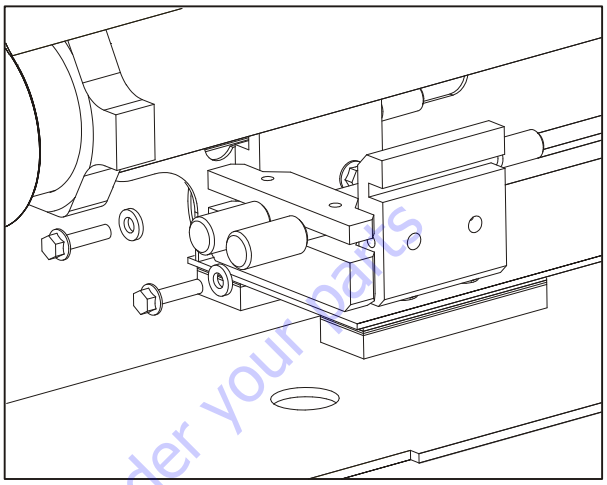
**24.** Adjust the boom cables as outlined under Section 4.7, Boom Rope Torquing Procedures.

## Installation

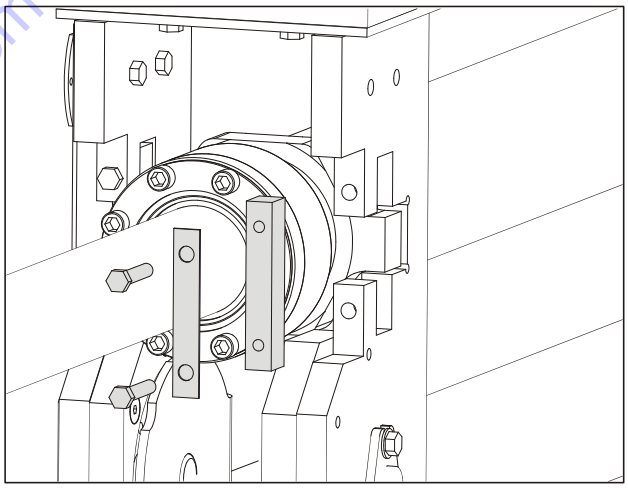
1. Using a suitable lifting device, position boom assembly on upright so that the pivot holes in both boom and upright are aligned.
2. Install boom pivot pin, ensuring that location of hole in pin is aligned with attach point on upright.
3. If necessary, gently tap pin into position with soft headed mallet. Secure pin mounting hardware.
4. Connect all wiring to the ground control box.
5. Connect all hydraulic lines running along side of boom assembly.
6. Using all applicable safety precautions, operate lifting device in order to position boom lift cylinder so that holes in the cylinder rod end and boom structure are aligned. Insert the lift cylinder pin, ensuring that location of hole in pin is aligned with attach point on boom.
7. Align holes in boom structure with hole in master cylinder. Insert the master cylinder pin, ensuring that location of hole in pin is aligned with attach point on boom.
8. Adjust retract and extend cables to the proper torque. Refer to Section 4.7, Boom Rope Torquing Procedures.
9. Using all applicable safety precautions, operate machine systems and raise and extend boom fully, noting the performance of the extension cycle.
10. Retract and lower boom, noting the performance of the retraction cycle.

## Telescope Cylinder/Boom Cable Removal

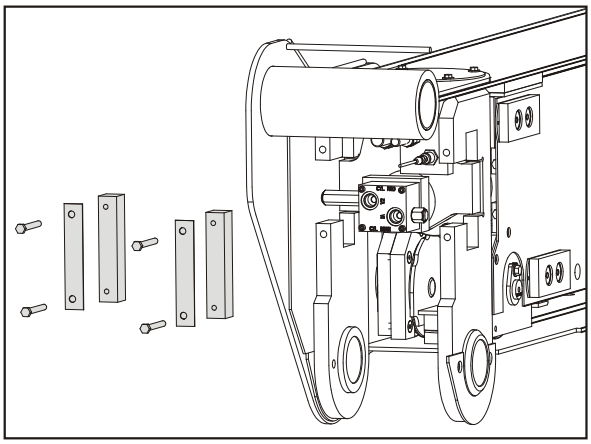
1. Make sure the machine is on a firm, level surface.
2. Raise the boom to a horizontal position.
3. Extend the boom approximately 2 ft. (0.6 m). This will enable access to the bolts that secure the cable mount block to the boom fly section.
4. Tag and disconnect all hydraulic hoses running to the telescope cylinder. Cap or plug all openings to prevent any foreign matter from entering the hydraulic system.
5. Using a 3/8 drive extension approximately 4 ft. (1.2 m) long, remove the bolts and washers securing the cable mount block to the boom fly section.



6. Remove the four bolts, shims, and attachment blocks that secure the telescope cylinder barrel to the boom mid section.



7. Remove the four bolts, shims, and mounting blocks that secure the telescope cylinder rod to the boom base section.

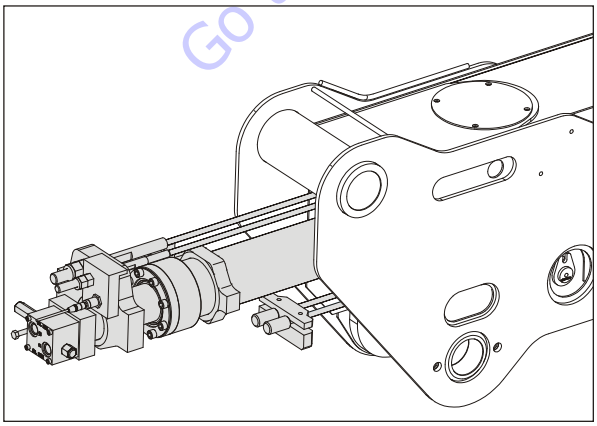


**NOTICE**

**WHEN REMOVING THE TELESCOPE CYLINDER FROM THE BOOM, IT MAY BE NECESSARY AT SOME POINT TO TURN THE CYLINDER SLIGHTLY IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY FROM THE BOOM. DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.**

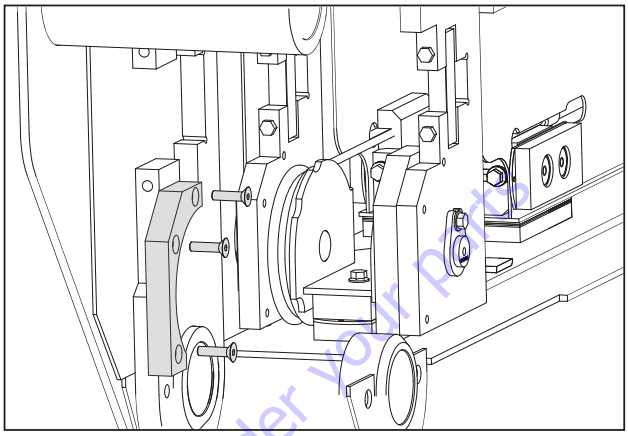
***NOTE:*** *The telescope cylinder weighs approximately 600 lbs. (272 kg).*

8. Using overhead cranes or other suitable lifting/supporting devices, carefully pull the telescope cylinder out from the back of the boom. At the same time, also pull the cable mount block out so the extension cables come out with the telescope cylinder and do not bind. The lifting/supporting devices will have to be repositioned to support the weight of the cylinder as it is drawn out of the boom.

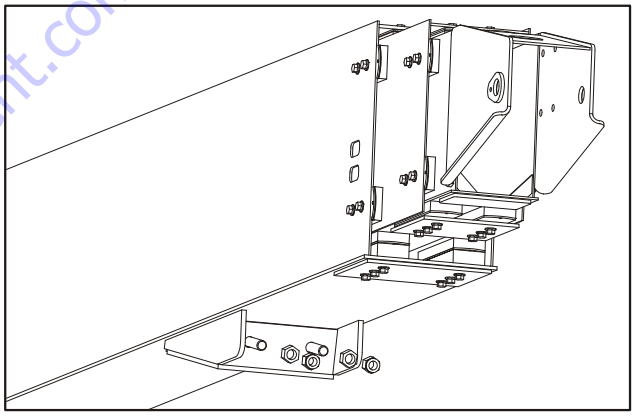


9. Push the boom fly sections back in to gain access to the boom retraction cable.

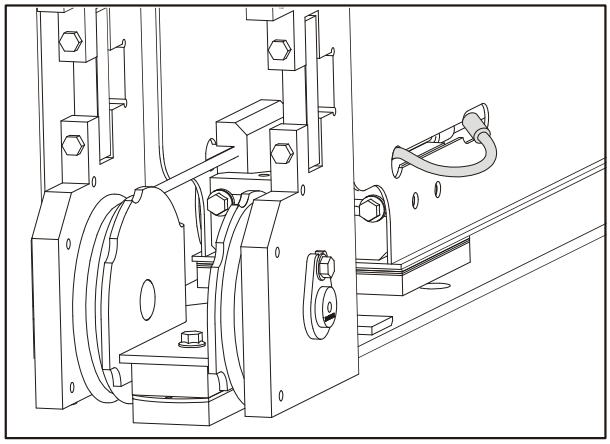
10. Remove the screws securing the sheave guards to the boom mid section and remove the sheave guards.



11. Remove the adjusting nuts and lock nuts from the opposite end of the retraction cables at the front of the boom base section. To aid in installing new retraction cables, fasten a length of tie wire as long as the retraction cables to the ends of the cables.



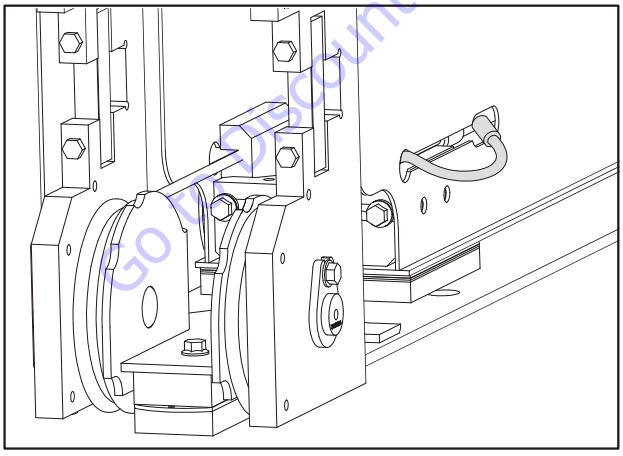
12. Twist the ends of the retraction cables to remove the ends of the cables from the slots in the side of the boom fly section.



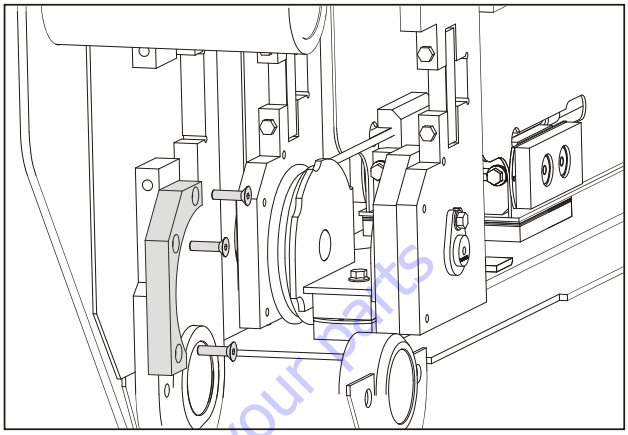
13. From the rear of the boom, pull out the boom retraction cables.

## Telescope Cylinder/Boom Cable Installation

1. Attach the threaded end of the new retraction cables to the tie wires used in the removal procedure.
2. From the front of the boom, pull the retraction cables through the boom and through the attachment holes in the bottom of the boom base section. Loosely install the adjustment nuts and jam nuts.
3. Install new retract sheaves, then route the opposite end of the retraction cables around the sheaves. Push the ends of the cables through the slots in the side of the boom fly section.



4. Install the sheave guards and secure them in place with the retaining screws.



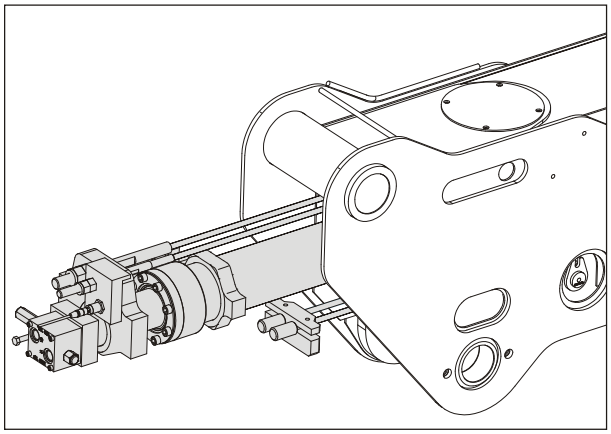
5. Pull the boom sections out to approximately where they were extended to for telescope cylinder removal.
6. Install a new extend sheave on the end of the telescope cylinder.
7. Route new extend cables around the telescope cylinder. Loosely fasten the threaded end of the cables to the rod end of the telescope cylinder with the adjusting nuts and lock nuts. Install the opposite end of the cables in the cable mount block.
8. Use tape or tie straps to fasten the cables to the telescope cylinder assembly. It is important that the tape or straps be strong enough to hold the cable in place yet weak enough to break and fall away when the cables are adjusted.

**NOTICE**

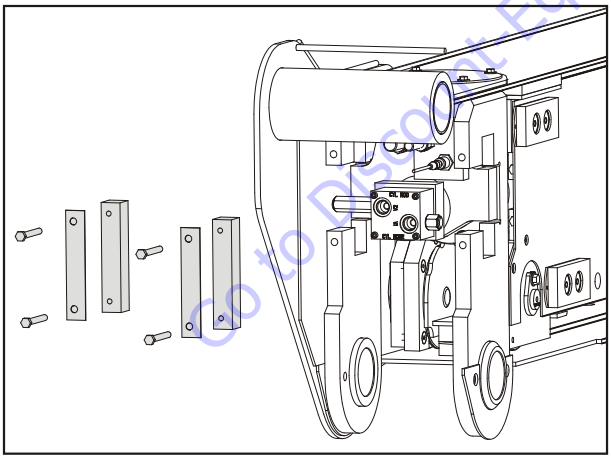
**WHEN PUSHING THE TELESCOPE CYLINDER INTO THE BOOM, IT MAY BE NECESSARY AT SOME POINT TO TURN THE CYLINDER SLIGHTLY IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY INTO THE BOOM. DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.**

***NOTE:*** *The telescope cylinder weighs approximately600 lbs. (272 kg).*

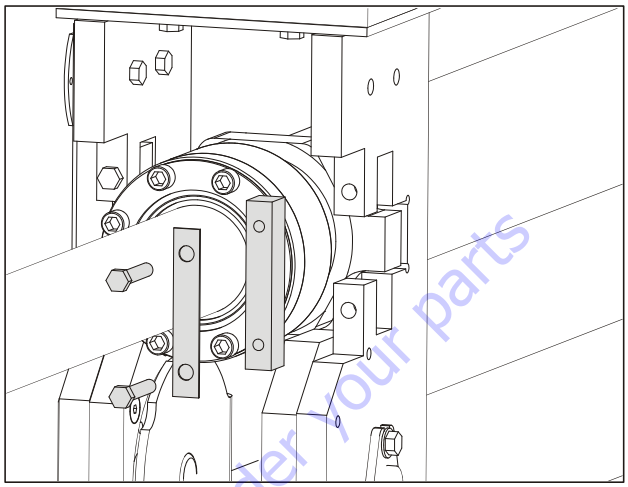
**9.** Using adequate lifting equipment, carefully push the telescope cylinder assembly and cables back into the boom.



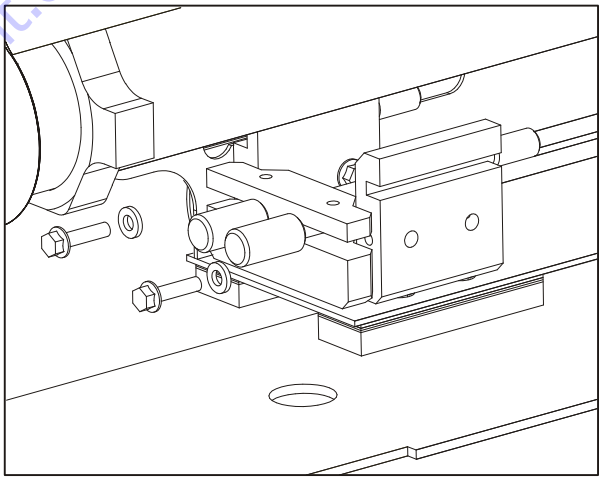
**10.** Apply JLG Threadlocker P/N 0100011 to the bolts and fasten the telescope cylinder rod to the boom base section with the bolts, shims, mounting blocks.



**11.** Apply JLG Threadlocker P/N 0100011 to the bolts and fasten the telescope cylinder barrel to the boom mid section with the bolts, shims, mounting blocks.



**12.** Using a 3/8 drive extension approximately 4 ft. (1.2 m) long, install the bolts and washers securing the cable mount block to the boom fly section. Tape the bolts to the socket at the end of the extension to prevent it from coming out of the socket before it engages the mounting threads.



**13.** Connect all the hydraulic lines to the cylinder as tagged during the removal procedure.

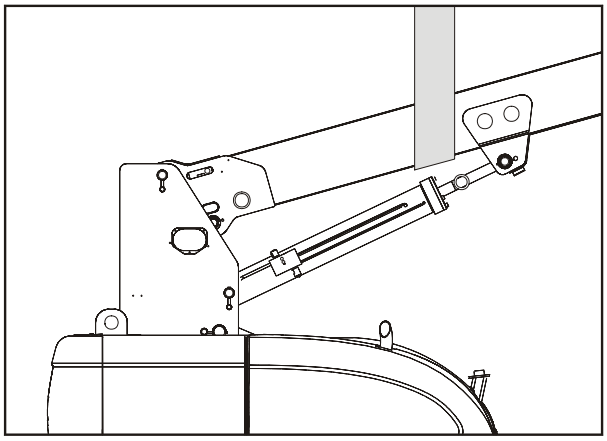
**14.** Adjust the boom cables as outlined under Section 4.7, Boom Rope Torquing Procedures.

**15.** Run the boom through all lift and telescope functions and check for proper operation or any leakage.

## Lift Cylinder Removal

1. Elevate the boom enough to gain access to the lift cylinder lower pivot pin.
2. Use an adequate supporting device to support the weight of the boom and associated components as shown below.

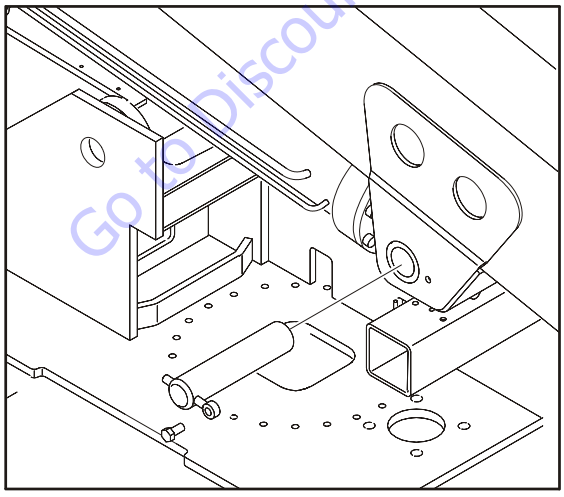
***NOTE:*** *The supporting device must be able to support approximately 5350 lbs (2430 kg).*



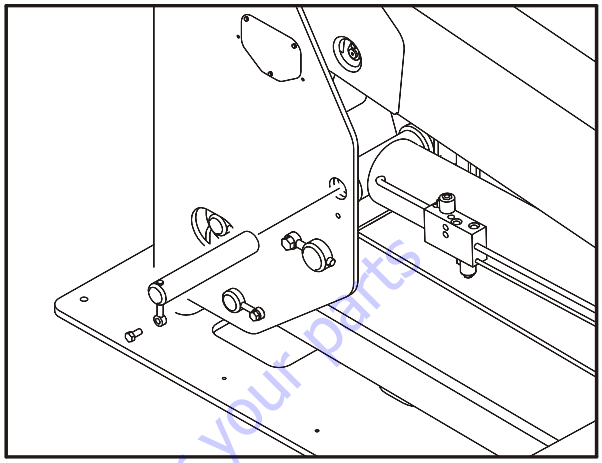
3. Tag and disconnect the hydraulic hoses from the lift cylinder.
4. Use an adequate lifting device to support the lift cylinder.

***NOTE:*** *The lift cylinder weighs approximately 618 lbs (280 kg).*

5. Remove the bolt and keeper pin securing the main lift cylinder pivot pin and remove the pivot pin.



6. Remove the bolt and keeper pin securing the lower lift cylinder pivot pin and remove the pivot pin.



7. Using the lifting device, slide the lift cylinder back enough to allow the cylinder end to clear the attachment point on the boom.
8. Slide the lift cylinder sideways enough to remove it from the machine.

## Lift Cylinder Installation

1. Using an adequate lifting device, position the lift cylinder in the machine in the same manner that it was removed.
2. Install the lower pivot pin and secure it in place with the keeper pin and bolt.
3. Connect the hydraulic lines to the cylinder as tagged during removal.
4. Extend the cylinder rod until it aligns with the attachment point on the boom. Take care not to extend the cylinder rod too far.
5. Install the main lift cylinder pivot pin and secure it in place with the keeper pin and bolt.
6. Remove the supporting device and function check the boom to make sure the lift cylinder operates properly and there are no leaks.

## 4.6 WIRE ROPE

**⚠ CAUTION**

**WIRE ROPE CAN HAVE SHARP EDGES AND CAUSE SERIOUS INJURY. NEVER HANDLE WIRE ROPE WITH BARE HANDS.**

Each day before using machine:

1. Raise main boom approximately horizontal.
2. Extend and retract the boom sections.
3. Check for delayed movement of fly section which indicates loose wire ropes.

**⚠ WARNING**

**IF DELAYED MOVEMENT IS DETECTED IN WIRE ROPE OPERATION, LOWER PLATFORM TO STOWED POSITION, SHUT DOWN MACHINE, AND HAVE WIRE ROPES INSPECTED/SERVICED BY A QUALIFIED JLG MECHANIC. LOOSE OR MISADJUSTED WIRE ROPES COULD RESULT IN SERIOUS INJURY OR DEATH.**

### Inspection

***NOTE:*** *The pictures in this paragraph are just samples to show the replacement criteria of the rope.*

1. Inspect ropes for broken wires, particularly valley wire breaks and breaks at end terminations.

***NOTE:*** *Flexing a wire rope can often expose broken wires hidden in valleys between strands.*

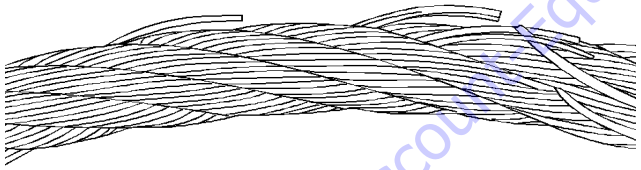


**Figure 4-15. Wire Rope Wire Breaks**

2. Inspect ropes for corrosion.
3. Inspect ropes for kinks or abuse.

***NOTE:*** *A kink is caused by pulling down a loop in a slack line during improper handling, installation, or operation.*

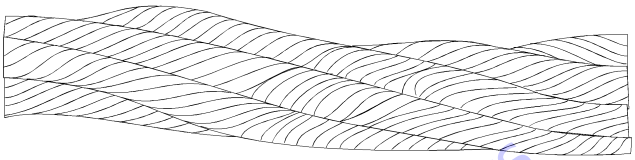


**Figure 4-16. Wire Rope Kink**

4. Inspect sheaves for condition of bearings/pins. (See Dimension Of Sheaves for proper dimension.)
5. Inspect sheaves for condition of flanges. (See Dimension Of Sheaves for proper dimension.)
6. Inspect sheaves with a groove wearout gauge for excessive wear.

***NOTE:*** *Check groove so that it may be clearly seen if gauge contour matches sheave groove contour.*

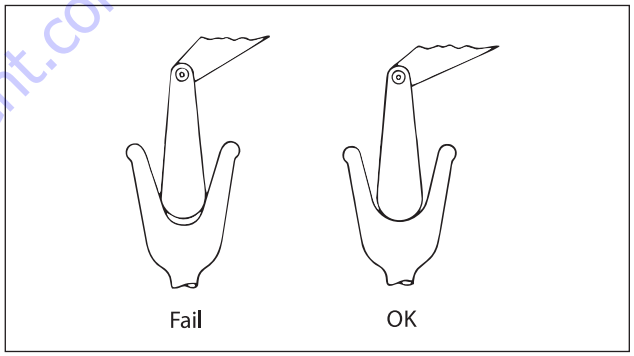



**Figure 4-17. Sheave Groove Wear**

7. Ropes passing inspection should be lubricated with wire rope lubricant before reassembly.

### Three Month Inspection

1. Remove boom covers and visually (with flashlight) inspect the ropes for rust, broken wires, frays, abuse, or any signs of abnormalities.
2. Check rope tension by deflecting the ropes by hand. Properly tensioned ropes should have little or no movement.

### Additional Inspection Required If:

1. Machine is exposed to hostile environment or conditions.
2. Erratic boom operation or unusual noise exists.
3. Machine is idle for an extended period.
4. Boom is overloaded or sustained a shock load.
5. Boom exposed to electrical arc. Wires may be fused internally.

### 12 Year or 7000 Hour Replacement

1. Mandatory wire rope and sheave replacement.

### Additional Replacement Criteria

1. Rusted or corroded wire ropes.
2. Kinked, "bird caged", or crushed ropes.
3. Ropes at end of adjustment range.
4. Sheaves failing wearout gage inspection.
5. Ropes with 6 total broken wires in one rope lay, 3 in one strand in one rope lay, 1 valley break, or 1 break at any end termination.

## 4.7 BOOM ROPE TORQUING PROCEDURES

### Torque Procedures

1. Position boom in fully down and fully retracted position.
2. Clamp both threaded ends of wire rope to prevent rotation.

***NOTE:*** *Do not clamp on threads.*

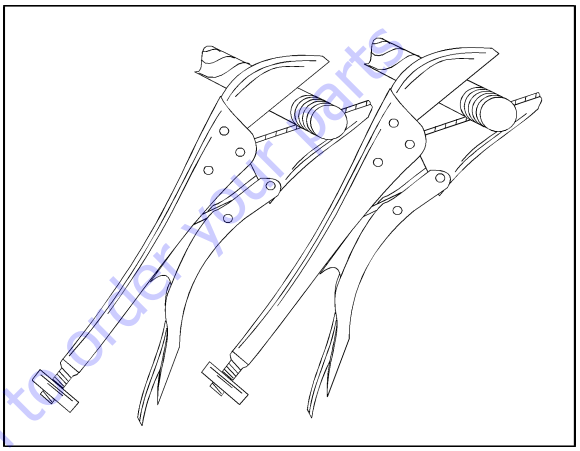


**Figure 4-18. Clamping Wire Ropes**

3. Install adjusting nuts (or remove nylon collar locknuts if re-adjusting) to both retract and extend wire ropes.
4. Torque retract adjusting nuts (platform end) to 15 ft. lbs. (20 Nm) alternating between the two wire ropes and keeping approximately the same amount of thread beyond the adjusting nut.

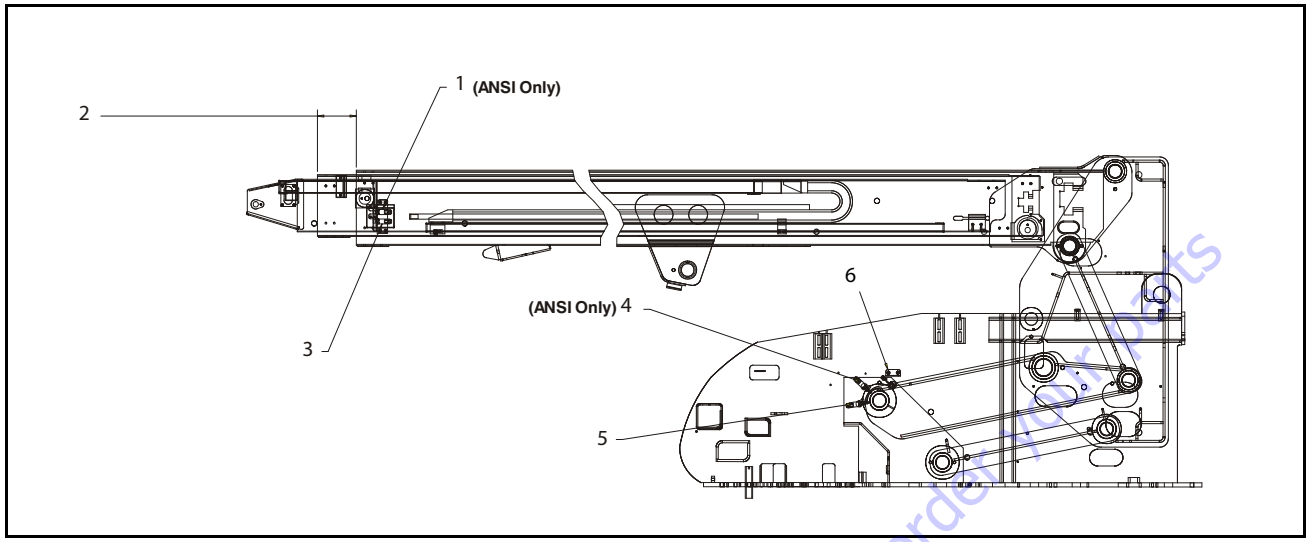
***NOTE:*** *Do not allow wire rope to rotate. This may damage the wire rope.*

5. Repeat the torque procedure in step #4 to the extend wire ropes (turntable end).
6. Extend the boom 2 - 3 ft. using the telescope function. Repeat step #4.
7. Retract the boom 1 - 2 ft. using the telescope function. Do not bottom out telescope cylinder. Repeat step #5.
8. Extend the boom approximately 2 - 3 ft. again and check torque on the retract wire ropes.
9. Retract the boom without bottoming out telescope cylinder and check torque on the extend wire ropes.

***NOTE:*** *Step #8 and #9 may need to be repeated to equalize the torque on all 4 wire ropes.*

10. After all wire ropes have been properly torqued, install nylon collar locknuts. Remove all clamping devices and install all covers and guards. Check the boom for proper function.

## 4.8 ELEVATION & CAPACITY SWITCHES - 800S




| | |
|---|---|
| 1 | Boom Capacity Length Switch to trip boom when it's 216" ± 1" (5486mm ± 25mm) from fully extended |
| 2 | 150.75" ± 1" (3829mm ± 25mm) position of boom sections to Trip Capacity Length Switch (ANSI Only)<br><br>18.25" ± 1" (463.5mm ± 25mm) position of boom sections to trip Transport Length Switch |
| 3 | Boom Transport Length Switch to trip when boom is 18" ± 1" from fully retracted |
| 4 | Boom Capacity Angle Switch to trip when upper boom is 50° to 55° above horizontal. 52° is the preferred trip angle<br><br>Boom Capacity Angle Switch to reset when upper boom is 59° to 64° above horizontal. 61° is the preferred reset angle |
| 5 | Boom Elevation Switch to trip when upper boom is 7° to 12° above horizontal. 9° is the preferred trip angle<br><br>Boom Elevation Switch to reset when upper boom is 3° below horizontal to 2° above horizontal. 0° is the preferred reset angle |
| 6 | End of Stroke Switch should trip when boom is 5° to 7° from end of extended cylinder stroke |

**Figure 4-19. Elevation, Dual Capacity and Transport Switch Information - 800S**

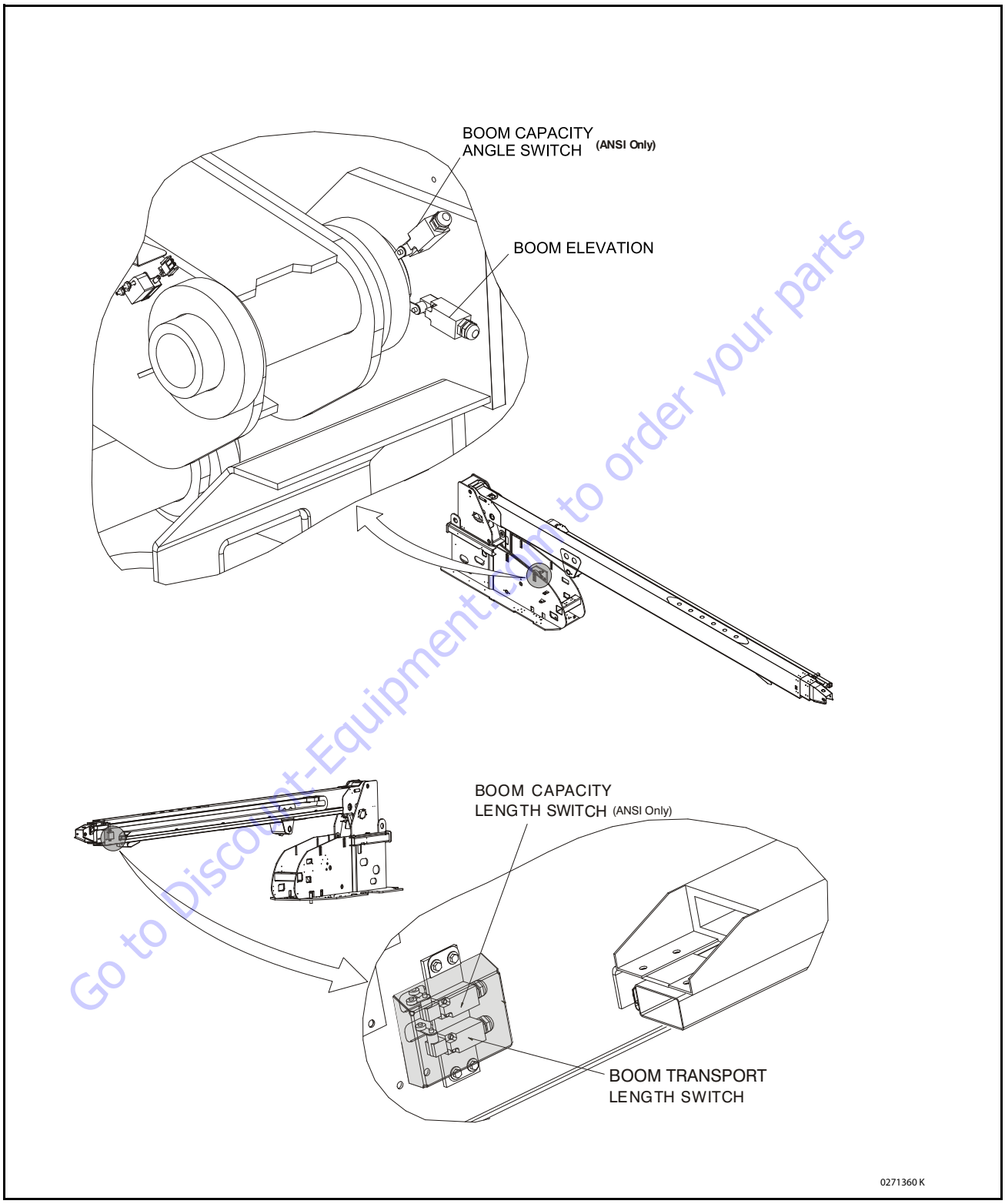
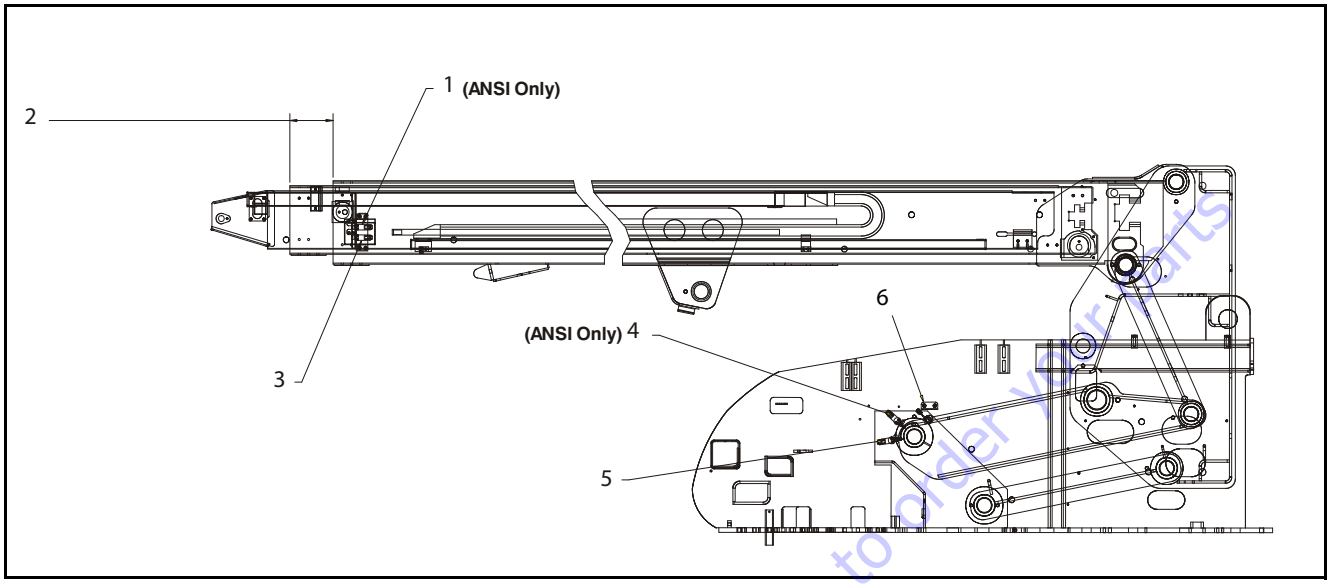





**Figure 4-20. Elevation, Dual Capacity and Transport Switch Installation - 800S**

## 4.9 ELEVATION, DUAL CAPACITY, & TRANSPORT SWITCH - 810SJ & 860SJ




| | |
|---|---|
| 1 | Boom Capacity Length Switch to trip boom when it's 180" ± 1" (4572mm ± 25mm) from fully extended |
| 2 | 160.25" ± 1" (4070mm ± 25mm) position of boom sections to Trip Capacity Length Switch (ANSI Only)<br><br>18.25" ± 1" (463.5mm ± 25mm) position of boom sections to trip Transport Length Switch |
| 3 | Boom Transport Length Switch to trip when boom is 18" ± 1" from fully retracted |
| 4 | Boom Capacity Angle Switch to trip when upper boom is 44° to 49° above horizontal. 46° is the preferred trip angle<br><br>Boom Capacity Angle Switch to reset when upper boom is 52° to 57° above horizontal. 55° is the preferred reset angle |
| 5 | Boom Elevation Switch to trip when upper boom is 9° to 14° above horizontal. 12° is the preferred trip angle<br><br>Boom Elevation Switch to reset when upper boom is 1° below horizontal to 4° above horizontal. 2° is the preferred reset angle |
| 6 | End of Stroke Switch should trip when boom is 5° to 7° from end of extended cylinder stroke |

**Figure 4-21. Elevation, Dual Capacity, and Transport Switch Information - 810SJ & 860SJ**

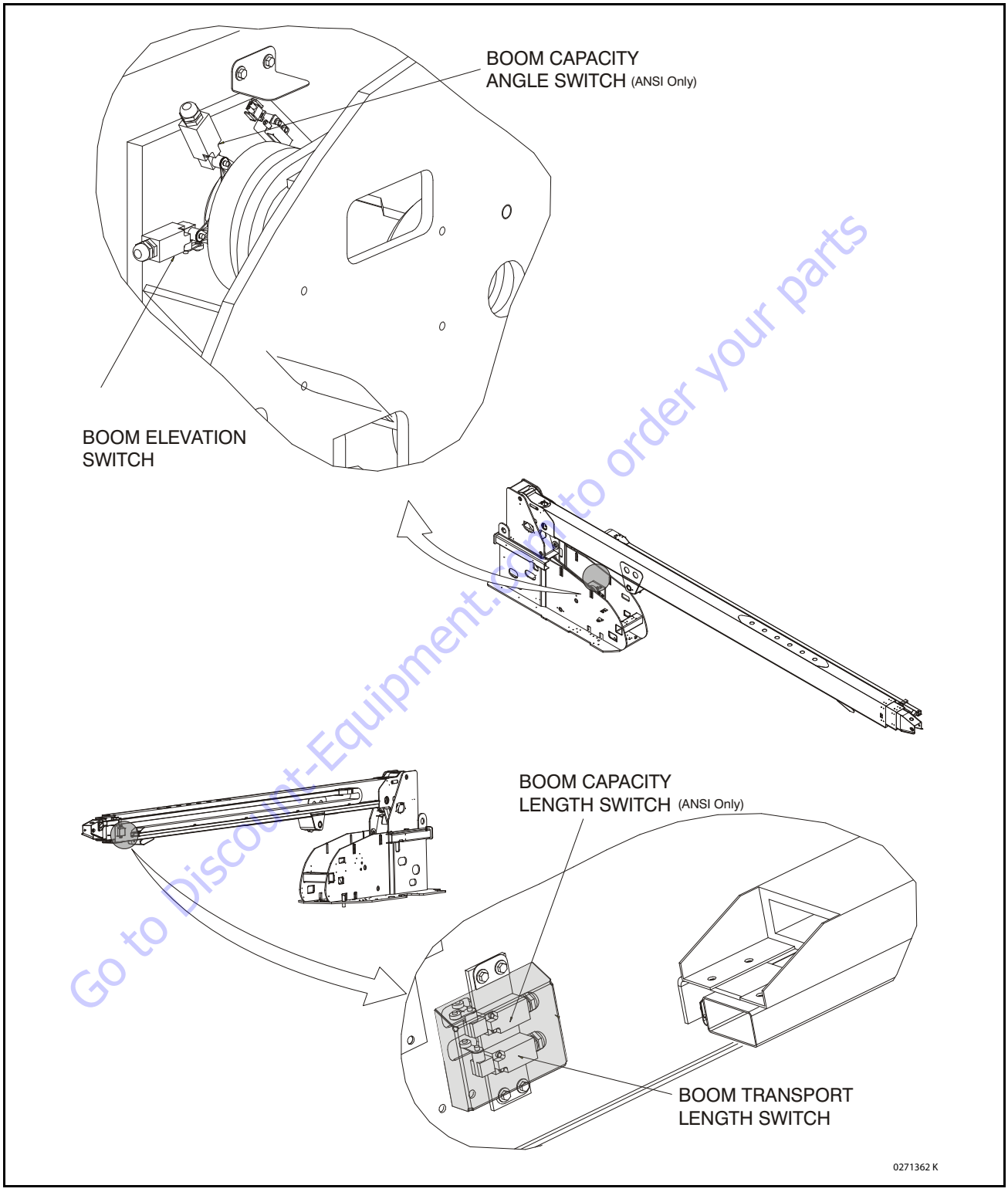





**Figure 4-22. Elevation, Dual Capacity, and Transport Switch Installation - 810SJ & 860SJ**

## 4.10 ELECTRONIC PLATFORM LEVELING

### Description

Electronic platform leveling replaces the conventional hydraulic method of platform leveling. The term “platform leveling” does not refer to the system maintaining the platform at level (or 0°) with respect to gravity, but instead refers to the controls automatically maintaining the platform within several degrees of a preset angle.

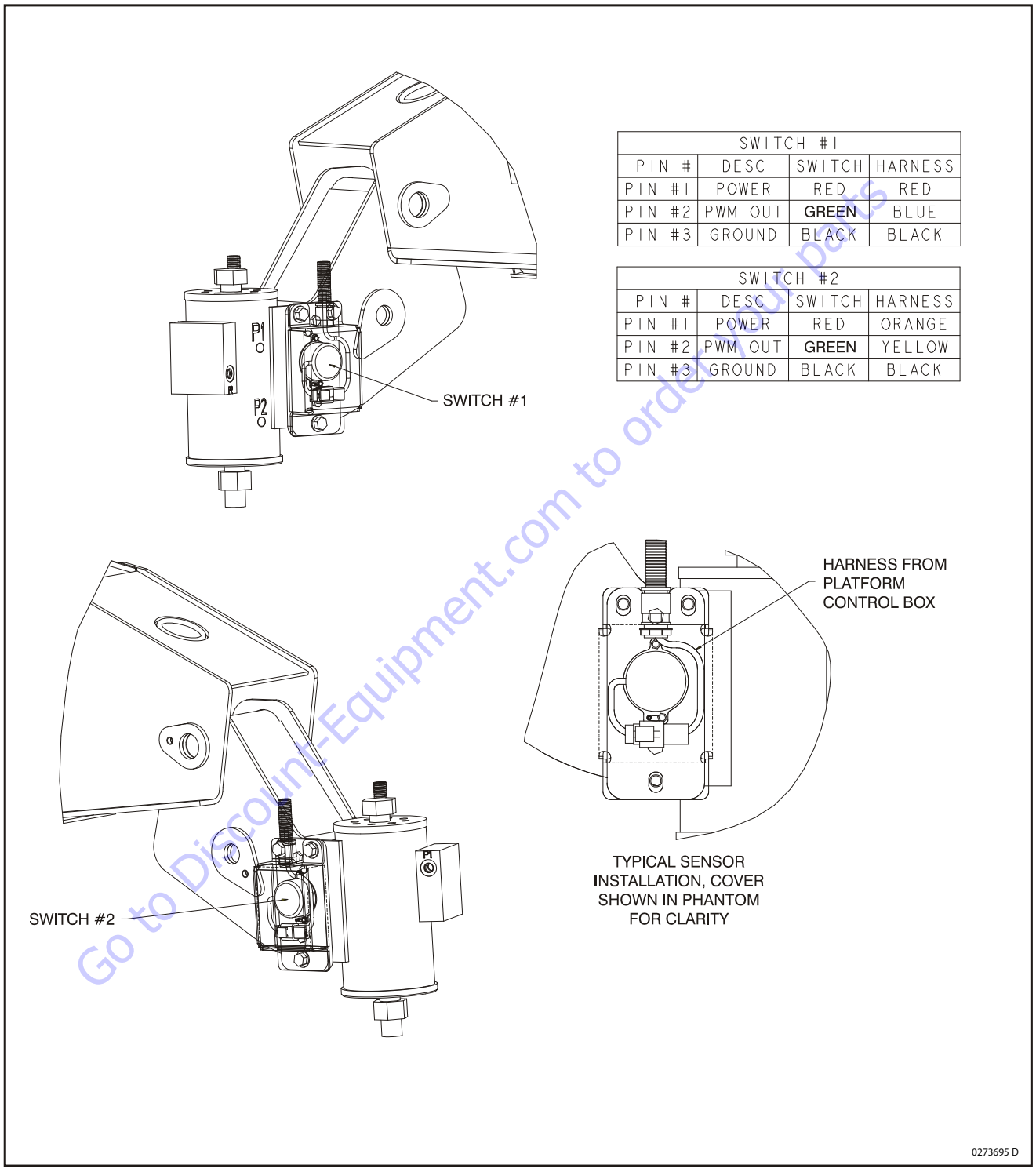
To control electronic platform leveling the platform is equipped with a pair of tilt sensors, one primary and one secondary, mounted to the non-rotating portion of the platform rotator, level up and level down valves that are used to provide proportional hydraulic flow for each directional function, and a control module that interprets the sensor readings and actuates the leveling valves.

#### PRIMARY AND SECONDARY TILT SENSOR INTERACTION

Two tilt sensors, mounted on each side of the platform support, are used to measure the incline of the platform with respect to gravity and control the automatic platform angle control function. The right one (as viewed from standing in the platform) is used as the primary sensor and the left one as a secondary backup sensor.

If a fault occurs with the primary sensor, control will revert to the secondary sensor. (This is discussed in more detail in the error response section.)

Because of the mounting orientation of the tilt sensors, the primary tilt sensor will output ascending voltage values with increases in positive platform tilt angle. The backup or secondary tilt sensor will output descending voltage values with increases in positive platform angle.

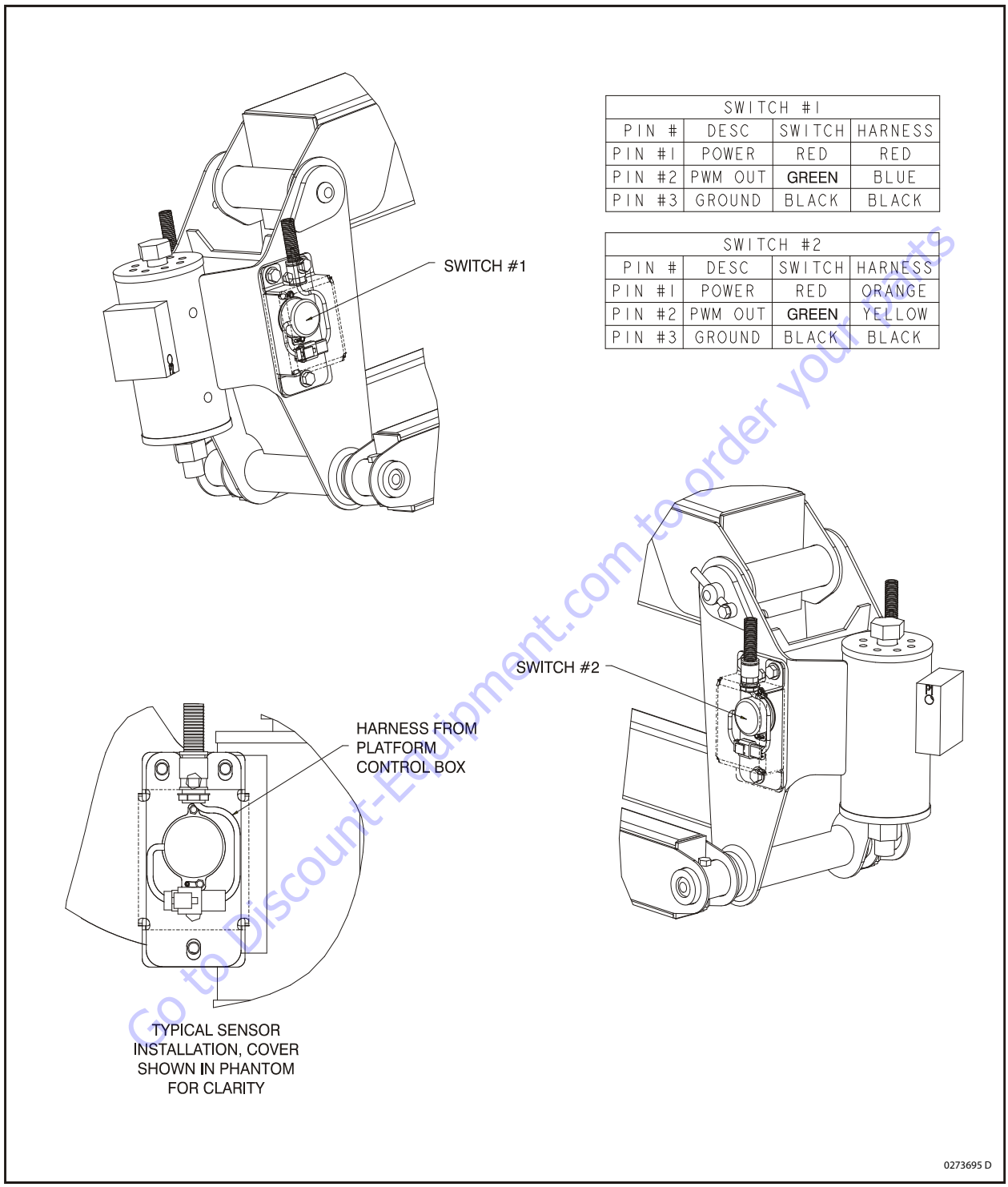



| SWITCH #1 | | | |
|---|---|---|---|
| PIN # | DESC | SWITCH | HARNESS |
| PIN #1 | POWER | RED | RED |
| PIN #2 | PWM OUT | GREEN | BLUE |
| PIN #3 | GROUND | BLACK | BLACK |

| SWITCH #2 | | | |
|---|---|---|---|
| PIN # | DESC | SWITCH | HARNESS |
| PIN #1 | POWER | RED | ORANGE |
| PIN #2 | PWM OUT | GREEN | YELLOW |
| PIN #3 | GROUND | BLACK | BLACK |



**Figure 4-23. Level Switches - 800S**




| SWITCH #1 | | | |
|---|---|---|---|
| PIN # | DESC | SWITCH | HARNESS |
| PIN #1 | POWER | RED | RED |
| PIN #2 | PWM OUT | GREEN | BLUE |
| PIN #3 | GROUND | BLACK | BLACK |

| SWITCH #2 | | | |
|---|---|---|---|
| PIN # | DESC | SWITCH | HARNESS |
| PIN #1 | POWER | RED | ORANGE |
| PIN #2 | PWM OUT | GREEN | YELLOW |
| PIN #3 | GROUND | BLACK | BLACK |



**Figure 4-24. Level Switches - 860SJ**

### PLATFORM VALVES

The platform specific valves are located in a manifold at the platform.

There are six valves that control various platform functions. Two control Platform Level up and down for the leveling function, two are used to rotate the platform, and two to control jib up and down.

All platform valves are Pulse Width Modulated (PWM'd). PWM is a method of setting the voltage across a valve, and therefore the flow through it, by varying the On/Off duty cycle of the control module output. PWM permits proportional flow control.

There is also a Platform Dump Valve, located in the platform valve manifold, which is used to hydraulically isolate the control valves and to improve hydraulic response.

The Ground Module controls this valve to enable automatic platform leveling and to provide manual platform leveling in the event that the Platform Module is inoperable.

In ground mode, the platform dump valve is turned on whenever any platform or jib valve output is turned on. Whenever all platform and jib valves are turned off, the platform dump valve is turned off.

In platform mode, the platform dump valve is turned on whenever the footswitch is depressed.

## Normal Operation

### AUTOMATIC PLATFORM ANGLE CONTROL

The level system will assume a new fixed set point (fixed incline of the platform with respect to gravity) each time the control system is powered up (cycling of the EMS) and each time the footswitch is engaged.

Automatic platform angle control only functions while operating drive, telescope, lift or swing. It does not adjust the platform angle while operating any other function (e.g. rotate, jib, or steer). Furthermore, machines equipped with control system software P5.0 and later, automatic platform angle control for drive and swing may be disabled by using the analyzer. For this case, the platform angle setpoint is taken when the joystick moves from a non-leveling function (drive/swing) to a leveling function (lift/tele).

The machine controls attempt to maintain the angle of the platform to setpoint by providing a command proportional to the angular error from setpoint. Since the sensors used to measure the platform angle are fluid-filled, gravity-based sensors, reading the sensors in real time would cause constant correction of the platform position due to machine vibration and inertial changes of the boom. Therefore, the sensor readings are averaged over time, or filtered, in order to achieve a more uniform reading. This filtering has the advantage of providing smoother operation, but has the disadvantage of causing a lag (or sluggishness) in the system response. This lag may cause the platform to be several degrees from setpoint.

In order to provide a better system response, the controls also compute the rate of angular change of the platform position and set the leveling valve positions to achieve a matching velocity. The measured velocity is the average platform speed over the last 0.5 seconds. The desired valve command is computed by comparing the measured velocity to the desired velocity and setting the valve opening to correspond to the required amount of make-up angle. The amount the valve opens when making an automatic correction is proportional to and directly affected by:

- Crackpoint setting
- Velocity error (proportional factor)
- Sum of velocity errors over time (integral factor)

These three factors are summed together with appropriate gain factors to compute the resulting current to the valves. The operator does not have control over the latter two factors, but can affect the resulting current by adjusting the crackpoint. Increasing the crackpoint makes the valve current higher, resulting in quicker more aggressive control and larger amounts of overshoot. Decreasing the crackpoint will result in smoother operation but may not permit enough platform velocity to keep up with the boom (i.e., may get platform timeout alarms) in some multi-function operations. The platform controls are set up to provide smooth leveling operations for the majority of conditions and will perform best for steady operator command, as opposed to command values for function, that change frequently.

In order to obtain acceptable performance while performing all hydraulic functions, five sets of parameters are used. These "zones" allow compensation for differences in how the basket level changes when doing different functions. These zones are as follows:

1. Lift up
2. Lift down
3. Other boom functions
4. Drive
5. Auxiliary

The other boom functions zone includes Swing, Telescope, Jib swing (It is not necessary to level with jib lift, since the mechanical linkage keeps the basket level).

These zones are prioritized when multiple functions are active. The priorities are as follows.

1. Auxiliary power and any other function, zone = auxiliary power
2. Drive and any other function, zone = Drive

3. Lift up and any other function, zone = Lift up
4. Lift down and any other function, zone = Lift down
5. Other boom functions, zone = Other boom functions

During the power-up procedure, function enable, in both Platform and Ground Mode, is delayed during the 1.5 second startup lamp test. During this 1.5 second startup period, the basket level up valve will be energized at 100% duty cycle for 0.5 second, and then the basket level down valve energized at 100% duty cycle for 0.5 second. This will help to keep the valves from sticking.

**PLATFORM LEVEL MANUAL OVERRIDE**

In addition to automatic platform angle control, the operator is able to manually adjust the platform level position by means of the level override switches located at the platform and ground control positions (similar to a Master/Slave hydraulic system).

If a command from the Platform Level Up and Down toggle switch on either the platform or the ground is received, automatic platform angle control will cease and the appropriate output will be commanded to turn on.

The duty cycle of the output shall be scaled from the pump potentiometer. When the toggle switch is released, after one second, the current filtered value of tilt angle will be taken as the new set point.

In other words the operator can chose a platform level incline other than level with gravity and the system will maintain the chosen platform angle within several degrees of setpoint.

## Platform Leveling Fault

The JLG Control System takes a snapshot of the two sensor values and records the difference once on each power up. The Control system allows a ±5 degrees difference from those values. For example, if Sensor 1 is at 5 degrees and Sensor 2 is at 11 degrees, the difference is 6 degrees and the DTC is triggered when the sensors are 1 degree (or less) apart or 11 degrees (or more) apart.

If a fault occurs in the platform leveling system the following will occur:

1. Automatic platform angle control will stop and the platform dump valve will be disabled (level, rotate, and jib functions disabled). The exception is when there is a fault in only one sensor automatic platform angle control will remain active as the control system will use the other sensor to control leveling.
2. The level system fault lamp will flash (to indicate that the leveling function has been lost).
3. The platform alarm will sound.
4. A system fault will be logged.
5. All function speeds (lift, swing, telescope and drive) will be placed in creep mode (except when the platform is in the transport position see below).

To reset the fault the emergency stop switch should be recycled.

**NOTICE**

**IF THE LEVEL SYSTEM FAULT INDICATOR REMAINS ILLUMINATED, RETURN THE PLATFORM TO THE STOWED POSITION, SHUT DOWN THE MACHINE, AND REPAIR THE LEVELING SYSTEM.**

**ERROR RESPONSE**

If basket level varies from the current **setpoint** by ± 5.5° for more than 2 seconds for large variations from setpoint when the platform is not in the transport position, the controls assume the system is not properly set up or has degraded and initiate a fault.

When the unit is in the transport position and driving and the current setpoint varies by ± 5.5° for more than 10 seconds the events 1,2,3 & 4 above will occur. (note function speeds will operate normally). Since the control system can not anticipate all conditions under which a machine is to be operated, these parameters have been chosen to provide reasonable performance and safe operation. If an error occurs, cycling the EMS will clear the fault. The operator should evaluate the operating situation and assess his machine to determine the source of the fault.

**VALVE DRIVER ERRORS**

There are three possible level valve driver errors, short to battery, short to ground, and open circuit.

1. In the case of a **short to ground or an open circuit**, the platform valve cannot be turned on and the following will occur:
   - **a.** All interactions with platform leveling shall cease
   - **b.** The Electronic Leveling System Fault Lamp shall flash (to indicate that the leveling function has been lost).
   - **c.** The platform alarm will sound.
   - **d.** A system fault will be logged.
   - **e.** All function speeds (lift, swing, telescope and drive) will be placed in creep mode (except when the platform is in the transport position).
2. In the case of a **short to battery** on one of the platform leveling valves, the valve cannot be turned off and the following will occur:
   - **a.** The platform dump valve will be turned off to prevent unintended tilting of the platform.
   - **b.** All interactions with platform leveling shall cease.
   - **c.** The Electronic Leveling System Fault Lamp shall flash (to indicate that the leveling function has been lost).
   - **d.** The platform alarm will sound.
   - **e.** A system fault will be logged.
   - **f.** All function speeds (lift, swing, telescope and drive) will be placed in creep mode (except when the platform is in the transport position)
3. In the case of a **short to battery on the platform dump valve**, the valve cannot be turned off. The controllability of the platform leveling function will be impaired and the following will occur:
   - **a.** All interactions with platform leveling shall cease.
   - **b.** The Electronic Leveling System Fault Lamp shall flash (to indicate that the leveling function has been lost).
   - **c.** The platform alarm will sound.
   - **d.** A system fault will be logged.
   - **e.** All function speeds (lift, swing, telescope and drive) will be placed in creep mode (except when the platform is in the transport position).

Lift, swing, drive and telescope will continue to operate

In each of the cases above it shall be necessary to re-cycle the EMS to clear the fault. Operable functions shall be in the creep mode except while below elevation.

**TILT SENSOR ERRORS**

If the secondary tilt sensor is faulty, the control system will continue to utilize information from the primary sensor.

If the primary sensor is faulty, the control system will switch to the backup sensor for control.

In both cases above the following will occur:

1. The Electronic Leveling System Fault Lamp will flash (to indicate that there is a leveling fault).
2. The platform alarm will sound.
3. A system fault will be logged.
4. All function speeds (lift, swing, telescope, jib and drive) will be placed in creep mode (except when the platform is in the transport position).
5. Automatic platform angle control remains active.

Lift, swing, drive and telescope will continue to operate.

In each of the cases above it will be necessary to re-cycle the EMS to clear the fault. Operable functions shall be in the creep mode except while below elevation.

When both sensors appear to be working but have measurements that disagree by ±5.5º The following will occur:

1. All interactions with platform leveling shall cease.
2. The Electronic Leveling System Fault Lamp shall flash (to indicate that the leveling function has been lost).
3. The platform alarm will sound.
4. A system fault will be logged.
5. All function speeds (lift, swing, telescope and drive) will be placed in creep mode (except when the platform is in the transport position)

At this point, the operator must use the level up and down toggle switch to manually level during descent. It shall be necessary to re-cycle the EMS to clear the fault.

## CAN Errors

The Ground Module has two direct outputs dedicated to overriding the Platform Module's control of the leveling valves. The EPBC Ground Module "Platform Level Up/Down" outputs are used to control the platform level up and down valves.

When in ground mode, if the Ground Module reads a platform leveling switch command, the switch command is communicated over CAN to the Platform Module where it is handled normally.

If Ground Module determines that CAN communication is inoperable, it turns on the platform control valve and the appropriate platform leveling override outputs while the switch is engaged.

If the Platform Module is still running when CAN is down nothing will operate when in platform mode. When the operator switches to ground mode, the platform will not control any of its valve outputs and a CAN error message is signaled.

## Replacing the Level Sensors

Earlier generations of this machine had three different generations of level sensors that were used on this machine. JLG P/N 4360503, P/N 4360528, and P/N 4360544. P/N 4360528 and 4360544 supersede P/N 4360503. If one of the 4360503 sensors fail, BOTH sensors must be replaced with two P/N 4360544 sensors. 4360503 Sensors can be identified by the code SSY0185-13 which is printed on the sensor. Otherwise, single 4360528 or 4360544 9999 sensors may be replaced.

## Additional Platform and Jib Valves

The high side drivers for the platform left and right and the jib up and down valves are be located in the Platform Module and are PWM'd. The control for these functions are the same as currently implemented for the EPBC except that the flow through the valves is individually controllable instead of controlled by single the flow control valve. The individually controlled duty cycle will be the same as would otherwise have been commanded to the flow control valve.

Only one platform or jib function is allowed at one time to limit the amount of current draw, minimizing the voltage drop on the supply to the PM.

The function is enabled first shall remain active until it is released. Any other function commanded while another function is active is ignored.

If only one other function is commanded when the active function is released, the other function will be activated.

If more than one function is commanded when the active function is released, only one function shall be activated.

## Platform Leveling Calibration Procedure

**STEP 1: SETTING THE PLATFORM VALVE MINIMUMS**

1. Put machine into "Ground Mode".
2. Start machine and plug in Analyzer.
3. Go to the "Access Level 2" screen.
4. Enter "33271" to get into Access Level 1 mode.
5. Go to the "Personalities" menu and adjust the following personalities. Refer to the Personality Ranges/Defaults table in Section 6 - JLG Control System for proper setting values.

   Basket Level Up Min
   Basket Level Up Max
   Basket Level Down Max
   Jib Up Min
   Jib Down Min
6. Recycle EMS.

**STEP 2: CALIBRATING THE PLATFORM LEVEL SENSORS (FOR PLATFORM SOFTWARE PRIOR TO VERSION P3.4)**

1. Put machine into "Ground Mode".
2. Start machine and plug in Analyzer.
3. Manually level the platform with the switch on the MTB.
4. Go to the "Access Level 2" screen.
5. Enter "33271" to get into Access Level 1 mode.
6. Go to the "Calibrations" menu and hit ENTER.

7. Use RIGHT ARROW go to “Plat. Leveling” screen.
8. Hit ENTER. “Calibrate?” prompt should appear.
9. Hit ENTER again to calibrate level sensors.
10. When calibration has been successful “Cal Complete” should appear.
11. Cycle power to the machine.

**STEP 3: BLEEDING THE PLATFORM VALVES**

Start up the machine and exercise the following platform functions (from the ground) eight (8) to ten (10) times for 5 seconds in each direction.

Basket Rotate
Basket Level
Jib U/D (if configured)

**STEP 4: CALIBRATING THE PLATFORM LEVEL UP AND DOWN VALVE CRACKPOINTS**

***NOTE:*** *Since the valve position which allows minimum oil flow (crackpoint) is dependent on the oil pressure, verify the proper stand-by pressure as outlined in Section 5.4 prior to setting the crackpoints.*

1. Put machine into “Ground Mode”.
2. Start machine and plug in Analyzer.
3. Go to the “Access Level 2” screen.
4. Enter “33271” to get into Access Level 1 mode.
5. Go to the “Calibrations” menu and hit ENTER.
6. Go to the “Basket U Crkpt” Screen. Hit ENTER.
7. “Calibrate?” prompt should appear. Hit ENTER again.
8. You will hear engine go to 1800 rpm.
9. Using UP ARROW, increase the value until you see the basket up movement. (Typically from 275 – 425).
10. Hit ENTER again. “Cal Complete” message should appear
11. Engine should again return to idle.
12. Hit ESC should return to “Basket U Crkpt” screen.
13. Hit RIGHT ARROW to get to the “Basket D Crkpt” screen. Hit ENTER.
14. “Calibrate?” prompt should appear. Hit ENTER again.
15. You will hear engine go to 1800 rpm.
16. Using UP ARROW, increase the value until you see the basket down movement. (Typically from 275 – 425).
17. Hit ENTER again. “Cal Complete” message should appear.
18. Engine should again return to idle.
19. Hit ESC to exit.
20. Cycle power to the machine.
21. The preceding steps will provide acceptable crackpoint settings for the majority of machines. However, there exists the possibility certain machines could still have too high or too low a crackpoint setting.

    If the operator can feel small jolts in the platform from the valve opening during a leveling operation, the crackpoint is likely too high. A high crackpoint may also lead to over-leveling, causing the platform to drift beyond the set point. An example of this would be the platform tilting too far backwards during a Lift Up operation. Use the following guidelines to evaluate whether further crackpoint adjustment is required.

    a. Telescope the boom halfway.
    b. Perform a continued Lift Up command (do not cycle the joystick on/off repeatedly). If the basket leans backward (over compensates), the Level Down crackpoint is too high. If the basket leans forward or a BASKET LEVELING SYSTEM TIMEOUT fault occurs, the Level Down crackpoint is too low.
    c. Perform a continued Lift Down command (do not cycle the joystick on/off repeatedly). If the basket leans forward (over compensates), the Level Up crackpoint is too high. If the basket leans backwards or the Tilt Cutout Alarm comes on, the Level Up crackpoint is too low.

    If Platform Level is slow to respond during Lift commands, causing PLATFORM LEVEL TIMED OUT faults, it may be necessary to increase the crackpoint settings. Use the following guidelines to evaluate whether further crackpoint adjustment is required.

    a. Perform a continued Lift Up command (do not cycle the joystick on/off repeatedly). If the PLATFORM LEVEL TIMED OUT fault sets or if Platform Level Down seems slow to respond, an increase in the Platform Level Down crackpoint may be necessary.
    b. Perform a continued Lift Down command (do not cycle the joystick on/off repeatedly). If the PLATFORM LEVEL TIMED OUT fault sets or if Platform Level Up seems slow to respond an increase in the Platform Level Up crackpoint may be necessary.

## 4.11 HELAC ROTARY ACTUATOR

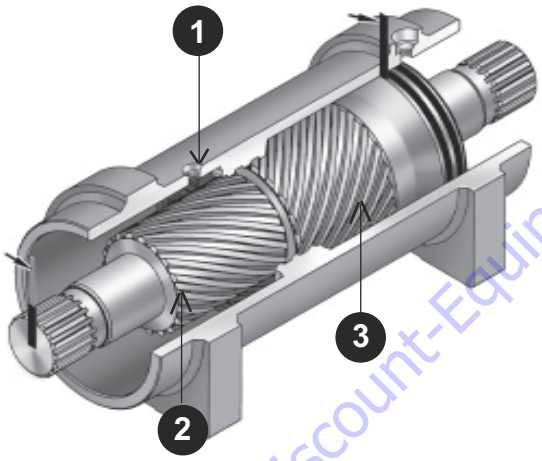
### Theory of Operation

The rotary actuator is a simple mechanism that uses the sliding spline operating concept to convert axial piston motion into powerful shaft rotation. Each actuator is composed of a housing with integrated gear ring (1) and only two moving parts: the central shaft with integrated bearing tube and mounting flange (2), and the annular piston sleeve (3). Helical spline teeth machined on the shaft engage matching splines on the inside diameter of the piston. The outside diameter of the piston carries a second set of splines, of opposite hand, which engage with matching splines in the housing. As hydraulic pressure is applied, the piston is displaced axially within the housing similar to the operation of a hydraulic cylinder while the splines cause the shaft to rotate. When the control valve is closed, oil is trapped inside the housing, preventing piston movement and locking the shaft in position.

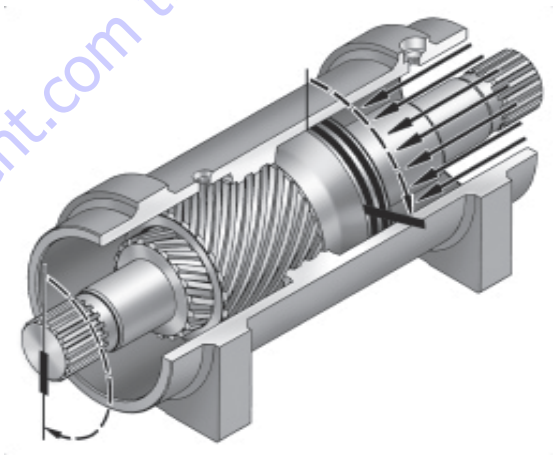
The shaft is supported radially by the large upper radial bearing and the lower radial bearing. Axially, the shaft is separated from the housing by the upper and lower thrust washers. The end cap is adjusted for axial clearance and locked in position by set screws or pins.

The actuators are equipped with factory installed counterbalance valves, which performs four major functions.

- Protects the actuator in the event of overload
- Enables the actuator to hold position without drifting when external loads are applied
- Reduces hydraulic backlash by pressuring the hydraulic fluid
- Provides a constant controlled rate of rotation in over-center load conditions

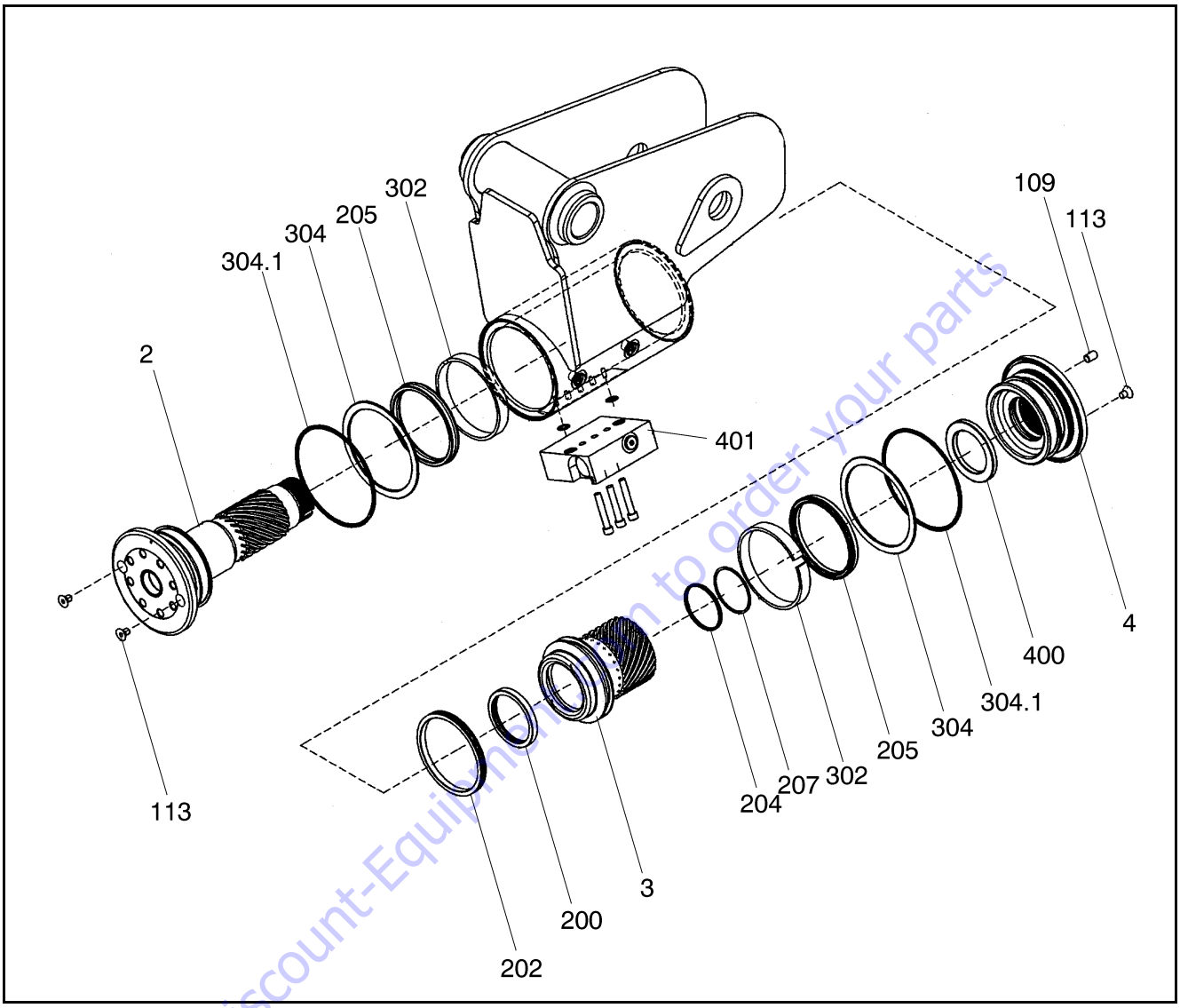



Bars indicate starting positions of piston and shaft. Arrows indicate direction they will rotate. The housing with integral ring gear remains stationary.



Applying fluid pressure will displace the piston axially while the helical gearing causes the piston and shaft to rotate simultaneously.

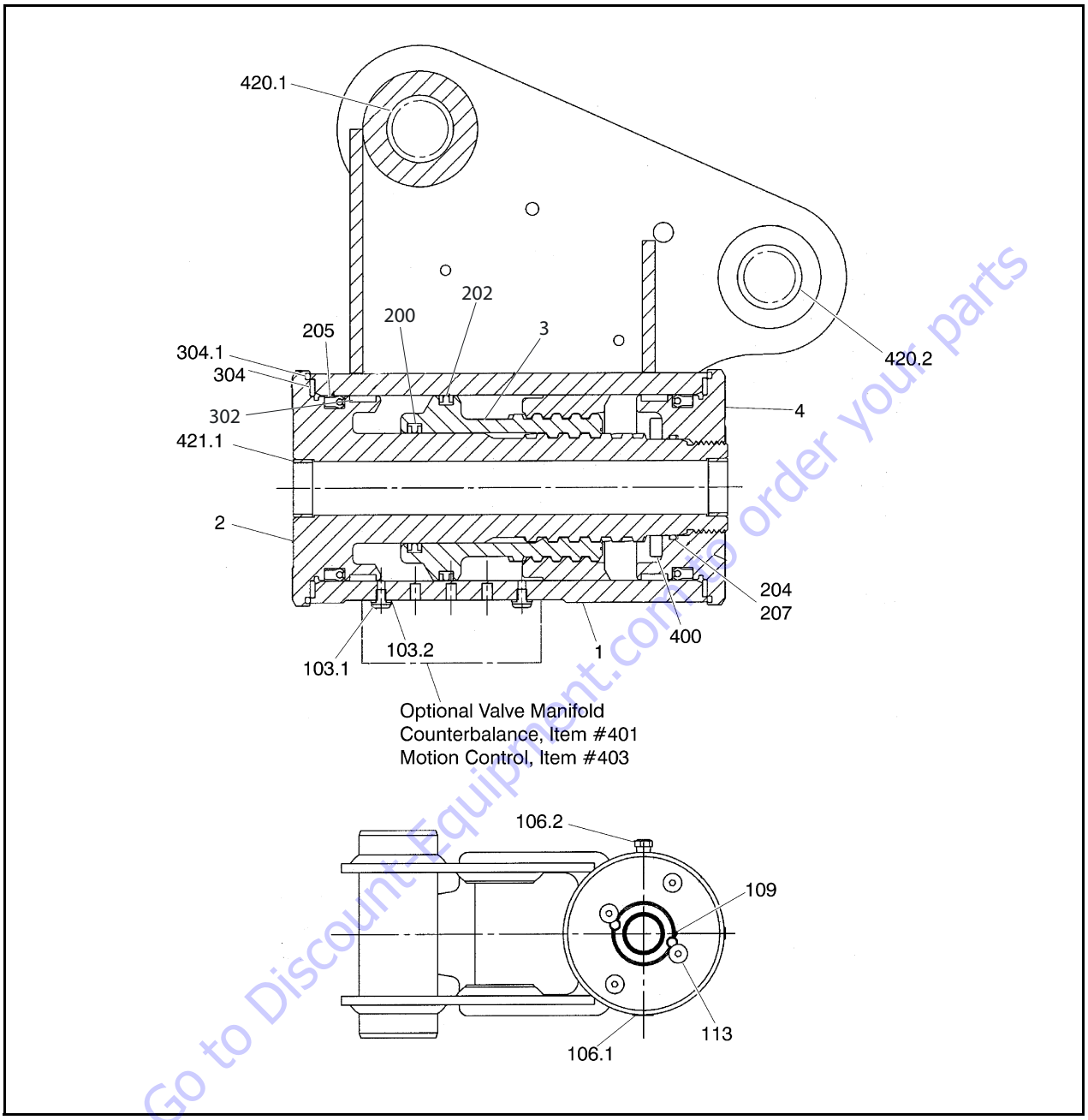
The double helix design compounds rotation: shaft rotation is about twice that of the piston. Applying pressure to the opposite port will return the piston and shaft.






1. Housing
2. Shaft
3. Piston Sleeve
4. End Cap
109. Lock Pin
113. Capscrew
200. T-Seal
202. T-Seal
204. O-ring
205. Cup Seal
207. Backup Ring
302. Wear Guide
304. Thrust Washer
304.1. Wiper Seal
400. Counterbalance Valve
401. Counterbalance Valve

**Figure 4-25. Rotary Actuator (Exploded View)**





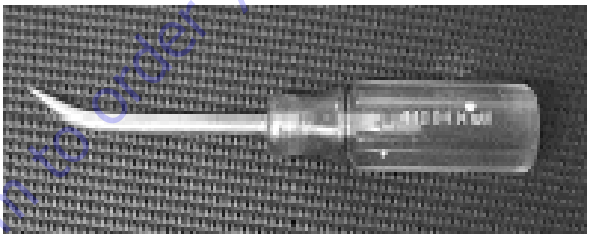

1. Housing
2. Shaft
3. Piston Sleeve
4. End Cap
103.1. Screw (Optional)
103.2. Washer (Optional)
106.1. Port Plug
106.2. Port Plug
109. Lock Pin
113. Capscrew
200. T-Seal
202. T-Seal
204. O-ring
205. Cup Seal
207. Backup Ring
302. Wear Guide
304. Thrust Washer
304.1. Wiper Seal
400. Stop Tube (Optional)
420.1. Bushing
420.2. Bushing (Optional)
421.1. Bushing (Optional)

**Figure 4-26. Rotary Actuator (Cutaway View)**

## Tools Required for Assembly/Disassembly

Upon assembly and disassembly of the actuator there are basic tools required. The tools and their intended functions are as follows:

1. Pipe Vise
2. Hex Wrench - Removal and replacement of port plugs and set screws.
3. Assorted Screws
4. Safety Glasses
5. End Cap Removal Tools
6. Drill
7. Flashlight- Helps in locating and examining timing marks, component failure and overall condition.
8. Rubber mallet- removal and installation of shaft and piston sleeve assembly.
9. Plastic Mandrel
10. Pry bar- removal of end cap and manual rotation of shaft.
11. Felt Marker- Highlights timing marks and outlines troubled areas. Permanent ink is recommended.
12. T - Handle Screw Extractor
13. Hex Wrench Set - Removal and replacement of port plugs and set screws (106,110).
14. Seal tools - Removal and installation of seals and wear guides. Directions on making a seal tool are provided at bottom.
15. Punch
16. Dowel Pins - Removal and installation of end cap.



The seal tool is merely a customized standard flat head screwdriver. To make this tool you will need to heat the flat end with a torch. Secure the heated end of the screwdriver in a vise and physically bend the heated end to a slight radius. Once the radius is achieved round off all sharp edges of the heated end by using a grinder. There may be some slight modifications for your own personal preference.

**⚠ CAUTION**

**TO AVOID INJURY: BE CAREFUL WHEN HANDLING THE SCREWDRIVER WHEN HOT**

## Disassembly

1. Remove port plugs (106.1) (106.2) and drain oil. Inspect oil for signs of contamination, i.e. water, metal shavings.

2. Remove the capscrews (113) over end caplock pins (109).

3. Using a 1/8" (3 mm) drill bit, drill a hole in the center of each lock pin to a depth of approximately 3/ 16" (5 mm).

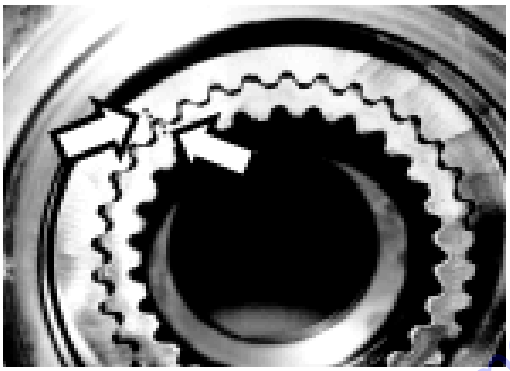
4. Remove the lock pins using an "Easy Out" (a size #2 is shown). If the pin will not come out with the "Easy Out", use 5/16" drill bit to a depth of 1/2" (12.7mm) to drill out the entire pin.

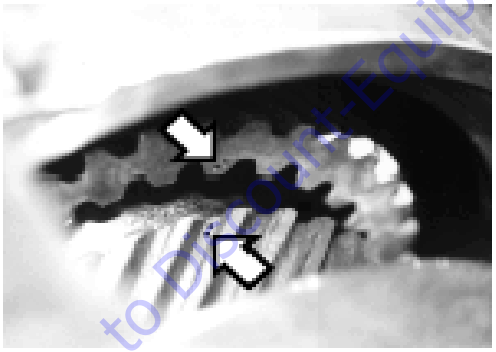
5. Install the end cap removal tools provided with the Helac seal kit.

6. Using a metal bar, or something similar, unscrew the end cap (4) by turning it counterclockwise.

7. Remove the end cap (4) and set aside for later inspection.

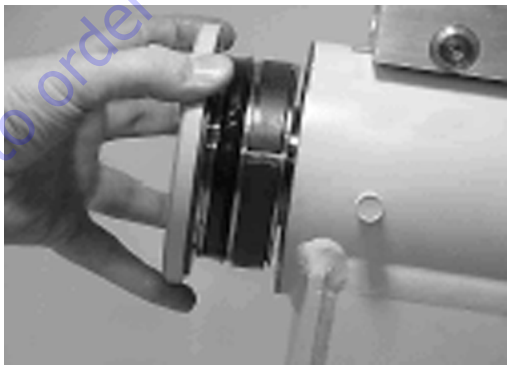
8. Remove the stop tube (400) if included. The stop tube is an available option to limit the rotation of the actuator.





9. Every actuator has timing marks for proper engagement.

10. Prior to removing the shaft, (2), use a felt marker to clearly indicate the timing marks between shaft and piston. This will greatly simplify timing during assembly.



11. Remove the shaft (2). It may be necessary to strike the threaded end of the shaft with a rubber mallet.

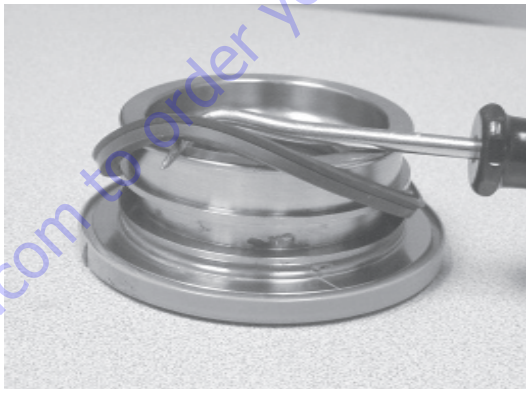
12. Before removing the piston (3), mark the housing (1) ring gear in relation to the piston O.D. gear. There should now be timing marks on the housing (1) ring gear, the piston (3) and the shaft (2).

**13.** To remove the piston (3) use a rubber mallet and a plastic mandrel so the piston is no damaged.

**14.** At the point when the piston gear teeth come out of engagement with the housing gear teeth, mark the piston and housing with a marker as shown.

**15.** Remove the o-ring (204) and backup ring (207) from end cap (4) and set aside for inspection.

**16.** Remove the wear guides (302) from the end cap (4) and shaft (2).



**17.** Remove the main pressure seal (205).

**18.** Remove the thrust washers (304), from the end cap (4) and shaft (2).

**19.** Remove the O-ring (304.1) from its groove in the end cap (4) and shaft (2).

**20.** Remove the piston O.D. piston seal (202).

**21.** Remove the piston I.D. seal (200).

## Inspection

**NOTICE**

**PRIOR TO ASSEMBLY OF ACTUATOR, THESE STEPS MUST BE CLOSELY FOLLOWED TO INSURE PROPER OPERATION OF THE ACTUATOR.**

1. Clean all parts in a solvent tank and dry with compressed air prior to inspecting.
2. Carefully inspect all critical areas for any surface finish abnormalities: Seal grooves, bearing grooves, thrust surfaces, rod surface, housing bore and gear teeth.

**NOTICE**

**SMALL OR MINOR SURFACE SCRATCHES CAN BE CAREFULLY POLISHED.**

## Assembly

1. Gather all the components and tools into one location prior to re-assembly. Use the cut away drawing to reference the seal orientations.

2. Coat the thrust washers (304) with a generous amount of Lithium grease. Install the thrust washer (304) onto shaft (2) and end cap (4).

3. Install the exclusion (304.1) into it's groove on the shaft (2) and end cap (4) around the outside edge of the thrust washer (304).

4. Using a seal tool install the main pressure seal (205) onto shaft (2) and end cap (4). Use the seal tool in a circular motion.

5. Install the wear guide (302) on the end cap (4) and shaft (2).

6. Install the O-ring (204) and backup ring (207) into the inner seal groove on the end cap (4).

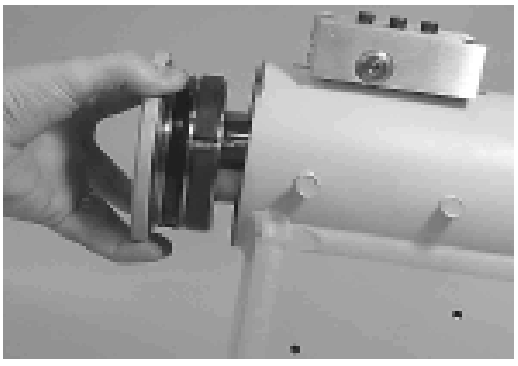
**7.** Install the inner T-seal (200) into the piston (3) using a circular motion. Install the outer T-seal (202) by stretching it around the groove in a circular motion. Each T-seal has 2 backup rings (see drawing for orientation).

Beginning with the inner seal (200) insert one end of backup ring in the lower groove and feed the rest in using a circular motion. Make sure the wedged ends overlap correctly. Repeat this step for the outer seal (202).

**8.** Insert the piston (3) into the housing (1) as shown, until the outer piston seal (202) is touching inside the housing bore.

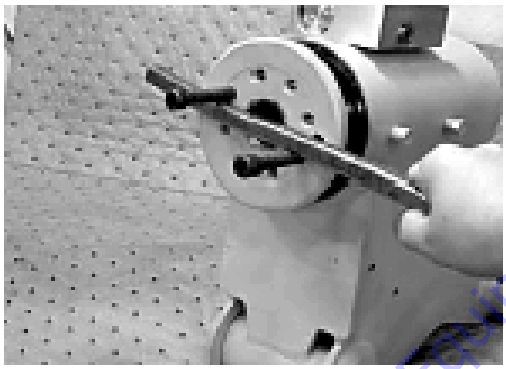
**9.** Looking into the housing bore from the shaft flange end, rotate the piston (3) until the marks you put on the piston and the housing (1) during disassembly align as shown. Using a rubber mallet, tap the piston into the housing until the gear teeth contact.

**10.** Looking into the bore from the opposite end of the housing (1) be sure the timing marks align correctly. Rotate the piston as necessary until aligned, then gently tap the piston (3) into the housing until the gear teeth mesh together. Tap the piston into the housing until it completely bottoms out against the ring gear.



**11.** Install the shaft (2) into the piston (3). Be careful not to damage the seals. Do not engage the piston gear teeth yet.

**12.** Looking at the actuator from the end opposite the shaft flange, use the exisitng timing marks to align the gear teeth on the shaft (2) with the gear teeth on the inside of the piston (3). When the marks align, gently tap the flange end of the shaft with a rubber mallet until the gear teeth engage.



**13.** Install two bolts in the threaded holes in the flange. Using a bar, rotate the shaft in a clockwise direction until the wear guides are seated inside the housing bore.

**NOTICE**

**AS THE SHAFT IS ROTATED, BE CAREFUL NOT TO DISENGAGE THE PISTON AND HOUSING GEARING.**

**14.** Install the stop tube (400) onto the shaft end if necessary. Stop tubes are an available option to limit the rotation of an actuator.

**15.** Coat the threads on the end of the shaft with antiseize grease to prevent galling.

**16.** Thread the end cap (4) onto the shaft (2) end. Make sure the wear guide stays in place on the end cap as it is threaded into the housing (1).

**17.** Tighten the end cap (4) using a metal bar. In most cases the original holes for the lock pins will align.

**18.** Place the lock pins (109) provided in the Helac seal kit in the holes with the dimple side up. Then, using a punch, tap the lock pins to the bottom of the hole.

**19.** Insert the set screws (113) over the lock pins. Tighten them to 25 in. lbs. (2.8 Nm).

## Installing Counterbalance Valve

*Refer to Figure 4-27., Rotator Counterbalance Valve.*

1. Make sure the surface of the actuator is clean, free of any contamination and foreign debris including old JLG Threadlocker.
2. Make sure the new valve has the O-rings in the counter-bores of the valve to seal it to the actuator housing.
3. The bolts that come with the valve are grade 8 bolts. New bolts should be installed with a new valve. JLG Threadlocker P/N 0100011 should be applied to the shank of the three bolts at the time of installation.
4. Torque the 1/4 inch bolts 110 to 120 inch. lbs. (12.4 to 13.5 Nm). Do not torque over 125 inch. lbs. (14.1 Nm). Torque the 5/16-inch bolts 140 inch. lbs. (15.8 Nm). Do not torque over 145 inch. lbs(16.3 Nm).

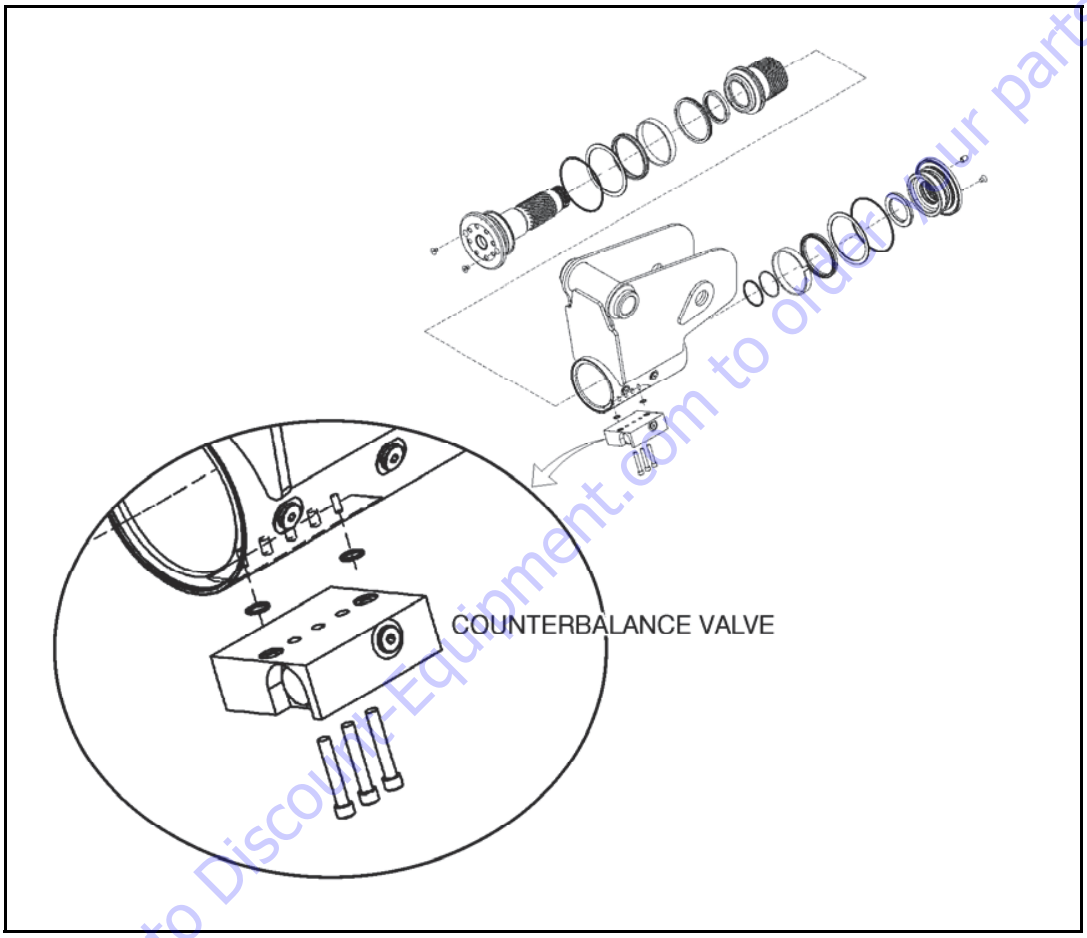



**Figure 4-27. Rotator Counterbalance Valve**

## Greasing Thrust Washers

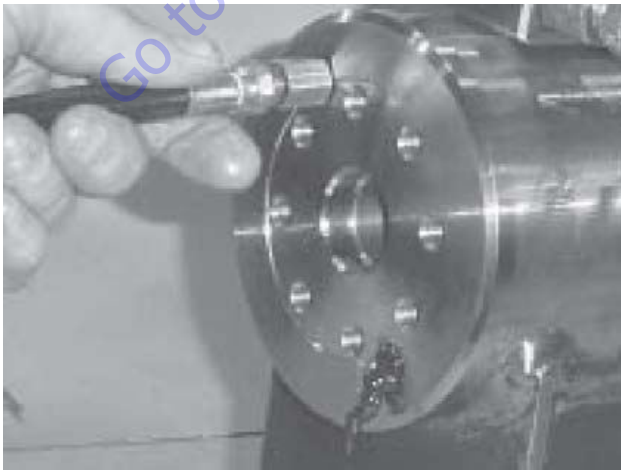
5. After the actuator is assembled but before it is put into service, the thrust washer area must be packed with Lithium grease.

6. There are two grease ports located on both the shaft flange and the end cap. They are plugged with capscrews (6) or set screws. Remove the grease port screws from the shaft flange and end cap. (See exploded view)

**NOTICE**

**IF A HYDRAULIC TEST BENCH IS NOT AVAILABLE, THE ACTUATOR CAN BE ROTATED BY HAND, OPEN THE PRESSURE PORTS AND USE A PRY BAR WITH CAPSCREWS INSERTED INTO THE SHAFT FLANGE TO TURN THE SHAFT IN THE DESIRED DIRECTION.**

7. Insert the tip of a grease gun into one port and apply grease to the shaft flange. Continue applying until grease flows from the opposite port. Cycle the actuator five times and apply grease again. Repeat this process on the end cap. Insert the capscrews into the grease ports and tighten to 25 in-lbs. (2.8 Nm).



## Testing the Actuator

If the equipment is available, the actuator should be tested on a hydraulic test bench. The breakaway pressure — the pressure at which the shaft begins to rotate — should be approximately 400 psi (28 bar). Cycle the actuator at least 25 times at 3000 psi (210 bar) pressure. After the 25 rotations, increase the pressure to 4500 psi (315 bar) to check for leaks and cracks. Perform the test again at the end of the rotation in the opposite direction.

### TESTING THE ACTUATOR FOR INTERNAL LEAKAGE

If the actuator is equipped with a counterbalance valve, plug the valve ports. Connect the hydraulic lines to the housing ports. Bleed all air from the actuator (see Installation and Bleeding) Rotate the shaft to the end of rotation at 3000 psi (210 bar) and maintain pressure. Remove the hydraulic line from the non-pressurized side.

Continuous oil flow from the open housing port indicates internal leakage across the piston. Replace the line and rotate the shaft to the end of rotation in the opposite direction. Repeat the test procedure outlined above for the other port. If there is an internal leak, disassemble, inspect and repair.

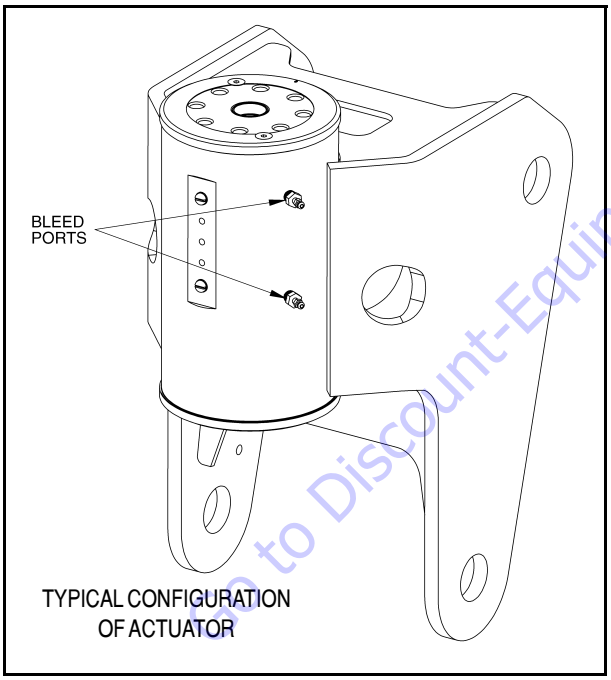
## Installation and Bleeding

After installation of the actuator on the equipment, it is important that all safety devices such as tie rods or safety cables are properly reattached.

To purge air from the hydraulic lines, connect them together to create a closed loop and pump hydraulic fluid through them. Review the hydraulic schematic to determine which hydraulic lines to connect. The linear feet and inside diameter of the hydraulic supply lines together with pump capacity will determine the amount of pumping time required to fully purge the hydraulic system.

Bleeding may be necessary if excessive backlash is exhibited after the actuator is connected to the hydraulic system. The following steps are recommended when a minimum of two gallons (8 liters) is purged.

1. Connect a 3/16" inside diameter x 5/16" outside diameter x 5 foot clear, vinyl drain tube to each of the two bleed nipples. Secure them with hose clamps. Place the vinyl tubes in a clean 5-gallon container to collect the purged oil. The oil can be returned to the reservoir after this procedure is completed.



TYPICAL CONFIGURATION
OF ACTUATOR

2. With an operator in the platform, open both bleed nipples 1/4 turn. Hydraulically rotate the platform to the end of rotation (either clockwise or counterclockwise), and maintain hydraulic pressure. Oil with small air bubbles will be seen flowing through the tubes. Allow a 1/2 gallon of fluid to be purged from the actuator.
3. Keep the fittings open and rotate the platform in the opposite direction to the end position. Maintain hydraulic pressure until an additional 1/4 gallon of fluid is pumped into the container.
4. Repeat steps 2 & 3. After the last 1/2 gallon is purged, close both bleed nipples before rotating away from the end position.

## Troubleshooting

**Table 4-1. Troubleshooting**

| Problem | Cause | Solution |
|---|---|---|
| 1. Shaft rotates slowly or not at all | a. Insufficient torque output | a. Verify correct operating pressure. Do not exceed OEM's pressure specifications. Load may be above maximum capacity of the actuator. |
| | b. Low rate of fluid flow | b. Inspect ports for obstructions and hydraulic lines for restrictions and leaks. |
| | c. Control or counterbalance valve has internal leak | c. Disconnect hydraulic lines and bypass valve. Leave valve ports open and operate the actuator through housing ports (do not exceed OEM's operating pressure). The valve must be replaced if a steady flow of fluid is seen coming from the valve ports. |
| | d. Piston and/or shaft seal leak | d. Remove the plug and the housing's valve ports. Operate the actuator through the housing ports. Conduct the internal leakage test as described in the Testing section on page 24 of this manual. |
| | e. Corrosion build-up on the thrust surfaces | e. Re-build the actuator. Remove all rust then polish. Replacement parts may be needed. |
| | f. Swollen seals and composite bearings caused by incompatible hydraulic fluid | f. Re-build the actuator. Use fluid that is compatible with seals and bearings. |
| 2. Operation is erratic or not responsive | a. Air in actuator | a. Purge air from actuator. See bleeding procedures. |
| 3. Shaft will not fully rotate | a. Twisted or chipped gear teeth overload conditions | a. Check for gear binding. Actuator may or may not be able to be re-built and may need to be replaced. |
| | b. Port fittings are obstructing the piston during stroke | b. Check thread length of port fittings. Fittings should not reach inside the housing bore. |
| 4. Selected position cannot be maintained | a. Control or counterbalance valve has internal leak | a. Disconnect hydraulic lines and bypass valve. Leave valve ports open and operate the actuator through housing ports (do not exceed OEM's operating pressure). The valve must be replaced if a steady flow of fluid is seen coming from the valve ports. |
| | b. Piston and/or shaft seal leak | b. Remove the plug and the housing's valve ports. Operate the actuator through the housing ports. Conduct the internal leakage test as described in the Testing section of this manual. |
| | c. Air in actuator | c. Purge air from actuator. See bleeding procedures |

## 4.12 LOAD SENSING DEVICE

### Calibrating the Load Sensor

***NOTE:*** *Refer to Section 6 - JLG Control System.*

1. Place the boom in the following position.
   - **a.** Boom - Stowed
   - **b.** Telescope - In
   - **c.** Jib - 0 Degrees
   - **d.** Swing - 0 Degrees
   - **e.** Basket Level - 0 Degrees
   - **f.** Basket Rotate - 0 Degrees
   - **g.** Weight in Basket - 0
   - **h.** Machine parked on firm, level surface
2. Activate both emergency stop switches and turn the key switch to the platform position.
3. Remove all loads from the platform, including the operator.
4. Turn P1 clockwise (in) until the potentiometer begins to click.
5. Plug the analyzer into the port in the platform.
6. Select Access Level from Main Menu.
7. Enter 33271.
8. Select Machine Set-Up>Load Cell>1 Warn Only.
9. Select Machine Diagnostics>System Load Cell on the Analyzer.
10. Adjust P2 until the Load = 0%.
11. Place 525 lbs. (238 kg) in the center of the basket.
12. Adjust P1 until the Load = 100%.
13. Verify that the overload indicator lights continuously and the alarm sounds continuously during an overload condition.
14. Remove the weight from the platform.
15. Adjust P2 until the Load = 0%.
16. Place 525 lbs. (238 kg) in the center of the basket.
17. Adjust P1 until the Load = 100%.
18. Remove the weight from the basket.
19. Seal the potentiometers with fingernail polish.

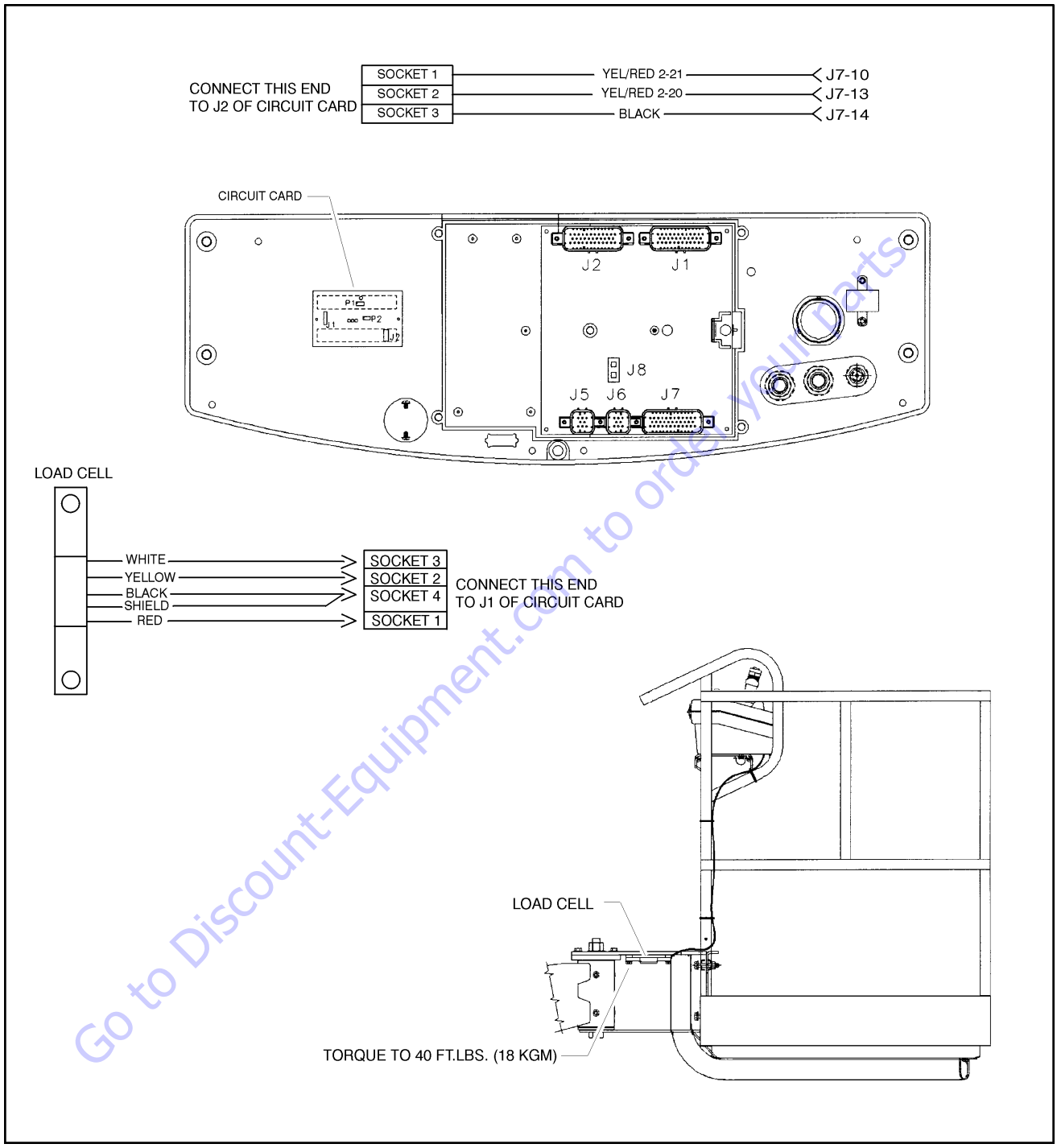




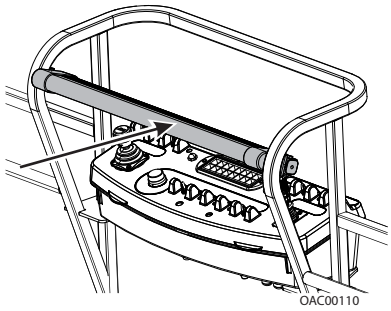

**Figure 4-28. Load Sensing Device**

## 4.13 SKYGUARD®

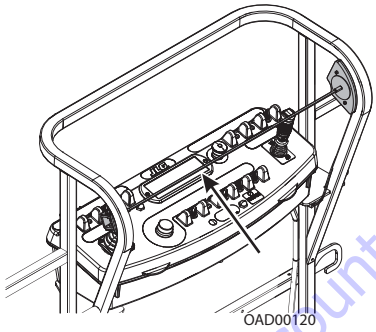
### Operation

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.

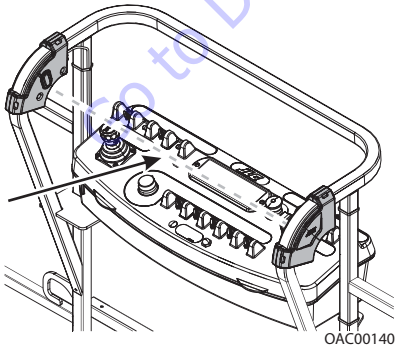
Consult the following illustrations to determine which type of SkyGuard the machine is equipped with. Regardless of the type, SkyGuard function according to the SkyGuard Function Table does not change.




**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:*

1. Operation is allowed regardless of SkyGuard activation.

#### BOTH SKYGUARD AND SOFT TOUCH

Perform this procedure if both SkyGuard and Soft Touch are selected in machine setup (refer to Table 6-2).

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

***NOTE:*** *Machine will treat Soft Touch/SkyGuard override switch as if it is a Soft Touch and SkyGuard switch.*

1. Operate the telescope out function, then activate SkyGuard sensor.
2. Once sensor has been activated, ensure telescope out function stops. 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 sure normal operation is available.

*In Ground Mode:*

1. Operation is allowed regardless of SkyGuard activation.

### SOFT TOUCH ONLY

If **Soft Touch only** 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 installed on the machine, but no option is 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 6-9 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 | Boom Lift Up | Boom Lift Down | Boom Tele Out | Boom Tele In | Jib Lift | Basket Level | Basket Rotate |
|---|---|---|---|---|---|---|---|---|---|---|
| R*/C** | R | C | R | R | R | R | 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 | | | | | | | | | | |
| **Note:** If SkyGuard is enabled with the Soft Touch system, functions will cut out instead of reversing. | | | | | | | | | | |

## 4.14 BOLT-ON EXTERNAL FALL ARREST

The Bolt-On External Fall Arrest system is designed to provide a lanyard attach point while allowing the operator to access areas outside the platform. Exit/Enter the platform through the gate area only. The system is designed for use by one person.

Personnel must use fall protection at all times. A full body harness is required with lanyard not to exceed 6 ft. (1.8 M) in length, that limits the maximum arrest force to 900 lbs. (408 kg).

Bolt-On External Fall Arrest System capacity is 310 lb (140 kg) - one (1) person maximum.

Do not move the platform during use of the Bolt-On External Fall Arrest system.

**⚠ WARNING**

**DO NOT OPERATE ANY MACHINE FUNCTIONS WHILE OUTSIDE OF PLATFORM. BE CAREFUL WHEN ENTERING/EXITING THE PLATFORM AT ELEVATION.**

**⚠ WARNING**

**IF THE BOLT-ON EXTERNAL FALL ARREST SYSTEM IS USED TO ARREST A FALL OR IS OTHERWISE DAMAGED, THE ENTIRE SYSTEM MUST BE REPLACED AND THE PLATFORM FULLY INSPECTED BEFORE RETURNING TO SERVICE. REFER TO THE SERVICE MANUAL FOR REMOVAL AND INSTALLATION PROCEDURES.**

**THE BOLT-ON EXTERNAL FALL ARREST SYSTEM REQUIRES AN ANNUAL INSPECTION AND CERTIFICATION. THE ANNUAL INSPECTION AND CERTIFICATION MUST BE PERFORMED BY A QUALIFIED PERSON OTHER THAN THE USER.**

### Inspection Before Use

The Bolt-On External Fall Arrest system must be inspected before each use of the aerial work platform. Replace components if there are any signs of wear or damage.

Before each use, perform a visual inspection of the following components:

- Cable: Inspect cable for proper tension, broken strands, kinks, or any signs of corrosion.

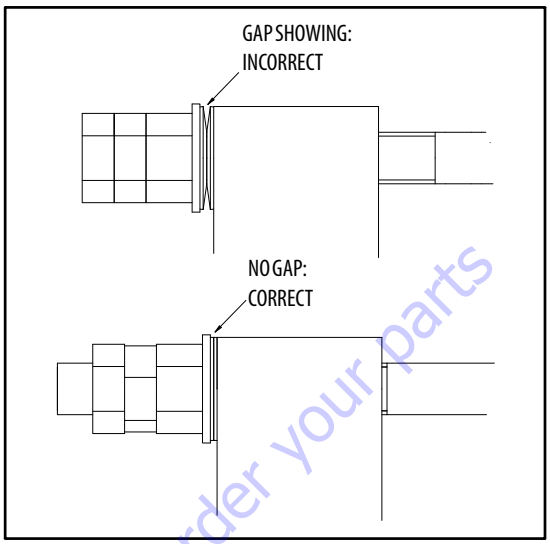
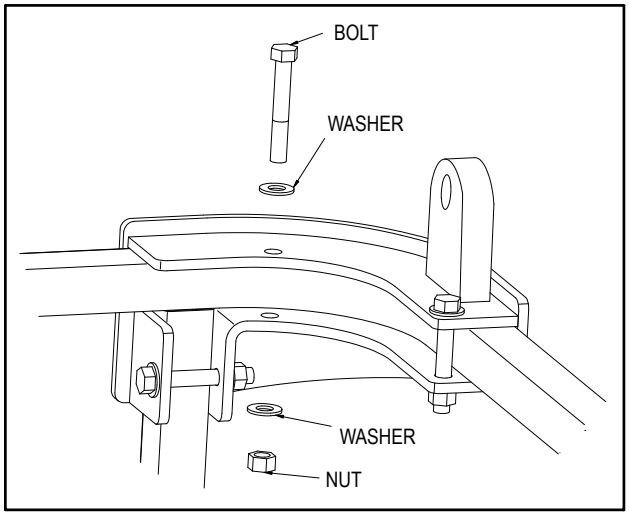



**Figure 4-29. Bolt-On External Fall Arrest Cable Tension**

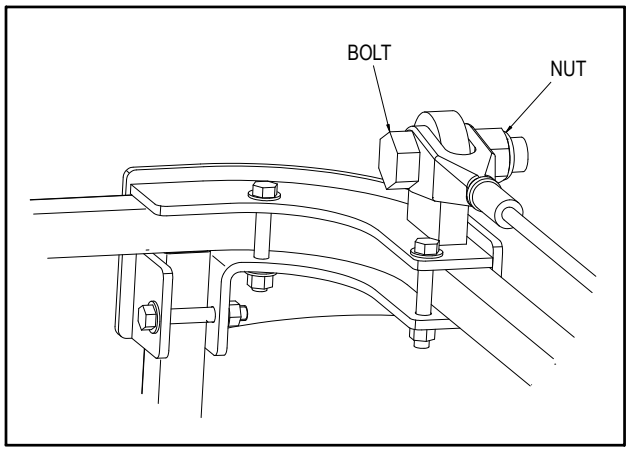
- Fittings & Brackets: Ensure all fittings are tight and there are no signs of fractures. Inspect brackets for any damage.
- Attachment Ring: No cracks or signs of wear are acceptable. Any signs of corrosion requires replacement.
- Attaching Hardware: Inspect all attaching hardware to ensure there are no missing components and hardware is properly tightened.
- Platform Rails: No visible damage is acceptable.

### Installation

1. Install the retaining hardware (bolts, nuts, and washers) and secure the brackets to the platform rail. Tighten the nuts but do not torque them yet.

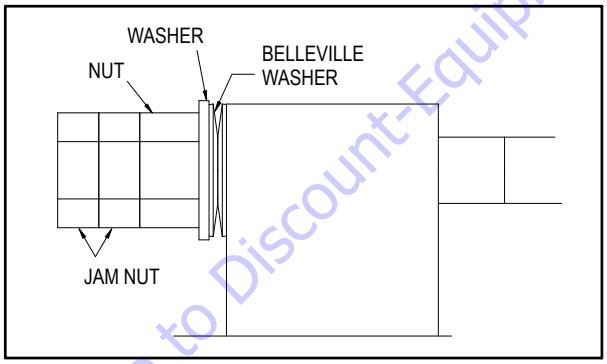


2. Attach the fall arrest cable to the right hand bracket Using the attaching bolt and nut. Orient the bolt as shown below. Do not tighten the nut so cable can still rotate.

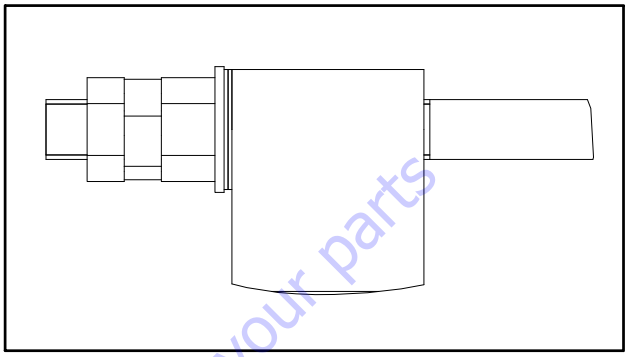



3. Install the Attachment Ring onto the cable.

4. Without twisting the fall arrest cable, pull it through the left hand bracket and mark the top of the swaged cable end. Install the fall arrest cable through the left hand bracket and secure it using the belleville washers, washer, retaining nut, and jam nuts. Orient the hardware as shown below and with the belleville washers so the gap is present at the outside diameter of the washers. install the nuts onto the cable finger tight so the mark on the cable does not move.

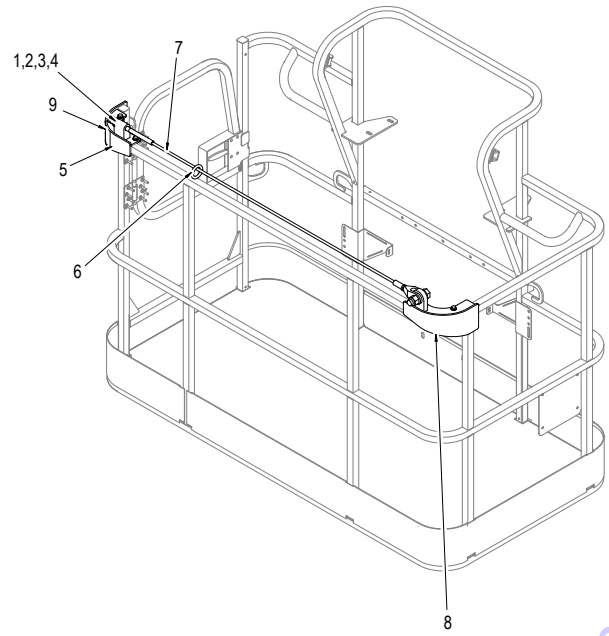



5. Use the two jam nuts to prevent the cable from rotating while the nut is tightened. Tighten the nut until the belleville washers are fully compressed and no gap is present at the outside diameter of the washers. Ensure the cable has not rotated during tightening.



6. Tighten the first jam nut against the retaining nut to keep the nut from loosening. Tighten the remaining jam nut against the first jam nut.

7. Torque the nuts and bolts securing the brackets to 15 ft.lbs. (20 Nm).




1. Belleville Washer
2. Washer
3. Hex Nut
4. Jam Nut
5. LH Bracket
6. Attachment Ring
7. Cable
8. RH Bracket
9. Decal

**Figure 4-30. Bolt-On External Fall Arrest System**

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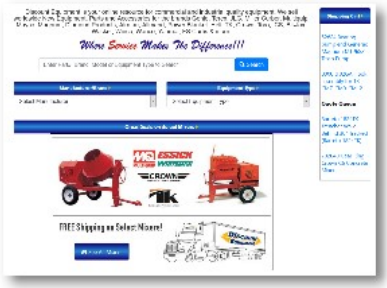

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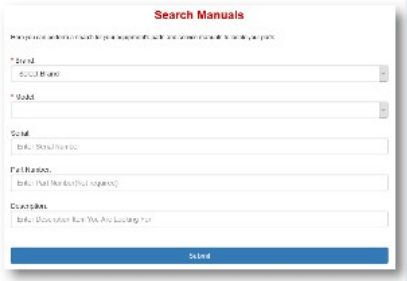


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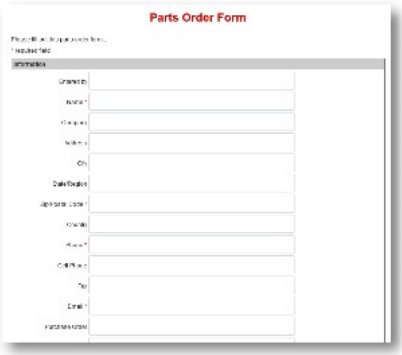


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# SECTION 5. BASIC HYDRAULICS INFORMATION & SCHEMATICS

## 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

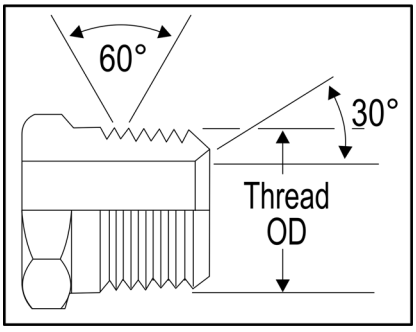



**Figure 5-1. NPTF thread**

BSPT = British standard pipe tapered per ISO7-1

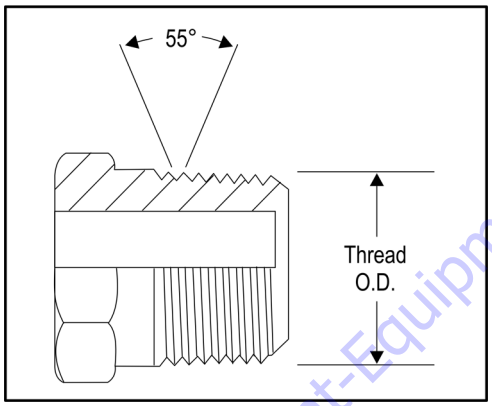



**Figure 5-2. BSPT thread**

### Straight Thread Types, Tube and Hose Connections

JIC = 37° flare per SAE J514

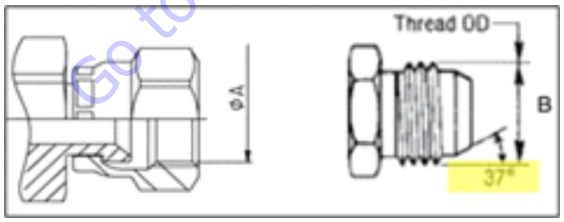



**Figure 5-3. JIC Thread**

SAE = 45° flare per SAE J512

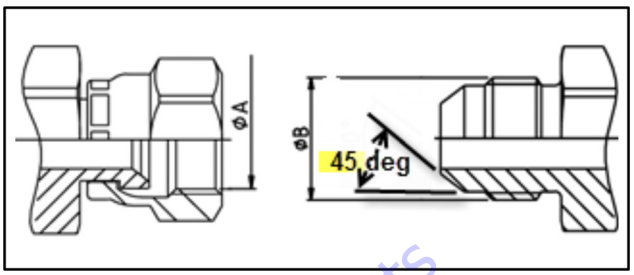



**Figure 5-4. SAE Thread**

ORFS = o-ring face seal per SAE J1453

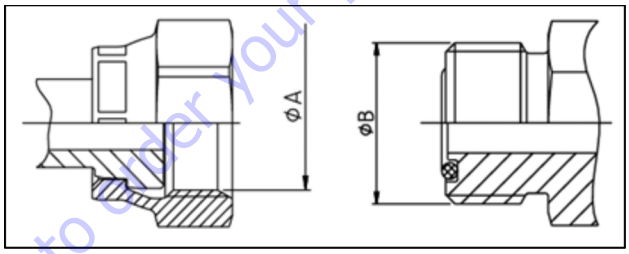



**Figure 5-5. ORFS Thread**

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

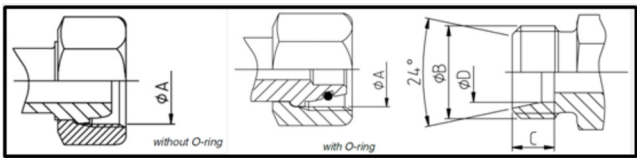



**Figure 5-6. MTBL-MBTS Thread**

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

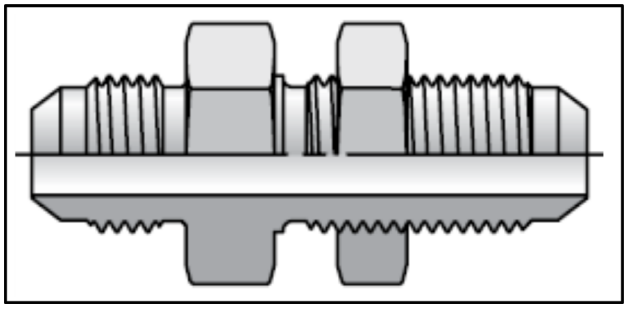
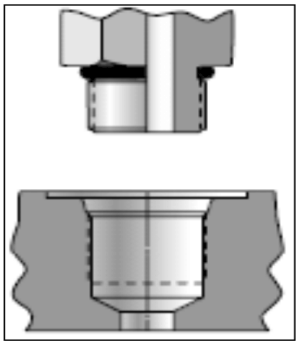


**Figure 5-7. Bulkhead Thread**

## 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



MFF = metric flat face port per ISO 9974-1

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

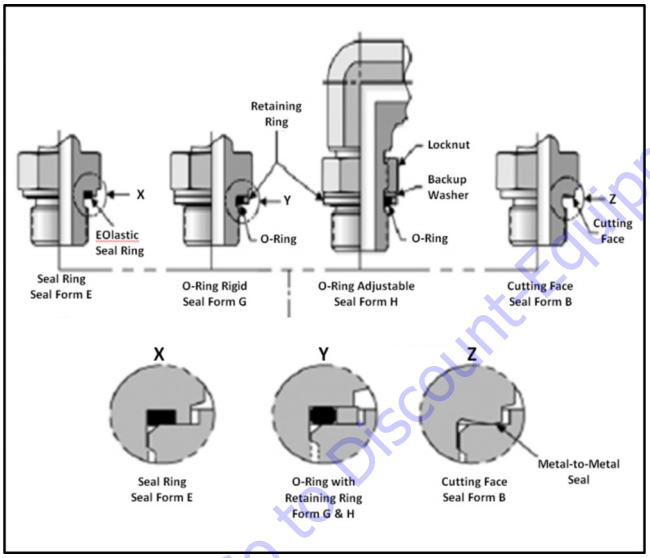



**Figure 5-8. MFF-BSPP Thread**

## Flange Connection Types

FL61 = code 61 flange per SAE J518, ISO 6162

FL62 = code 62 flange per SAE J518, ISO 6162

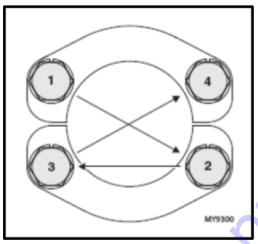



**Figure 5-9. ORB-MPP Thread**

## 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 Nm). 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.

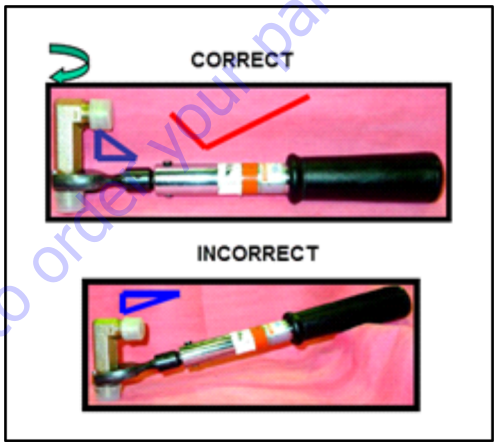



**Figure 5-10. Torque Wrench Angle**

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 Loctite 567, 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.**

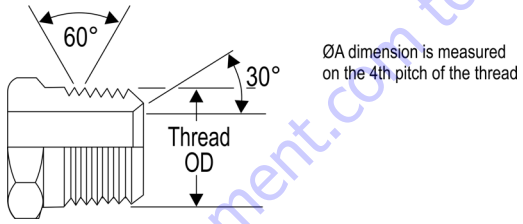
**NEVER BACK OFF (LOOSEN) PIPE THREADED CONNECTORS TO ACHIEVE ALIGNMENT. MEET THE MINIMUM REQUIRED TURNS AND USE THE LAST TURN FOR ALIGNMENT.**

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:*

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

**Table 5-1. NPTF Pipe Thread**




| TYPE/FITTING IDENTIFICATION | | | | | Turns From Finger Tight (TFFT)** |
|---|---|---|---|---|---|
| Material | Dash Size | Thread Size | ØA* | | |
| | | (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 subsection 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 Loctite 567, 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.**

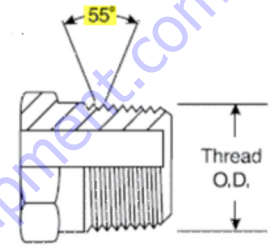
**NEVER BACK OFF (LOOSEN) PIPE THREADED CONNECTORS TO ACHIEVE ALIGNMENT. MEET THE MINIMUM REQUIRED TURNS AND USE THE LAST TURN FOR ALIGNMENT.**

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:*

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

**Table 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 Appendix B 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.**

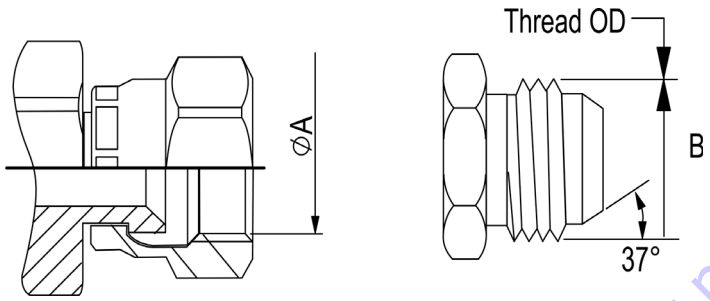
3. Torque assembly to value listed in Table 5-3, 37° Flare (JIC)Thread - Steel or Table 5-4, 37° Flare (JIC)Thread - Aluminum/Brass while using the Double Wrench Method per Double Wrench Method. Refer to FFWR and TFFT Methods for procedure requirements if using the FFWR method.

***NOTE:*** *Torque values provided in Table 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:

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

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

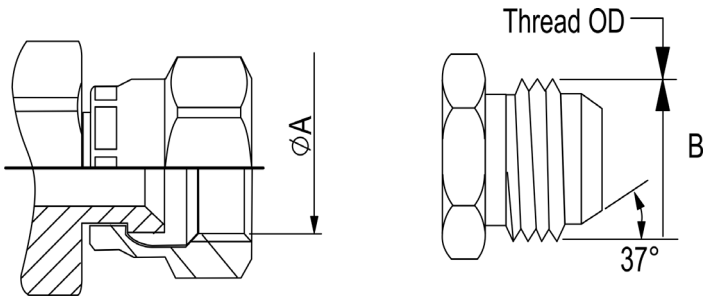



| Type/Fitting Identification | | | | | | | Torque | | | | | | Flats from Wrench Resistance (F.F.W.R)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MATERIAL | Dash Size | Thread Size | ØA* | | ØB* | | [Ft-Lb] | | | [N-m] | | | |
| | | (UNF) | (in) | (mm) | (in) | (mm) | Min | Nom | Max | Min | Nom | Max | |
| 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 Appendix B for FFWR procedure requirements.

**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 | 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 | 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.**

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.

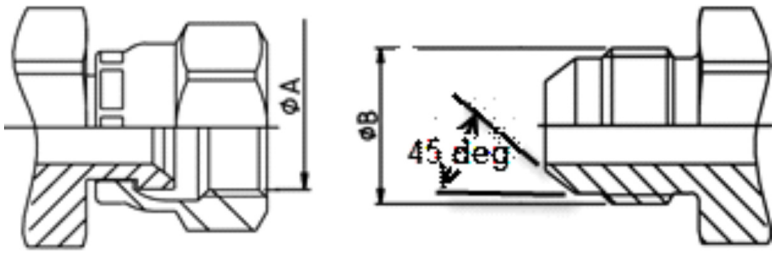
***NOTE:*** *Torque values provided in Table 5-5, 45° Flare (SAE) - Steel and Table 5-6, 45° Flare (SAE) - Aluminum/Brass are segregated based on the material configuration of the connection.*

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

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

mating components.

**Table 5-5. 45° Flare (SAE) - Steel**

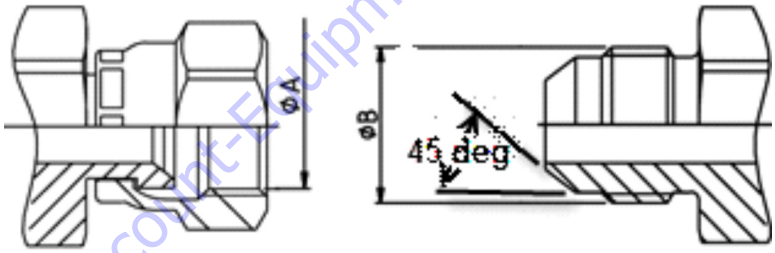



| TYPE/FITTING IDENTIFICATION | | | | | | | Torque | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MATERIAL | Dash Size | Thread Size | ØA* | | ØB* | | [Ft-Lb] | | | [N-m] | | |
| | | (UNF) | (in) | (mm) | (in) | (mm) | Min | Nom | Max | Min | Nom | Max |
| STEEL FITTINGS WITH STEEL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

* ØA and ØB thread dimensions for reference only.

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

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




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

* ØA and ØB thread dimensions for reference only.

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

## Assembly Instructions for O-Ring Face Seal (ORFS) Fittings

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

**⚠ CAUTION**

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

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

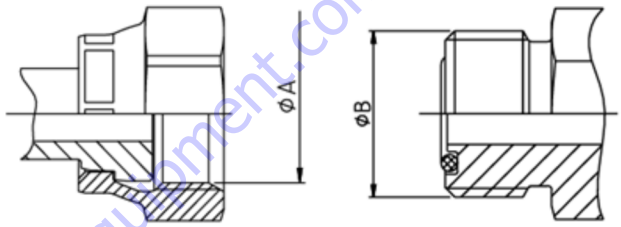
***NOTE:*** *Torque values provided in Table 5-7, O-ring Face Seal (ORFS) - Steel and Table 5-8, O-ring Face Seal (ORFS) - Aluminum/Brass are segregated based on the material configuration of the connection.*

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

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

BRASS mating components

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

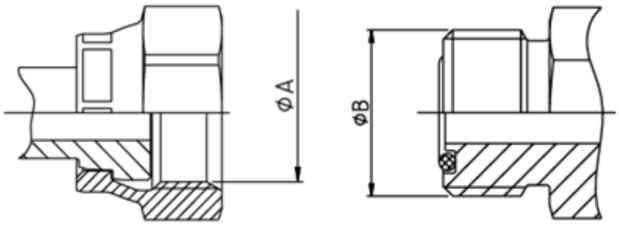



| TYPE/FITTING IDENTIFICATION | | | | | | | Torque | | | | | | Flats from Wrench Resistance (F.F.W.R)** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MATERIAL | Dash Size | Thread Size | ØA* | | ØB* | | [Ft-Lb] | | | [N-m] | | | Tube Nuts | Swivel & Hose Ends |
| | | (UNF) | (in) | (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 | 111/16-12 | 1.59 | 40.50 | 1.69 | 42.90 | 150 | 158 | 165 | 203 | 214 | 224 | 1/4 to 1/2 | 1/2 to 3/4 |
| | 24 | 2-12 | 1.92 | 48.80 | 2.00 | 50.80 | 230 | 242 | 253 | 312 | 328 | 343 | 1/4 to 1/2 | 1/2 to 3/4 |
| | 32 | 21/2-12 | 2.43 | 61.67 | 2.50 | 63.50 | 375 | 394 | 413 | 508 | 534 | 560 | 1/4 to 1/2 | 1/2 to 3/4 |

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methodsfor FFWR procedure requirements.

**Table 5-8. O-ring Face Seal (ORFS) - Aluminum/Brass**




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

* ØA and ØB thread dimensions for reference only.

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

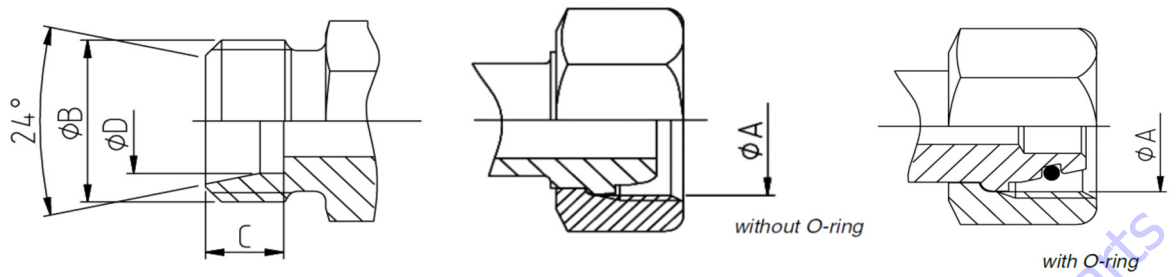
## Assembly Instructions for DIN 24° Flare Bite Type Fittings (MBTL and MBTS)

**⚠ CAUTION**

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

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

**Table 5-9. DIN 24°Cone (MBTL & MBTS)**




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

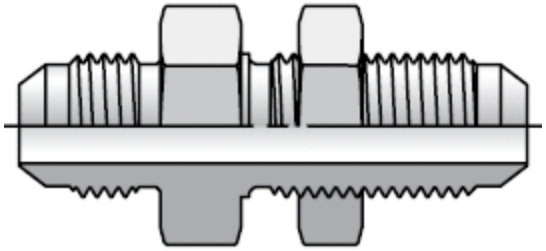
* ØA, ØB, C, & ØD thread dimensions for reference only.

** See Appendix B for FFWR procedure requirements.

## Assembly Instructions for Bulkhead (BH) Fittings

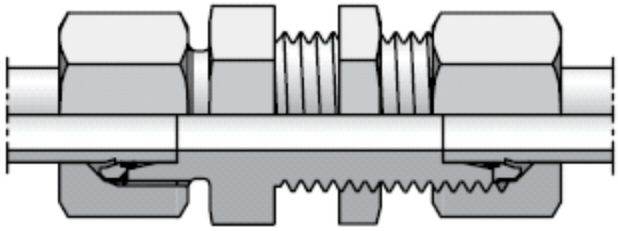
1. Ensure threads and surface are free of rust, weld and brazing splatter, splits, burrs or other foreign material. If necessary replace fitting or adapter.
2. Remove the locknut from the bulkhead assembly.
3. Insert the bulkhead side of the fitting into the panel or bulkhead bracket opening.
4. Hand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

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



| TYPE/FITTING IDENTIFICATION | | | | FASTENING JAM NUT for Bulkhead Connectors | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| MATERIAL | TYPE | Dash Size | Thread Size | Torque | | | | | |
| | | | | [Ft-Lb] | | | [N-m] | | |
| | | | (UNF) | Min | Nom | Max | Min | Nom | Max |
| STEEL FITTINGS | O-RING FACE SEAL (ORFS) BULKHEAD FITTING | 4 | 9/16-18 | 15 | 16 | 17 | 20 | 22 | 23 |
| | | 6 | 11/16-16 | 25 | 27 | 28 | 34 | 37 | 38 |
| | | 8 | 13/16-16 | 55 | 58 | 61 | 75 | 79 | 83 |
| | | 10 | 1-14 | 85 | 90 | 94 | 115 | 122 | 127 |
| | | 12 | 13/16-12 | 135 | 142 | 149 | 183 | 193 | 202 |
| | | 14 | 15/16-12 | 170 | 179 | 187 | 230 | 243 | 254 |
| | | 16 | 17/16-12 | 200 | 210 | 220 | 271 | 285 | 298 |
| | | 20 | 111/16-12 | 245 | 258 | 270 | 332 | 350 | 366 |
| | | 24 | 2-12 | 270 | 284 | 297 | 366 | 385 | 403 |
| | TYPE | Dash Size | Thread Size | Torque | | | | | |
| | | | | [Ft-Lb] | | | [N-m] | | |
| | | | (UNF) | Min | Nom | Max | Min | Nom | Max |
| | 37° FLARE (JIC) BULKHEAD FITTING | 3 | 3/8-24 | 8 | 9 | 9 | 11 | 12 | 12 |
| | | 4 | 7/16-20 | 13 | 14 | 14 | 18 | 19 | 19 |
| | | 5 | 1/2-20 | 20 | 21 | 22 | 27 | 28 | 30 |
| | | 6 | 9/16-18 | 25 | 27 | 28 | 34 | 37 | 38 |
| | | 8 | 3/4-16 | 50 | 53 | 55 | 68 | 72 | 75 |
| | | 10 | 7/8-14 | 85 | 90 | 94 | 115 | 122 | 127 |
| | | 12 | 11/16-12 | 135 | 142 | 149 | 183 | 193 | 202 |
| | | 14 | 13/16-12 | 170 | 179 | 187 | 230 | 243 | 254 |
| | | 16 | 15/16-12 | 200 | 210 | 220 | 271 | 285 | 298 |
| | | 20 | 15/8-12 | 245 | 258 | 270 | 332 | 350 | 366 |
| | | 24 | 17/8-12 | 270 | 284 | 297 | 366 | 385 | 403 |
| | | 32 | 21/2-12 | 310 | 326 | 341 | 420 | 442 | 462 |

**Table 5-11. Bulkhead Fittings (BH) - METRIC**



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

## Assembly Instructions for O-Ring Boss (ORB) Fittings

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

**⚠ CAUTION**

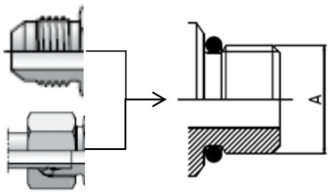
**CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.**

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

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

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

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



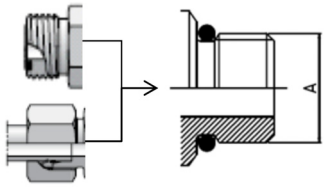
| TYPE/FITTING IDENTIFICATION | | | | | HEX TYPE PLUGS & STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| MATERIAL | Dash Size | Thread Size | ØA* | | Torque | | | | | |
| | | (UNF) | (in) | (mm) | Min | Nom | Max | Min | Nom | Max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

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

* ØA Thread OD dimension for reference only.

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

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

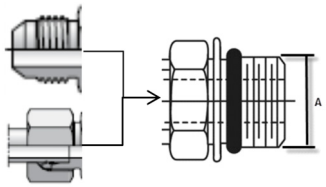


| TYPE/FITTING IDENTIFICATION | | | | | STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| MATERIAL | Dash Size | Thread Size | ØA* | | Torque | | | | | |
| | | (UNF) | (in) | (mm) | Min | Nom | Max | Min | Nom | Max |
| STEEL FITTINGS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

* ØA Thread OD dimension for reference only.

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

**Table 5-14. O-ring Boss (ORB) - Table 3 of 6**



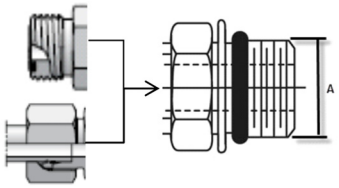

| TYPE/FITTING IDENTIFICATION | | | | | ADJUSTABLE STUD END with 37° (JIC) or L series DIN (MBTL) opposite end | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| MATERIAL | Dash Size | Thread Size | ØA* | | Torque | | | | | |
| | | (UNF) | (in) | (mm) | Min | Nom | Max | Min | Nom | Max |
| STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS | 2 | 5/16-24 | 0.31 | 7.93 | (60) | (63) | (66) | 7 | 7 | 7 |
| | 3 | 3/8-24 | 0.37 | 9.52 | (100) | (105) | (110) | 11 | 12 | 12 |
| | 4 | 7/16-20 | 0.44 | 11.11 | 15 | 16 | 17 | 20 | 22 | 23 |
| | 5 | 1/2-20 | 0.50 | 12.70 | 21 | 22 | 23 | 28 | 30 | 31 |
| | 6 | 9/16-18 | 0.56 | 14.28 | 29 | 31 | 32 | 40 | 42 | 43 |
| | 8 | 3/4-16 | 0.75 | 19.10 | 52 | 55 | 57 | 70 | 75 | 77 |
| | 10 | 7/8-14 | 0.87 | 22.22 | 85 | 90 | 94 | 115 | 122 | 127 |
| | 12 | 1 1/16-12 | 1.06 | 27.00 | 135 | 142 | 149 | 185 | 193 | 202 |
| | 14 | 1 3/16-12 | 1.19 | 30.10 | 175 | 184 | 193 | 235 | 249 | 262 |
| | 16 | 1 5/16-12 | 1.31 | 33.30 | 200 | 210 | 220 | 270 | 285 | 298 |
| | 20 | 1 5/8-12 | 1.63 | 41.30 | 250 | 263 | 275 | 340 | 357 | 373 |
| | 24 | 1 7/8-12 | 1.87 | 47.60 | 305 | 321 | 336 | 415 | 435 | 456 |
| | 32 | 2 1/2-12 | 2.50 | 63.50 | 375 | 394 | 413 | 510 | 534 | 560 |

| TYPE/FITTING IDENTIFICATION | | | | | ADJUSTABLE STUD END with 37° (JIC) or L series DIN (MBTL) opposite end | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| MATERIAL | Dash Size | Thread Size | ØA* | | Torque | | | | | |
| | | (UNF) | (in) | (mm) | Min | Nom | Max | Min | Nom | Max |
| ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS | 2 | 5/16-24 | 0.31 | 7.93 | (39) | (41) | (43) | 4 | 5 | 5 |
| | 3 | 3/8-24 | 0.37 | 9.52 | (65) | (69) | (72) | 7 | 8 | 8 |
| | 4 | 7/16-20 | 0.44 | 11.11 | 10 | 11 | 11 | 14 | 15 | 15 |
| | 5 | 1/2-20 | 0.50 | 12.70 | 14 | 15 | 15 | 19 | 20 | 20 |
| | 6 | 9/16-18 | 0.56 | 14.28 | 19 | 20 | 21 | 26 | 27 | 28 |
| | 8 | 3/4-16 | 0.75 | 19.10 | 34 | 36 | 37 | 46 | 49 | 50 |
| | 10 | 7/8-14 | 0.87 | 22.22 | 55 | 58 | 61 | 75 | 79 | 83 |
| | 12 | 1 1/16-12 | 1.06 | 27.00 | 88 | 93 | 97 | 119 | 126 | 132 |
| | 14 | 1 3/16-12 | 1.19 | 30.10 | 114 | 120 | 126 | 155 | 163 | 171 |
| | 16 | 1 5/16-12 | 1.31 | 33.30 | 130 | 137 | 143 | 176 | 186 | 194 |
| | 20 | 1 5/8-12 | 1.63 | 41.30 | 163 | 171 | 179 | 221 | 232 | 243 |
| | 24 | 1 7/8-12 | 1.87 | 47.60 | 198 | 208 | 218 | 268 | 282 | 296 |
| | 32 | 2 1/2-12 | 2.50 | 63.50 | 244 | 256 | 268 | 331 | 347 | 363 |

* ØA Thread OD dimension for reference only.

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

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

* ØA Thread OD dimension for reference only.

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

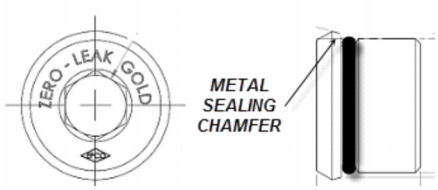
**Table 5-16. O-ring Boss (ORB) - Table 5 of 6**

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

* ØA Thread OD dimension for reference only.

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

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




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

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

* ØA Thread OD dimension for reference only.

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

## Assembly Instructions for Adjustable Port End Metric (MFF) Fittings

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

**⚠ CAUTION**

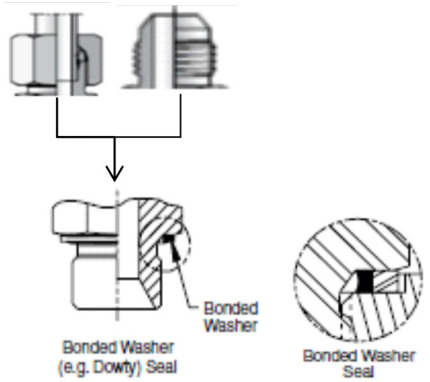
**CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.**

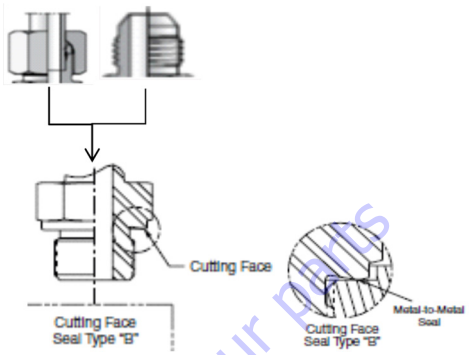
3. Pre-lubricate the O-ring with Hydraulic Oil.
4. For Non-Adjustable Fittings and Plugs, thread the fitting by hand until contact.
5. For Adjustable fittings, refer to Adjustable Stud End Assembly for proper assembly.
6. Torque the fitting or nut to value listed in Table 5-18, Table 5-19, Table 5-20,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

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

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

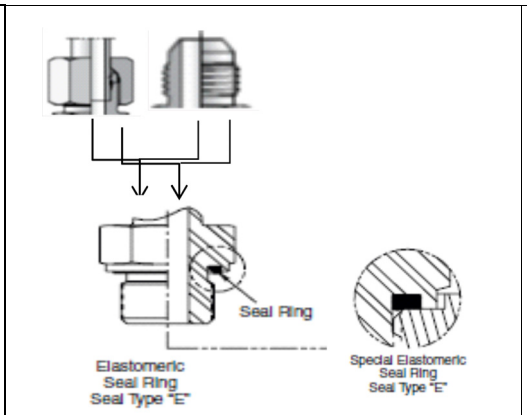
**Table 5-18. Metric Flat Face Port (MFF) - L Series - Table 1 of 3**

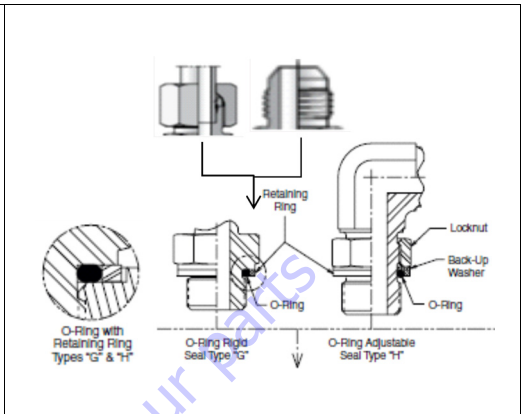



| TYPE/FITTING IDENTIFICATION | | | FORM A (SEALING WASHER) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end | | | | | | FORM B (CUTTING FACE) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MATERIAL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

**Table 5-19. Metric Flat Face Port (MFF) - L Series - Table 2 of 3**




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

**Table 5-20. Metric Flat Face Port (MFF) - L Series - Table 3 of 3**

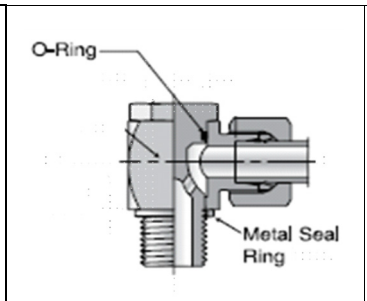
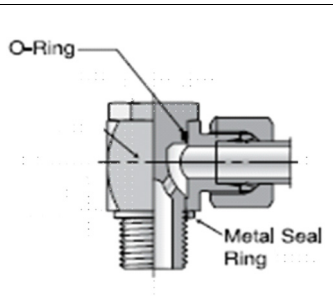
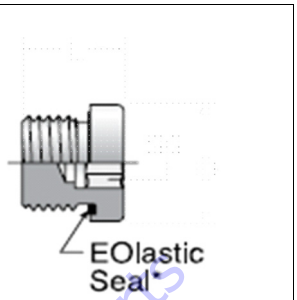
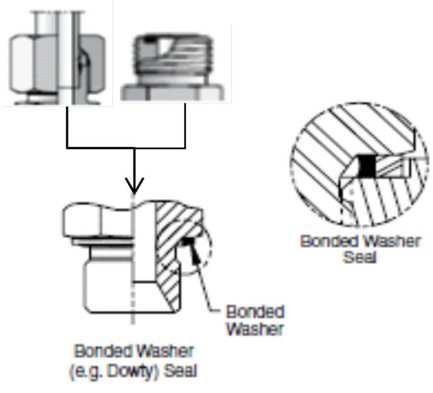
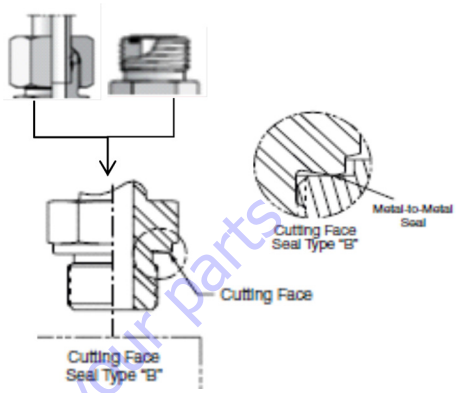
| | | |  | | |  | | |  | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TYPE/FITTING IDENTIFICATION | | | BANJO FITTINGS with L series DIN (MBTL) opposite end | | | | | | HIGH PRESSURE BANJO FITTINGS with L series DIN (MBTL) opposite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

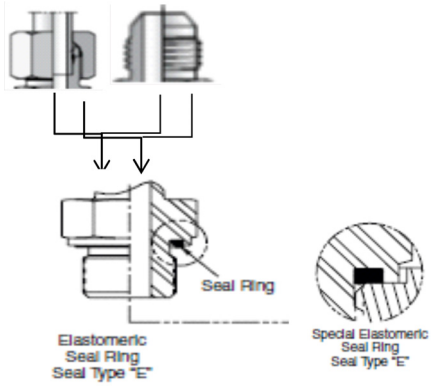
**Table 5-21. Metric Flat Face Port (MFF) - S Series - Table 1 of 3**

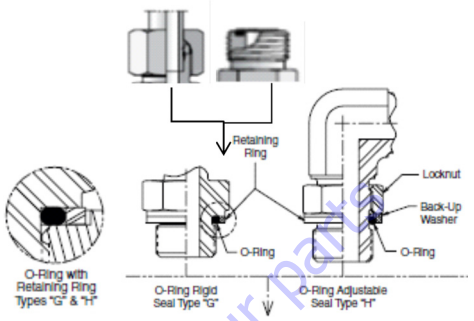



| TYPE/FITTING IDENTIFICATION | | | FORM A (SEALING WASHER) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end | | | | | | FORM B (CUTTING FACE) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MATERIAL | Thread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

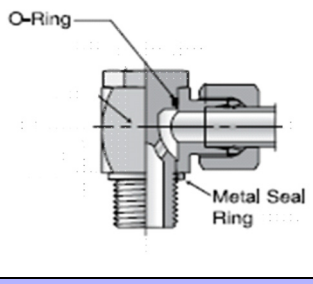
**Table 5-22. Metric Flat Face Port (MFF) - S Series - Table 2 of 3**

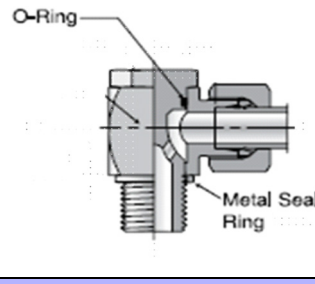


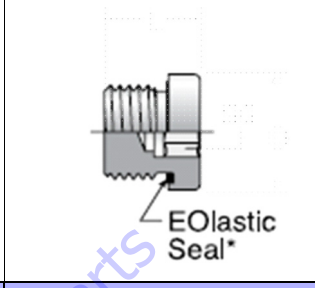




| TYPE/FITTING IDENTIFICATION | | | FORM E (EOLASTIC SEALING RING) STUD ENDS AND HEX TYPE PLUGS with (ORFS) or S series DIN (MBTS) opposite end | | | | | | FORM G/H (O-RING W/ RETAINING RING) STUD ENDS & ADJUSTABLE STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|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

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




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

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

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

**⚠ CAUTION**

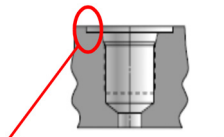
**CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.**

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

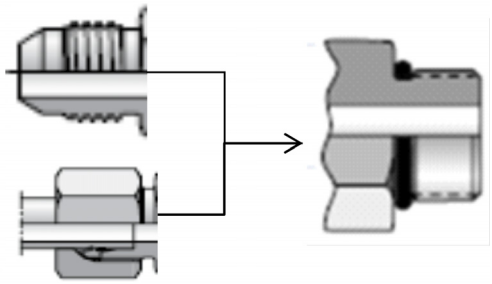
- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

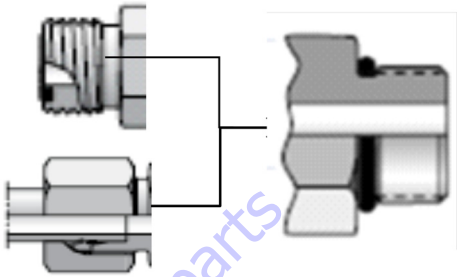
7. Inspect to ensure the O-ring is not pinched and the washer is seated flat on the counterbore of the port.

**Table 5-24. Metric Pipe Parallel O-Ring Boss (MPP)**



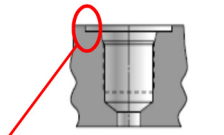
**Note:** Metric O-ring only style (ISO 6149) requires o-ring chamfer in the port, similar to ISO 11926 (SAE ORB),**but is not interchangeable.**



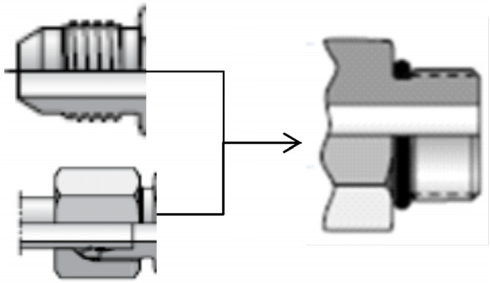


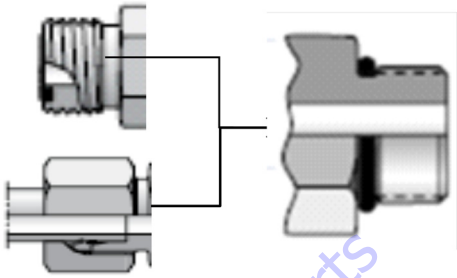
| TYPE/FITTING IDENTIFICATION | | | STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end | | | | | | STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MATERIAL | Thread M Size | Connecting Tube O.D. | Torque | | | | | | Torque | | | | | |
| | | | [Ft-Lb] | | | [N-m] | | | [Ft-Lb] | | | [N-m] | | |
| | (metric) | (mm) | Min | Nom | Max | Min | Nom | Max | Min | Nom | Max | Min | Nom | Max |
| STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS | M8x1 | 4 | 6 | 7 | 7 | 8 | 9 | 9 | 8 | 9 | 9 | 10 | 12 | 12 |
| | M10x1 | 6 | 11 | 12 | 12 | 15 | 16 | 16 | 15 | 16 | 17 | 20 | 22 | 23 |
| | M12x1.5 | 8 | 18 | 19 | 20 | 25 | 26 | 27 | 26 | 28 | 29 | 35 | 38 | 39 |
| | M14x1.5 | 10 | 26 | 28 | 29 | 35 | 38 | 39 | 33 | 35 | 36 | 45 | 47 | 49 |
| | M16x1.5 | 12 | 30 | 32 | 33 | 40 | 43 | 45 | 41 | 43 | 45 | 55 | 58 | 61 |
| | M18x1.5 | 15 | 33 | 35 | 36 | 45 | 47 | 49 | 52 | 55 | 57 | 70 | 75 | 77 |
| | M20x1.5 | -- | -- | -- | -- | -- | -- | -- | 59 | 62 | 65 | 80 | 84 | 88 |
| | M22x1.5 | 18 | 44 | 46 | 48 | 60 | 62 | 65 | 74 | 78 | 81 | 100 | 106 | 110 |
| | M27x2 | 22 | 74 | 78 | 81 | 100 | 106 | 110 | 125 | 132 | 138 | 170 | 179 | 187 |
| | M30x2 | -- | 95 | 100 | 105 | 130 | 136 | 142 | 175 | 184 | 193 | 237 | 249 | 262 |
| | M33x2 | 25 | 120 | 126 | 132 | 160 | 171 | 179 | 230 | 242 | 253 | 310 | 328 | 343 |
| | M38x2 | -- | 135 | 142 | 149 | 183 | 193 | 202 | 235 | 247 | 259 | 319 | 335 | 351 |
| | M42x2 | 30 | 155 | 163 | 171 | 210 | 221 | 232 | 245 | 258 | 270 | 330 | 350 | 366 |
| | M48x2 | 38 | 190 | 200 | 209 | 260 | 271 | 283 | 310 | 326 | 341 | 420 | 442 | 462 |
| | M60x2 | 50 | 230 | 242 | 253 | 315 | 328 | 343 | 370 | 389 | 407 | 500 | 527 | 552 |

**Table 5-24. Metric Pipe Parallel O-Ring Boss (MPP)**



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





| TYPE/FITTING IDENTIFICATION | | | STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end | | | | | | STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MATERIAL | Thread M Size | Connecting Tube O.D. | Torque | | | | | | Torque | | | | | |
| | | | [Ft-Lb] | | | [N-m] | | | [Ft-Lb] | | | [N-m] | | |
| | (metric) | (mm) | Min | Nom | Max | Min | Nom | Max | Min | Nom | Max | Min | Nom | Max |
| ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS | M8x1 | 4 | 4 | 5 | 5 | 5 | 7 | 7 | 5 | 6 | 6 | 7 | 8 | 8 |
| | M10x1 | 6 | 7 | 8 | 8 | 9 | 11 | 11 | 10 | 11 | 11 | 14 | 15 | 15 |
| | M12x1.5 | 8 | 12 | 13 | 13 | 16 | 18 | 18 | 17 | 18 | 19 | 23 | 24 | 26 |
| | M14x1.5 | 10 | 17 | 18 | 19 | 23 | 24 | 26 | 21 | 22 | 23 | 28 | 30 | 31 |
| | M16x1.5 | 12 | 20 | 21 | 21 | 27 | 28 | 28 | 27 | 28 | 29 | 37 | 38 | 39 |
| | M18x1.5 | 15 | 21 | 22 | 23 | 28 | 30 | 31 | 34 | 36 | 37 | 46 | 49 | 50 |
| | M20x1.5 | -- | -- | -- | -- | -- | -- | -- | 30 | 40 | 42 | 41 | 54 | 57 |
| | M22x1.5 | 18 | 29 | 30 | 31 | 39 | 41 | 42 | 48 | 51 | 53 | 65 | 69 | 72 |
| | M27x2 | 22 | 48 | 51 | 53 | 65 | 69 | 72 | 81 | 86 | 90 | 110 | 117 | 122 |
| | M30x2 | -- | 62 | 65 | 68 | 84 | 88 | 92 | 114 | 120 | 125 | 155 | 163 | 169 |
| | M33x2 | 25 | 78 | 82 | 86 | 106 | 111 | 117 | 150 | 157 | 164 | 203 | 213 | 222 |
| | M38x2 | -- | 88 | 93 | 97 | 119 | 126 | 132 | 153 | 161 | 168 | 207 | 218 | 228 |
| | M42x2 | 30 | 101 | 106 | 111 | 137 | 144 | 150 | 159 | 168 | 176 | 216 | 228 | 239 |
| | M48x2 | 38 | 124 | 130 | 136 | 168 | 176 | 184 | 202 | 212 | 222 | 274 | 287 | 301 |
| | M60x2 | 50 | 150 | 157 | 164 | 203 | 213 | 222 | 241 | 253 | 265 | 327 | 343 | 359 |

## Assembly Instructions for Adjustable Port End (BSPP) Fittings

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

**⚠ CAUTION**

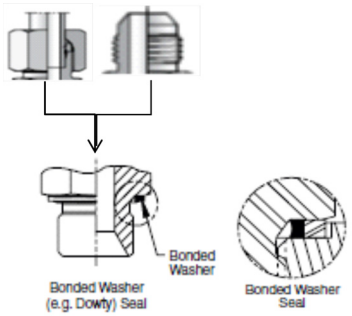
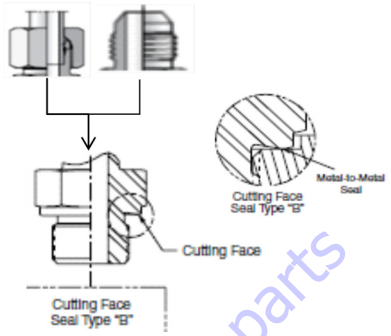
**CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.**

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

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

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

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

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

* Typical for JLG Straight Male Stud Fittings

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

*** Typical for JLG Adjustable Fittings

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

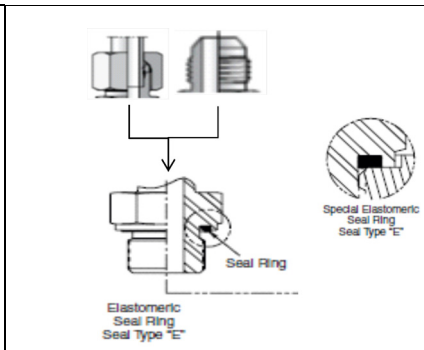
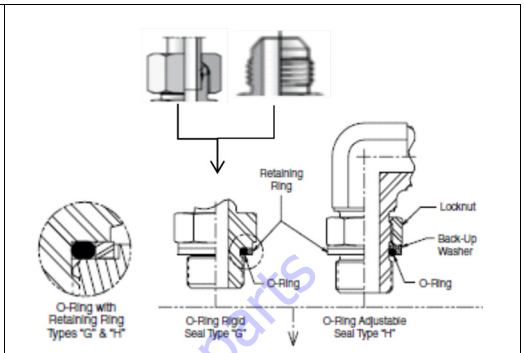
| | | |  | | | | | |  | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TYPE/FITTING IDENTIFICATION | | | FORM E* (EOLASTIC SEALING RING) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end | | | | | | FORM G/H*** (O-RING W/ RETAINING RING) STUD ENDS & ADJUSTABLE STUD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

**Table 5-27. British Standard Parallel Pipe Port (BSPP) - L Series - Table 3 of 3**

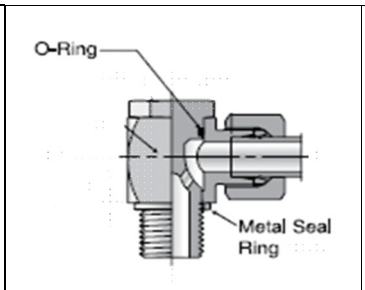
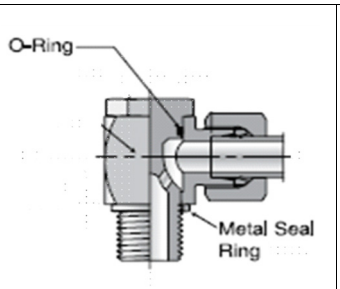
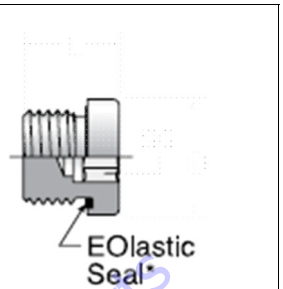
| | | |  | | |  | | |  | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TYPE/FITTING IDENTIFICATION | | | BANJO FITTINGS with L series DIN (MBTL) opposite end | | | | | | HIGH PRESSURE BANJO FITTINGS with L series DIN (MBTL) opposite end | | | | | | FORM E (EOLASTIC SEALING RING) HOLLOW HEX PLUGS | | | | | |
| MATERIAL | BSPP Thread G Size | Connecting Tube O.D. | Torque | | | | | | 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 | G 1/8A | 6 | 13 | 14 | 14 | 18 | 19 | 19 | 13 | 14 | 14 | 18 | 19 | 19 | 10 | 11 | 11 | 13 | 15 | 15 |
| | G 1/4A | 8 | 30 | 32 | 33 | 40 | 43 | 45 | 33 | 35 | 36 | 45 | 47 | 49 | 22 | 23 | 24 | 30 | 31 | 33 |
| | G 1/4A | 10 | 30 | 32 | 33 | 40 | 43 | 45 | 33 | 35 | 36 | 45 | 47 | 49 | 22 | 23 | 24 | 30 | 31 | 33 |
| | G 3/8A | 12 | 48 | 51 | 53 | 65 | 69 | 72 | 52 | 55 | 57 | 70 | 75 | 77 | 44 | 46 | 48 | 60 | 62 | 65 |
| | G 1/2A | 15 | 66 | 70 | 73 | 90 | 95 | 99 | 89 | 94 | 98 | 120 | 127 | 133 | 59 | 62 | 65 | 80 | 84 | 88 |
| | G 1/2A | 18 | 66 | 70 | 73 | 90 | 95 | 99 | 89 | 94 | 98 | 120 | 127 | 133 | 59 | 62 | 65 | 80 | 84 | 88 |
| | G 3/4A | 22 | 92 | 97 | 101 | 125 | 132 | 137 | 170 | 179 | 187 | 230 | 243 | 254 | 103 | 108 | 113 | 140 | 146 | 153 |
| | G 1A | 28 | -- | -- | -- | -- | -- | -- | 236 | 248 | 260 | 320 | 336 | 353 | 148 | 156 | 163 | 200 | 212 | 221 |
| | G 1-1/4A | 35 | -- | -- | -- | -- | -- | -- | 398 | 418 | 438 | 540 | 567 | 594 | 295 | 313.5 | 332 | 400 | 425 | 450 |
| | G 1-1/2A | 42 | -- | -- | -- | -- | -- | -- | 516 | 542 | 568 | 700 | 735 | 770 | 332 | 349 | 365 | 450 | 473 | 495 |
| MATERIAL | BSPP Thread G Size | Connecting Tube O.D. | Torque | | | | | | Torque | | | | | | Torque | | | | | |
| | | | [Ft-Lb] | | | [N-m] | | | [Ft-Lb] | | | [N-m] | | | [Ft-Lb] | | | [N-m] | | |
| | (metric) | (mm) | Min | Nom | Max | Min | Nom | Max | Min | Nom | Max | Min | Nom | Max | Min | Nom | Max | Min | Nom | Max |
| ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS | G 1/8A | 6 | 8 | 9 | 9 | 11 | 12 | 12 | 8 | 9 | 9 | 11 | 12 | 12 | 6 | 7 | 7 | 8 | 9 | 9 |
| | G 1/4A | 8 | 20 | 21 | 21 | 27 | 28 | 28 | 21 | 22 | 23 | 28 | 30 | 31 | 14 | 15 | 16 | 19 | 20 | 22 |
| | G 1/4A | 10 | 20 | 21 | 21 | 27 | 28 | 28 | 21 | 22 | 23 | 28 | 30 | 31 | 14 | 15 | 16 | 19 | 20 | 22 |
| | G 3/8A | 12 | 31 | 33 | 34 | 42 | 45 | 46 | 34 | 36 | 37 | 46 | 49 | 50 | 29 | 30 | 31 | 39 | 41 | 42 |
| | G 1/2A | 15 | 43 | 45 | 47 | 58 | 61 | 64 | 58 | 61 | 64 | 79 | 83 | 87 | 38 | 40 | 42 | 52 | 54 | 57 |
| | G 1/2A | 18 | 43 | 45 | 47 | 58 | 61 | 64 | 58 | 61 | 64 | 79 | 83 | 87 | 38 | 40 | 42 | 52 | 54 | 57 |
| | G 3/4A | 22 | 60 | 63 | 66 | 81 | 85 | 89 | 111 | 117 | 122 | 150 | 159 | 165 | 67 | 70 | 73 | 91 | 95 | 99 |
| | G 1A | 28 | -- | -- | -- | -- | -- | -- | 153 | 161 | 169 | 207 | 218 | 229 | 96 | 101 | 106 | 130 | 137 | 144 |
| | G 1-1/4A | 35 | -- | -- | -- | -- | -- | -- | 259 | 272 | 285 | 351 | 369 | 386 | 216 | 227 | 237 | 293 | 308 | 321 |
| | G 1-1/2A | 42 | -- | -- | -- | -- | -- | -- | 335 | 352 | 369 | 454 | 477 | 500 | 216 | 227 | 237 | 293 | 308 | 321 |
| * Typical for JLG Straight Male Stud Fittings | | | | | | | | | | | | | | | | | | | | |
| ** Non typical for JLG Straight Male Stud Fittings, reference only. | | | | | | | | | | | | | | | | | | | | |
| *** Typical for JLG Adjustable Fittings | | | | | | | | | | | | | | | | | | | | |

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

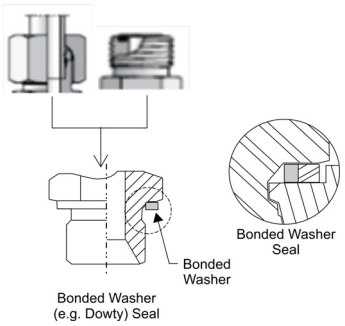
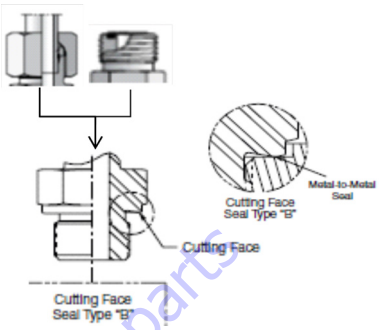
| | | |  | | | | | |  | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TYPE/FITTING IDENTIFICATION | | | FORM A** (SEALING WASHER) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end | | | | | | FORM B** (CUTTING FACE) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite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

**Table 5-29. British Standard Parallel Pipe Port (BSPP) - S Series - Table 2 of 3**

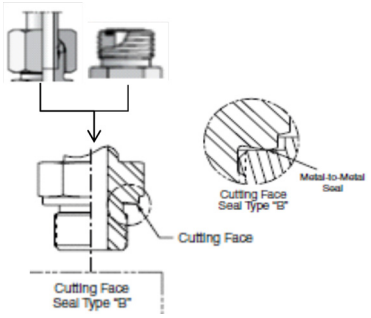
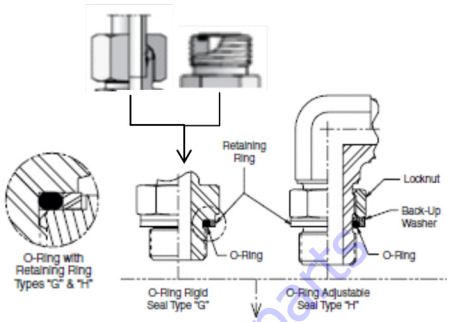
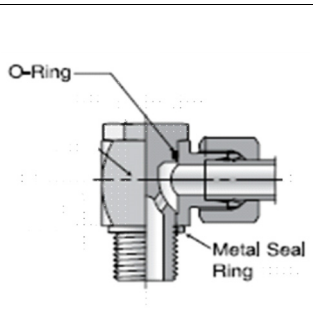
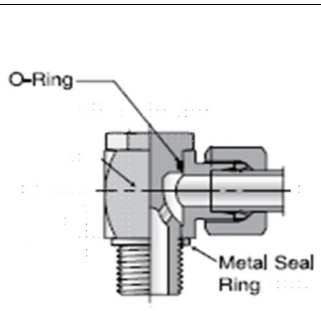
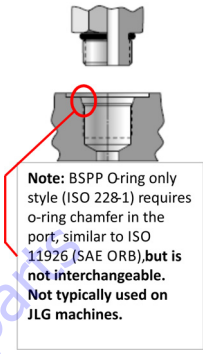
| | | |  | | | | | |  | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TYPE/FITTING IDENTIFICATION | | | FORM E* (EOLASTIC SEALING RING) STUD ENDS AND HEX TYPE PLUGS with (ORFS) or S series DIN (MBTS) opposite end | | | | | | FORM G/H*** (O-RING W/ RETAINING RING) STUD ENDS & 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 |
| MATERIAL | BSPP Thread G Size | Connecting Tube O.D. | Torque | | | | | | Torque | | | | | |
| | | | [Ft-Lb] | | | [N-m] | | | [Ft-Lb] | | | [N-m] | | |
| | (metric) | (mm) | Min | Nom | Max | Min | Nom | Max | Min | Nom | Max | Min | Nom | Max |
| ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS | G 1/4A | 6 | 27 | 28 | 29 | 37 | 38 | 39 | 17 | 18 | 19 | 23 | 24 | 26 |
| | G 1/4A | 8 | 27 | 28 | 29 | 37 | 38 | 39 | 17 | 18 | 19 | 23 | 24 | 26 |
| | G 3/8A | 10 | 38 | 40 | 42 | 52 | 54 | 57 | 34 | 36 | 37 | 46 | 49 | 50 |
| | G 3/8A | 12 | 38 | 40 | 42 | 52 | 54 | 57 | 34 | 36 | 37 | 46 | 49 | 50 |
| | G 1/2A | 14 | 55 | 58 | 61 | 75 | 79 | 83 | 43 | 45 | 47 | 58 | 61 | 64 |
| | G 1/2A | 16 | 55 | 58 | 61 | 75 | 79 | 83 | 43 | 45 | 47 | 58 | 61 | 64 |
| | G 3/4A | 20 | 86 | 91 | 95 | 117 | 123 | 129 | 86 | 91 | 95 | 117 | 123 | 129 |
| | G 1A | 25 | 149 | 157 | 164 | 202 | 213 | 222 | 149 | 157 | 164 | 202 | 213 | 222 |
| | G 1-1/4A | 30 | 216 | 227 | 237 | 293 | 308 | 321 | 216 | 227 | 237 | 293 | 308 | 321 |
| | G 1-1/2A | 38 | 259 | 272 | 285 | 351 | 369 | 386 | 259 | 272 | 285 | 351 | 369 | 386 |
| * Typical for JLG Straight Male Stud Fittings | | | | | | | | | | | | | | |
| ** Non typical for JLG Straight Male Stud Fittings, reference only. | | | | | | | | | | | | | | |
| *** Typical for JLG Adjustable Fittings | | | | | | | | | | | | | | |

**Table 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] | | |
| | (metric) | (mm) | Min | Nom | Max | Min | Nom | Max | Min | Nom | Max | Min | Nom | Max | Min | Nom | Max | Min | Nom | Max |
| STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS | G 1/4A | 6 | 30 | 32 | 33 | 40 | 43 | 45 | 33 | 35 | 36 | 45 | 47 | 49 | Fitting type not typically specified on JLG applications. Refer to the specific procedure in this Service Manual. | | | | | |
| | G 1/4A | 8 | 30 | 32 | 33 | 40 | 43 | 45 | 33 | 35 | 36 | 45 | 47 | 49 | | | | | | |
| | G 3/8A | 10 | 48 | 51 | 53 | 65 | 69 | 72 | 52 | 55 | 57 | 70 | 75 | 77 | | | | | | |
| | G 3/8A | 12 | 48 | 51 | 53 | 65 | 69 | 72 | 52 | 55 | 57 | 70 | 75 | 77 | | | | | | |
| | G 1/2A | 14 | 66 | 70 | 73 | 90 | 95 | 99 | 89 | 94 | 98 | 120 | 127 | 133 | | | | | | |
| | G 1/2A | 16 | 66 | 70 | 73 | 90 | 95 | 99 | 89 | 94 | 98 | 120 | 127 | 133 | | | | | | |
| | G 3/4A | 20 | 92 | 97 | 101 | 125 | 132 | 137 | 170 | 179 | 187 | 230 | 243 | 254 | | | | | | |
| | G 1A | 25 | -- | -- | -- | -- | -- | -- | 236 | 248 | 260 | 320 | 336 | 353 | | | | | | |
| | G 1-1/4A | 30 | -- | -- | -- | -- | -- | -- | 398 | 418 | 438 | 540 | 567 | 594 | | | | | | |
| | G 1-1/2A | 38 | -- | -- | -- | -- | -- | -- | 516 | 542 | 568 | 700 | 735 | 770 | | | | | | |
| MATERIAL | BSPP Thread G Size | Connecting Tube O.D. | Torque | | | | | | Torque | | | | | | Torque | | | | | |
| | | | [Ft-Lb] | | | [N-m] | | | [Ft-Lb] | | | [N-m] | | | [Ft-Lb] | | | [N-m] | | |
| | (metric) | (mm) | Min | Nom | Max | Min | Nom | Max | Min | Nom | Max | Min | Nom | Max | Min | Nom | Max | Min | Nom | Max |
| ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS | G 1/4A | 6 | 20 | 21 | 21 | 27 | 28 | 28 | 22 | 22 | 23 | 30 | 30 | 31 | Fitting type not typically specified on JLG applications. Refer to the specific procedure in this Service Manual. | | | | | |
| | G 1/4A | 8 | 20 | 21 | 21 | 27 | 28 | 28 | 22 | 22 | 23 | 30 | 30 | 31 | | | | | | |
| | G 3/8A | 10 | 31 | 33 | 34 | 42 | 45 | 46 | 34 | 36 | 37 | 46 | 49 | 50 | | | | | | |
| | G 3/8A | 12 | 31 | 33 | 34 | 42 | 45 | 46 | 34 | 36 | 37 | 46 | 49 | 50 | | | | | | |
| | G 1/2A | 14 | 43 | 45 | 47 | 58 | 61 | 64 | 58 | 61 | 64 | 79 | 83 | 87 | | | | | | |
| | G 1/2A | 16 | 43 | 45 | 47 | 58 | 61 | 64 | 58 | 61 | 64 | 79 | 83 | 87 | | | | | | |
| | G 3/4A | 20 | 60 | 63 | 66 | 81 | 85 | 89 | 111 | 117 | 122 | 150 | 159 | 165 | | | | | | |
| | G 1A | 25 | -- | -- | -- | -- | -- | -- | 153 | 161 | 169 | 207 | 218 | 229 | | | | | | |
| | G 1-1/4A | 30 | -- | -- | -- | -- | -- | -- | 259 | 272 | 285 | 351 | 369 | 386 | | | | | | |
| | G 1-1/2A | 38 | -- | -- | -- | -- | -- | -- | 335 | 352 | 368 | 454 | 477 | 499 | | | | | | |

* Typical for JLG Straight Male Stud Fittings

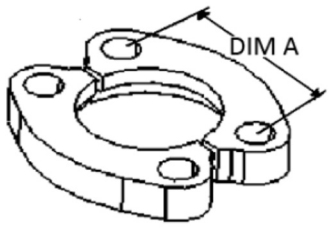
** Non typical for JLG Straight Male Stud Fittings, reference only.

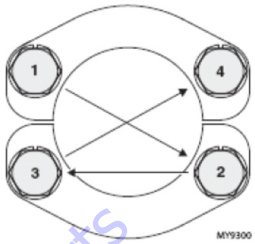
*** Typical for JLG Adjustable Fittings

## Assembly Instructions for Flange Connections: (FL61 and FL62)

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

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

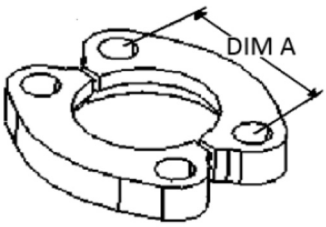


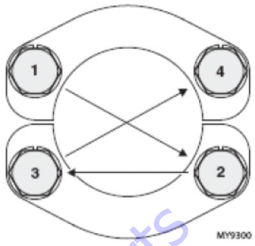




| TYPE/FITTING IDENTIFICATION | | | | | | STEEL 4-BOLT FLANGE SAE J518 (INCH FASTENERS) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TYPE | Inch Flange SAE Dash Size | Flange Size | | A* | | Bolt Thread Size | Fastener Torque for Flanges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

* A dimension for reference only.

**Table 5-32. Flange Code (FL61 & FL62) - Metric Fasteners**




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

* A dimension for reference only.

## Double Wrench Method

To prevent undesired hose or connector rotation, two wrenches must be used; one torque wrench and one back- up 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 5-11. for double wrench method requirements.

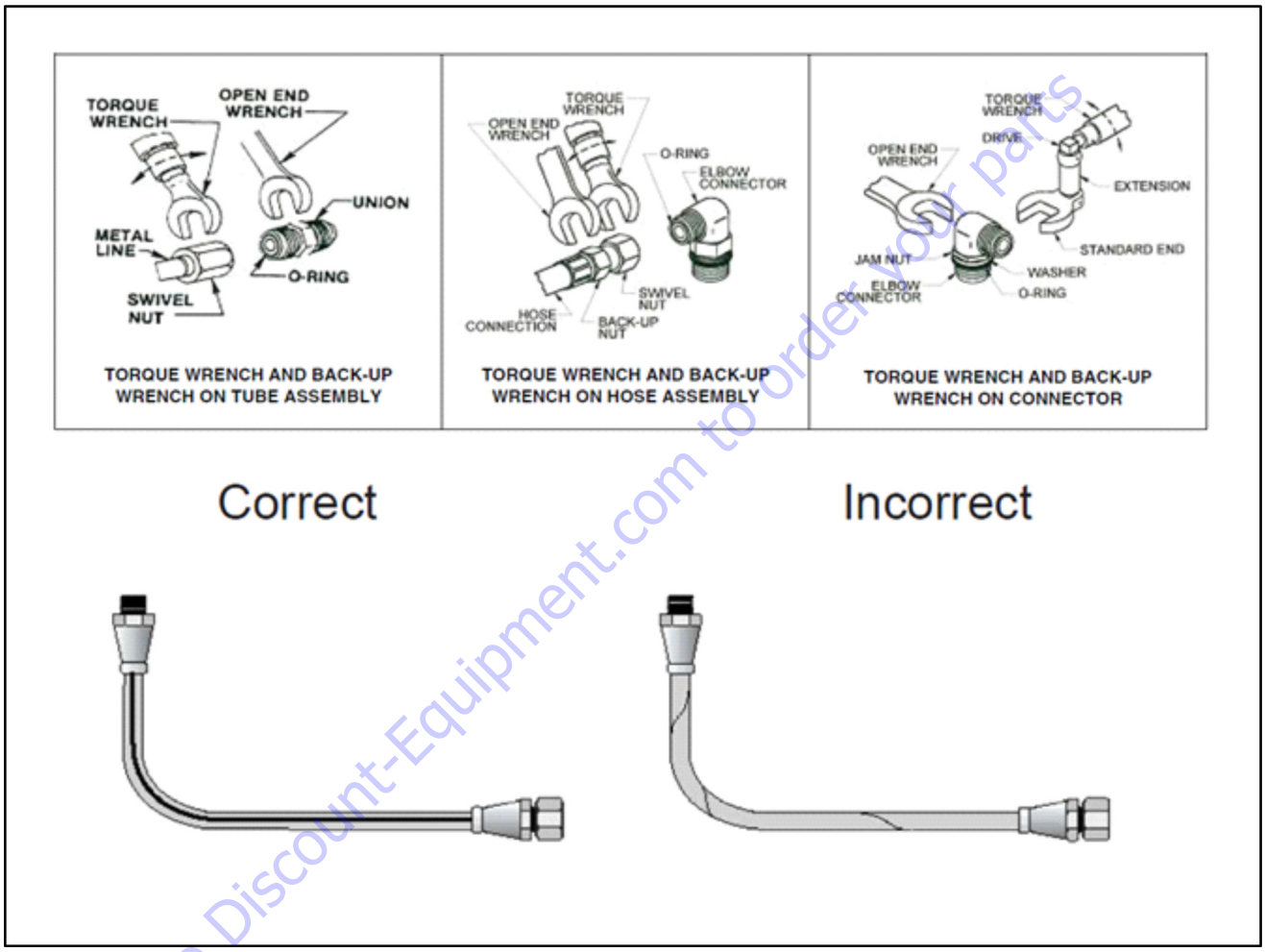



**Figure 5-11. Double Wrench Method**

## FFWR and TFFT Methods

### FFWR (FLATS FROM WRENCH RESISTANCE METHOD)

1. Tighten the swivel nut to the mating fitting until no lateral movement of the swivel nut can be detected; finger tight condition.
2. Mark a dot on one of the swivel hex nut flats and another dot in line on the connecting tube adapter. See Figure B.1.
3. Use the double wrench method per Appendix A, turn the swivel nut to tighten as shown in Figure 5-11. The nut is to be rotated clockwise the number of hex flats as defined by the applicable Table in Section 5.0.
4. After the connection has been properly tightened, mark a straight line across the connecting parts, not covering the dots, to indicate the connection has been properly tightened. See Figure 5-12.

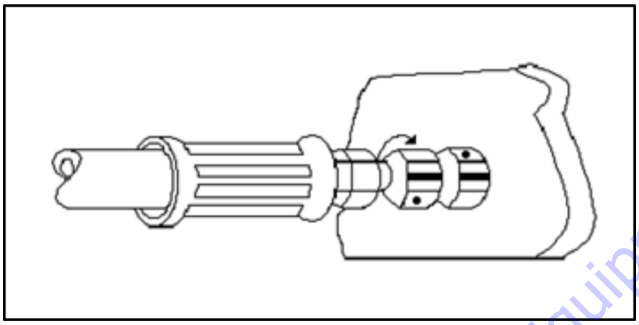


**Figure 5-12. FFWR Method**

### TFFT (TURNS FROM FINGER TIGHT METHOD)

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

## Adjustable Stud End Assembly

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

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

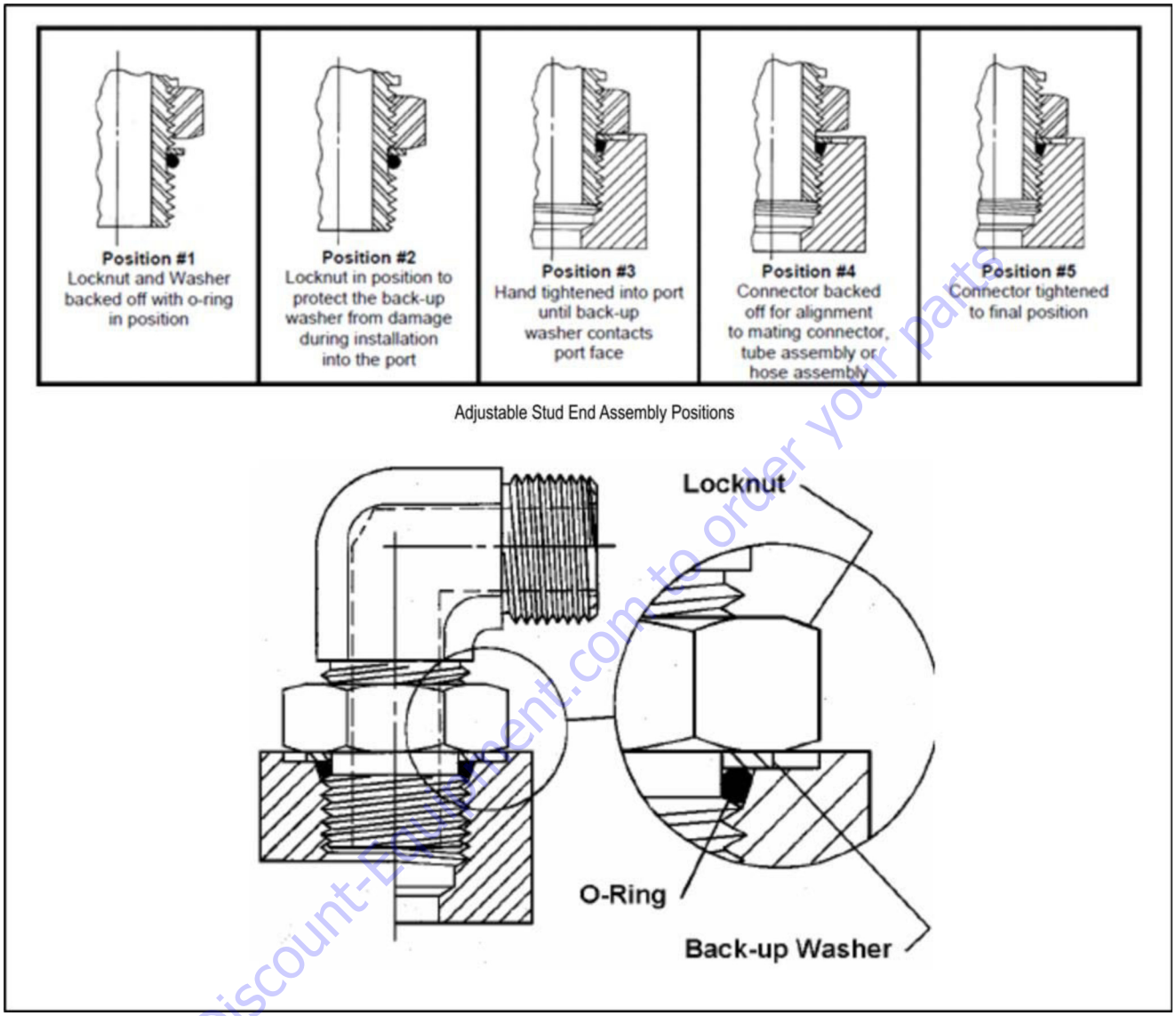



**Figure 5-13. Adjustable Stud End Assembly**



## O-ring Installation (Replacement)

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

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

## 5.3 HYDRAULIC CYLINDERS

### Axle Lockout Cylinder (SN 0300214571 to Present, SN B300001500 through B300002483)

#### DISASSEMBLY

**NOTICE**

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

**⚠ WARNING**

**ROD CAN FALL OUT OF BARREL AND CAUSE INJURY OR DAMAGE TO THE EQUIPMENT. BE CAREFUL WHEN REMOVING AXLE CYLINDER. OPENING BLEED VALVE CAN CAUSE ROD TO FALL OUT OF BARREL.**

1. Open bleeder valve. Rotate rod and remove from barrel.
2. Remove wiper. Do not scratch barrel bore.
3. Remove two wear rings and rod seal from grooves of rod bore. Do not scratch barrel bore.
4. Remove counterbalance valve.

#### CLEANING AND INSPECTION

1. Inspect bore and rod for scoring, pitting, or excessive wear.
2. Remove minor surface blemishes with wet sandpaper. Pitting requires replacement of barrel and rod.
3. Clean all parts with approved solvent and dry with compressed air.

#### 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.*

**NOTICE**

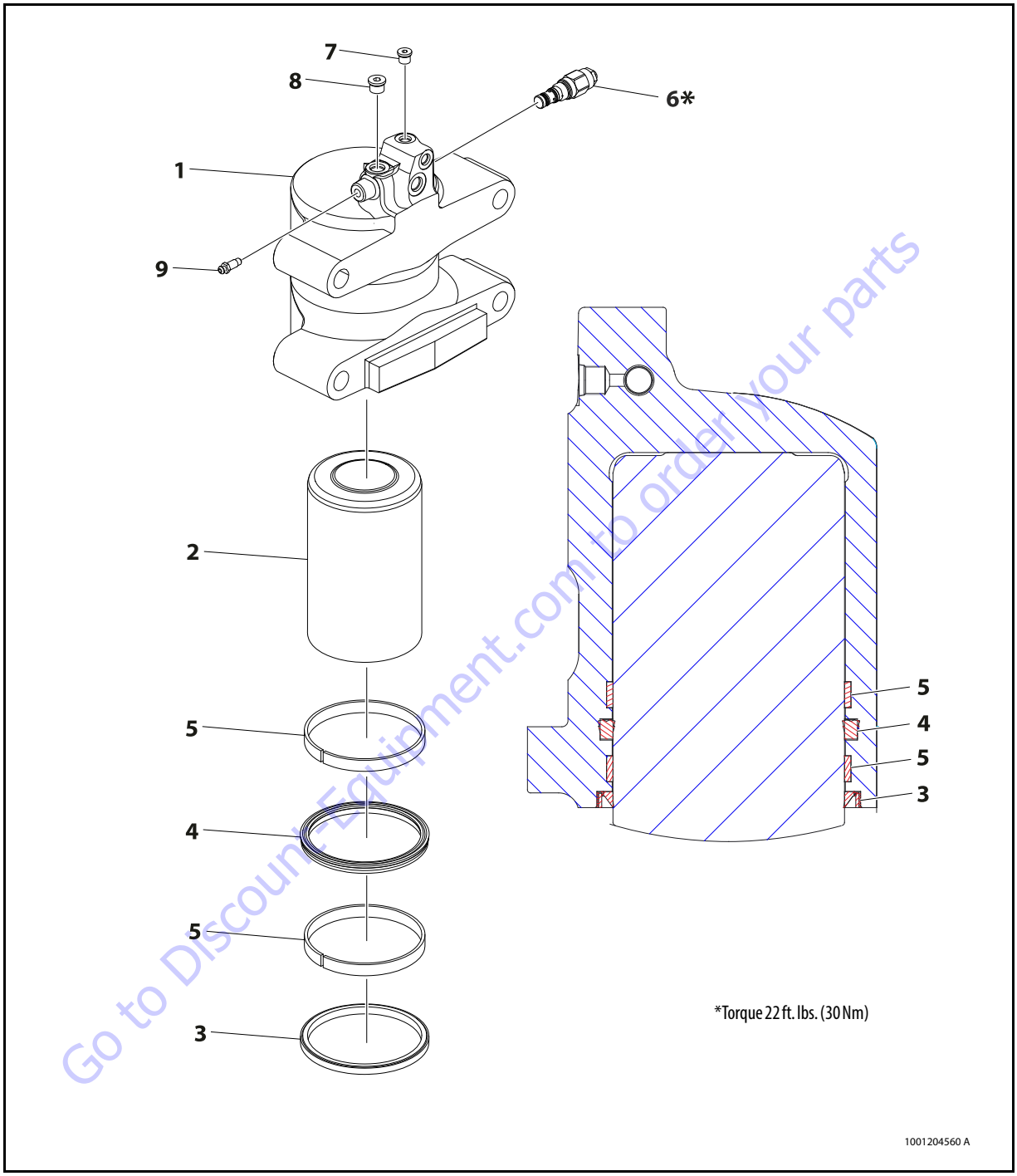
**WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.**

1. Install two new wear rings and rod seal in rod bore grooves. Make sure they are not twisted.
2. Install new wiper in barrel.
3. Lubricate rod bore with clean hydraulic fluid.

**NOTICE**

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

4. Install rod in bore and push to top of the bore.
5. Install counterbalance valve. Torque to 22 ft. lbs. (30 Nm).
6. Bleed system.






1. Barrel
2. Rod
3. Wiper Seal
4. Rod Seal
5. Wear Ring
6. Counterbalance Valve
7. Plug
8. Plug
9. Bleeder Valve

**Figure 5-14. Axle Lockout Cylinder**

## Axle Lockout Cylinder (SN B300002484 to Present)

### DISASSEMBLY

**NOTICE**

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

**⚠ WARNING**

**ROD CAN FALL OUT OF BARREL AND CAUSE INJURY OR DAMAGE TO THE EQUIPMENT. BE CAREFUL WHEN REMOVING AXLE CYLINDER. OPENING BLEED VALVE CAN CAUSE ROD TO FALL OUT OF BARREL.**

1. Open bleeder valve. Rotate rod and remove from barrel.
2. Remove wiper. Do not scratch barrel bore.
3. Remove two wear rings and rod seal from grooves of rod bore. Do not scratch barrel bore.
4. Remove counterbalance valve.

### CLEANING AND INSPECTION

1. Inspect bore and rod for scoring, pitting, or excessive wear.
2. Remove minor surface blemishes with wet sandpaper. Pitting requires replacement of barrel and rod.
3. Clean all parts with approved solvent and dry with compressed air.

### 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.*

**NOTICE**

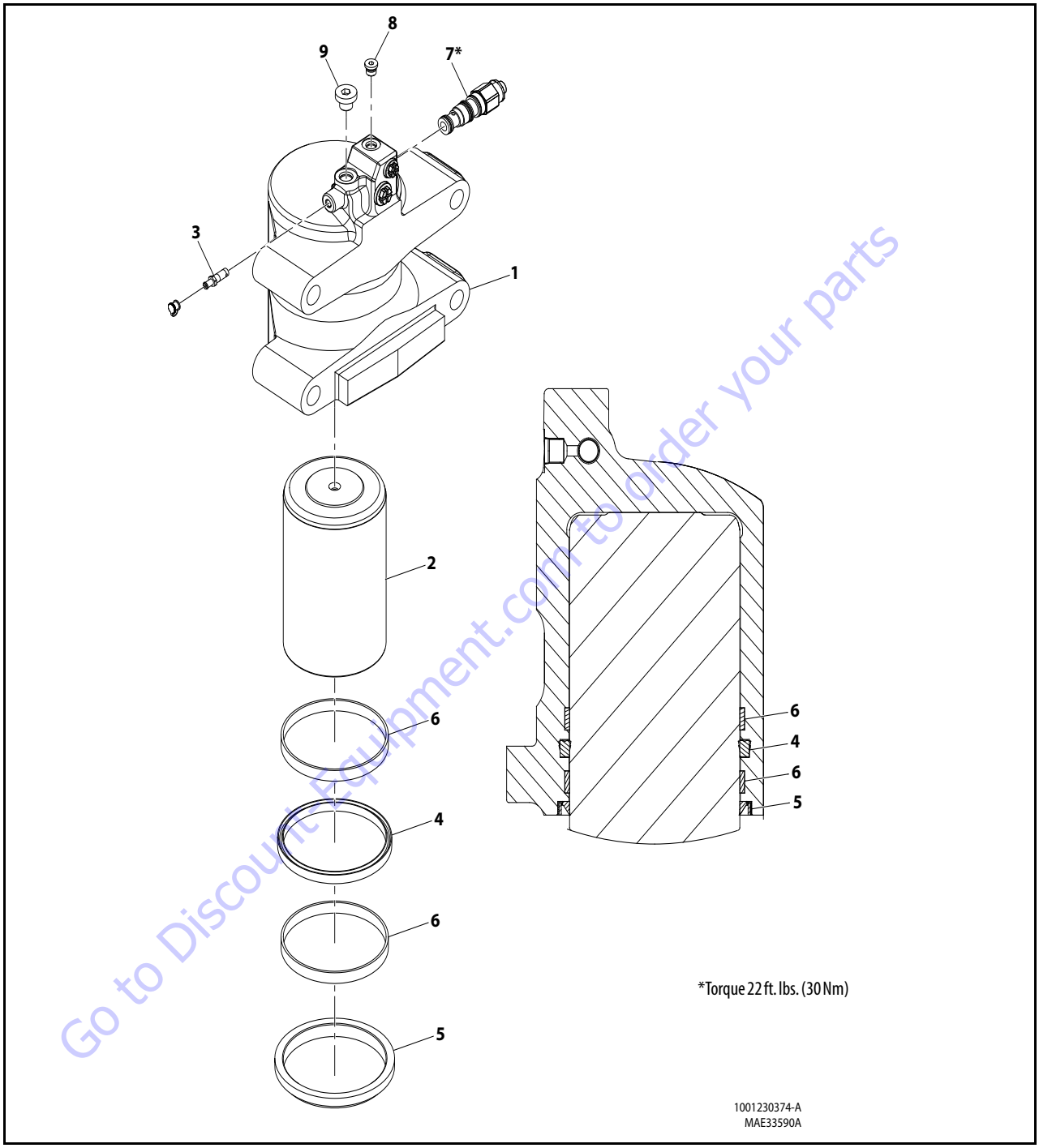
**WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.**

1. Install two new wear rings and rod seal in rod bore grooves. Make sure they are not twisted.
2. Install new wiper in barrel.
3. Lubricate rod bore with clean hydraulic fluid.

**NOTICE**

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

4. Install rod in bore and push to top of the bore.
5. Install counterbalance valve. Torque to 22-24 ft. lbs. (27-33 Nm).
6. Bleed system.






1. Barrel
2. Rod
3. Bleeder Valve
4. Rod Seal
5. Wear Seal
6. Wear Ring
7. Counterbalance Valve
8. Plug
9. Plug

**Figure 5-15. Axle Lockout Cylinder**

## Jib Lift Cylinder (860SJ Only) (SN 0300182743 through 0300244707, SN B300001092 through B300002483)

### DISASSEMBLY

**NOTICE**

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

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

**⚠ WARNING**

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

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

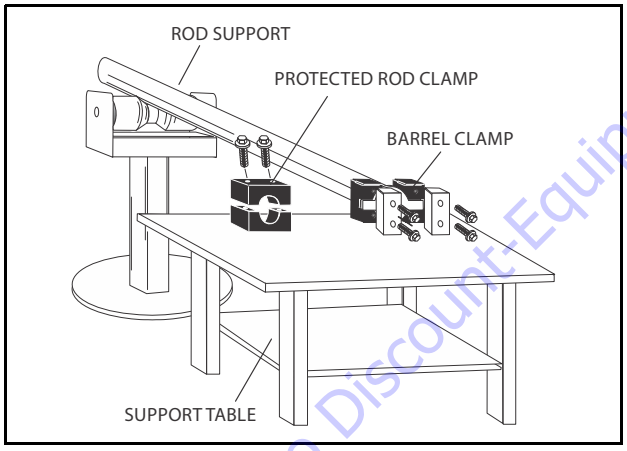



**Figure 5-16. Cylinder Barrel Support**

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

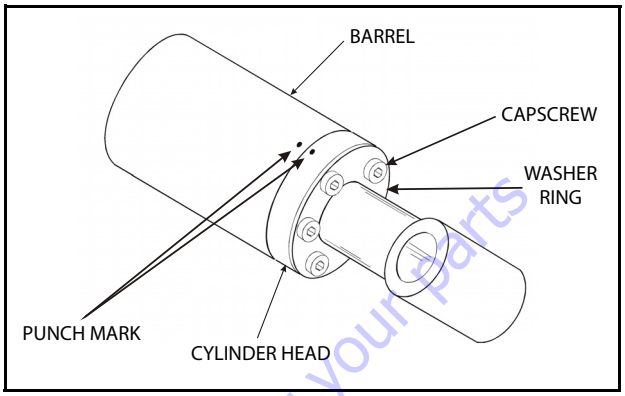



**Figure 5-17. Capscrew Removal**

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

**NOTICE**

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

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

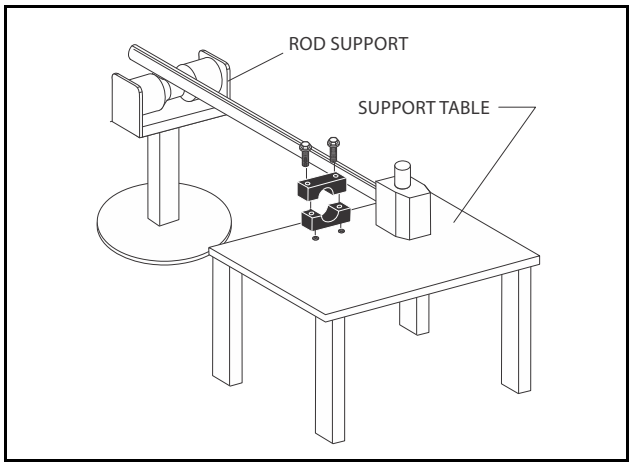
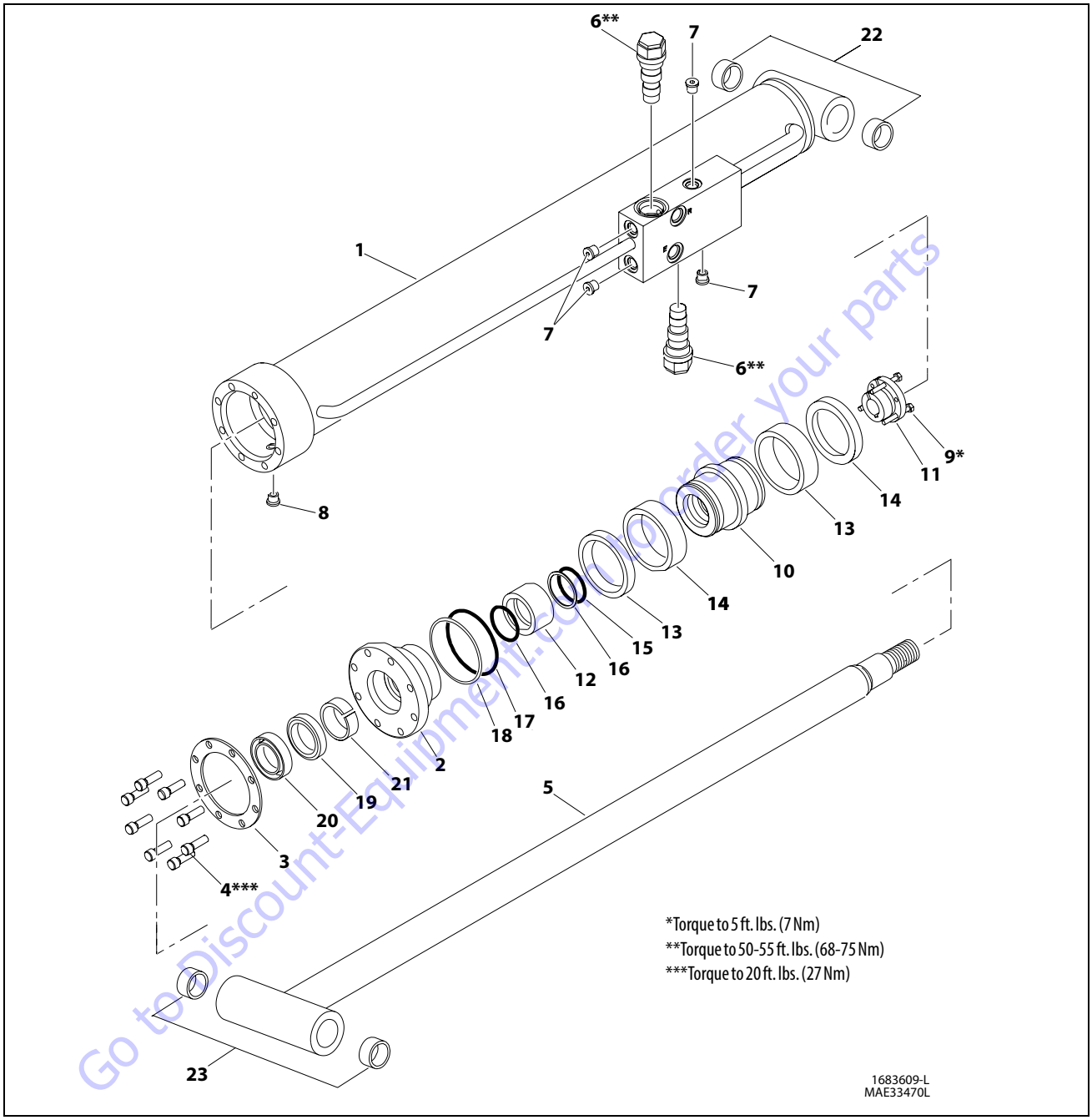



**Figure 5-18. Cylinder Rod Support**






1. Barrel
2. Head
3. Washer Ring
4. Bolt
5. Rod
6. Counterbalance Valve
7. Plug
8. Plug
9. Capscrew
10. Piston
11. Tapered Bushing
12. Spacer Tube
13. Lock Ring
14. Piston Seal
15. O-ring
16. Backup Ring
17. O-ring
18. Backup Ring
19. Wear Ring
20. Wiper
21. Seal
22. Bushing
23. Bushing

**Figure 5-19. Jib Lift Cylinder (860SJ Only)**

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Remove capscrews from drilled holes.
10. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen on the piston.
11. Remove the bushing from the piston.

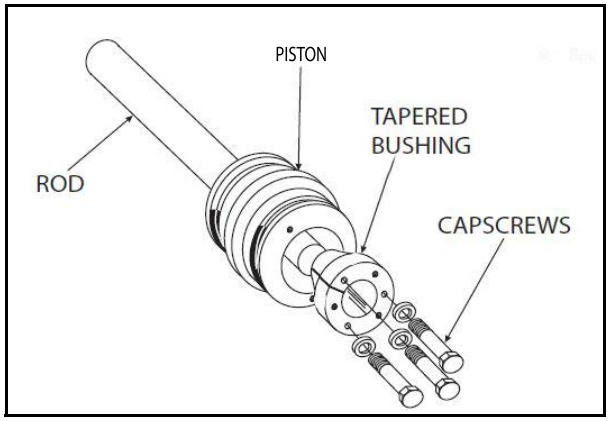



**Figure 5-20. Tapered Bushing Removal**

12. Screw the piston counterclockwise by hand and remove the piston from cylinder rod.
13. Remove and discard the piston o-rings, seal rings and backup rings.
14. Remove piston spacer from the rod.
15. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, wear rings 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, tapering, ovality or other damage. Replace if 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, tapering, ovality or other damage. Replace if necessary.
11. Inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace if 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 inner side 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.*

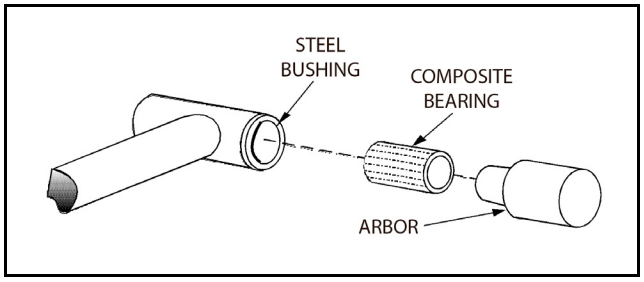



**Figure 5-21. Composite Bearing Installation**

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

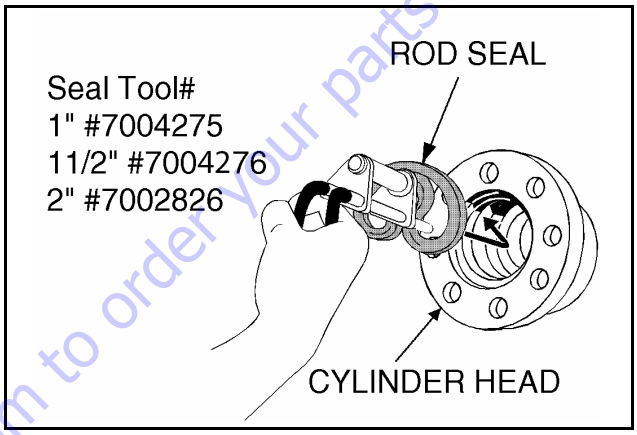



**Figure 5-22. Rod Seal Installation**

**NOTICE**

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

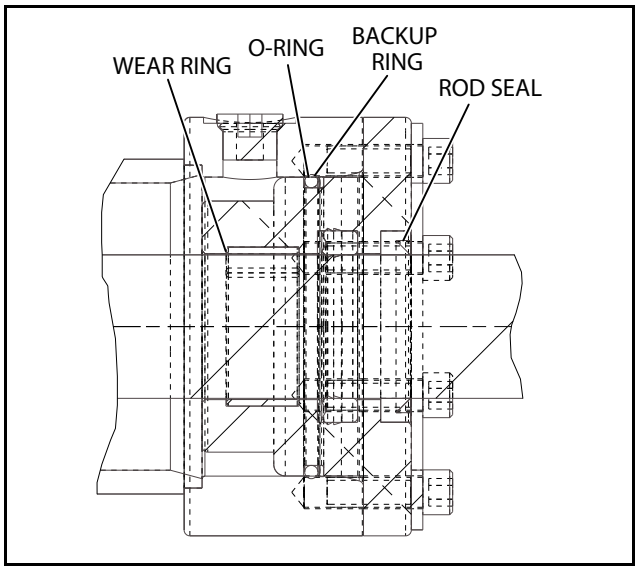



**Figure 5-23. Cylinder Head Seal Installation**

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

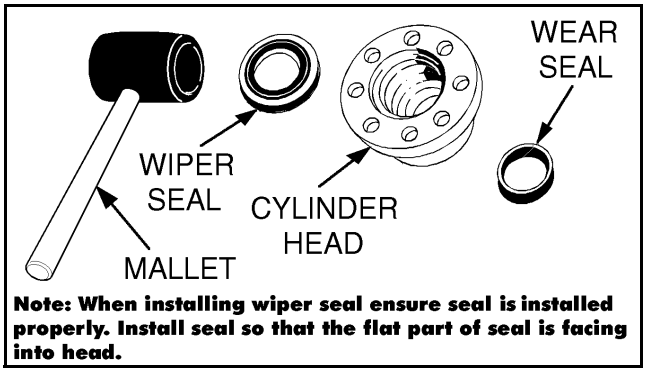



**Figure 5-24. Wiper Seal Installation**

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

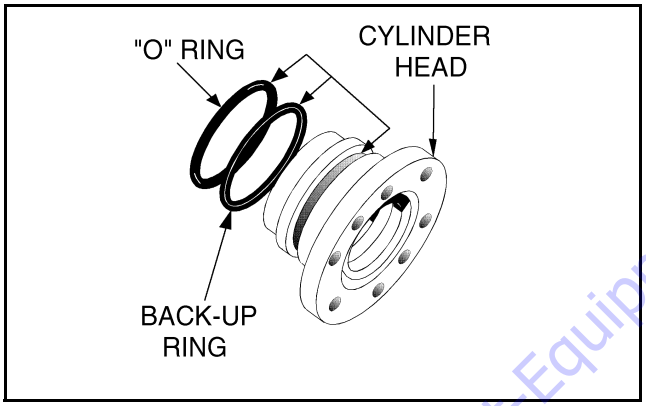



**Figure 5-25. Installation of Head Seal Kit**

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Carefully slide the piston spacer on the rod.

6. 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 and backup rings in the inner piston diameter groove.

8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

9. Thread piston onto rod end and install the tapered bushing.

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

10. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

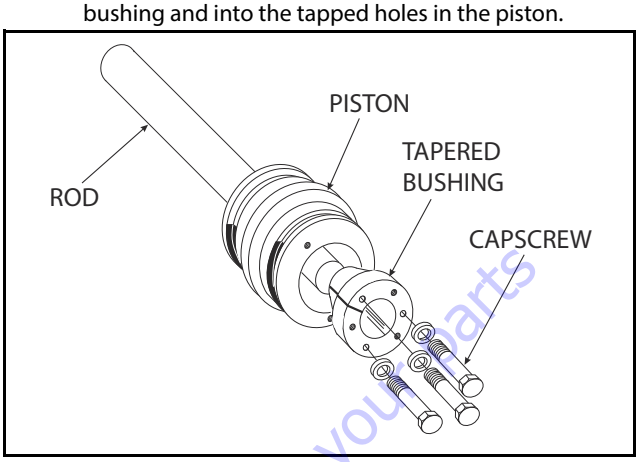



**Figure 5-26. Tapered Bushing Installation**

11. Tighten the capscrews evenly and progressively in rotation to 5 ft. lbs. (7 Nm).

12. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4 in. diameter) as follows:

    **a.** Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

    **b.** Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

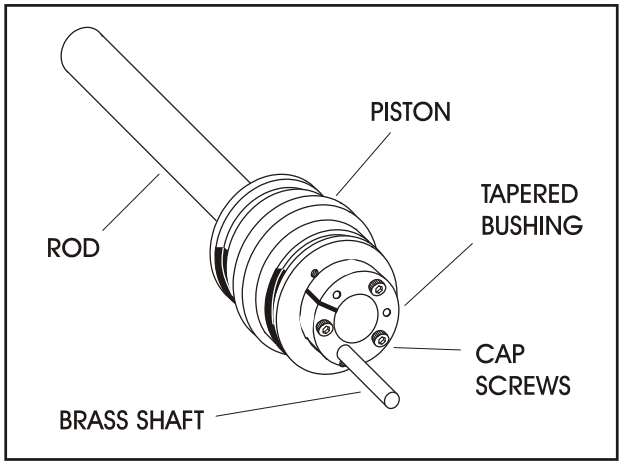



**Figure 5-27. Seating the Tapered Bearing**

13. Rotate the capscrews evenly and progressively in rotation to 5 ft. lbs. (7 Nm).

14. Remove the cylinder rod from the holding fixture.

**NOTICE**

**WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCKK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.**

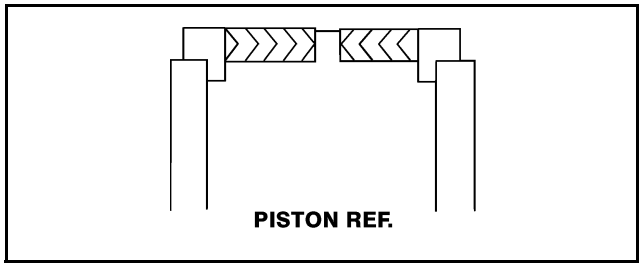



**Figure 5-28. Hydrolock Piston Seal Installation**

15. Place new hydrolock seal and guidelock 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).

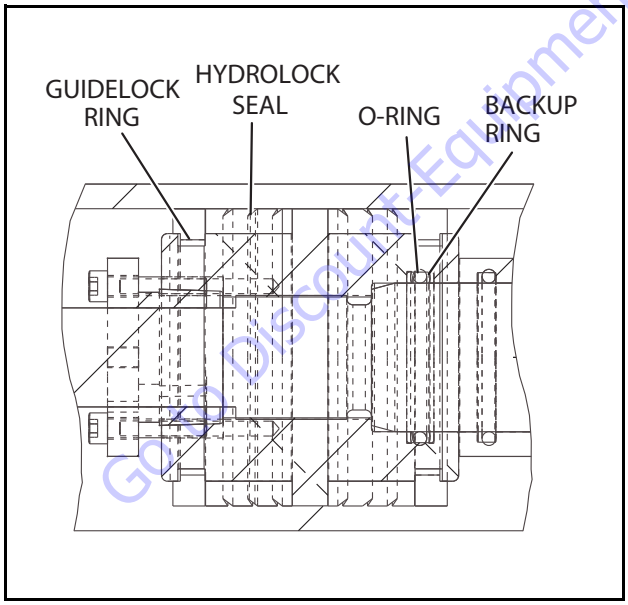



**Figure 5-29. Piston Seal Kit Installation**

16. 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.**

17. With barrel clamped secured and 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.

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

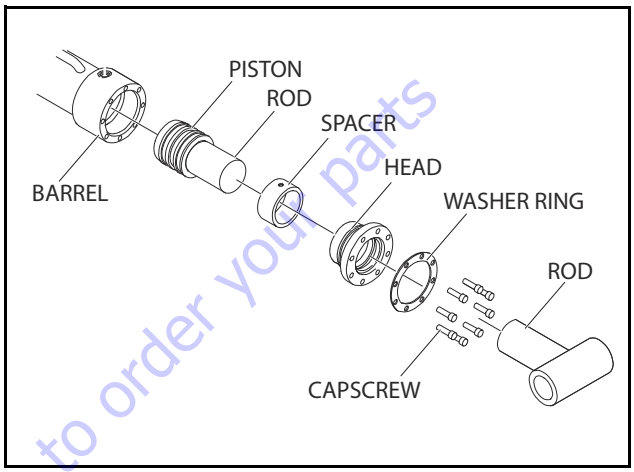



**Figure 5-30. Rod Assembly Installation**

19. Apply JLG Threadlocker P/N 0100011 to the socket head bolts and secure the cylinder head gland using the washer ring and capscrews. Torque capscrews to 20 ft. lbs. (27 Nm).

20. 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.

21. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable. Torque valves to 50-55 ft. lbs. (68-75 Nm).

## Jib Lift Cylinder (860SJ Only) (SN 0300244708 to Present)

### DISASSEMBLY

**NOTICE**

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

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

**⚠ WARNING**

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

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

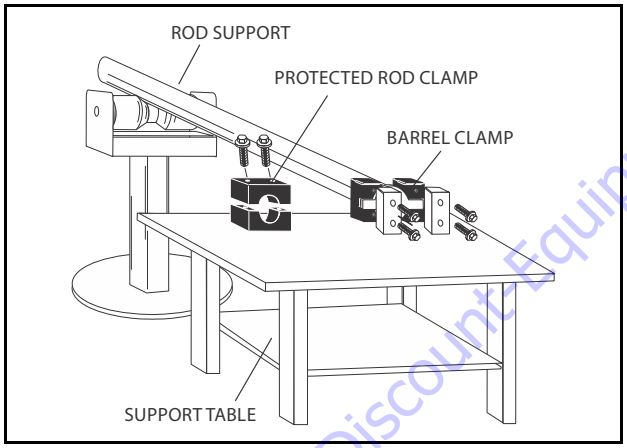



**Figure 5-31. Cylinder Barrel Support**

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

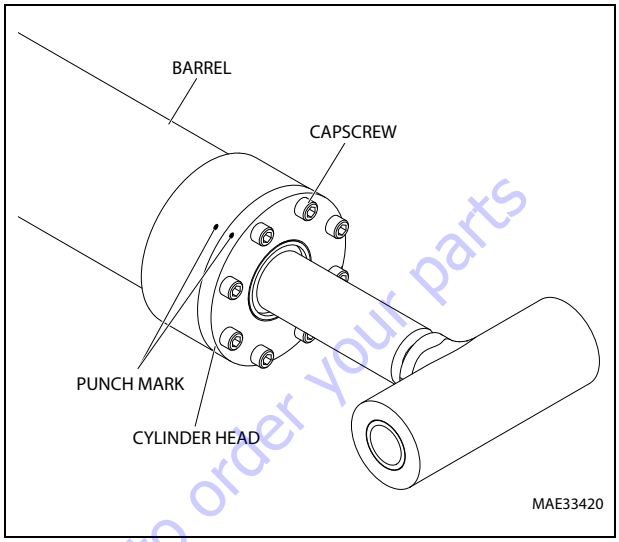



**Figure 5-32. Capscrew Removal**

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

**NOTICE**

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

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

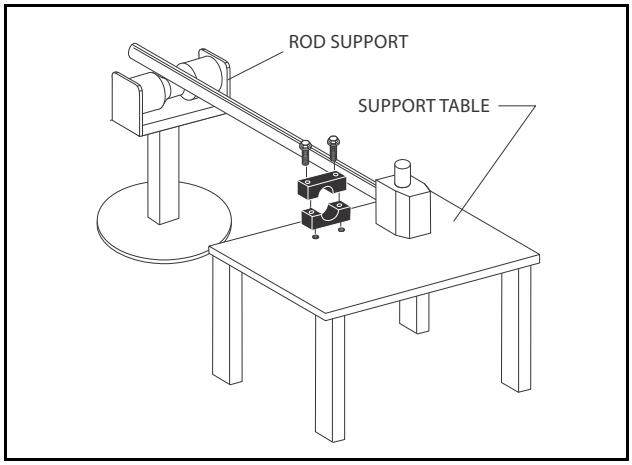
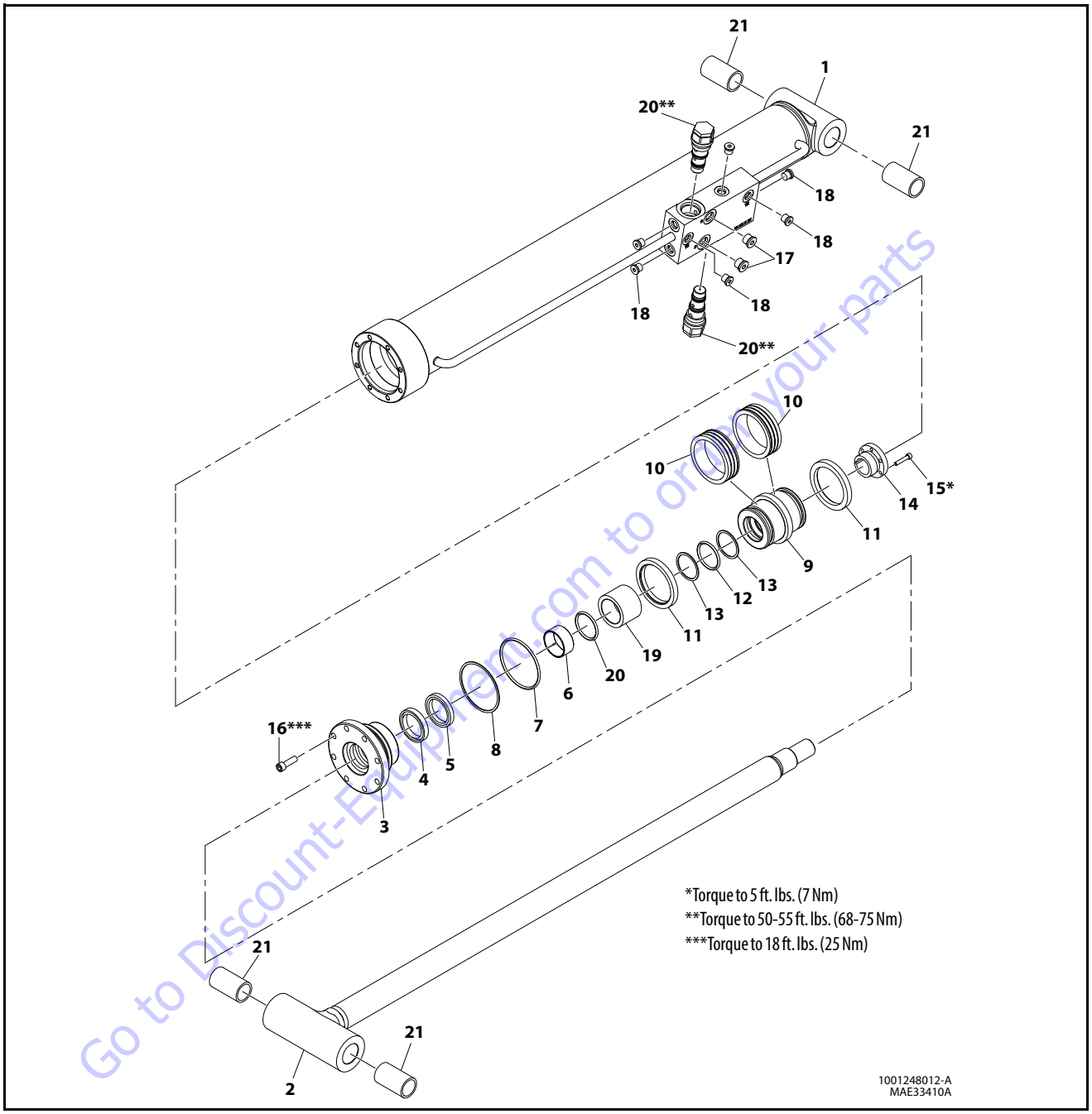



**Figure 5-33. Cylinder Rod Support**






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

**Figure 5-34. Jib Lift Cylinder (860SJ Only)**

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Remove capscrews from drilled holes.
10. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen on the piston.
11. Remove the bushing from the piston.

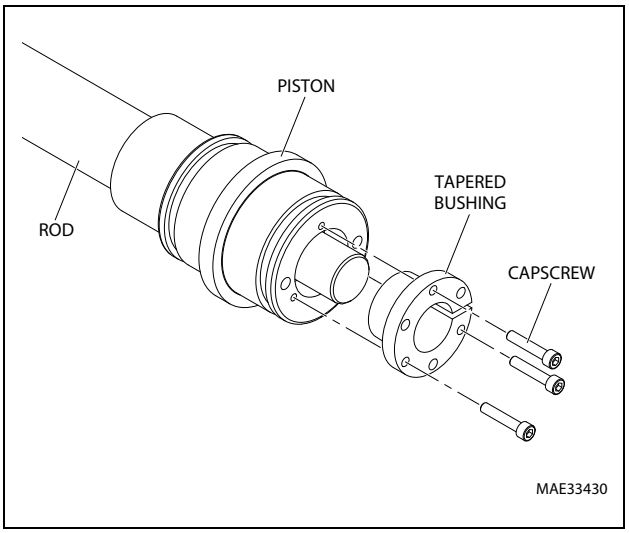



**Figure 5-35. Tapered Bushing Removal**

12. Screw the piston counterclockwise by hand and remove the piston from cylinder rod.
13. Remove and discard the piston o-rings, seal rings and backup rings.
14. Remove piston spacer from the rod.
15. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, wear rings 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, tapering, ovality or other damage. Replace if 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, tapering, ovality or other damage. Replace if necessary.
11. Inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace if 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 inner side 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.*

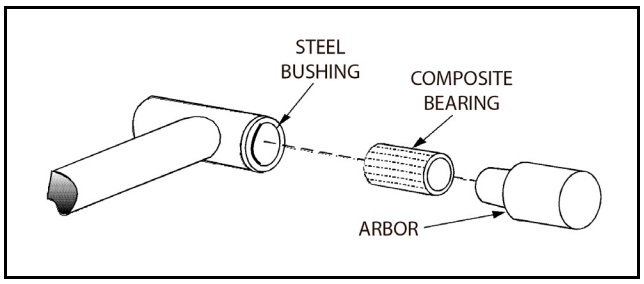



**Figure 5-36. Composite Bearing Installation**

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

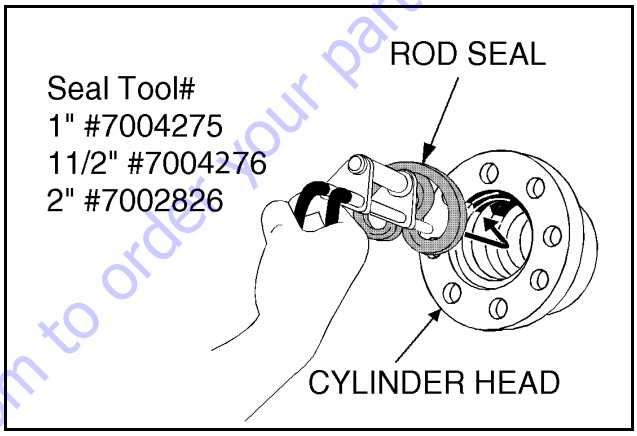



**Figure 5-37. Rod Seal Installation**

**NOTICE**

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

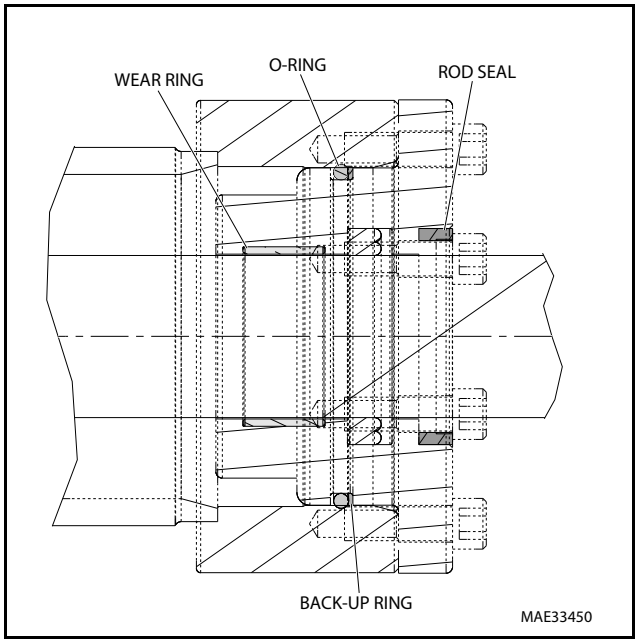



**Figure 5-38. Cylinder Head Seal Installation**

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

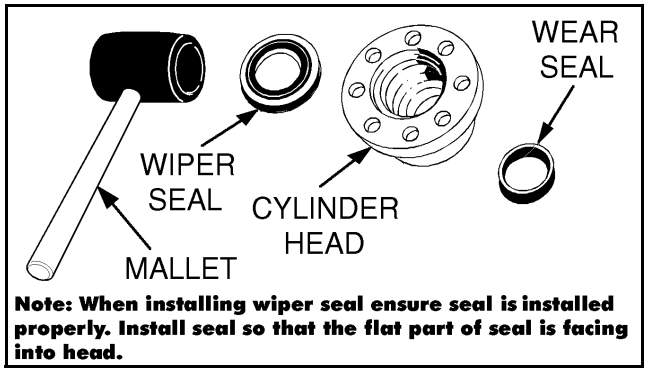



**Figure 5-39. Wiper Seal Installation**

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

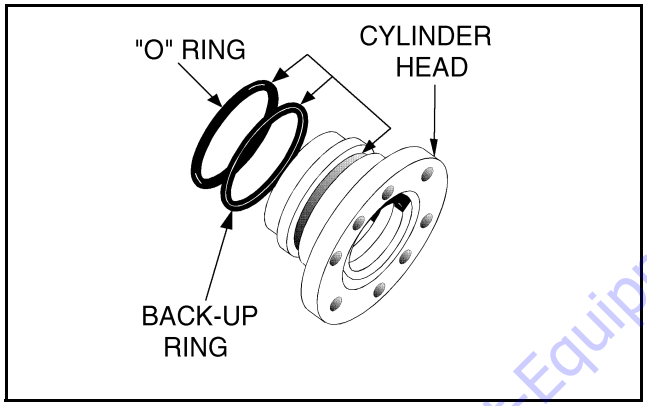



**Figure 5-40. Installation of Head Seal Kit**

4. Carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.
5. Carefully slide the piston spacer on the rod.
6. 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 and backup rings in the inner piston diameter groove.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.
9. Thread piston onto rod end and install the tapered bushing.

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

10. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

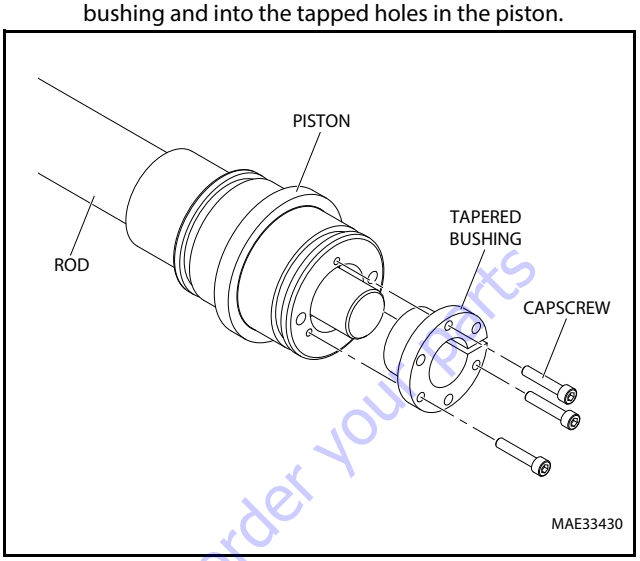



**Figure 5-41. Tapered Bushing Installation**

11. Tighten the capscrews evenly and progressively in rotation to 5 ft. lbs. (7 Nm).
12. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4 in. diameter) as follows:
    a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.
    b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

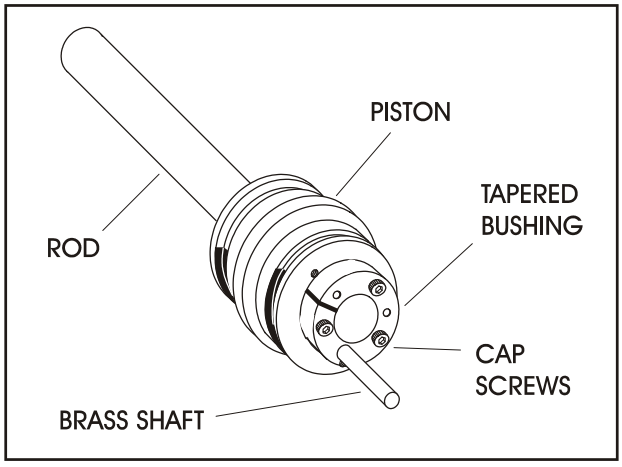



**Figure 5-42. Seating the Tapered Bearing**

13. Rotate the capscrews evenly and progressively in rotation to 5 ft. lbs. (7 Nm).

14. Remove the cylinder rod from the holding fixture.

**NOTICE**

**WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCKK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.**

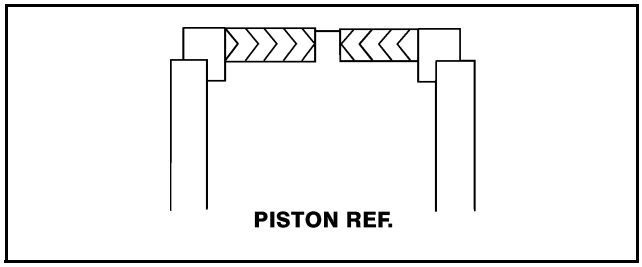



**Figure 5-43. Hydrolock Piston Seal Installation**

15. Place new hydrolock seal and guidelock 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).

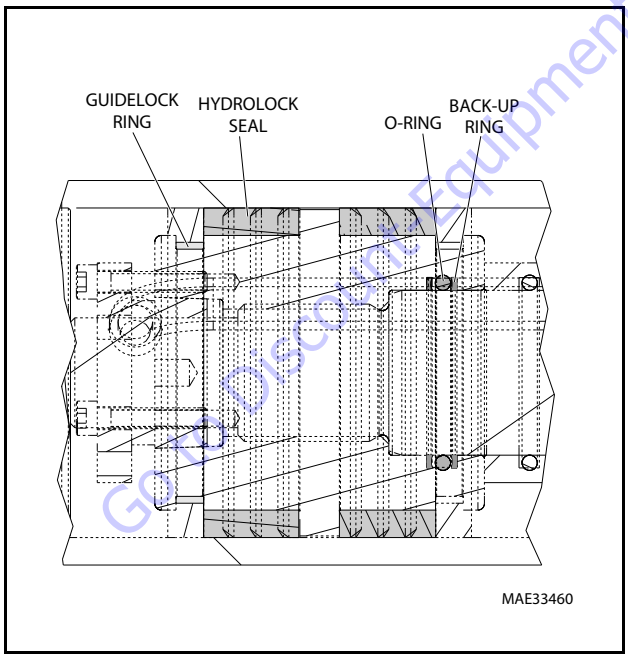



**Figure 5-44. Piston Seal Kit Installation**

16. 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.**

17. With barrel clamped secured and 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.

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

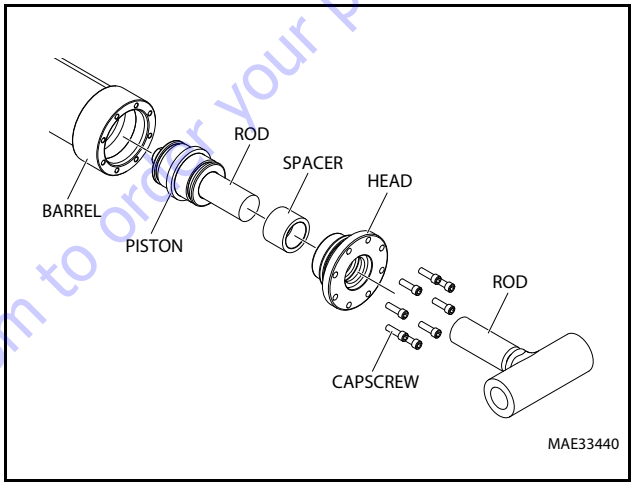



**Figure 5-45. Rod Assembly Installation**

19. Secure the cylinder head gland using the capscrews. Torque capscrews to 18 ft. lbs. (25 Nm).

20. 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.

21. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable. Torque valves to 50-55 ft. lbs. (68-75 Nm).

## Main Boom Lift Cylinder 800S (SN 0300182743 through 0300239593, SN B300001092 through B300002483), 860SJ (0300182743 through 0300239858, SN B300001092 through B300002483)

### DISASSEMBLY

**NOTICE**

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

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

**⚠ WARNING**

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove the proportional valve, lift holding valve, relief valve, check valve and plugs. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

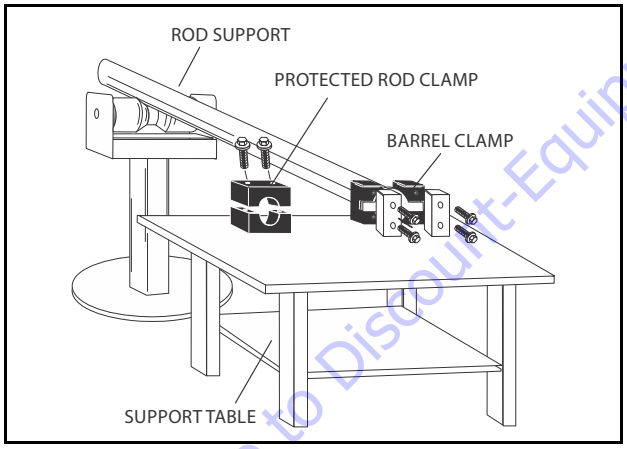



**Figure 5-46. Cylinder Barrel Support**

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

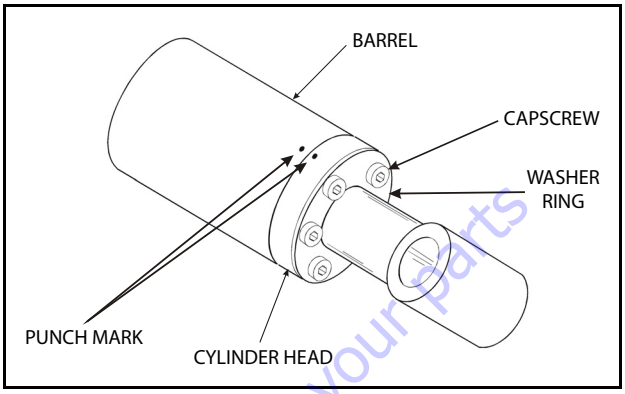



**Figure 5-47. Capscrew Removal**

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

**NOTICE**

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

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

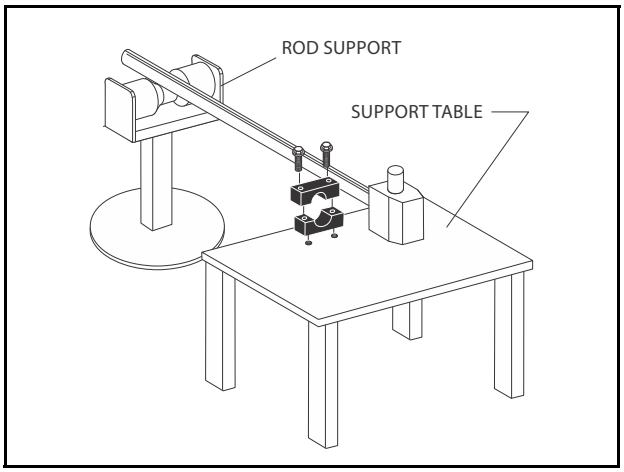
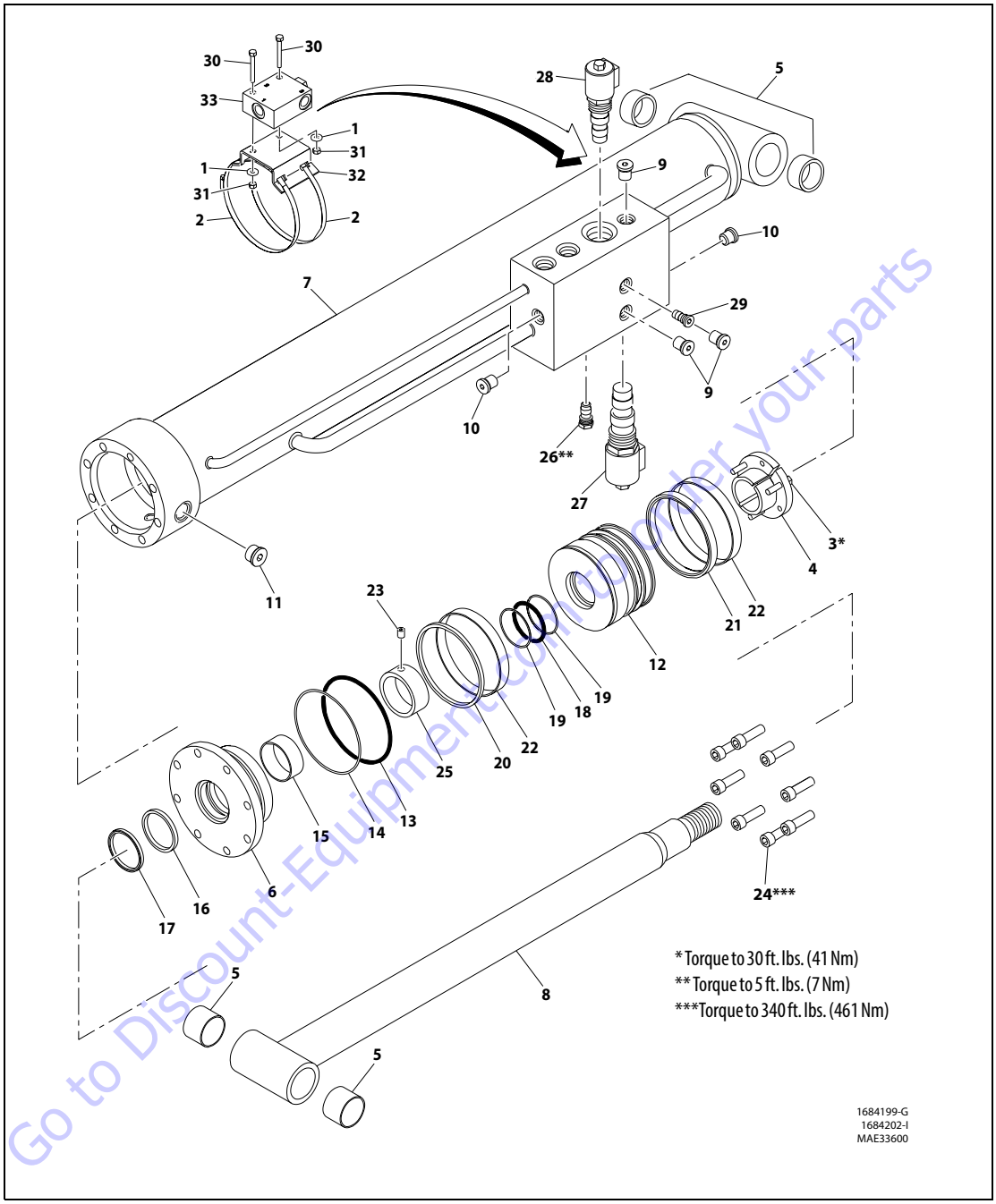



**Figure 5-48. Cylinder Rod Support**






1. Flatwasher
2. Clamp
3. Capscrew
4. Tapered Bushing
5. Bushing
6. Head
7. Barrel
8. Rod Weldment
9. O-ring Plug
10. O-ring Plug
11. O-ring Plug
12. Piston
13. O-ring
14. Backup Ring
15. Wear Ring
16. Rod Seal
17. Wiper Seal
18. O-ring
19. Backup ring
20. Guidelock Ring
21. Seal
22. Guidelock Ring
23. Setscrew
24. Capscrew
25. Spacer
26. Check Valve
27. Lift Holding Solenoid
28. Lift Dump Proportional Solenoid
29. Relief Valve
30. Bolt
31. Locknut
32. Plate
33. Check Valve

**Figure 5-49. Main Boom Lift Cylinder**

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Remove capscrews from drilled holes.
10. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen on the piston.
11. Remove the bushing from the piston.

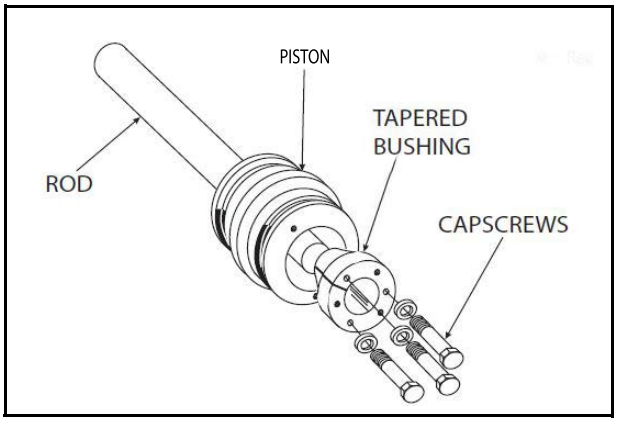



**Figure 5-50. Tapered Bushing Removal**

12. Screw the piston counterclockwise by hand and remove the piston from cylinder rod.
13. Remove and discard the piston o-rings, seal rings, wear rings and backup rings.
14. Remove setscrew and piston spacer from the rod.
15. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, wear rings 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, tapering, ovality or other damage. Replace if 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, tapering, ovality or other damage. Replace if necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace if 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 inner side 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.*

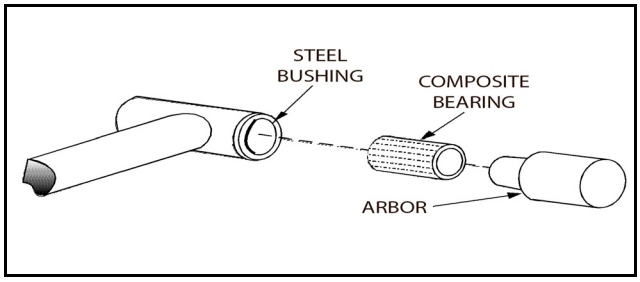



**Figure 5-51. Composite Bearing Installation**

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

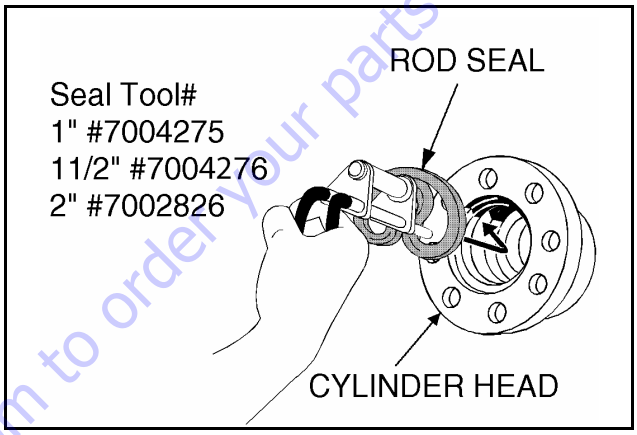



**Figure 5-52. Rod Seal Installation**

**NOTICE**

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

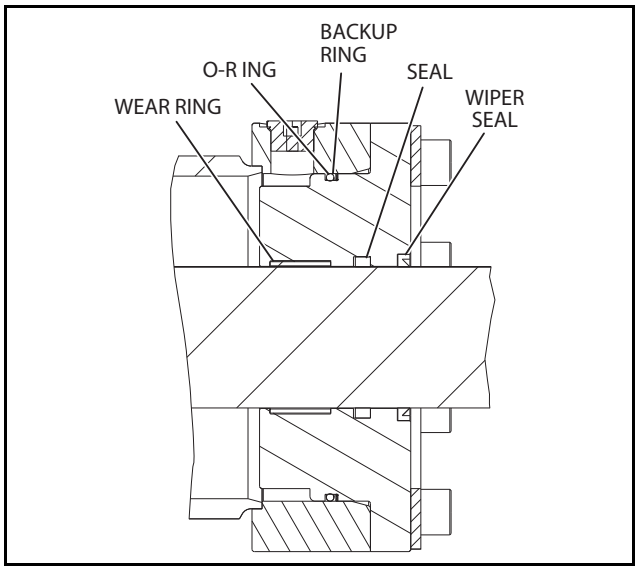



**Figure 5-53. Cylinder Head Seal Installation**

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

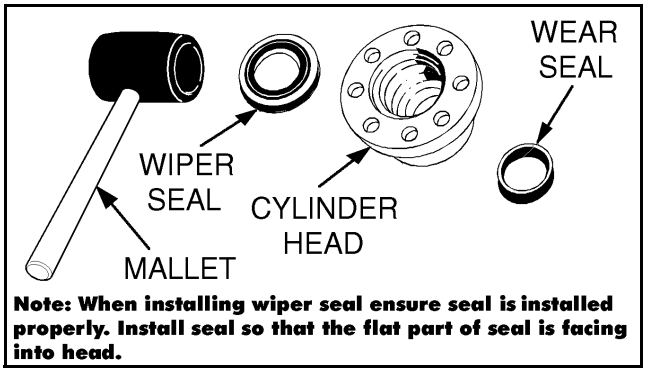



**Figure 5-54. Wiper Seal Installation**

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

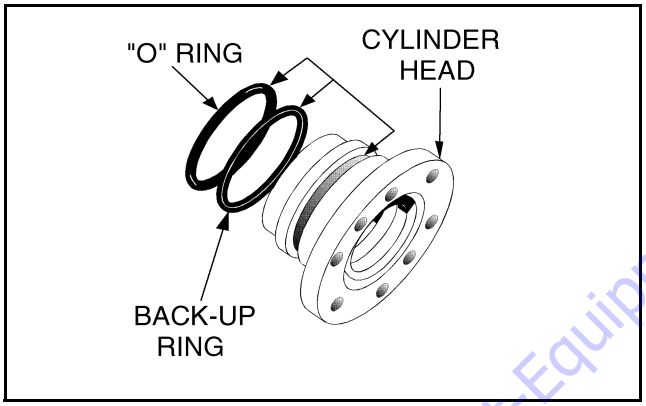



**Figure 5-55. Installation of Head Seal Kit**

4. Install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Carefully slide the piston spacer on the rod and tighten the setscrew.

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 and backup rings in the inner piston diameter groove.

8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

9. Thread piston onto rod hand tight and install the tapered bushing.

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

10. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

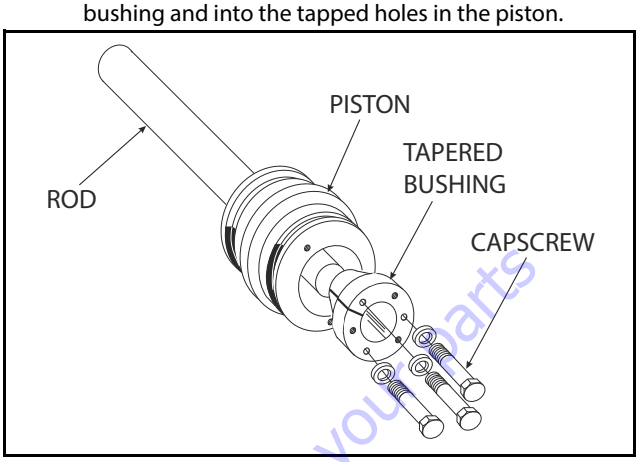



**Figure 5-56. Tapered Bushing Installation**

11. Tighten the capscrews evenly and progressively in rotation to 30 ft. lbs. (41 Nm).

12. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4 in. diameter) as follows:

    **a.** Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

    **b.** Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

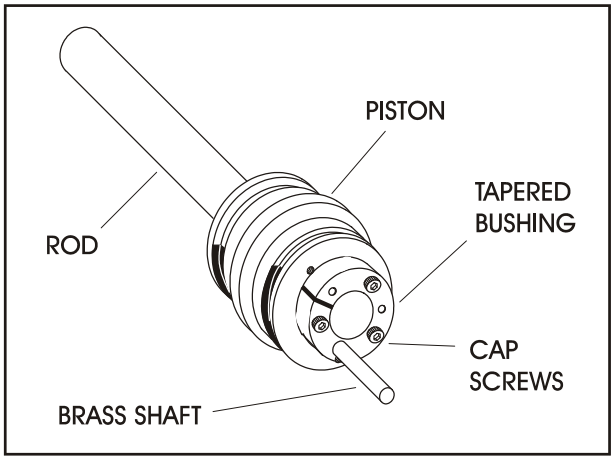



**Figure 5-57. Seating the Tapered Bearing**

13. Rotate the capscrews evenly and progressively in rotation to 30 ft. lbs. (41 Nm).

14. Remove the cylinder rod from the holding fixture.

15. Place new 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).

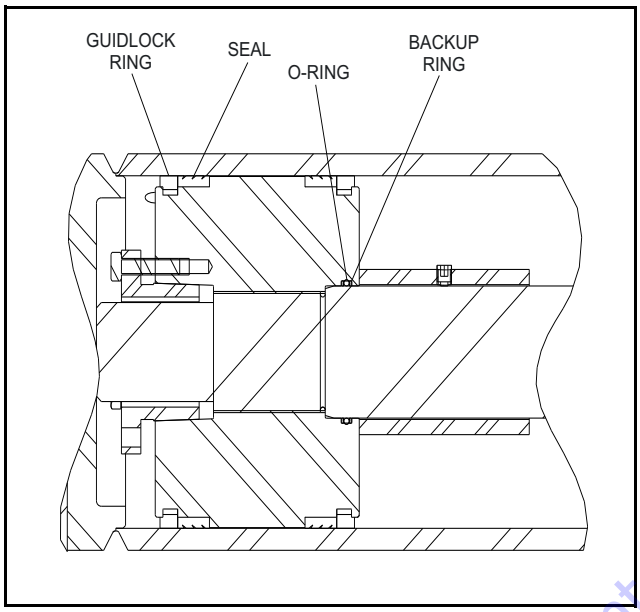



**Figure 5-58. Piston Seal Kit Installation**

16. 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.**

17. With barrel clamped secured and 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.

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

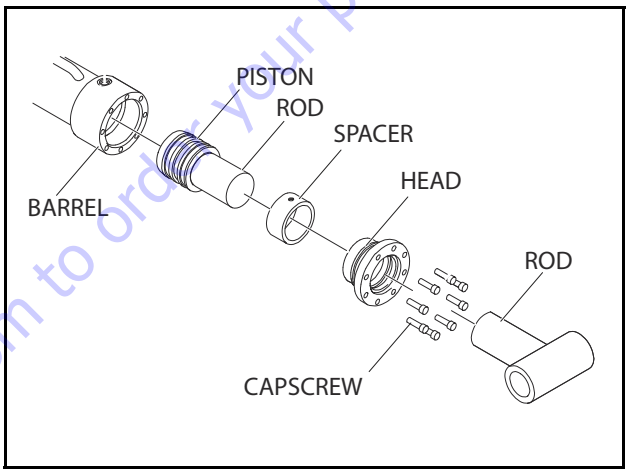



**Figure 5-59. Rod Assembly Installation**

19. Apply JLG Threadlocker P/N 0100011 to the socket head bolts and secure the cylinder head gland using the capscrews. Torque capscrews to 340 ft. lbs. (461 Nm).

20. 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.

21. If applicable, install the cartridge type holding valve and fittings in the rod port block, using new o-rings as applicable. Torque valves to 30-37 ft. lbs. (41-50 Nm).

22. Install the proportional valve, lift holding valve, relief valve, check valve and plugs, using new O-rings as applicable.

## Main Boom Lift Cylinder 800S (SN 0300239594 to Present, SN B300002484 to Present), 860SJ (SN 0300239859 to Present)

### DISASSEMBLY

**NOTICE**

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

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

**⚠ WARNING**

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove the proportional valve, lift holding valve, relief valve, check valve and plugs. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

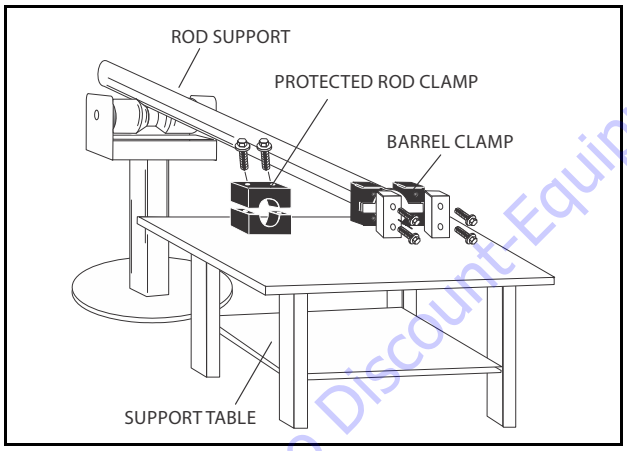



**Figure 5-60. Cylinder Barrel Support**

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

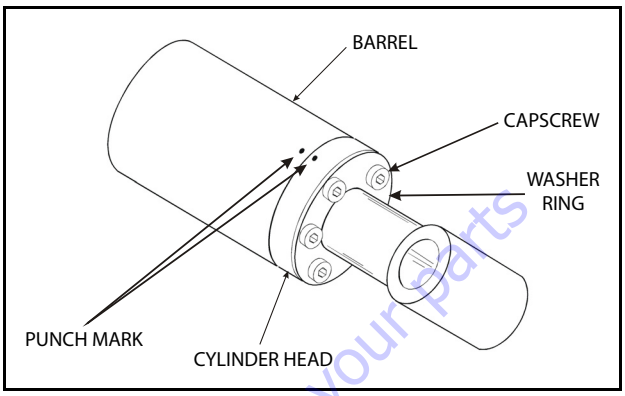



**Figure 5-61. Capscrew Removal**

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

**NOTICE**

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

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

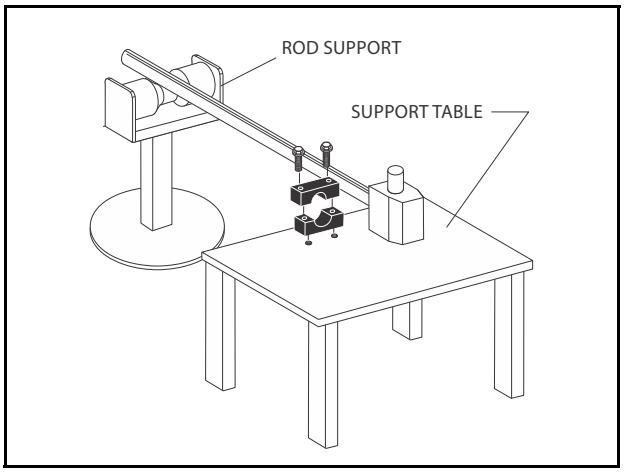
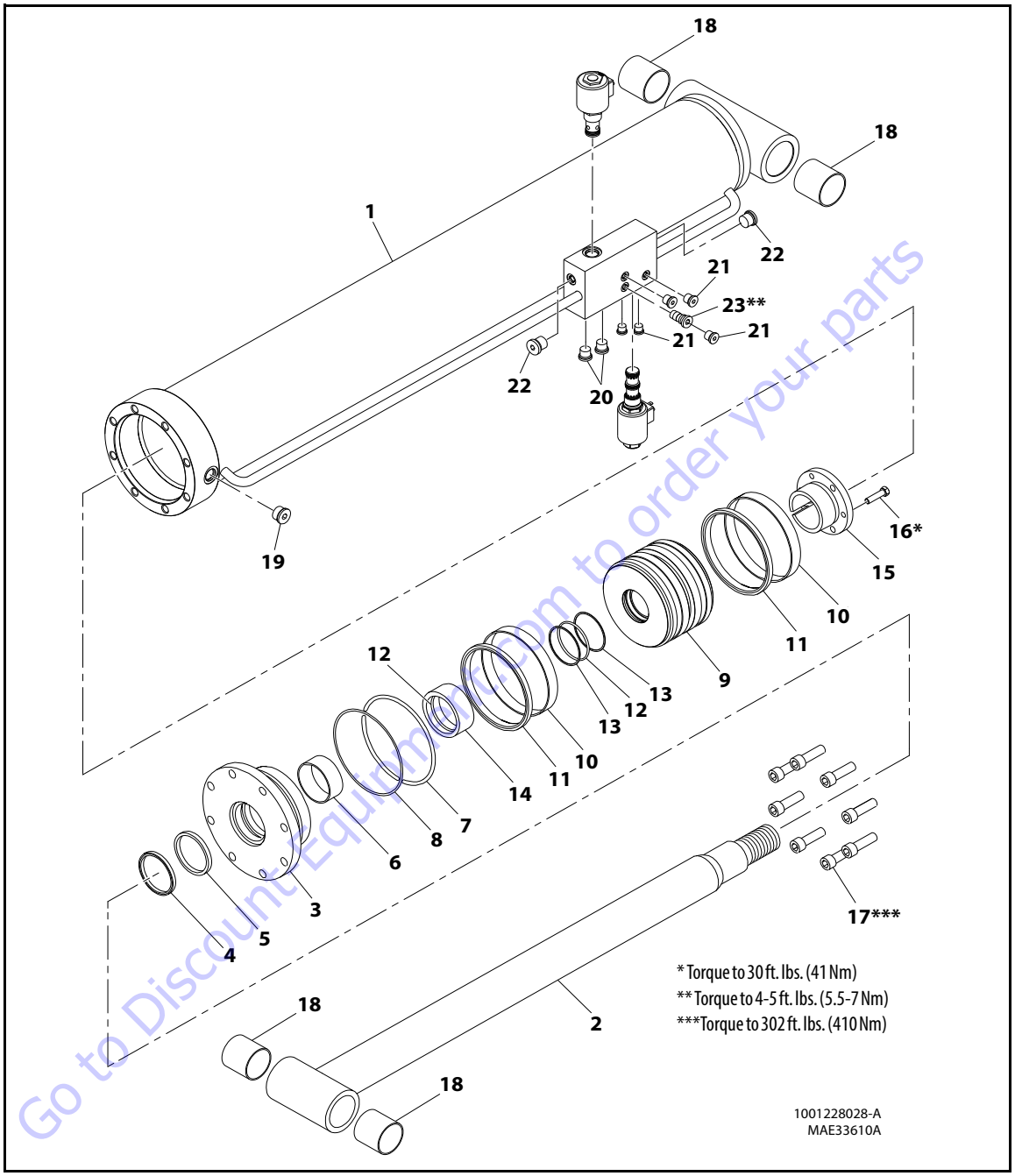


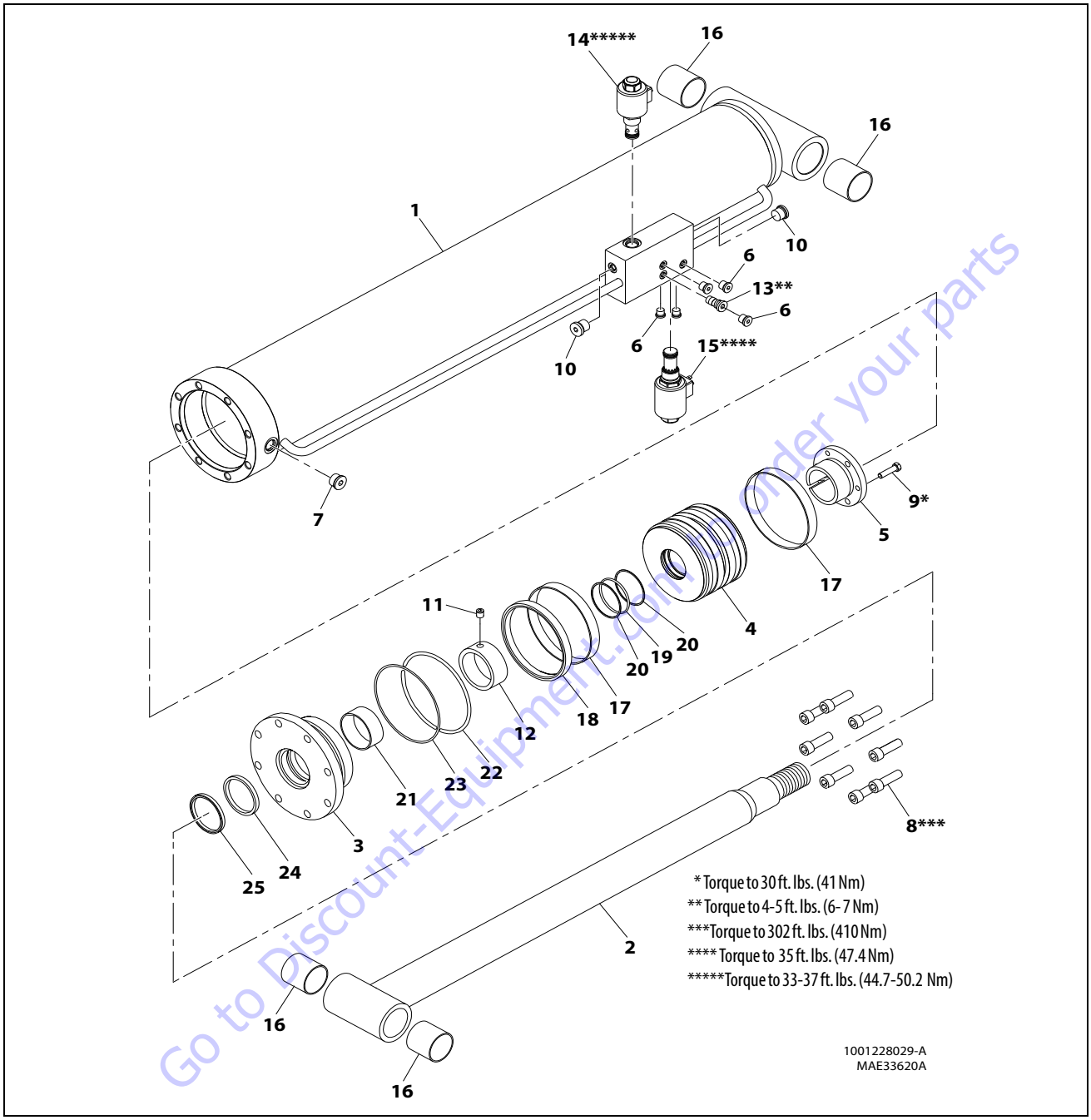

**Figure 5-62. Cylinder Rod Support**






1. Barrel
2. Rod
3. Head
4. Wiper Seal
5. Rod Seal
6. Wear Ring
7. O-ring
8. Backup Ring
9. Piston
10. Guidelock Ring
11. Guidelock Ring
12. O-ring
13. Backup Ring
14. Spacer
15. Tapered Bushing
16. Capscrew
17. Capscrew
18. Bushing
19. Plug
20. Plug
21. Plug
22. Plug
23. Cartridge, Relief Valve

**Figure 5-63. Main Boom Lift Cylinder (800S)**






1. Barrel
2. Rod
3. Head
4. Piston
5. Tapered Bushing
6. Plug
7. Plug
8. Capscrew
9. Capscrew
10. Plug
11. Setscrew
12. Tube Spacer
13. Cartridge, Relief Valve
14. Counterbalance Valve (Barrel End)
15. Counterbalance Valve (Rod End)
16. Bushing
17. Guidelock Ring
18. Seal
19. O-ring
20. Backup Ring
21. Wear Ring
22. O-ring
23. Backup Ring
24. Rod Seal
25. Wiper Seal

**Figure 5-64. Main Boom Lift Cylinder (860SJ)**

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Remove capscrews from drilled holes.
10. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen on the piston.
11. Remove the bushing from the piston.

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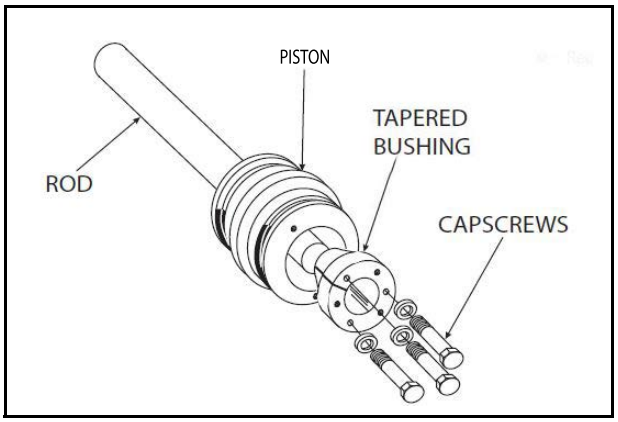



**Figure 5-65. Tapered Bushing Removal**

12. Screw the piston counterclockwise by hand and remove the piston from cylinder rod.
13. Remove and discard the piston o-rings, seal rings, wear rings and backup rings.
14. Remove piston spacer from the rod.
15. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, wear rings 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, tapering, ovality or other damage. Replace if 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, tapering, ovality or other damage. Replace if necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace if 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 inner side 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.*

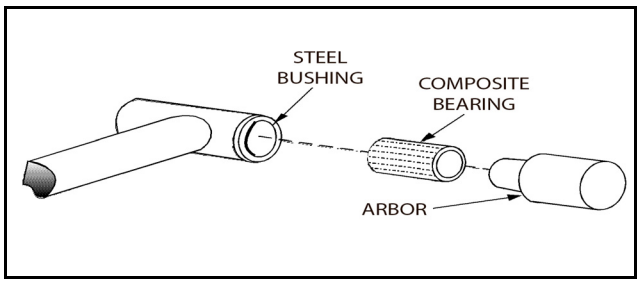



**Figure 5-66. Composite Bearing Installation**

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 if necessary.
14. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair if necessary.
15. If applicable, inspect piston rings for cracks or other damage. Replace if 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.

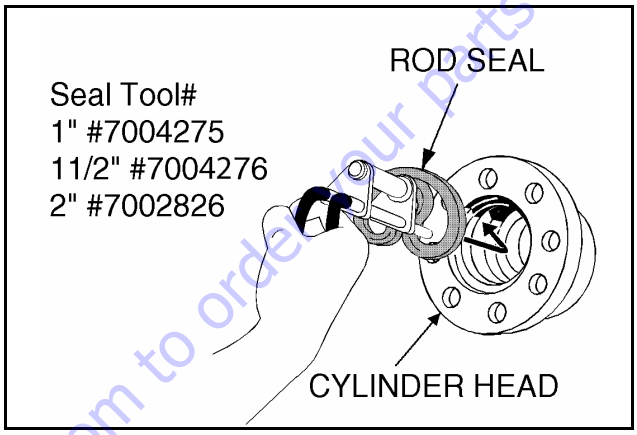



**Figure 5-67. Rod Seal Installation**

**NOTICE**

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

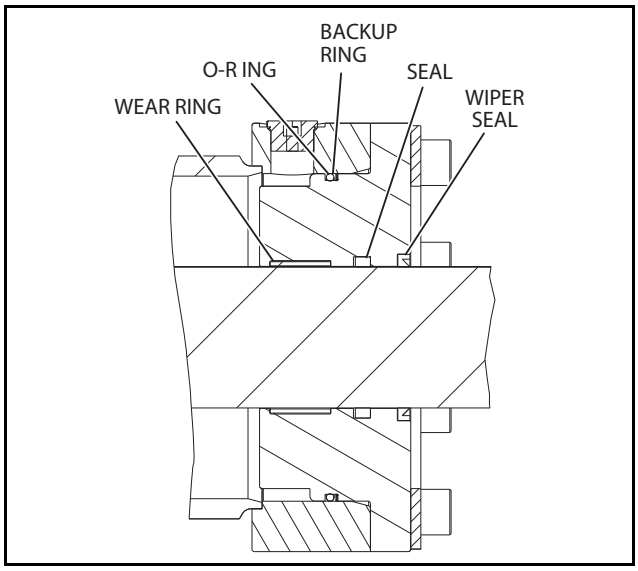



**Figure 5-68. Cylinder Head Seal Installation**

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

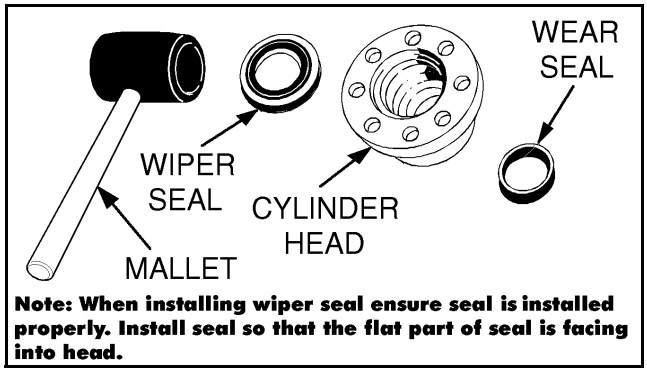



**Figure 5-69. Wiper Seal Installation**

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

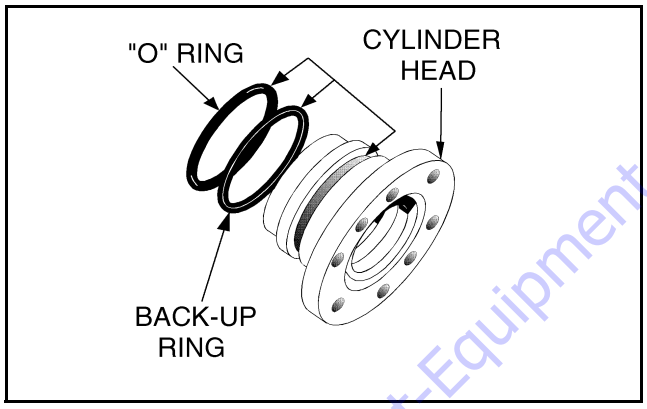



**Figure 5-70. Installation of Head Seal Kit**

4. Install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Carefully slide the piston spacer 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 and backup rings in the inner piston diameter groove.

8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

9. Thread piston onto rod hand tight and install the tapered bushing.

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

10. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

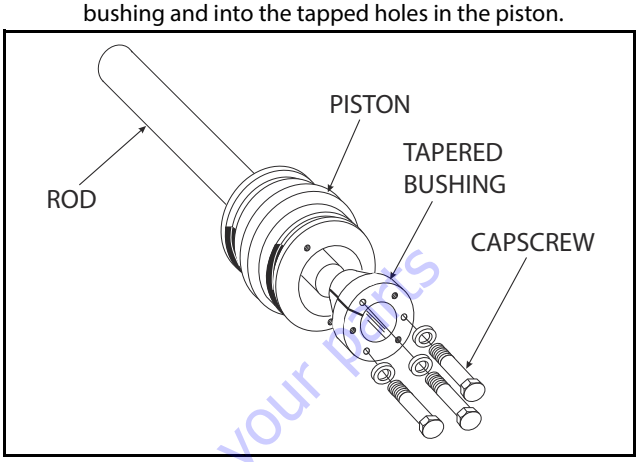



**Figure 5-71. Tapered Bushing Installation**

11. Tighten the capscrews evenly and progressively in rotation to 30 ft. lbs. (41 Nm).

12. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4 in. diameter) as follows:

    **a.** Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

    **b.** Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

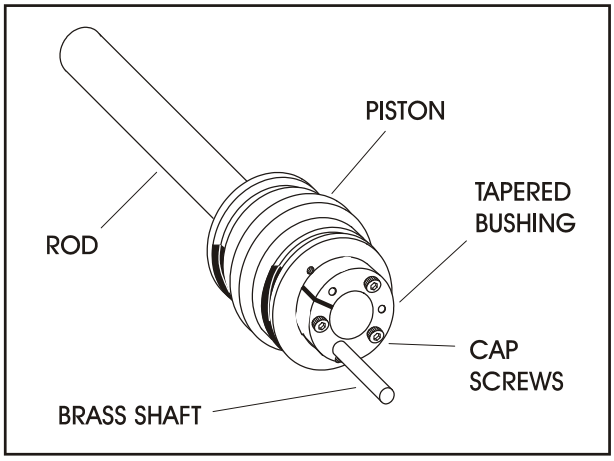



**Figure 5-72. Seating the Tapered Bearing**

13. Rotate the capscrews evenly and progressively in rotation to 30 ft. lbs. (41 Nm).

14. Remove the cylinder rod from the holding fixture.

15. Place new 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).

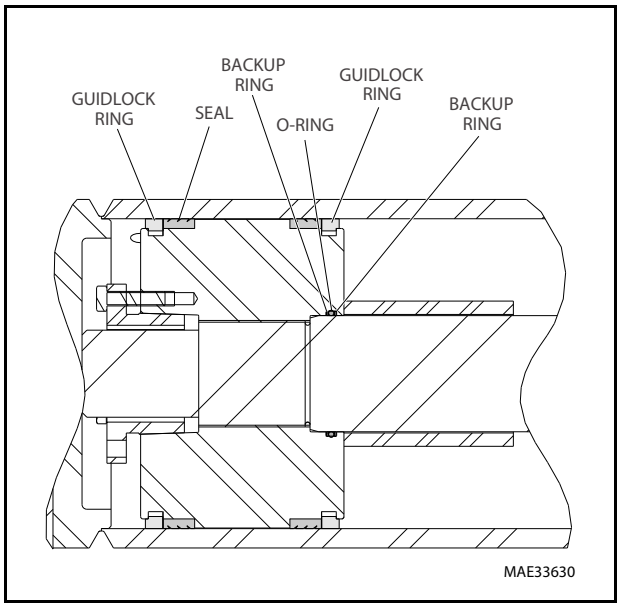



**Figure 5-73. Piston Seal Kit Installation (800S)**

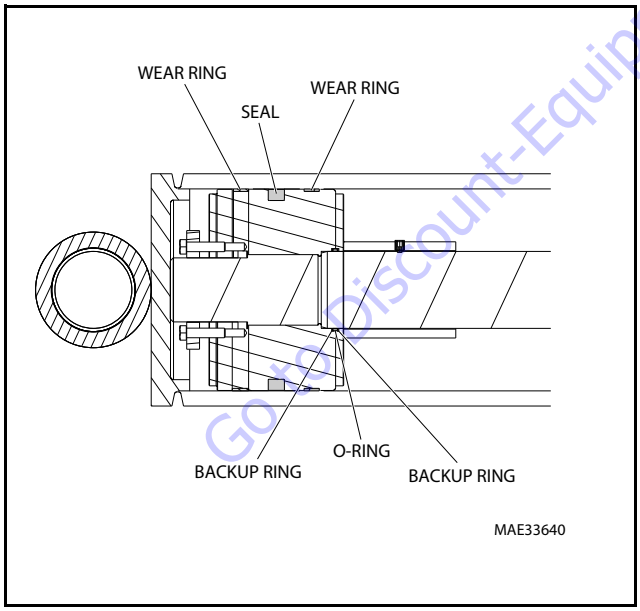



**Figure 5-74. Piston Seal Kit Installation (860SJ)**

16. 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.**

17. With barrel clamped secured and 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.

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

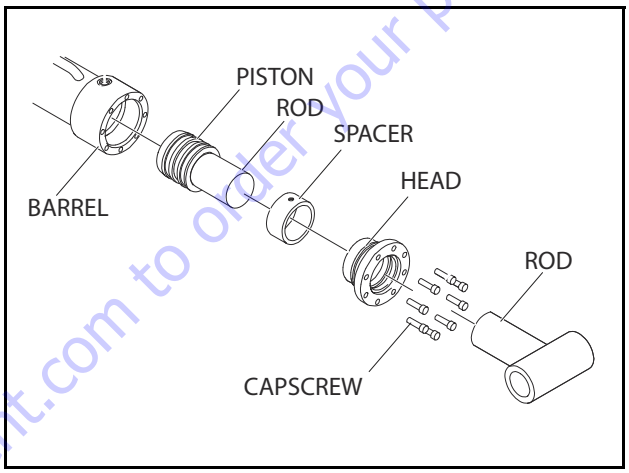



**Figure 5-75. Rod Assembly Installation**

19. Secure the cylinder head gland using the capscrews. Torque capscrews to 302 ft. lbs. (410 Nm).

20. 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.

21. Install the relief valve before installing the plug. Torque the relief valve as shown Figure 5-63., Main Boom Lift Cylinder (800S) and Figure 5-64., Main Boom Lift Cylinder (860SJ). Install the remaining plugs, using new o-rings as applicable.

22. Install the proportional valve, lift holding valve, relief valve, check valve and plugs, using new O-rings as applicable.

## Main Boom Lift Cylinder (860SJ) (SN B300002484 to Present)

### DISASSEMBLY

**NOTICE**

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

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

**⚠ WARNING**

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove the proportional valve, lift holding valve, relief valve, check valve and plugs. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

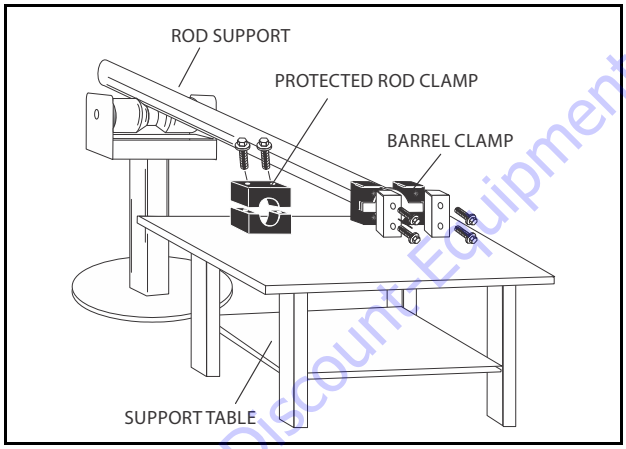



**Figure 5-76. Cylinder Barrel Support**

5. Mark cylinder head and barrel with center punch marks for later realignment. Using a pin-face spanner wrench, unscrew the cylinder head from the barrel.

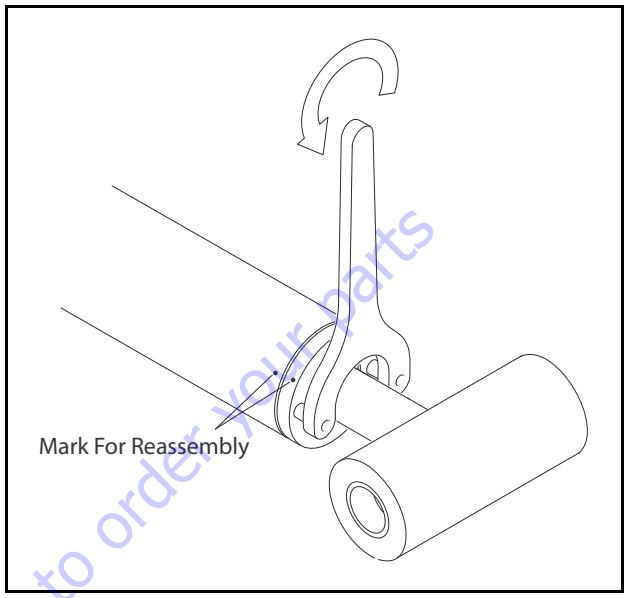



**Figure 5-77. Cylinder Head Removal**

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

**NOTICE**

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

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

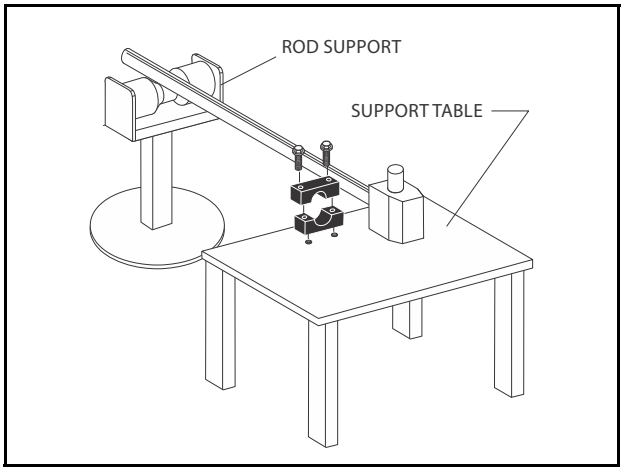
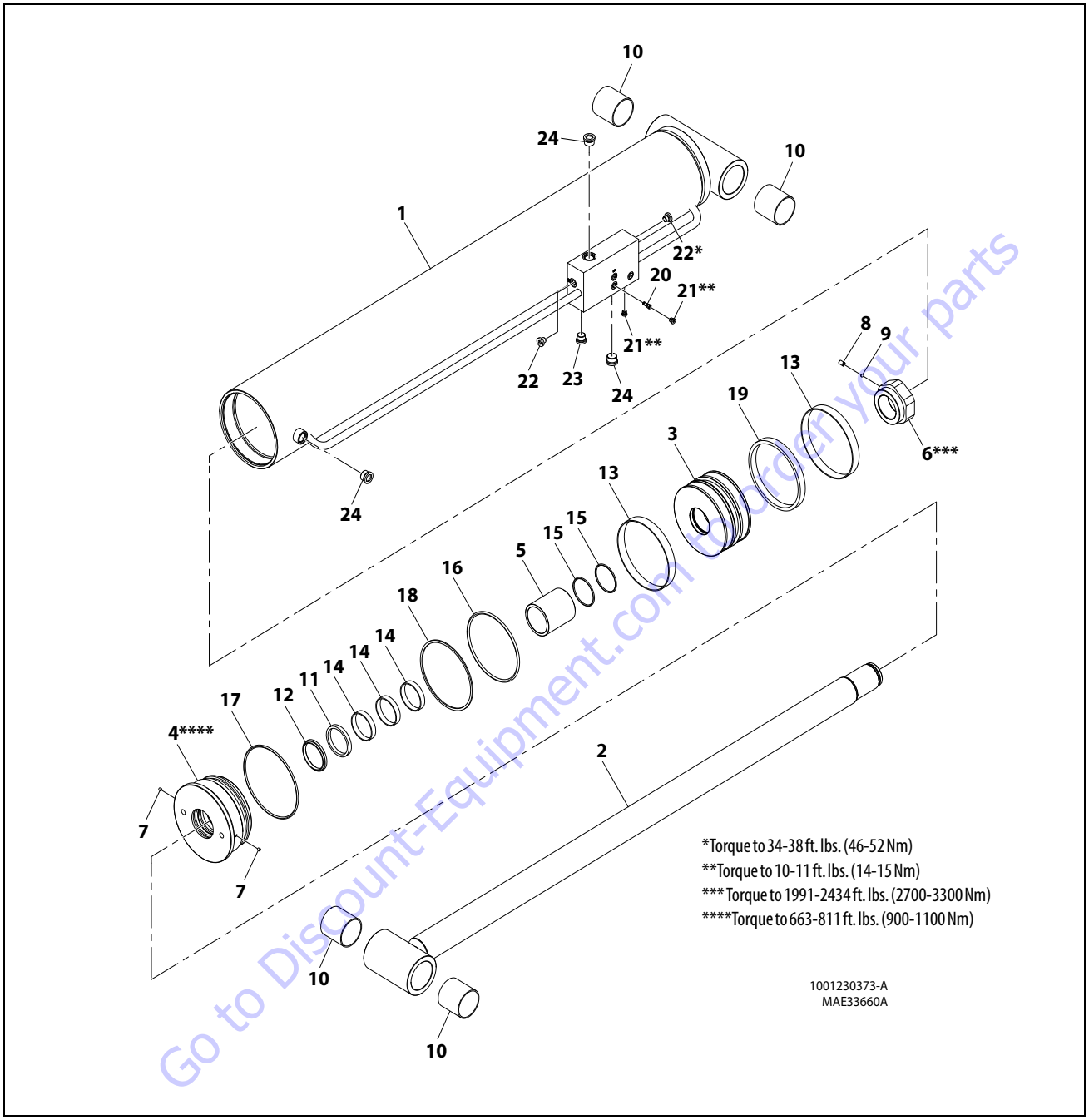



**Figure 5-78. Cylinder Rod Support**






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

**Figure 5-79. Main Boom Lift Cylinder (860SJ)**

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

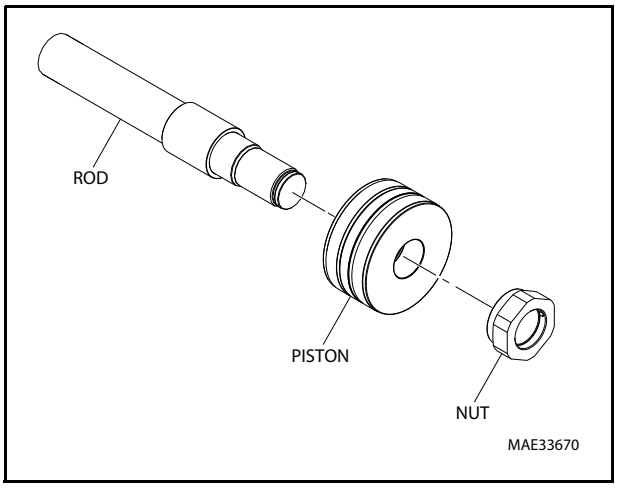



**Figure 5-80. Piston Removal**

10. Screw the piston counterclockwise by hand and remove the piston from cylinder rod.
11. Remove and discard the piston o-rings, seal rings, wear rings and backup 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, rod seals, wear rings 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, tapering, ovality or other damage. Replace if 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, tapering, ovality or other damage. Replace if necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace if 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 inner side 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.*

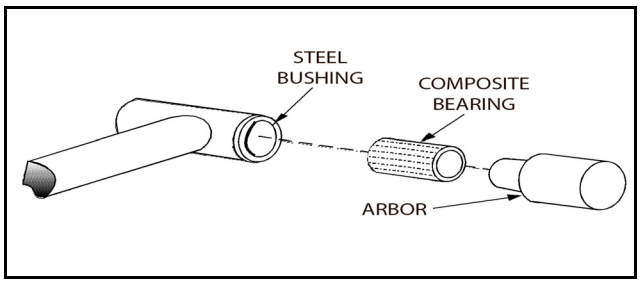



**Figure 5-81. Composite Bearing Installation**

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 if necessary.
14. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair if necessary.
15. If applicable, inspect piston rings for cracks or other damage. Replace if 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.

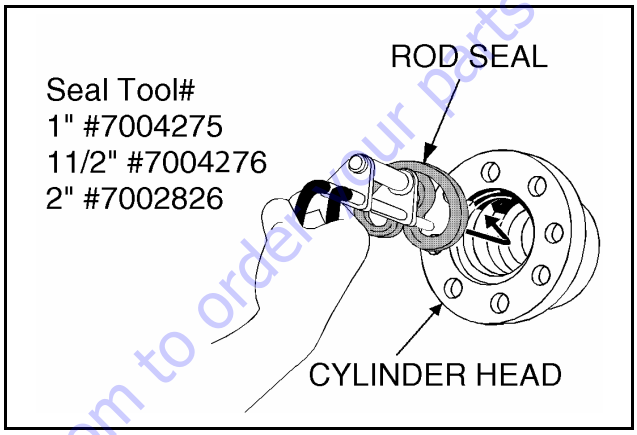



**Figure 5-82. Rod Seal Installation**

**NOTICE**

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

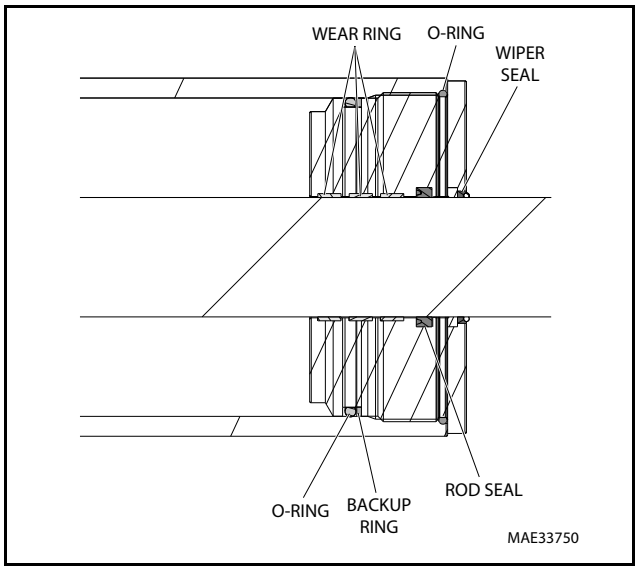



**Figure 5-83. Cylinder Head Seal Installation**

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

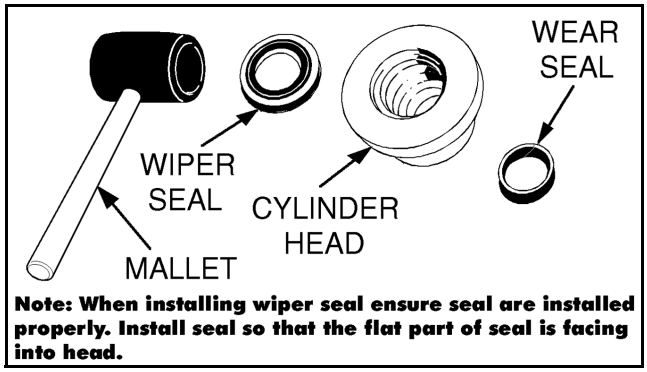



**Figure 5-84. Wiper Seal Installation**

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

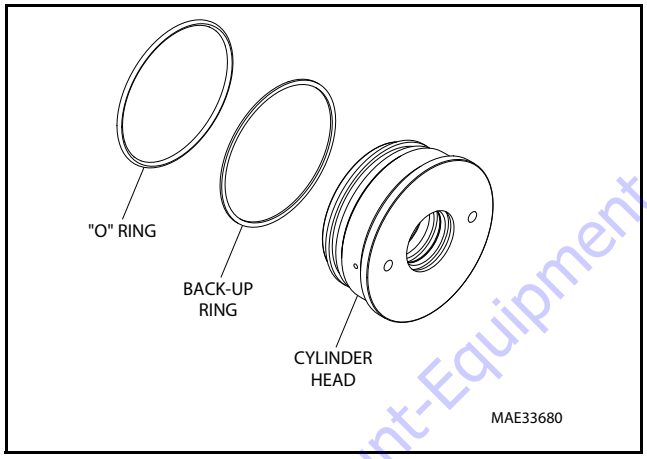



**Figure 5-85. Installation of Head Seal Kit**

4. Carefully install the cylinder head on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.
5. Carefully slide the piston spacer on the rod.
6. 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 and hand tight.
8. Install locknut onto the piston rod. torque locknut to 1991-2434 ft. lbs. (2700-3300 Nm).

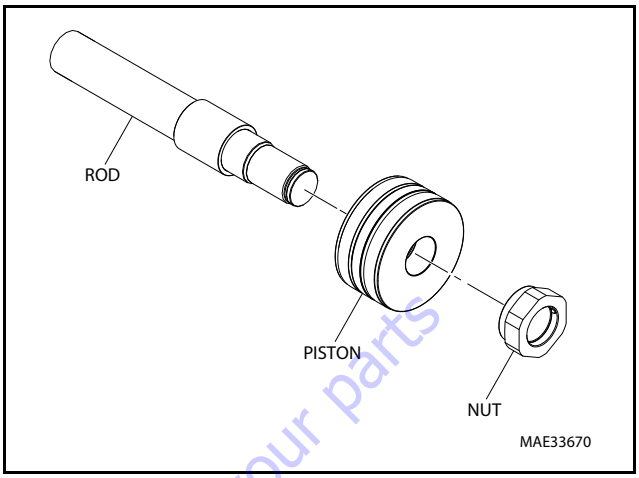



**Figure 5-86. Piston Installation**

9. Remove the cylinder rod from the holding fixture.
10. Place new 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).

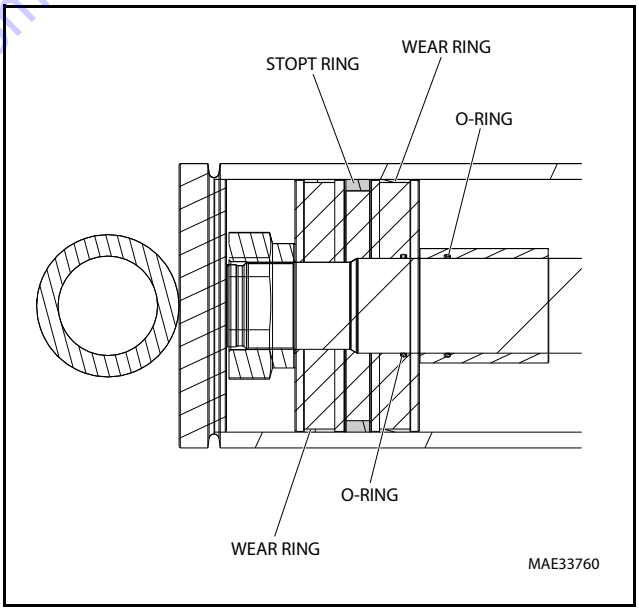



**Figure 5-87. Piston Seal Kit Installation**

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 secured and 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.

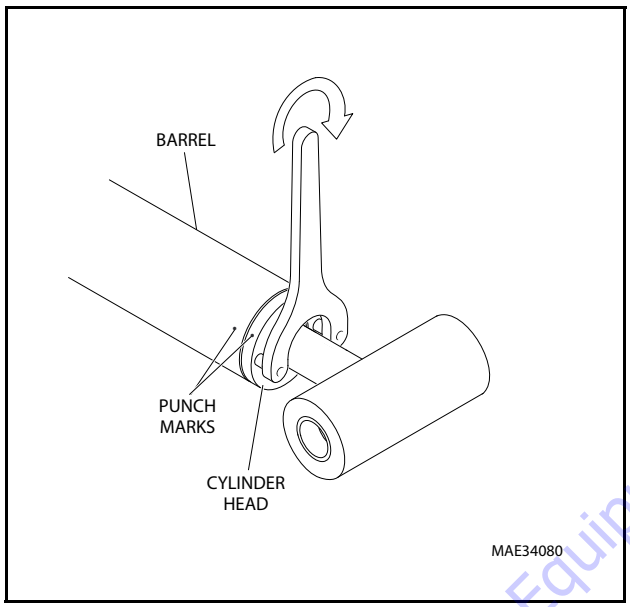



**Figure 5-88. Cylinder Head Installation**

14. Screw the cylinder head into the barrel using a pin-face spanner wrench and torque cylinder head to 663-811 ft. lbs. (900-1100 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.

16. Install the new o-rings and plugs into the cylinder port-block and torque plug as shown in Figure 5-79., Main Boom Lift Cylinder (860SJ).

17. Install the proportional valve, lift holding valve, relief valve, check valve and plugs, using new O-rings as applicable.

## Platform Level Cylinder (800S) (SN 0300182743 through 0300183962, SN 0300193127 through 0300198300, SN 0300198661 through 0300243278 & SN B300001092 through B300002584), (860SJ) (SN 0300182743 through 0300244707, SN B300001092 through B300002483)

### DISASSEMBLY

**NOTICE**

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

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

**⚠ WARNING**

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

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

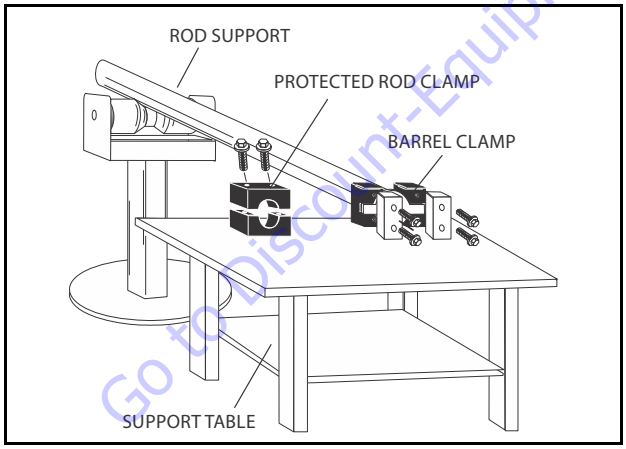



**Figure 5-89. Cylinder Barrel Support**

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

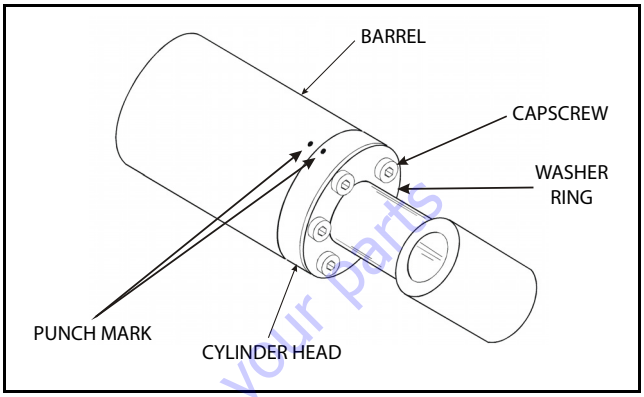



**Figure 5-90. Capscrew Removal**

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

**NOTICE**

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

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

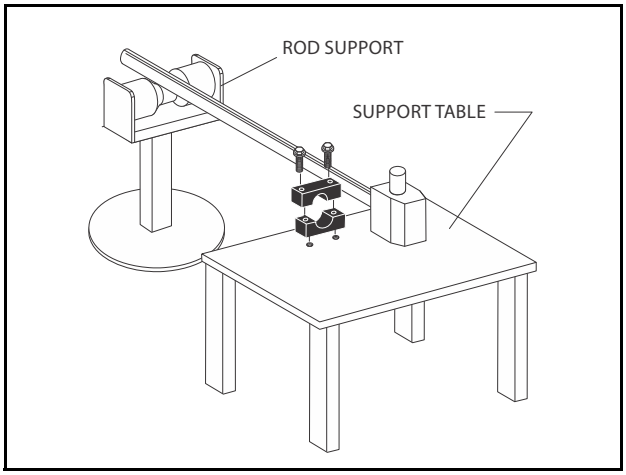
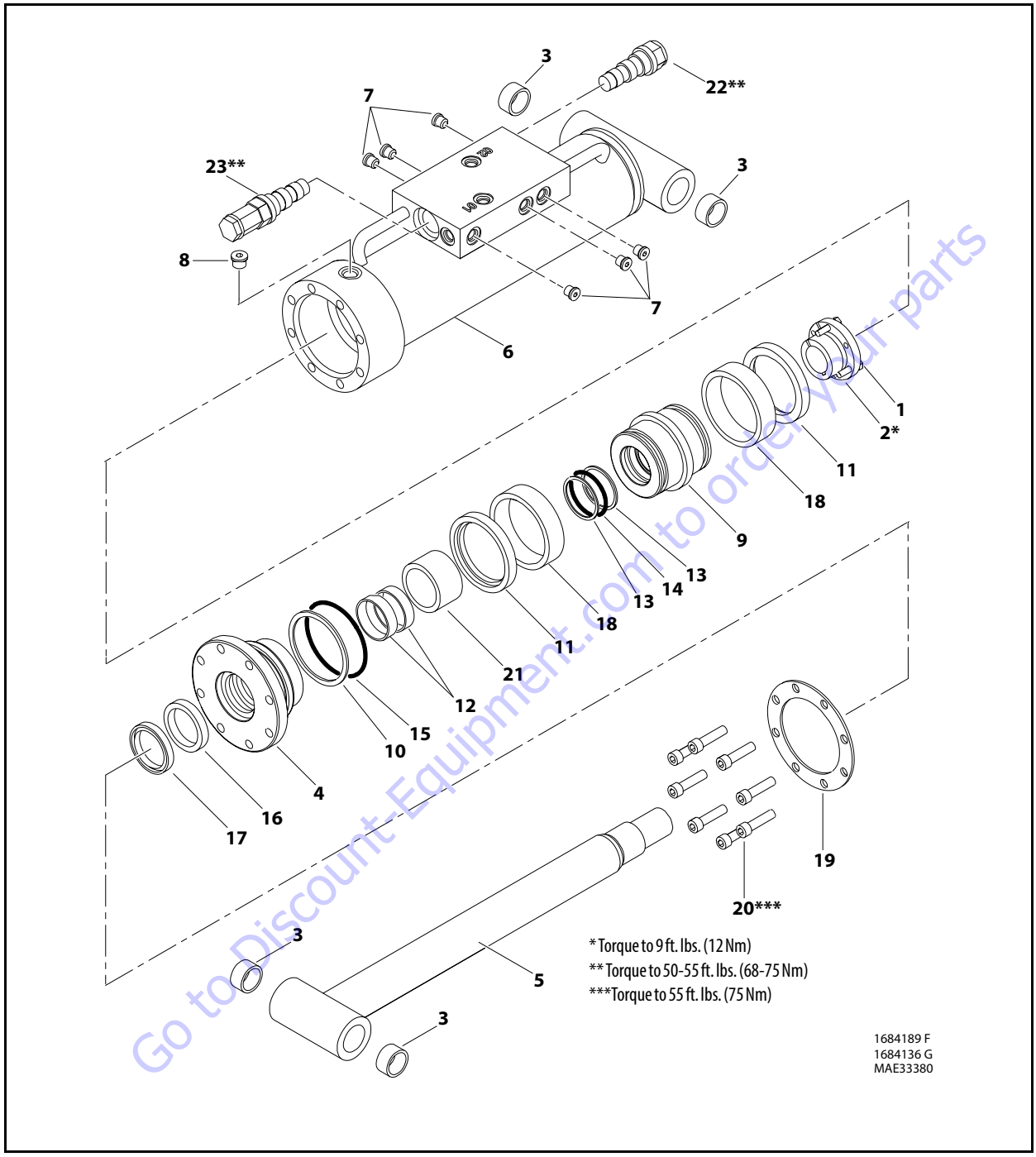



**Figure 5-91. Cylinder Rod Support**






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

**Figure 5-92. Platform Level Cylinder**

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Remove capscrews from drilled holes.
10. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen on the piston.
11. Remove the bushing from the piston.

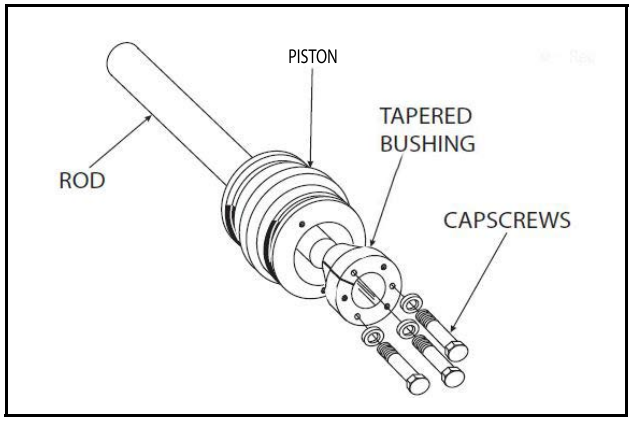



**Figure 5-93. Tapered Bushing Removal**

12. Screw the piston counterclockwise by hand and remove the piston from cylinder rod.
13. Remove and discard the piston o-rings, seal rings, lock rings and backup rings.
14. Remove piston spacer from the rod.
15. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, wear rings 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, tapering, ovality or other damage. Replace if 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, tapering, ovality or other damage. Replace if necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace if 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 inner side 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.*

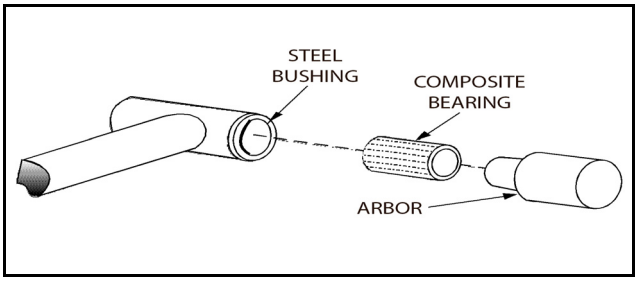



**Figure 5-94. Composite Bearing Installation**

**12.** If applicable, inspect port block fittings and holding valve. Replace if necessary.

**13.** Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair if necessary.

**14.** If applicable, inspect piston rings for cracks or other damage. Replace if 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.

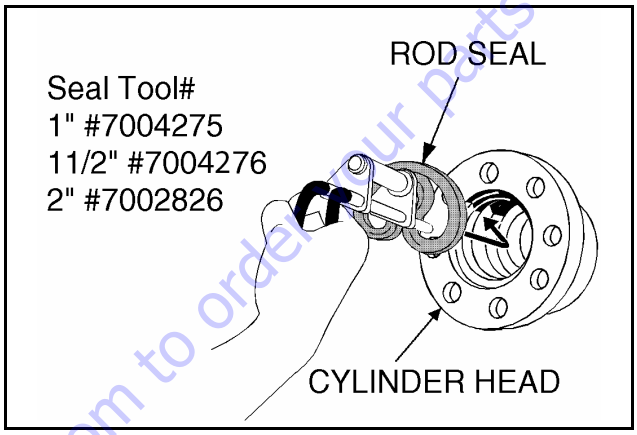



**Figure 5-95. Rod Seal Installation**

***NOTICE***

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

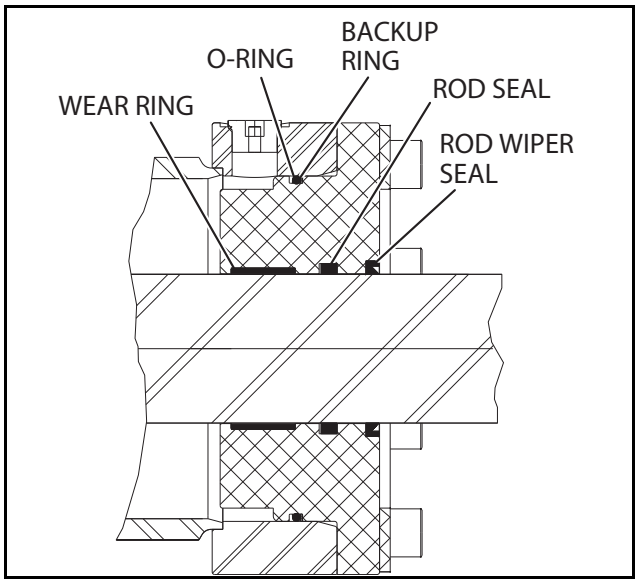



**Figure 5-96. Cylinder Head Seal Installation**

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

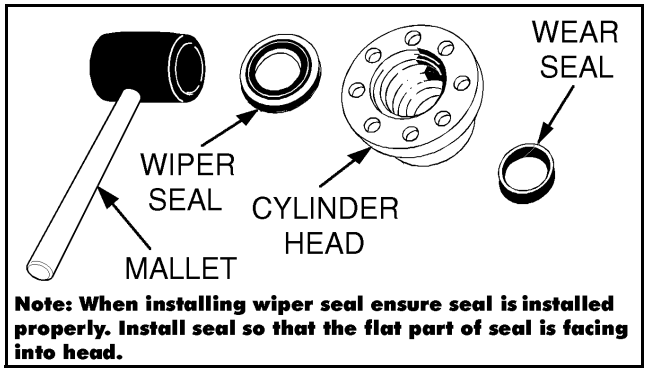



**Figure 5-97. Wiper Seal Installation**

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

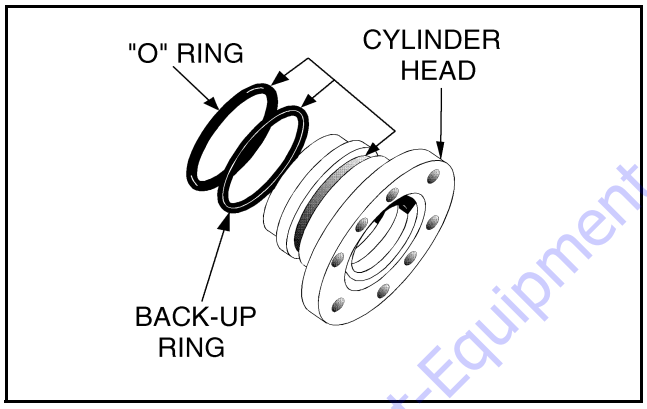



**Figure 5-98. Installation of Head Seal Kit**

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Carefully slide the piston spacer on the rod.

6. 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 and backup rings in the inner piston diameter groove.

8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

9. Thread piston onto rod and install the tapered bushing.

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

10. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

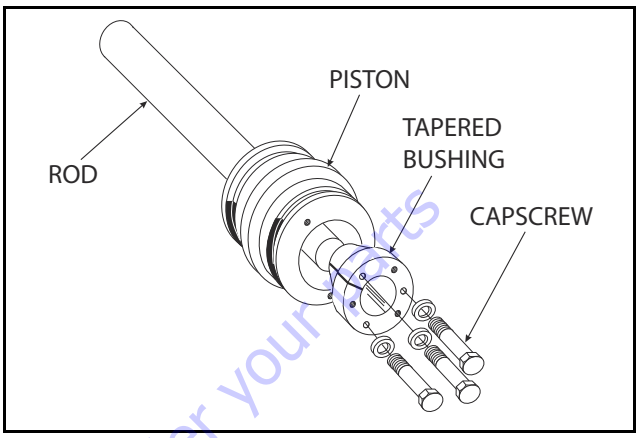



**Figure 5-99. Tapered Bushing Installation**

11. Tighten the capscrews evenly and progressively in rotation to 9 ft. lbs (12 Nm).

12. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4 in. diameter) as follows:

    **a.** Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

    **b.** Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

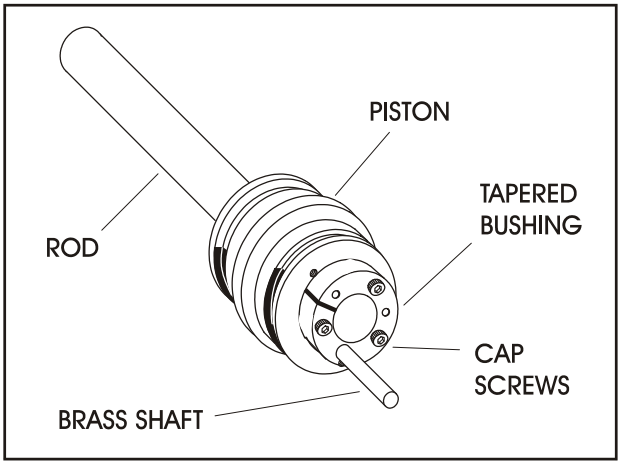



**Figure 5-100. Seating the Tapered Bearing**

13. Rotate the capscrews evenly and progressively in rotation to 9 ft. lbs (12 Nm).

14. Remove the cylinder rod from the holding fixture.

**NOTICE**

**WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.**

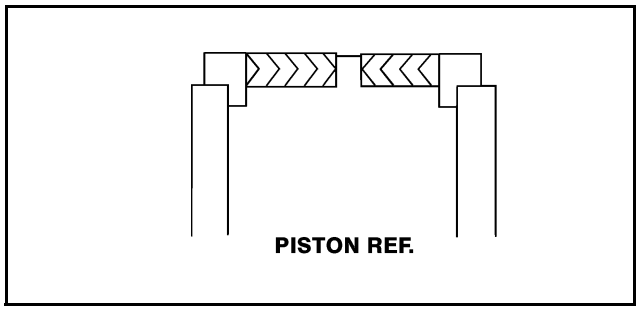



**Figure 5-101. Hydrolock Piston Seal Installation**

15. Place new hydrolock seal and guidelock 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).

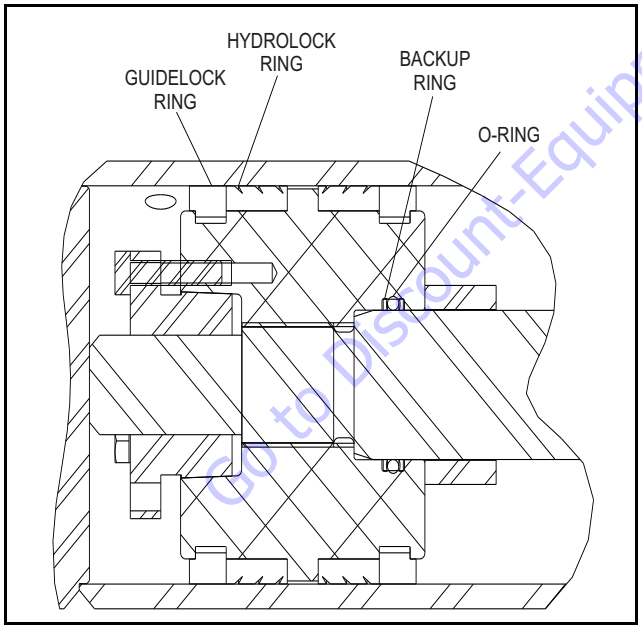



**Figure 5-102. Piston Seal Kit Installation**

16. 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.**

17. With barrel clamped secured and 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.

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

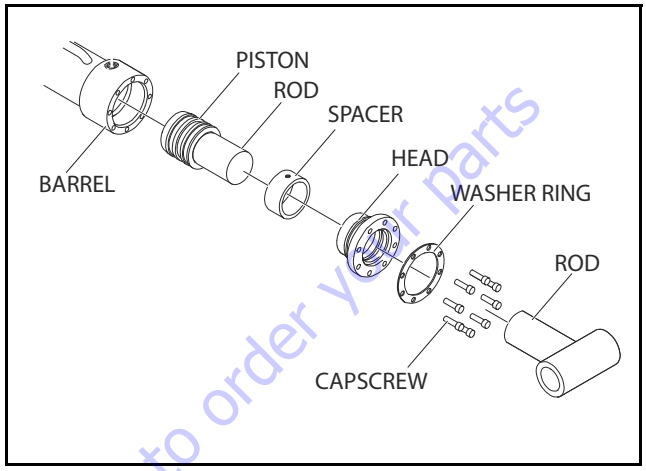



**Figure 5-103. Rod Assembly Installation**

19. Apply JLG Threadlocker P/N 0100011 to the socket head bolts and secure the cylinder head gland using the washer ring and capscrews. Torque capscrews to 55 ft. lbs. (75 Nm).

20. 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.

21. Install the cartridge-type holding valves and fittings in the rod port block, using new o-rings as applicable. Torque valves to 50-55 ft. lbs. (68-75 Nm).

## Platform Level Cylinder (800S) (SN 0300243279 to Present, SN B300002585 to Present) (860SJ) (SN 0300244708 to Present)

### DISASSEMBLY

**NOTICE**

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

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

**⚠ WARNING**

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

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

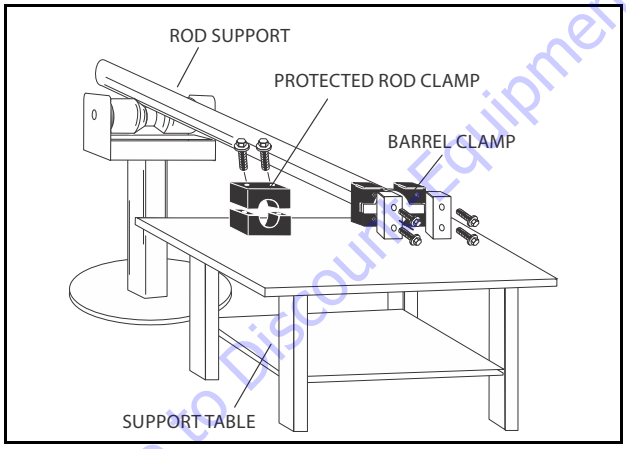



**Figure 5-104. Cylinder Barrel Support**

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

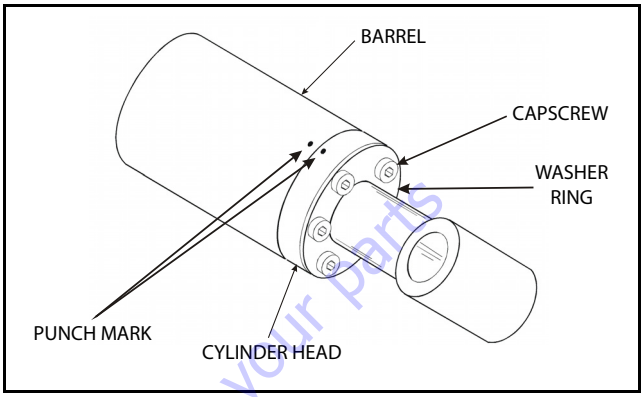



**Figure 5-105. Capscrew Removal**

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

**NOTICE**

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

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

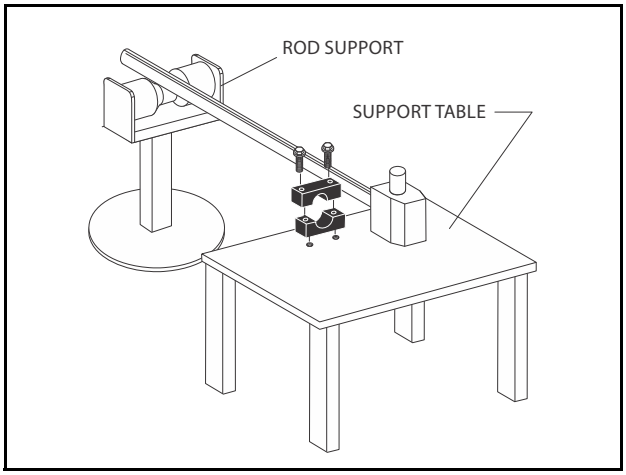
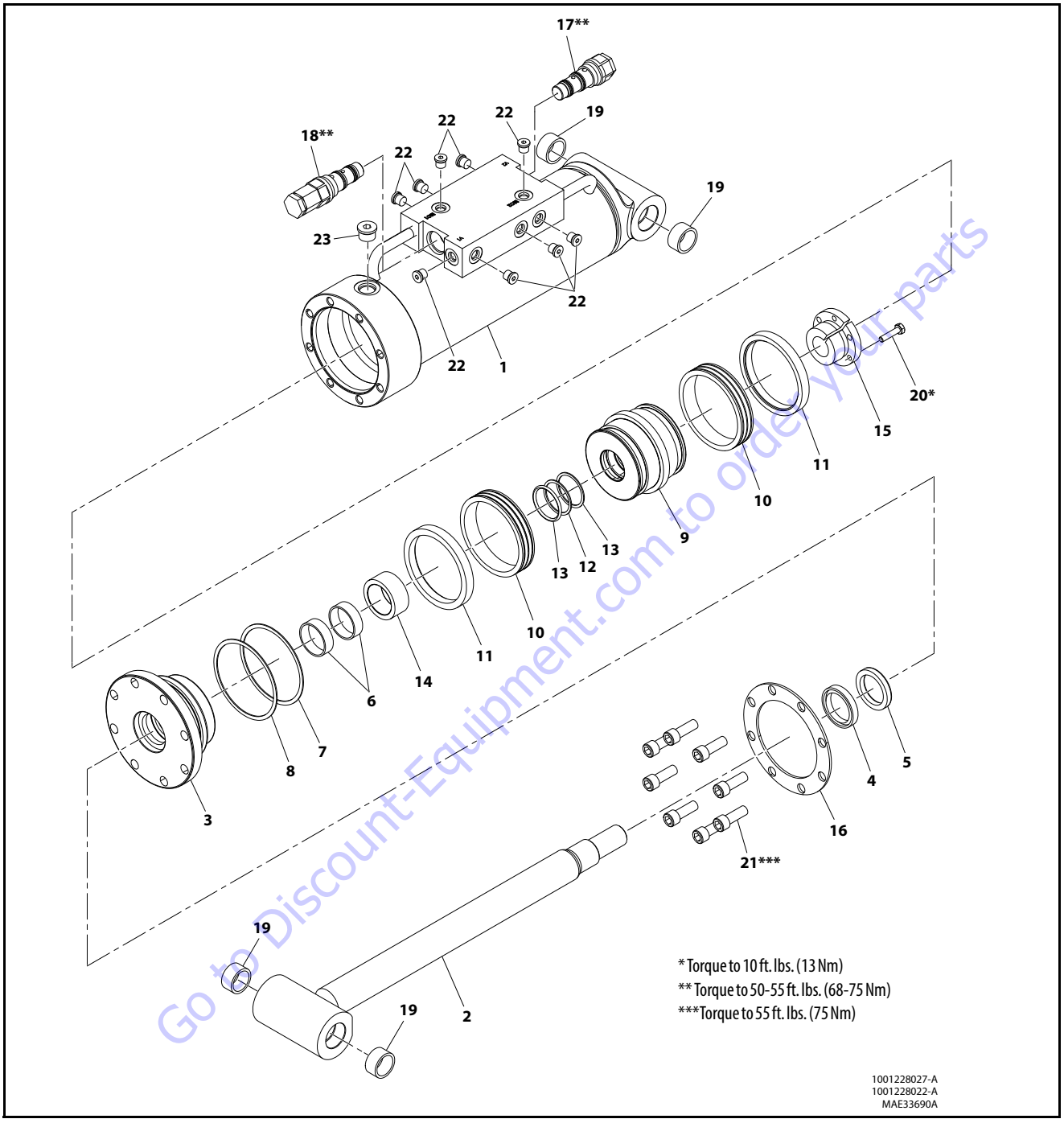



**Figure 5-106. Cylinder Rod Support**






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

**Figure 5-107. Platform Level Cylinder**

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Remove capscrews from drilled holes.
10. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen on the piston.
11. Remove the bushing from the piston.

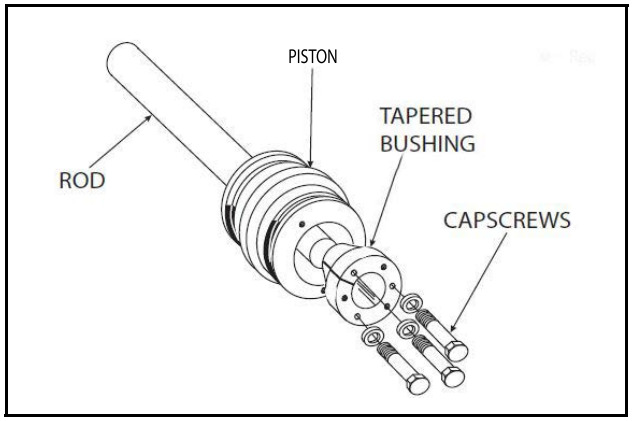



**Figure 5-108. Tapered Bushing Removal**

12. Screw the piston counterclockwise by hand and remove the piston from cylinder rod.
13. Remove and discard the piston hydrolock seals, guide-lock rings.
14. Remove piston spacer from the rod.
15. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, wear rings 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, tapering, ovality or other damage. Replace if 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, tapering, ovality or other damage. Replace if necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace if 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 inner side 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.*

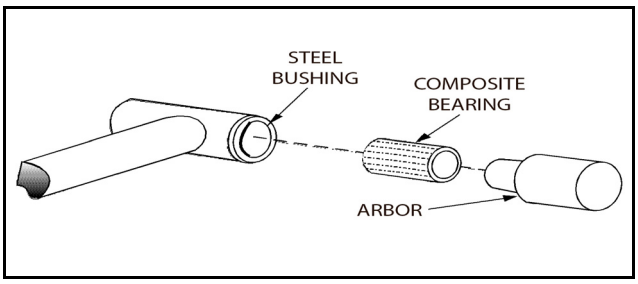



**Figure 5-109. Composite Bearing Installation**

**12.** If applicable, inspect port block fittings and holding valve. Replace if necessary.

**13.** Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair if necessary.

**14.** If applicable, inspect piston rings for cracks or other damage. Replace if 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.

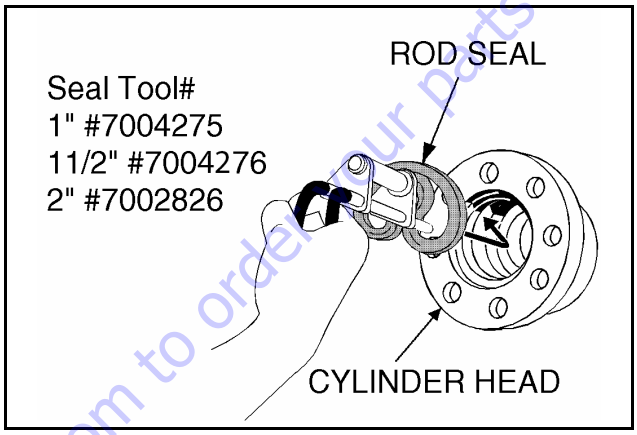



**Figure 5-110. Rod Seal Installation**

**NOTICE**

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

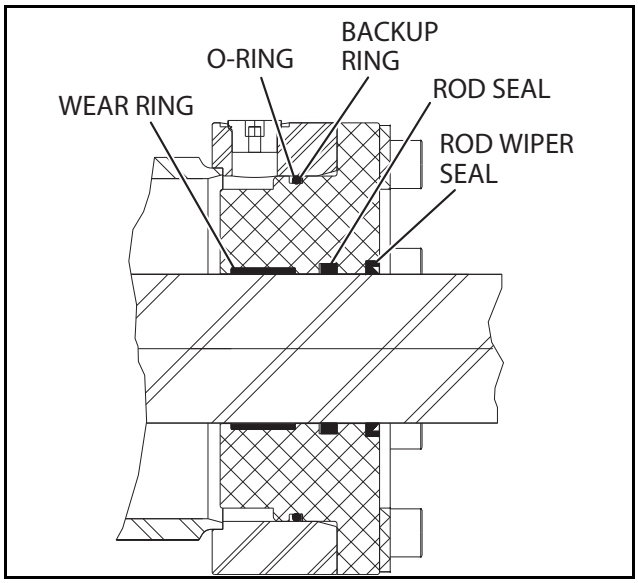



**Figure 5-111. Cylinder Head Seal Installation**

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

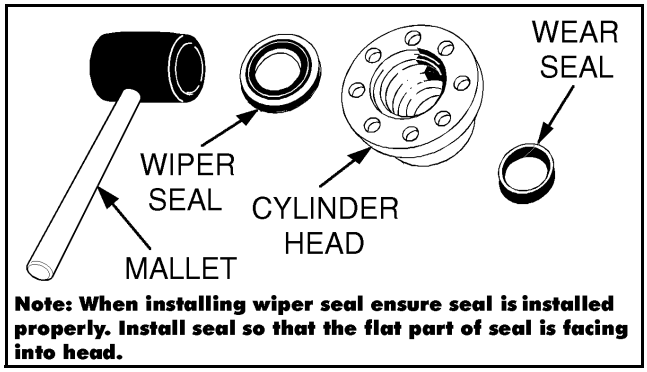



**Figure 5-112. Wiper Seal Installation**

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

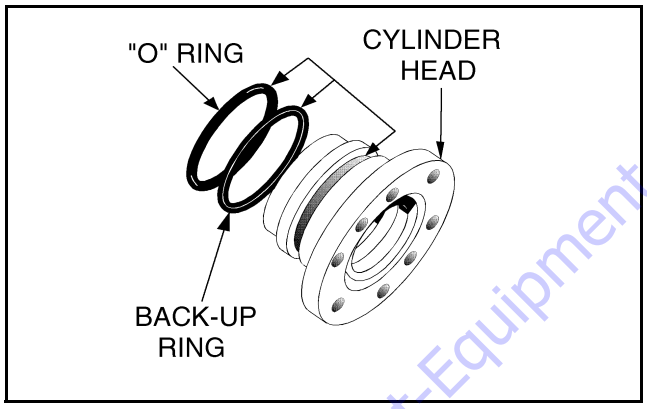



**Figure 5-113. Installation of Head Seal Kit**

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Carefully slide the piston spacer on the rod.

6. 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 and backup rings in the inner piston diameter groove.

8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

9. Thread piston onto rod and install the tapered bushing.

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

10. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

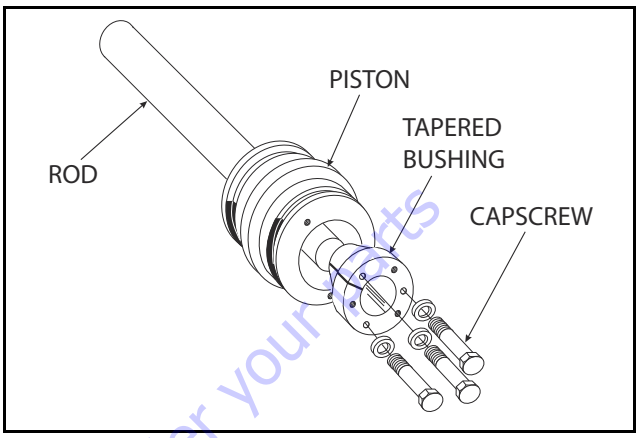



**Figure 5-114. Tapered Bushing Installation**

11. Tighten the capscrews evenly and progressively in rotation to 10 ft. lbs (13 Nm).

12. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4 in. diameter) as follows:

    **a.** Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

    **b.** Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

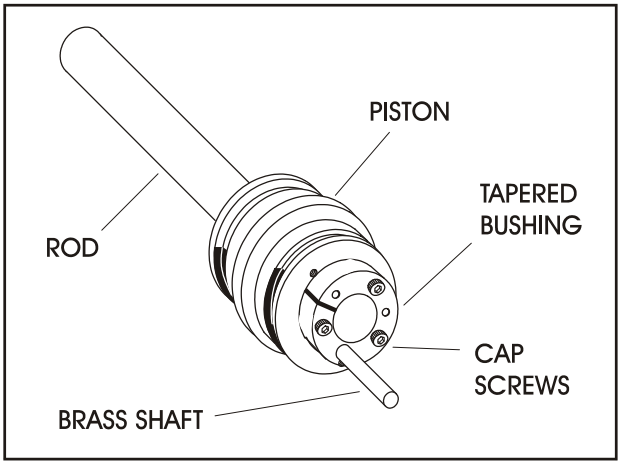



**Figure 5-115. Seating the Tapered Bearing**

13. Tighten the capscrews evenly and progressively in rotation to 10 ft. lbs (13 Nm).

14. Remove the cylinder rod from the holding fixture.

**NOTICE**

**WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.**

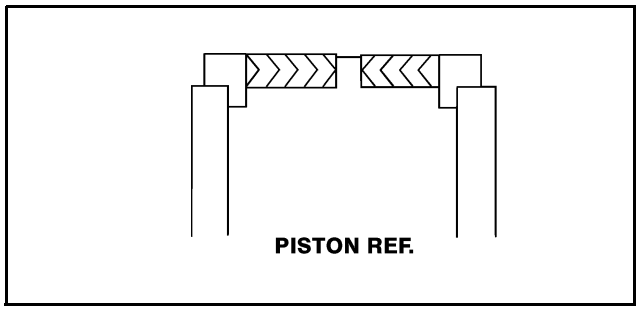



**Figure 5-116. Hydrolock Piston Seal Installation**

15. Place new hydrolock seal and guidelock 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).

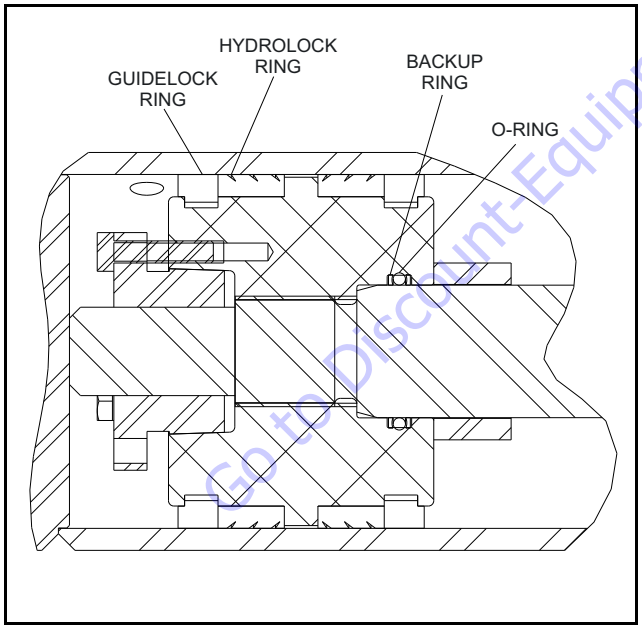



**Figure 5-117. Piston Seal Kit Installation**

16. 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.**

17. With barrel clamped secured and adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading hydrolock seals, guidelock rings are not damaged or dislodged.

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

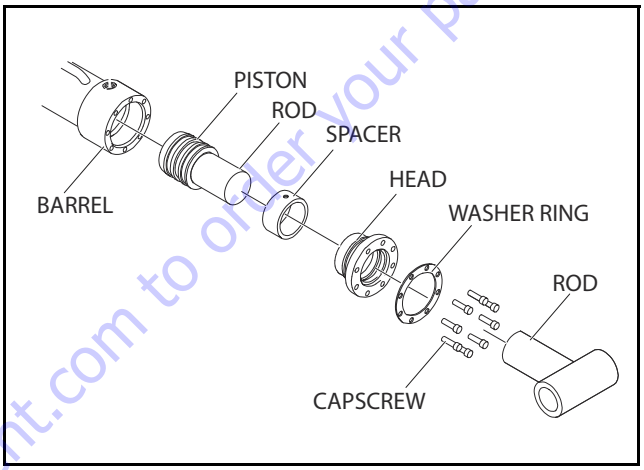



**Figure 5-118. Rod Assembly Installation**

19. Secure the cylinder head gland using the washer ring and capscrews. Torque capscrews to 55 ft. lbs. (75 Nm).

20. 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.

21. Install the cartridge-type holding valves and fittings in the rod port block, using new o-rings as applicable. Torque valves to 50-55 ft. lbs. (68-75 Nm).

## Platform Level Cylinder (860SJ) (SN B300002484 to Present)

### DISASSEMBLY

**NOTICE**

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

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

**⚠ WARNING**

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

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

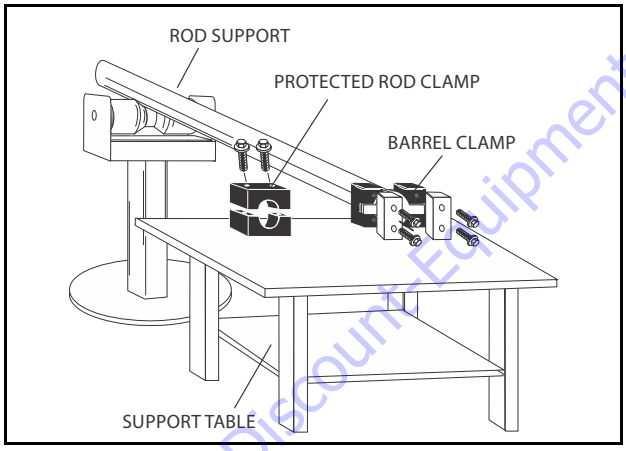



**Figure 5-119. Cylinder Barrel Support**

5. Mark cylinder head and barrel with center punch marks for later realignment. Using a pin-face spanner wrench, unscrew the cylinder head from the barrel..

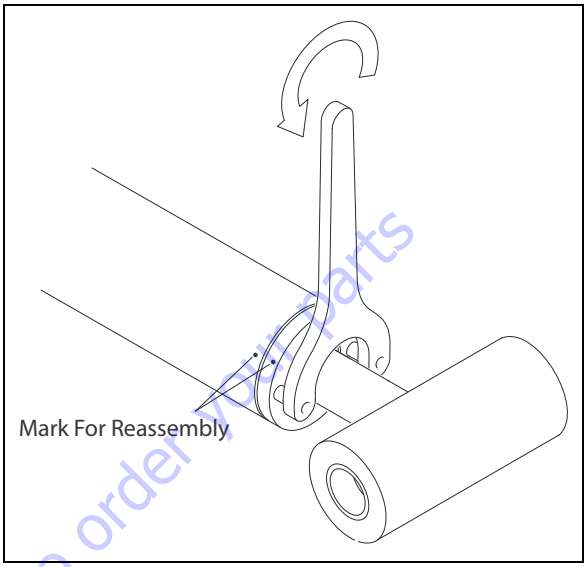



**Figure 5-120. Cylinder Head Removal**

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

**NOTICE**

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

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

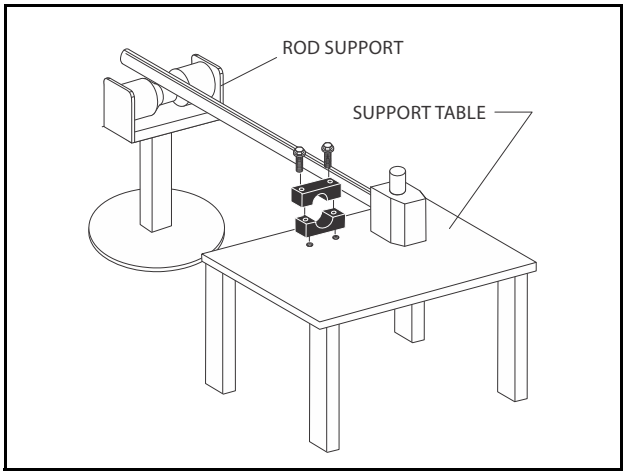
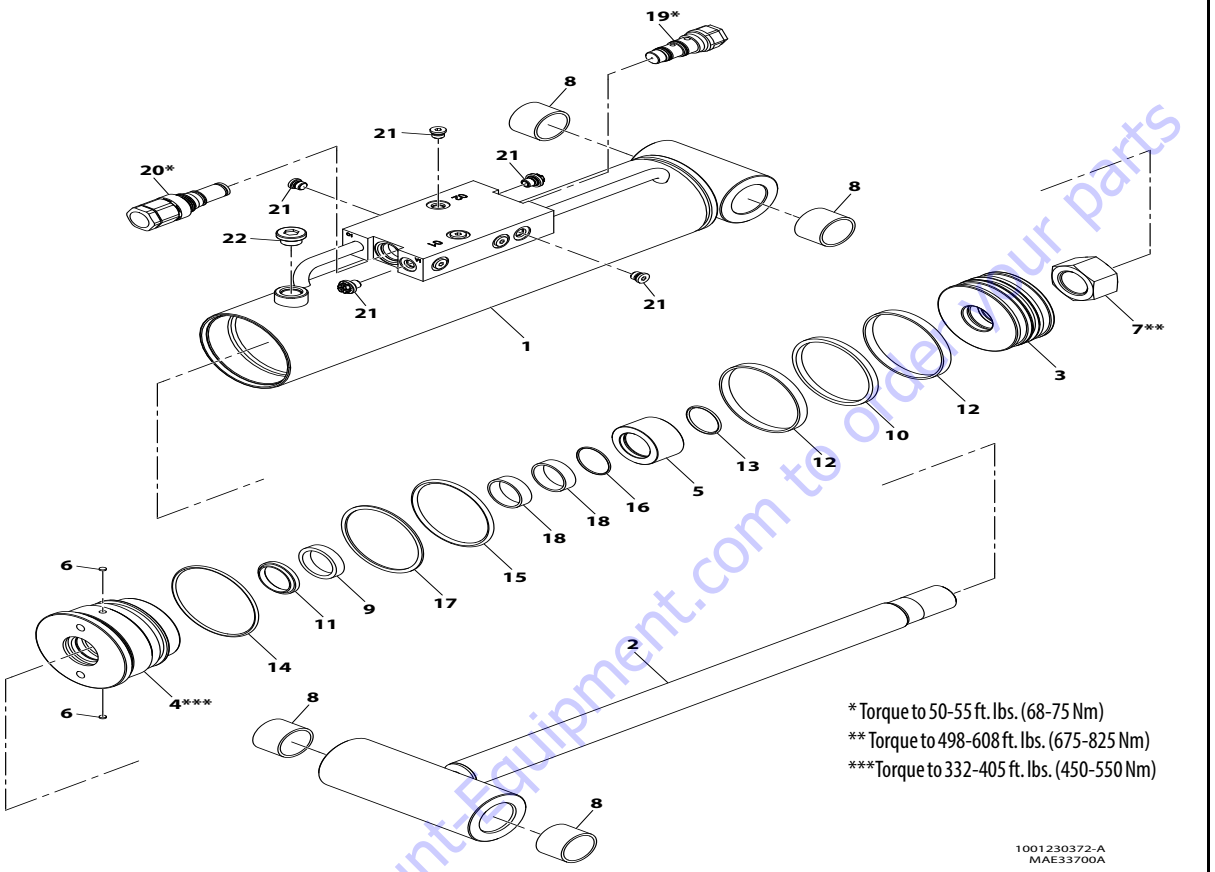



**Figure 5-121. Cylinder Rod Support**






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

**Figure 5-122. Platform Level Cylinder**

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

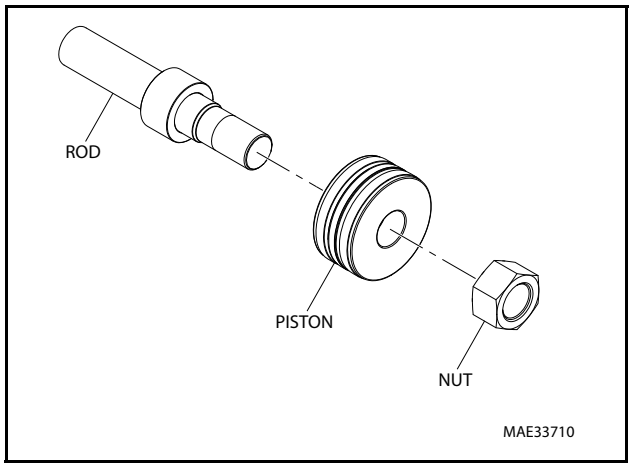



**Figure 5-123. Piston Removal**

10. Screw the piston counterclockwise by hand and remove the piston from cylinder rod.
11. Remove and discard the piston hydrolock seals, guide-lock 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, rod seals, wear rings 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, tapering, ovality or other damage. Replace if 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, tapering, ovality or other damage. Replace if necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace if 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 inner side 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.*

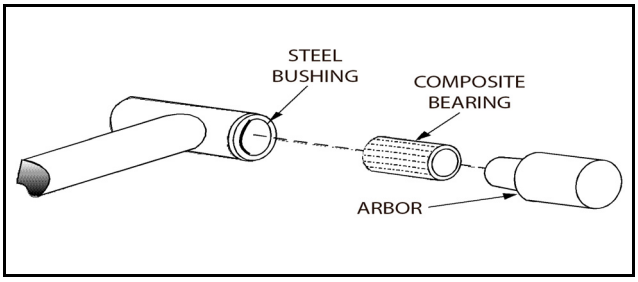



**Figure 5-124. Composite Bearing Installation**

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 if necessary.
14. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair if necessary.
15. If applicable, inspect piston rings for cracks or other damage. Replace if 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.

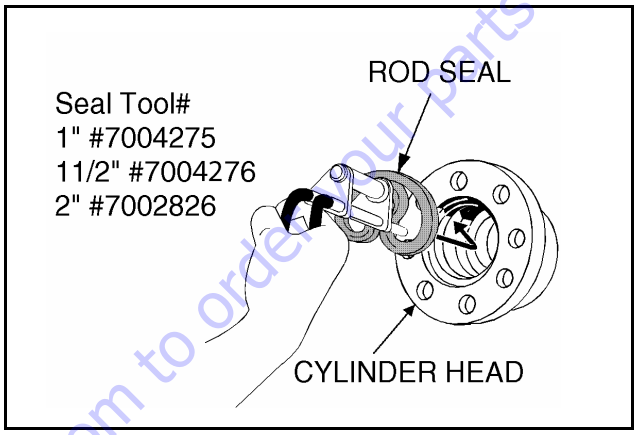



**Figure 5-125. Rod Seal Installation**

**NOTICE**

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

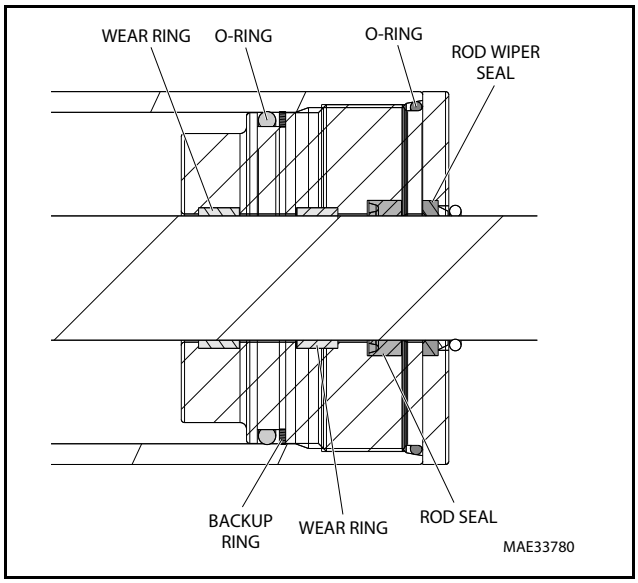
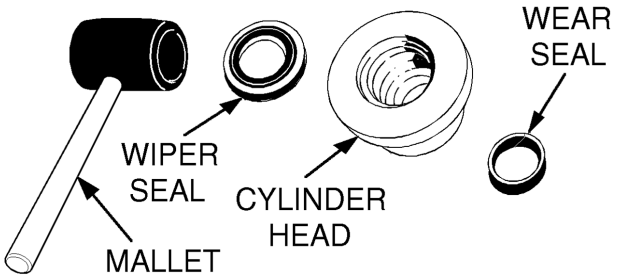



**Figure 5-126. Cylinder Head Seal Installation**

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




**Note: When installing wiper seal ensure seal are installed properly. Install seal so that the flat part of seal is facing into head.**

**Figure 5-127. Wiper Seal Installation**

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

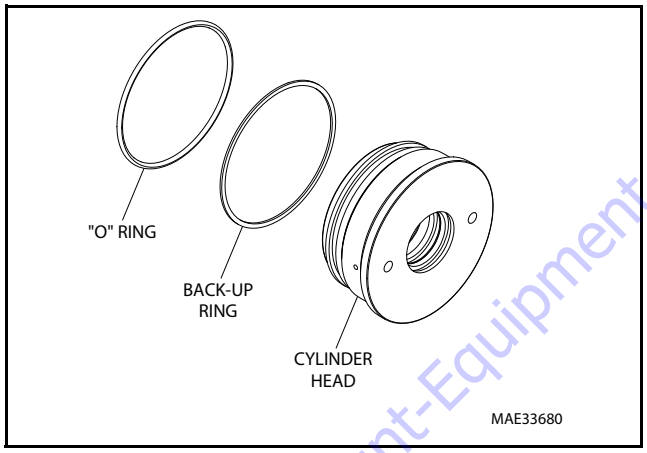



**Figure 5-128. Installation of Head Seal Kit**

4. Carefully install the cylinder head on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.
5. Carefully slide the piston spacer on the rod.
6. 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 and hand tight..
8. Install locknut onto the piston rod. torque locknut to 498-608 ft. lbs. (675-825 Nm).

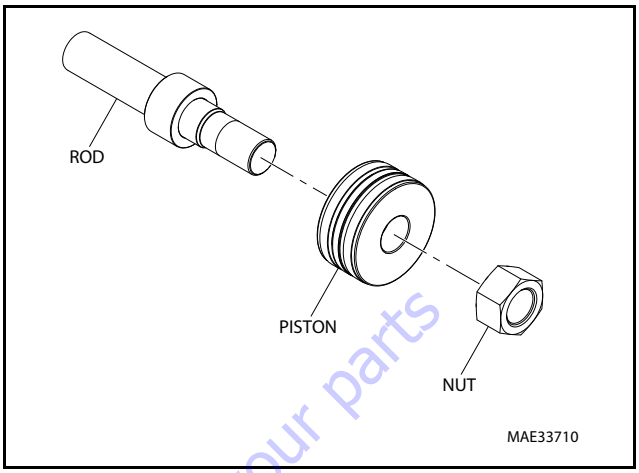



**Figure 5-129. Piston Installation**

9. Remove the cylinder rod from the holding fixture.

**NOTICE**

**WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.**

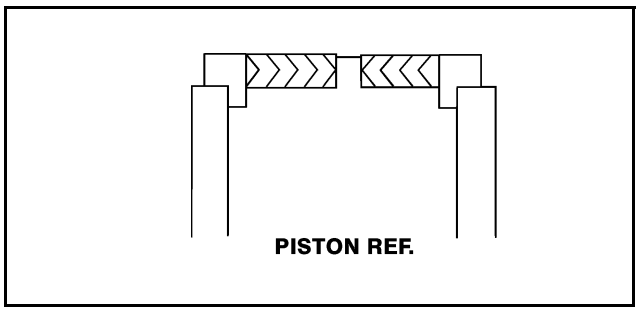



**Figure 5-130. Hydrolock Piston Seal Installation**

**10.** Place new hydrolock seal and guidelock 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).

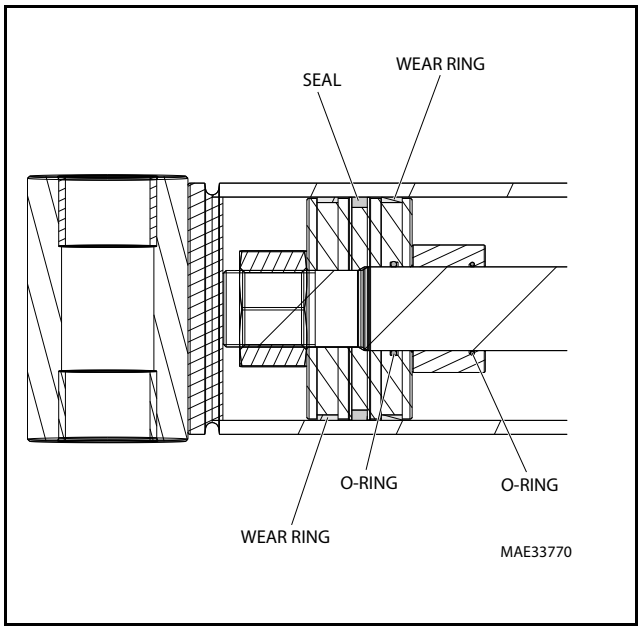



**Figure 5-131. Piston Seal Kit Installation**

**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 secured and adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading hydrolock seals, guidelock rings 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.

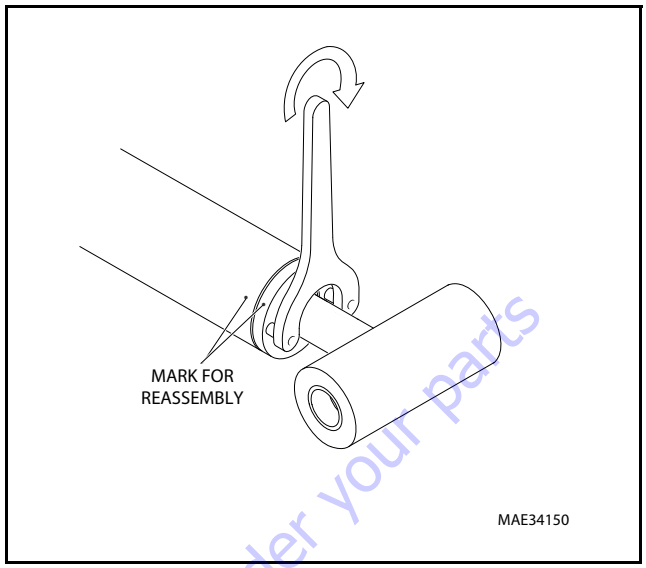



**Figure 5-132. Cylinder Head Installation**

**14.** Screw the cylinder head into the barrel using a pin-face spanner wrench and torque cylinder head to 332-405 ft. lbs. (450-550 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.

**16.** Install the cartridge-type holding valves and fittings in the rod port block, using new o-rings as applicable. Torque valves to 50-55 ft. lbs. (68-75 Nm).

## Platform Level Cylinder (SN 0300183963 through 0300193126 & SN 0300198301 through 300198660)

### DISASSEMBLY

**NOTICE**

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

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

**⚠ WARNING**

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

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

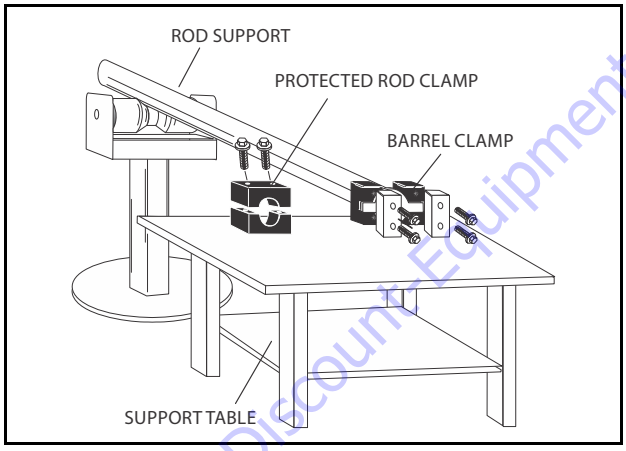



**Figure 5-133. Cylinder Barrel Support**

5. Mark cylinder head and barrel with a center punch for easy realignment. Using a pin-face spanner wrench, unscrew the cylinder head from the barrel.

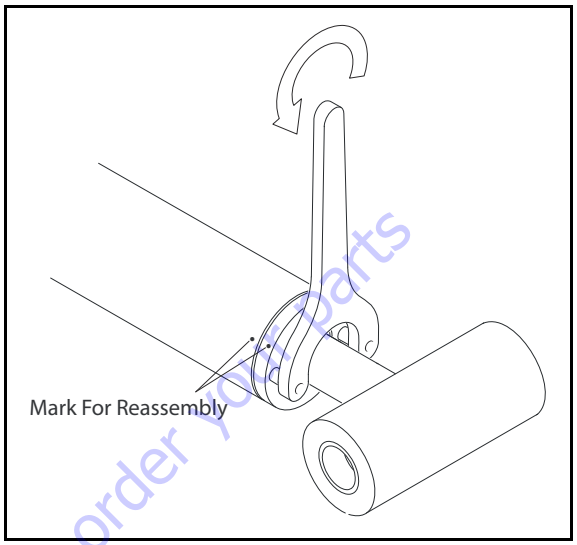



**Figure 5-134. Cylinder Head Removal**

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

**NOTICE**

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

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

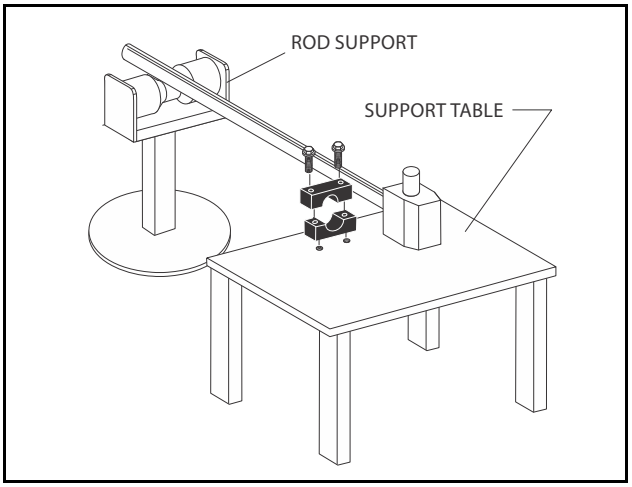
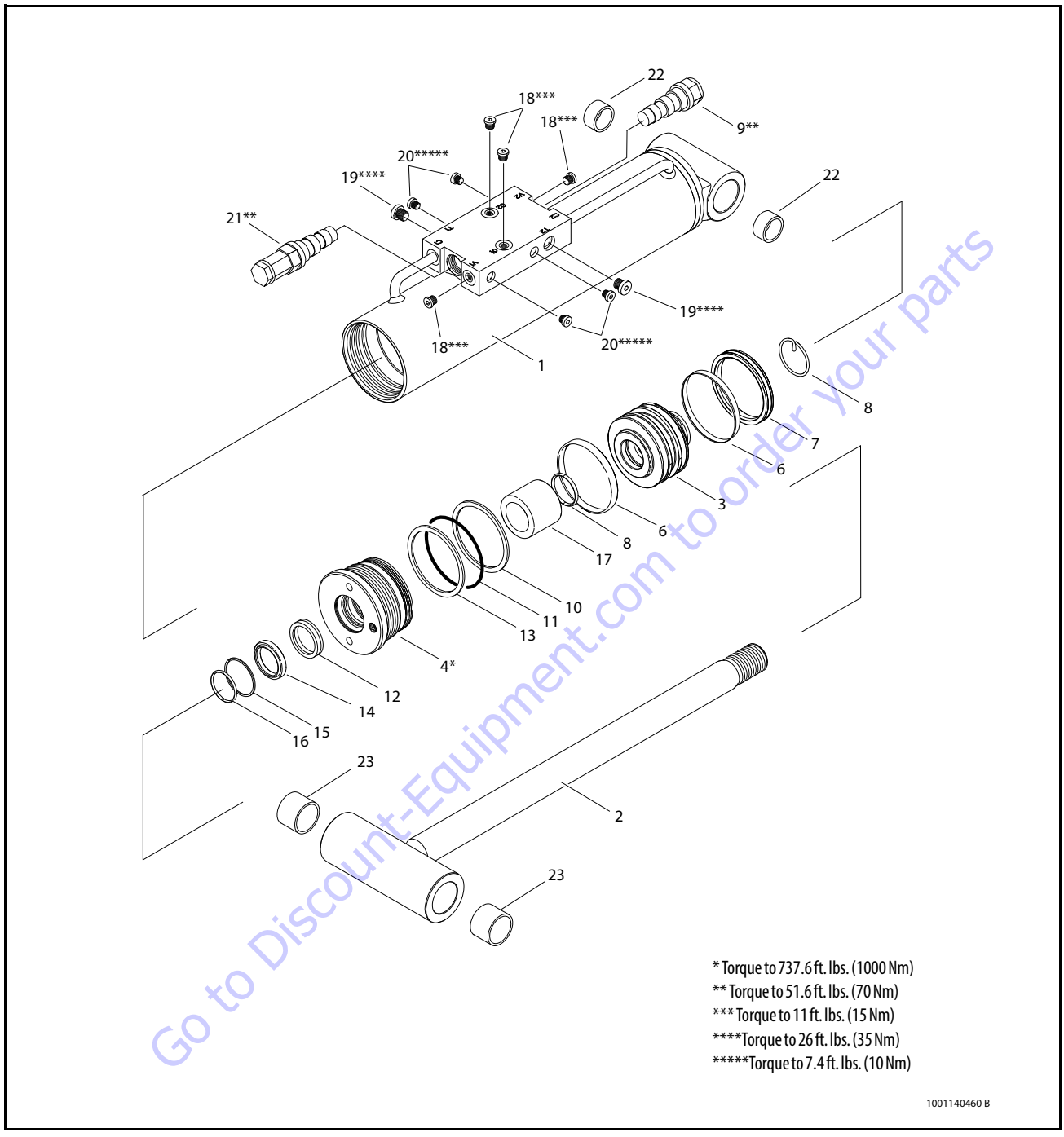



**Figure 5-135. Cylinder Rod Support**






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

**Figure 5-136. Platform Level Cylinder (SN 0300183963 through 0300193126 and SN 0300198301 through 300198660)**

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 from rod end.
10. Screw the piston counterclockwise by hand and remove the piston from cylinder rod.
11. Remove and discard the piston o-rings, seal rings and backup 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, rod seals, retaining ring 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 threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring, tapering, ovality or other damage. Replace if necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring, tapering, ovality or other damage. Replace if necessary.
13. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inner side 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.*

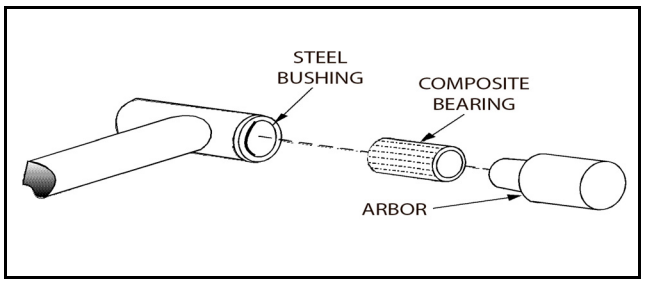



**Figure 5-137. Composite Bearing Installation**

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

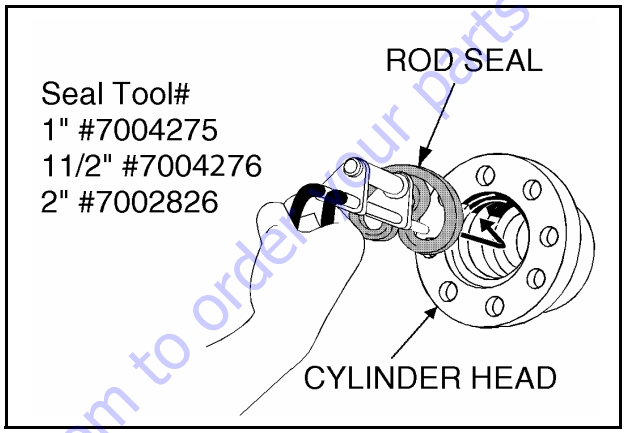



**Figure 5-138. Rod Seal Installation**

**NOTICE**

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

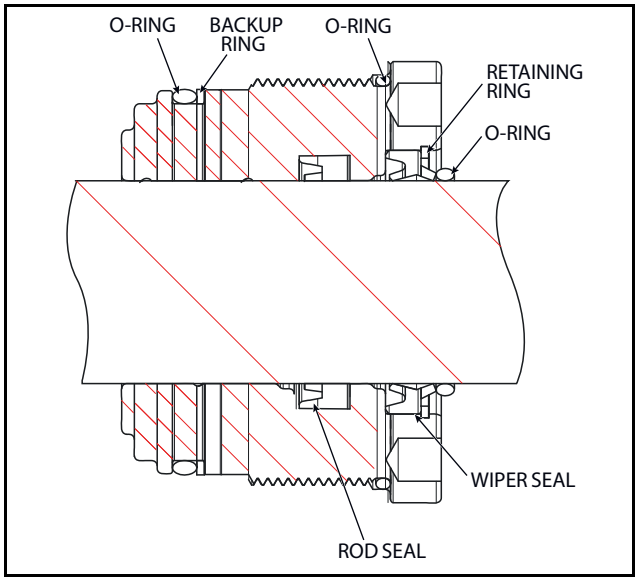



**Figure 5-139. Cylinder Head Seal Installation**

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

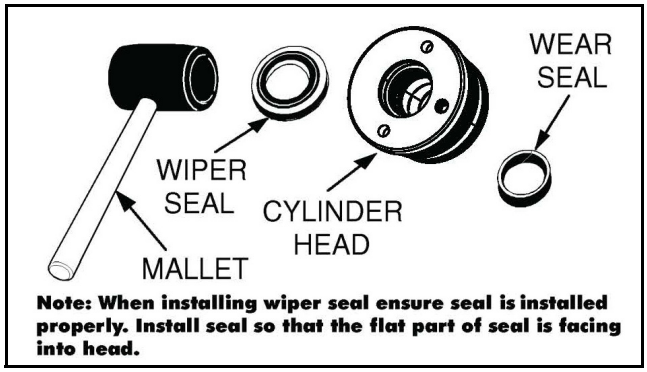



**Figure 5-140. Wiper Seal Installation**

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

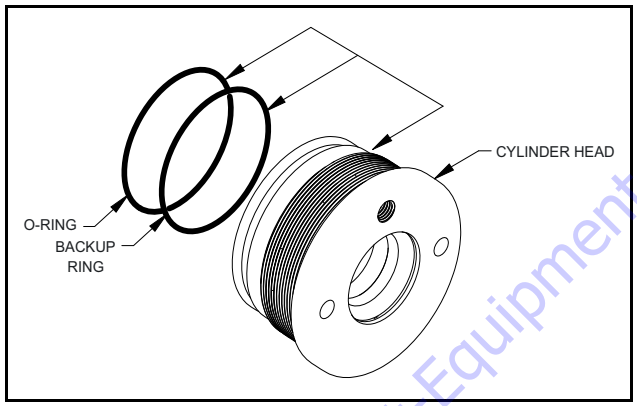



**Figure 5-141. Installation of Head Seal Kit**

4. Install o-ring onto cylinder rod, carefully install the head gland on the rod, ensuring that the wiper seal, retaining ring and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.
5. Install the spacer tube onto the cylinder 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 and backup rings are not damaged or dislodged.
9. Remove the cylinder rod from the holding fixture.
10. Place new seals 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).

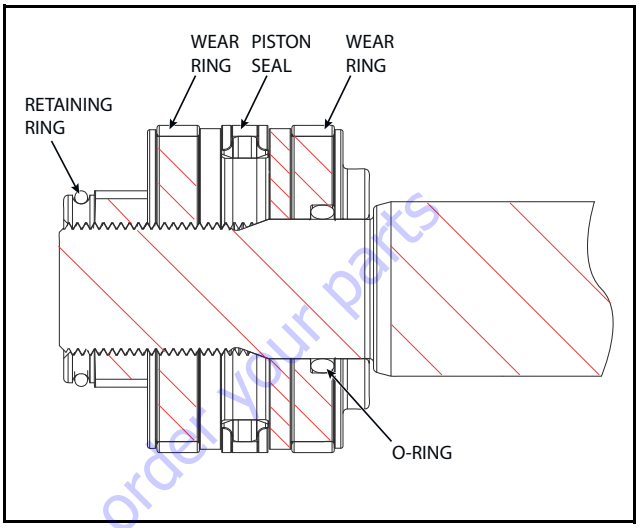



**Figure 5-142. Piston Seal Kit Installation**

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 and torque gland to 738 ft. lbs. (1000 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.
16. Install the counterbalance valves in the rod port block. Torque to 52 ft. lbs. (70 Nm).
17. Install the new o-rings and plugs into the cylinder port block and torque plug to 11 ft. lbs. (15 Nm).

## Steer Cylinder (SN 0300182743 to Present, SN B300001092 through B300002483)

### DISASSEMBLY

**NOTICE**

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

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

**⚠ WARNING**

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

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

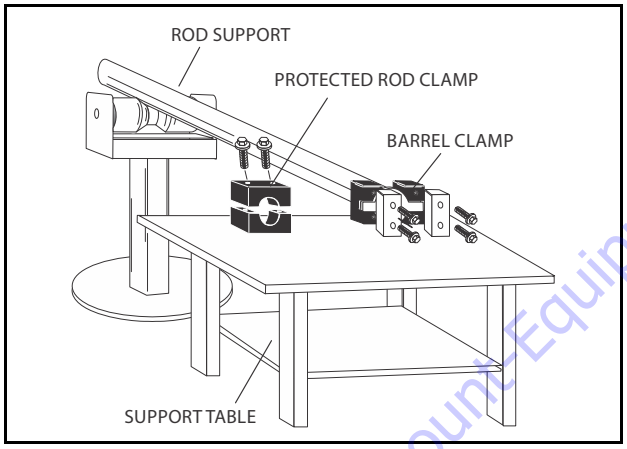



**Figure 5-143. Cylinder Barrel Support**

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

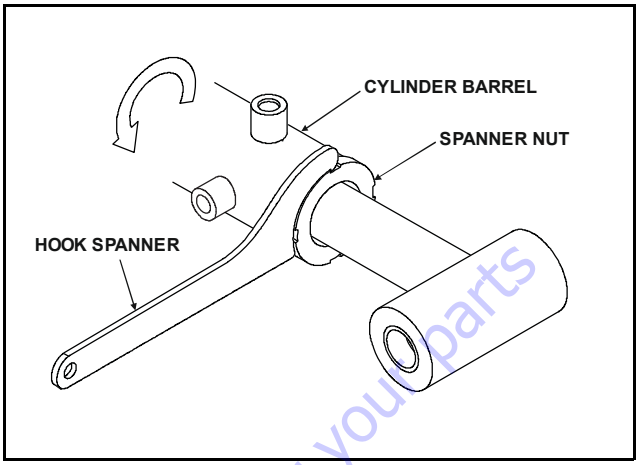



**Figure 5-144. Spanner Nut Removal**

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

**NOTICE**

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

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

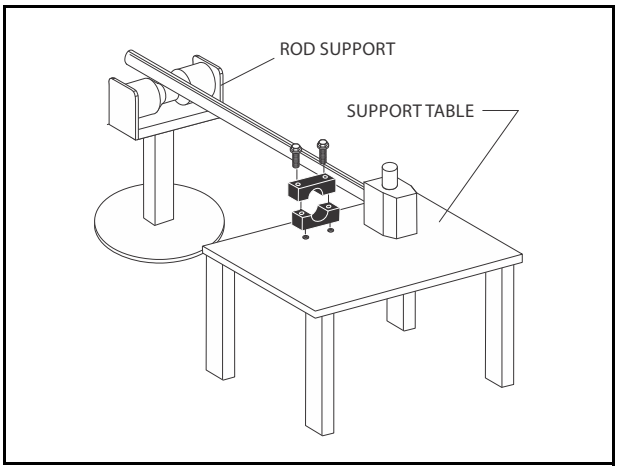
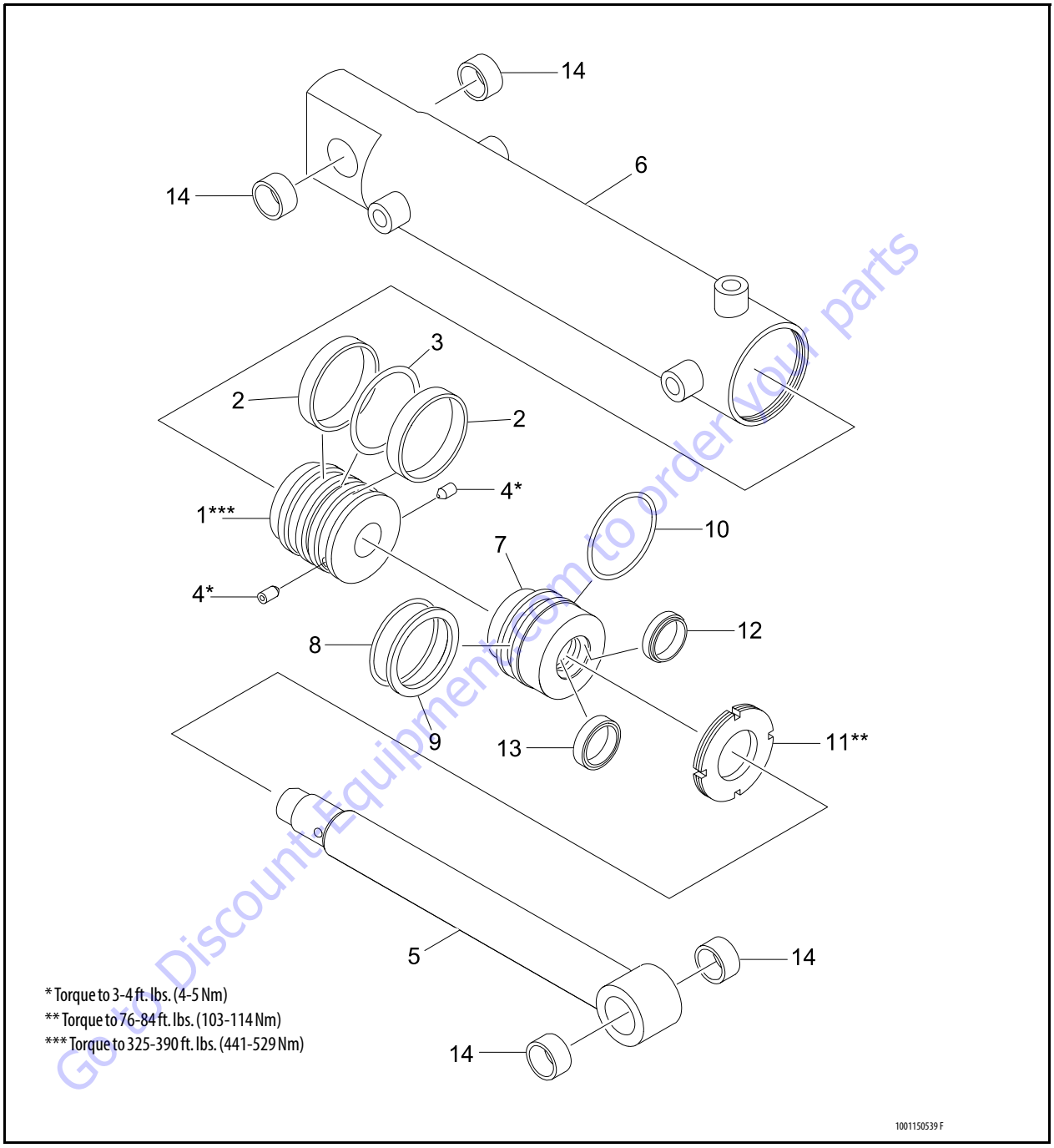



**Figure 5-145. Cylinder Rod Support**






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

**Figure 5-146. 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. Loosen and remove setscrew which attaches the piston to the rod.
9. Screw the piston counterclockwise by hand and remove the piston from cylinder rod.
10. Remove and discard the piston o-rings, seal rings.
11. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, c-ring 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 head inside diameter for scoring, tapering, ovality or other damage. Replace if 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, tapering or ovality other damage. Replace if necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace if 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 inner side 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.*

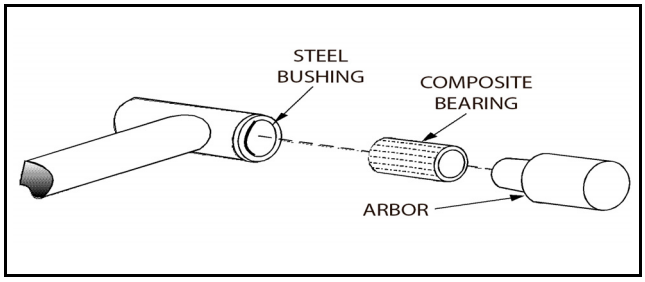



**Figure 5-147. Composite Bearing Installation**

**12.** Inspect piston rings for cracks or other damage. Replace if 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.

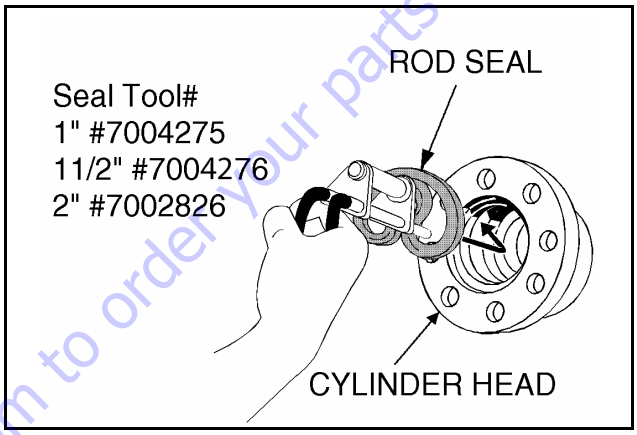



**Figure 5-148. Rod Seal Installation**

**NOTICE**

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

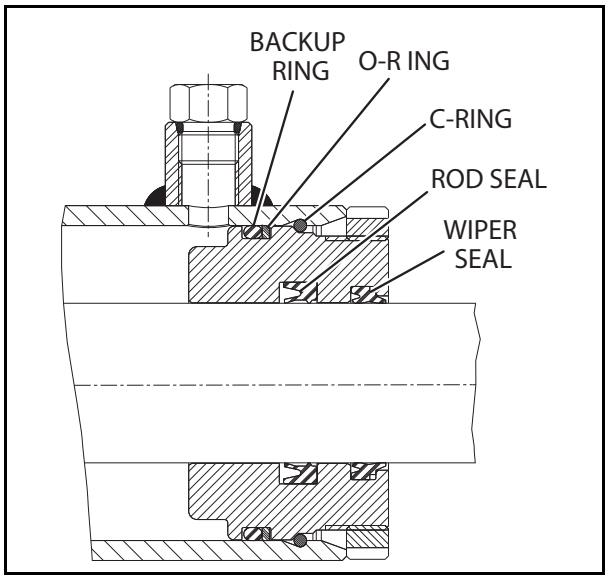



**Figure 5-149. Cylinder Head Seal Installation**

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

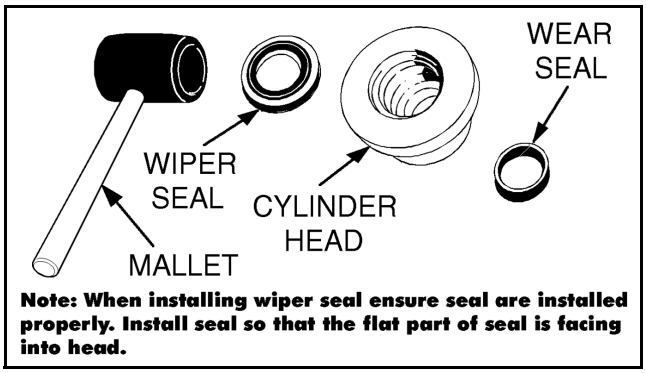



**Figure 5-150. Wiper Seal Installation**

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

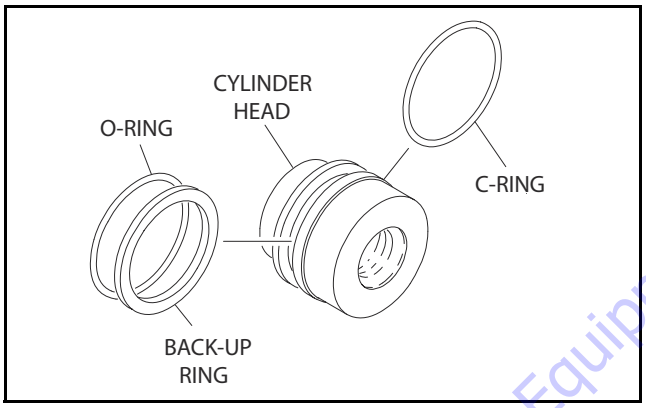



**Figure 5-151. Installation of Head Seal Kit**

4. Install spanner nut onto rod. Carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

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

6. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged. Torque piston to 325-390 ft. lbs. (441-529 Nm).

7. Install the setscrews on the piston. Torque the setscrews to 3-4 ft. lbs (4-5 Nm) and attached the piston onto the rod.

***NOTE:*** *Apply JLG Threadlocker P/N 0100011 to setscrew thread of piston.*

8. Remove the cylinder rod from the holding fixture.

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

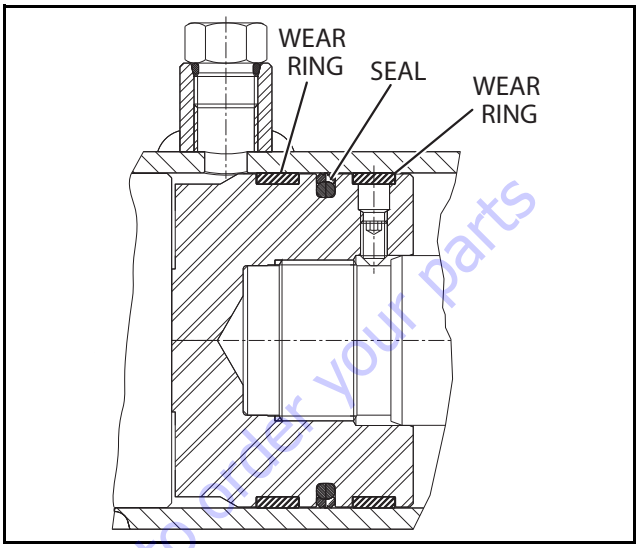



**Figure 5-152. Installation of Piston Seal Kit**

10. 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.**

11. With barrel clamped secured and 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.

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

13. Screw the cylinder head gland into the barrel using a spanner nut and torque gland to 76-84 ft. lbs. (103-114 Nm).

***NOTE:*** *Apply JLG Threadlocker P/N 0100011 to spanner nut thread.*

14. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted).

## Steer Cylinder (SN B300002484 to Present)

### DISASSEMBLY

**NOTICE**

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

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

**⚠ WARNING**

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

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

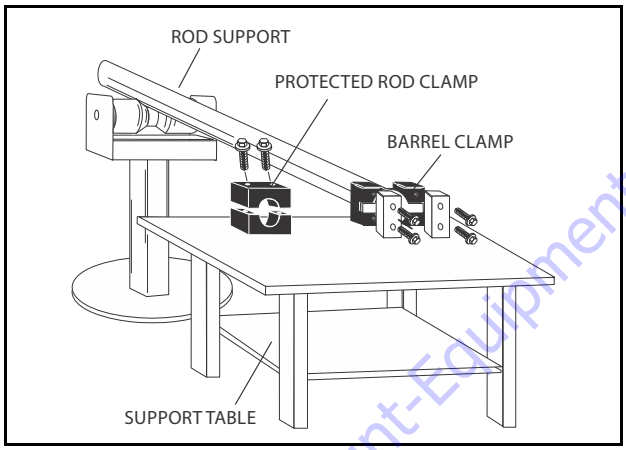



**Figure 5-153. Cylinder Barrel Support**

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

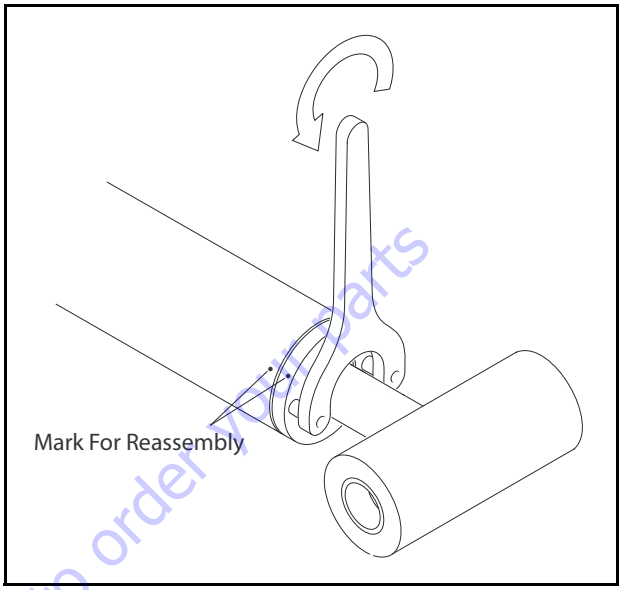



**Figure 5-154. Cylinder Head Removal**

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

**NOTICE**

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

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

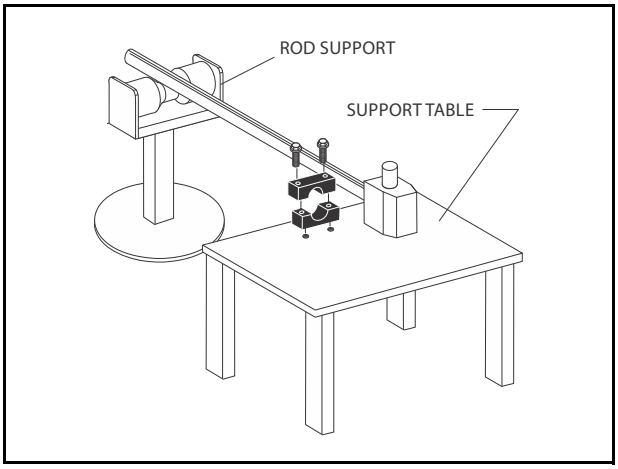
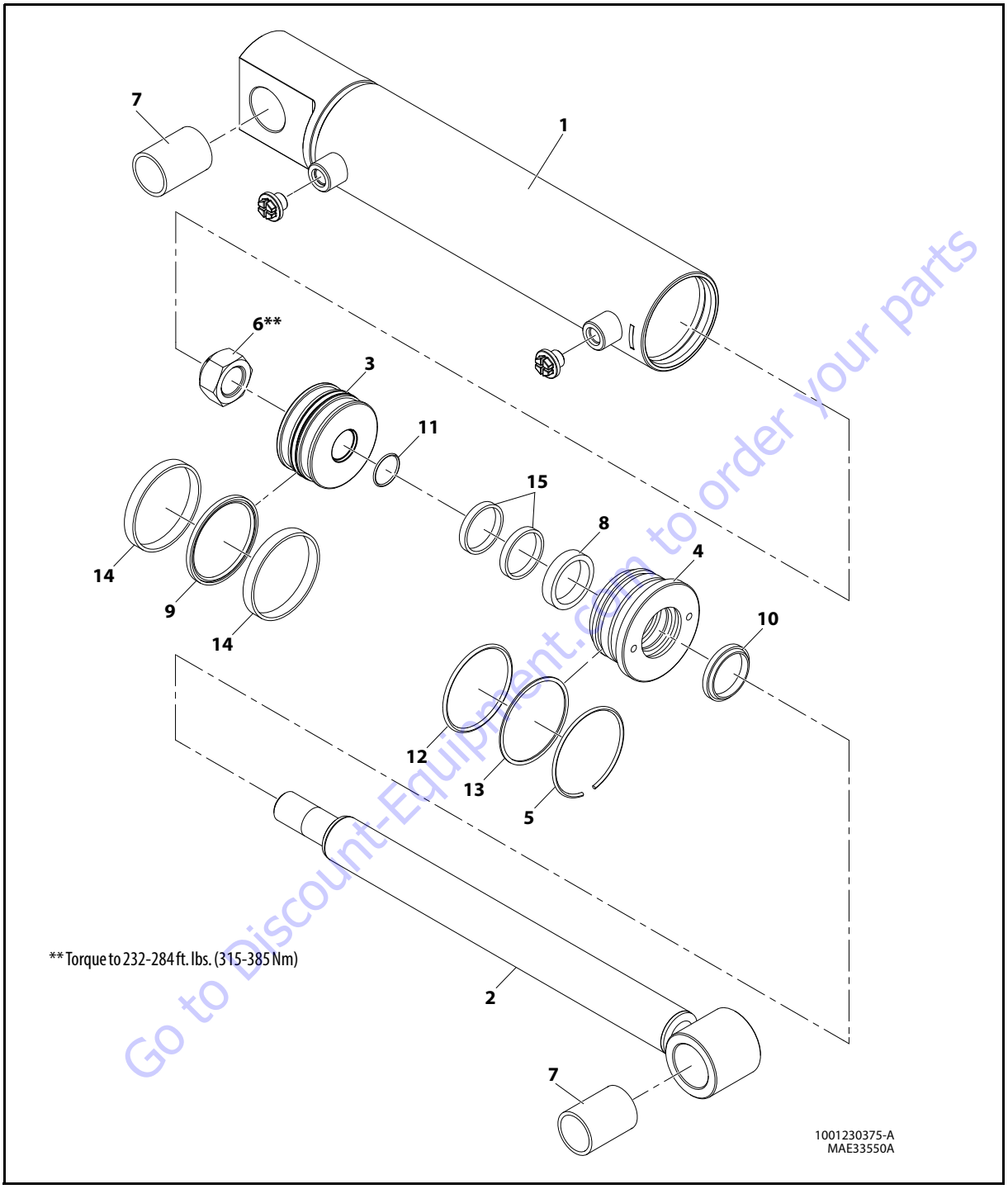



**Figure 5-155. Cylinder Rod Support**






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

**Figure 5-156. 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. Remove locknut from the piston rod.
9. Screw the piston counterclockwise by hand and remove the piston from cylinder rod.
10. Remove and discard the piston o-rings, seal rings.
11. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, c-ring 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 head inside diameter for scoring, tapering, ovality or other damage. Replace if 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, tapering or ovality other damage. Replace if necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace if 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 inner side 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.*

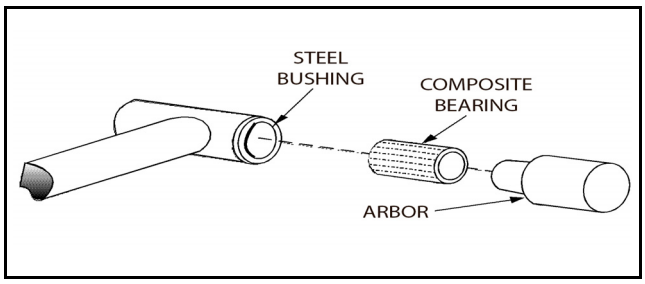



**Figure 5-157. Composite Bearing Installation**

**12.** Inspect piston rings for cracks or other damage. Replace if 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.

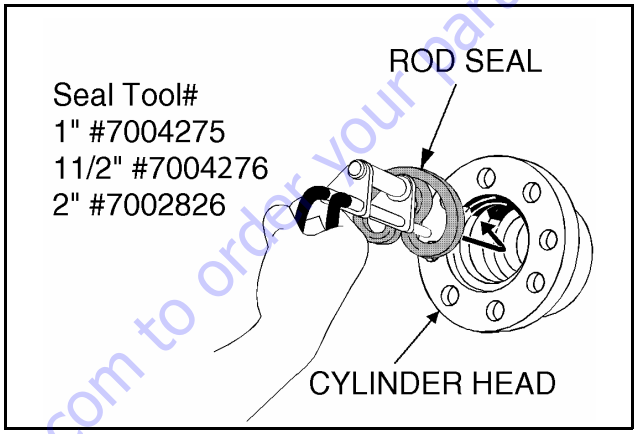



**Figure 5-158. Rod Seal Installation**

**NOTICE**

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

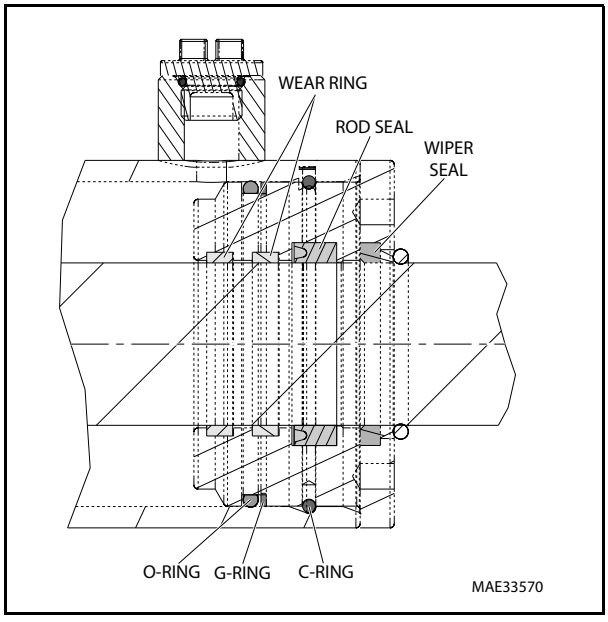



**Figure 5-159. Cylinder Head Seal Installation**

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

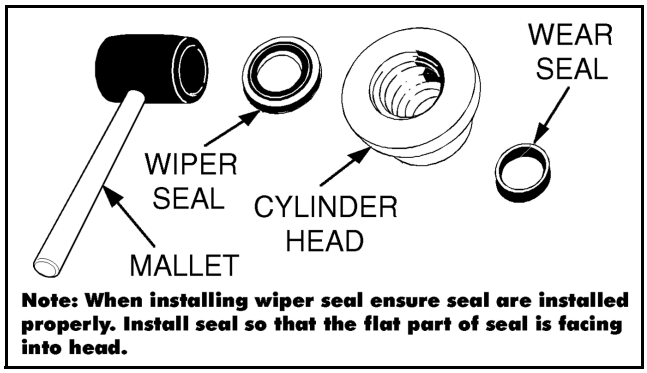



**Figure 5-160. Wiper Seal Installation**

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

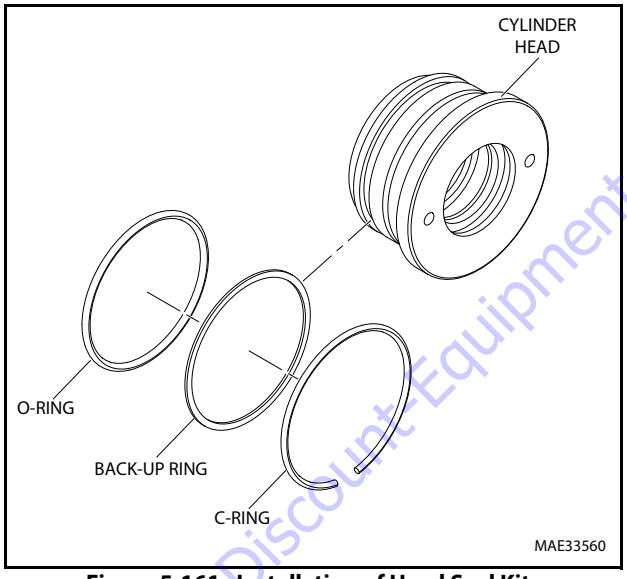



**Figure 5-161. Installation of Head Seal Kit**

4. Carefully install the cylinder head on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

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

6. Carefully thread the piston on the cylinder rod and hand tight.

7. Install locknut onto the piston rod. torque locknut to 232-284 ft. lbs. (315-385 Nm).

8. Remove the cylinder rod from the holding fixture.

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

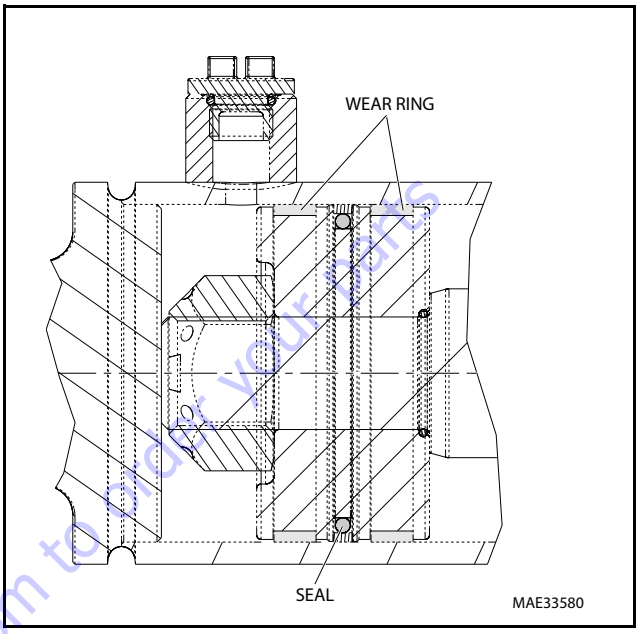



**Figure 5-162. Installation of Piston Seal Kit**

10. 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.**

11. With barrel clamped secured and 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.

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

13. Insert a steel rope into the slot on the cylinder barrel as shown.

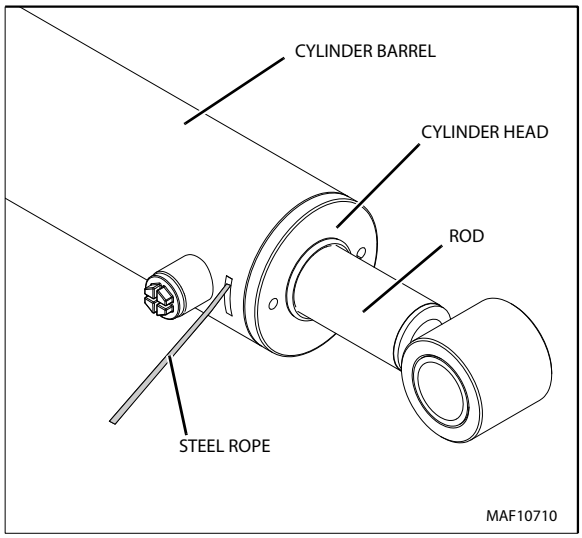



**Figure 5-163. Installation of Steel Rope**

**14.** Rotate the cylinder head using a pin face spanner until the steel rope is completely inserted.

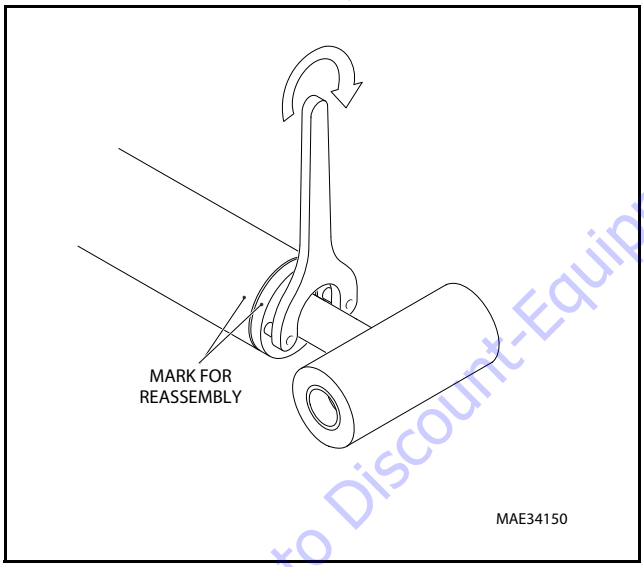



**Figure 5-164. Cylinder Head Installation**

**15.** Fill glass cement on the slot of cylinder barrel.

**16.** After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted).

## Telescope Cylinder (800S) (SN 0300196955 through 0300243278, SN B300001097 through B300002584) (860SJ) (SN 0300196955 through 0300244707, (SN B300001097 through B300002587)

### DISASSEMBLY

**NOTICE**

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

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

**⚠ WARNING**

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

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

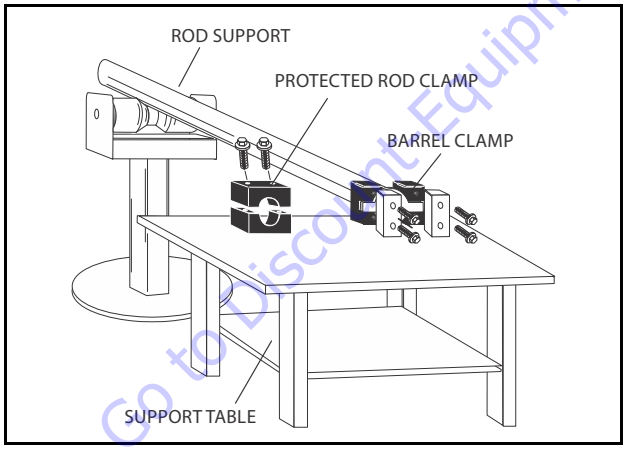



**Figure 5-165. Cylinder Barrel Support**

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

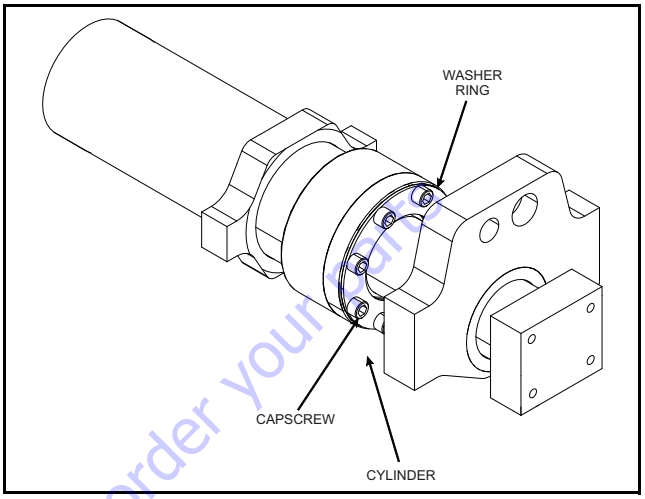



**Figure 5-166. Capscrew Removal**

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

**NOTICE**

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

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

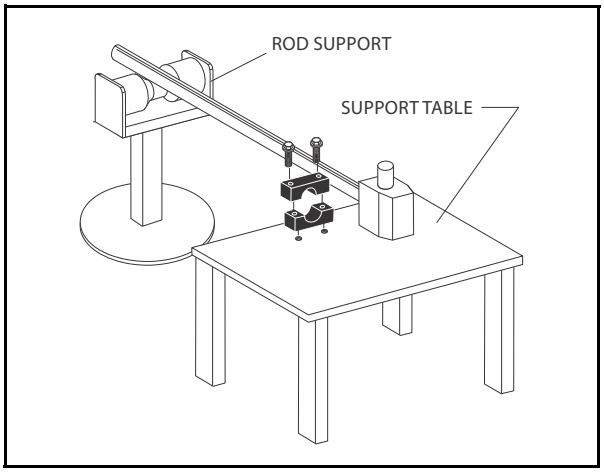
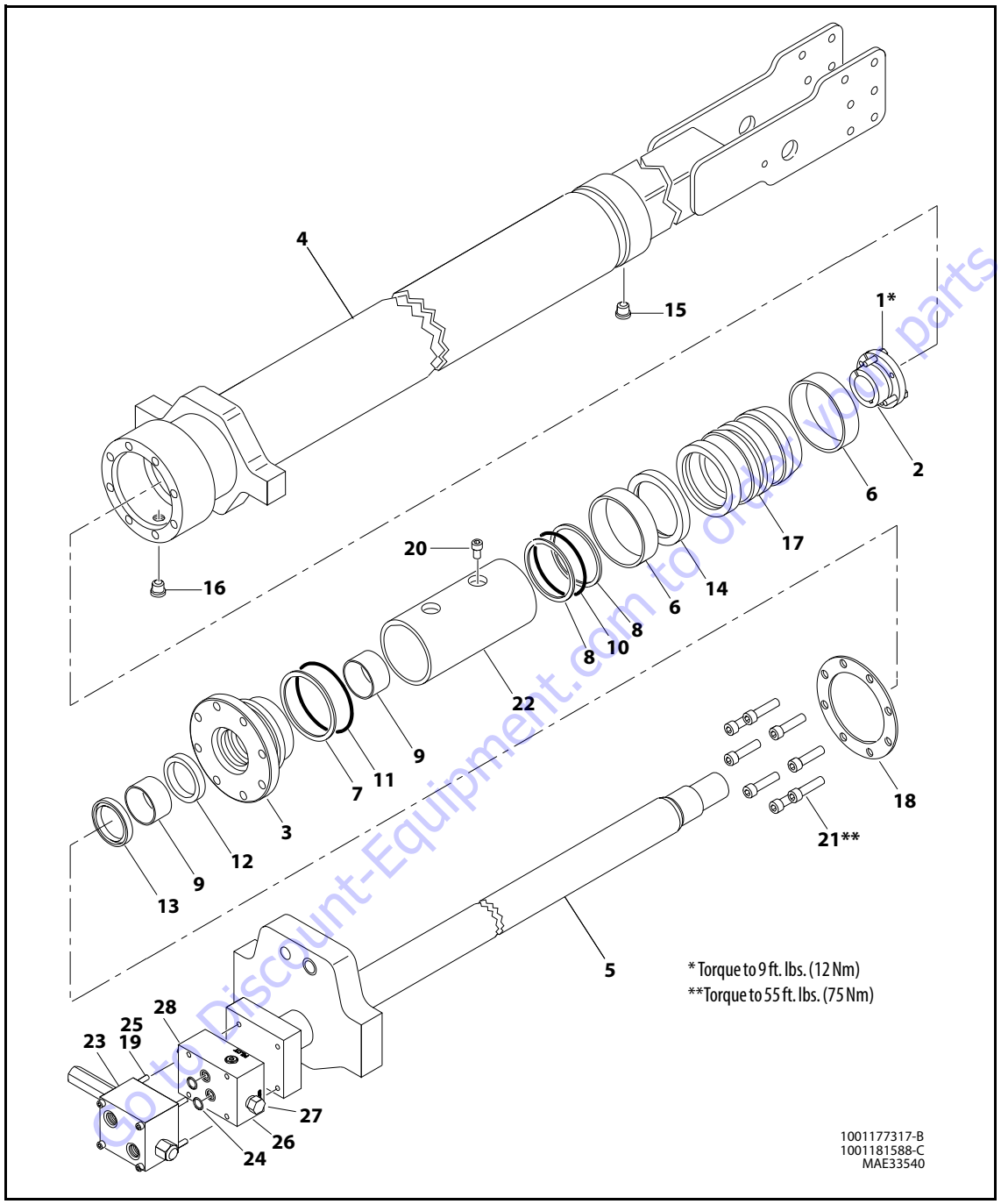



**Figure 5-167. Cylinder Rod Support**






1. Capscrew
2. Tapered Bushing
3. Head
4. Barrel
5. Rod
6. Wear Ring
7. Backup Ring
8. Backup Ring
9. Wear Ring
10. O-ring
11. O-ring
12. Rod Seal
13. Wiper
14. T-Seal
15. O-ring Plug
16. O-ring Plug
17. Piston
18. Washer Ring
19. Capscrew
20. Capscrew
21. Capscrew
22. Spacer
23. Valve assembly
24. O-ring
25. Capscrew
26. Assembly Valve
27. Cartridge Seal Kit
28. Cartridge Seal Kit

**Figure 5-168. Telescopic Cylinder**

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Remove capscrews from drilled holes
10. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen on the piston.
11. Remove the bushing from the piston.

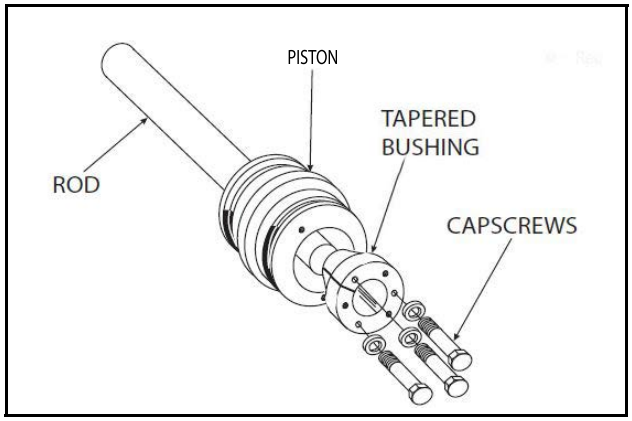



**Figure 5-169. Tapered Bushing Removal**

12. Screw the piston counterclockwise by hand and remove the piston from cylinder rod.
13. Remove and discard the piston o-rings, seal rings, wear rings and backup rings.
14. Remove setscrew from the piston spacer. Remove spacer from the rod.
15. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, wear rings 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, tapering, ovality or other damage. . Replace if 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, tapering, ovality or other damage. Replace if 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 inner side 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.*

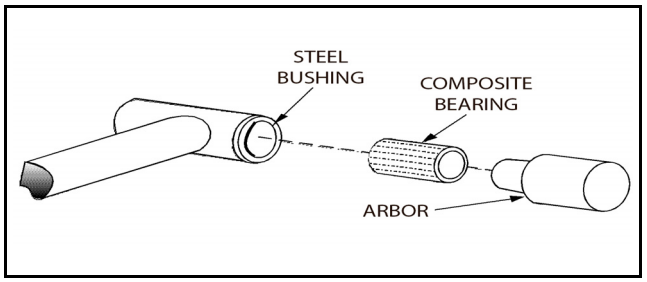



**Figure 5-170. Composite Bearing Installation**

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 if necessary.
14. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair if necessary.
15. If applicable, inspect piston rings for cracks or other damage. Replace if 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.

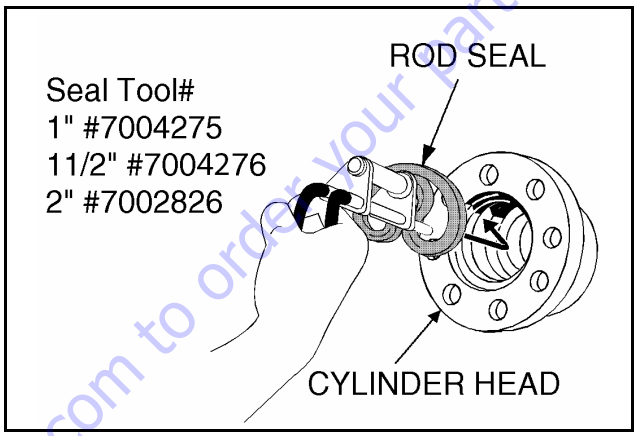



**Figure 5-171. Rod Seal Installation**

**NOTICE**

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

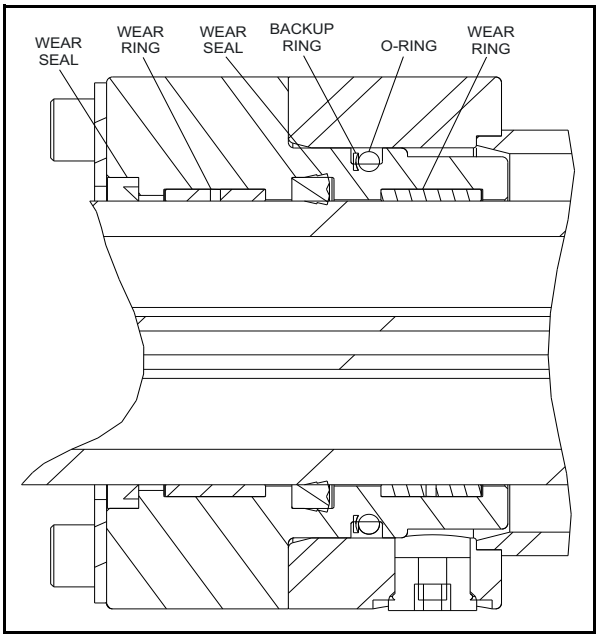



**Figure 5-172. Cylinder Head Seal Installation**

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

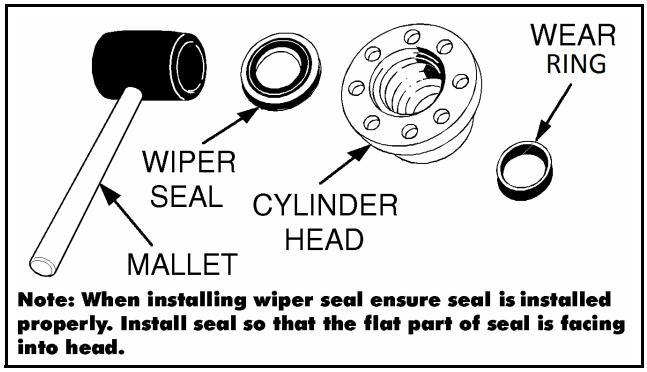



**Figure 5-173. Wiper Seal Installation**

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

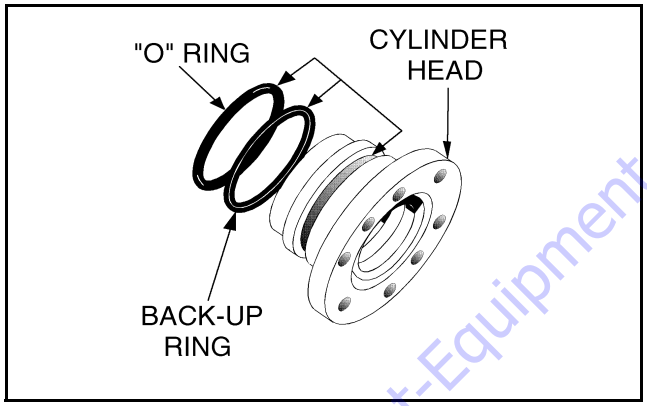



**Figure 5-174. Installation of Head Seal Kit**

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Carefully slide the piston spacer on the rod. Install setscrew on the spacer.

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 and backup rings in the inner piston diameter groove.

8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

9. Thread piston onto rod until it abuts the spacer end and install the tapered bushing.

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

10. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

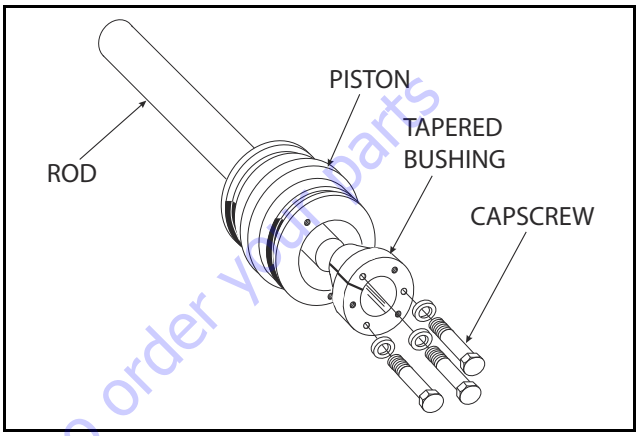



**Figure 5-175. Tapered Bushing Installation**

11. Tighten the capscrews evenly and progressively in rotation to 9 ft. lbs. (12 Nm).

12. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4 in. diameter) as follows:

    **a.** Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

    **b.** Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

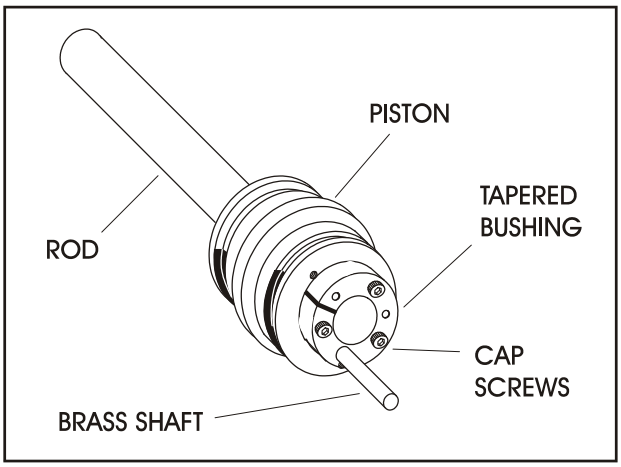



**Figure 5-176. Seating the Tapered Bearing**

13. Rotate the capscrews evenly and progressively in rotation to 9 ft. lbs. (12 Nm).

14. Remove the cylinder rod from the holding fixture.

15. Place new T-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).

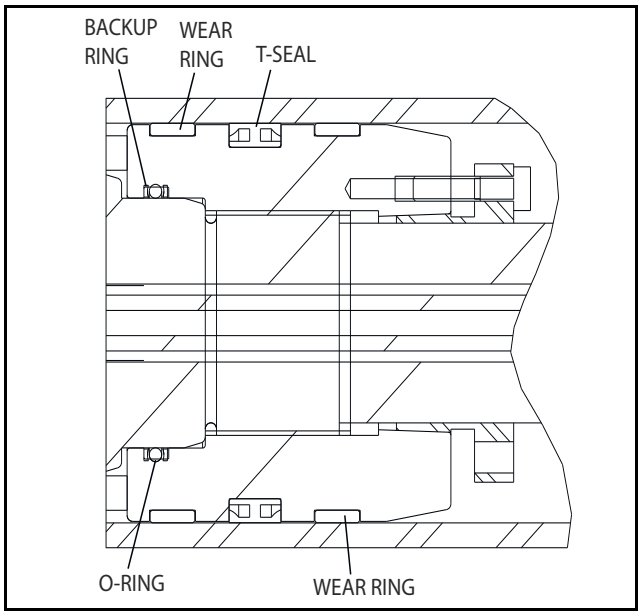



**Figure 5-177. Piston Seal Kit Installation**

16. 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.**

17. With barrel clamped secured, and 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.

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

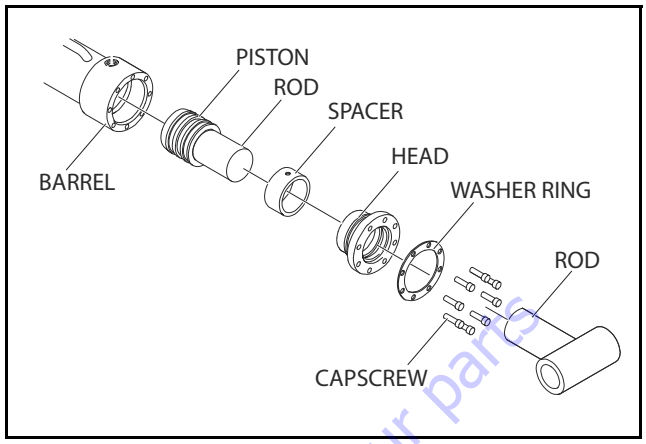



**Figure 5-178. Rod Assembly Installation**

19. Apply JLG Threadlocker P/N 0100011 to the socket head capscrews and secure the cylinder head gland using the washer ring and capscrews. Torque capscrews to 55 ft. lbs. (75 Nm).

20. 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.

21. Install the valve assembly. Torque capscrews to 9 ft. lbs. (12 Nm).

## Telescope Cylinder (800S) SN 0300243279 to Present, SN B300002585 to Present), (860SJ) (SN 030024708 to Present, SN B300002588 to Present)

### DISASSEMBLY

**NOTICE**

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

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

**⚠ WARNING**

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

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

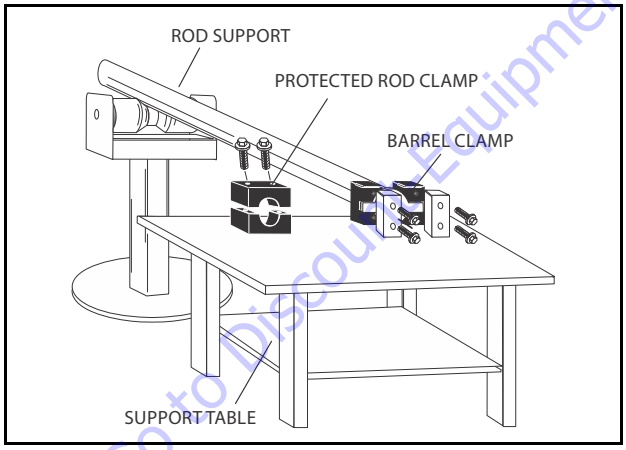



**Figure 5-179. Cylinder Barrel Support**

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

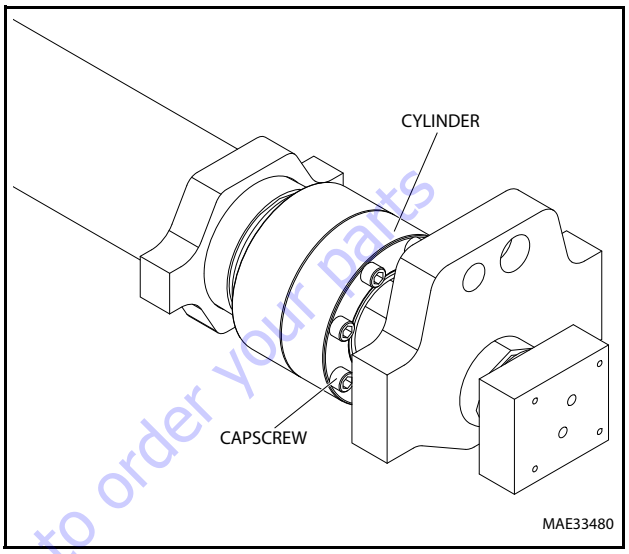



**Figure 5-180. Capscrew Removal**

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

**NOTICE**

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

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

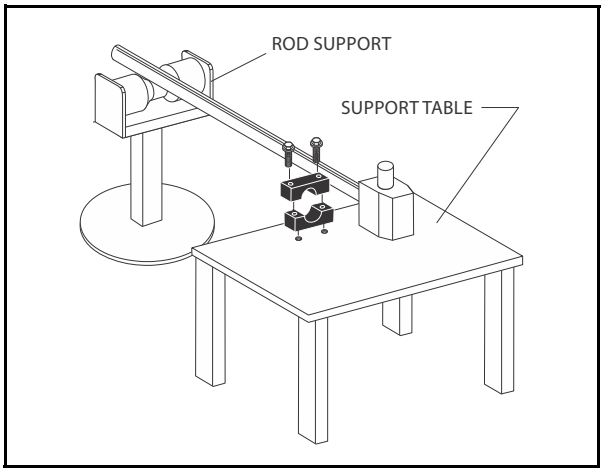
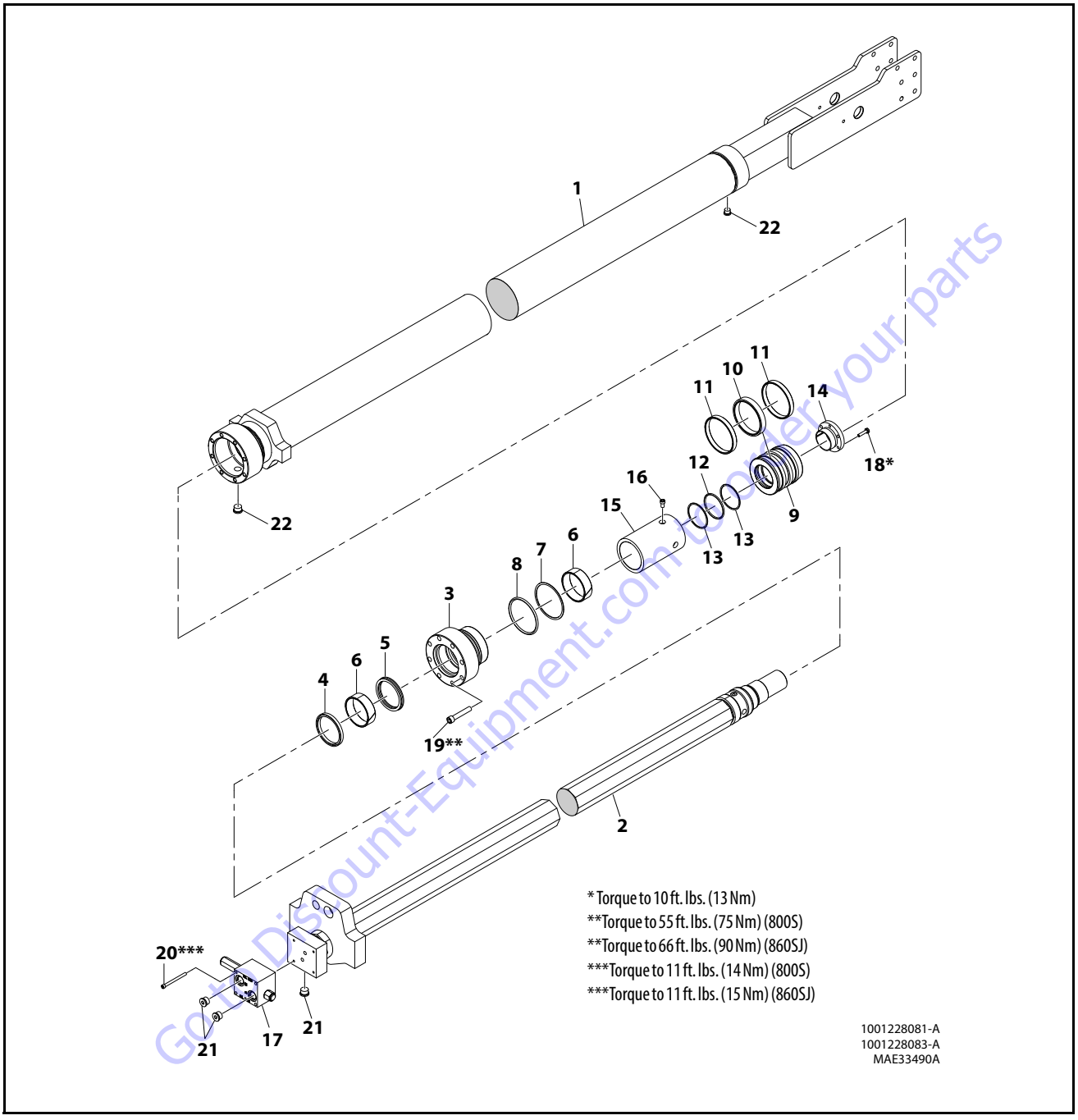



**Figure 5-181. Cylinder Rod Support**






1. Barrel
2. Rod
3. Head
4. Wiper
5. Rod Seal
6. Wear Ring
7. O-ring
8. Backup Ring
9. Piston
10. T-Seal
11. Wear Ring
12. O-ring
13. Backup Ring
14. Tapered Bushing
15. Tube Spacer
16. Capscrew
17. Valve assembly
18. Capscrew
19. Capscrew
20. Capscrew
21. Plug
22. Plug

**Figure 5-182. Telescopic Cylinder**

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Remove capscrews from drilled holes
10. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen on the piston.
11. Remove the bushing from the piston.

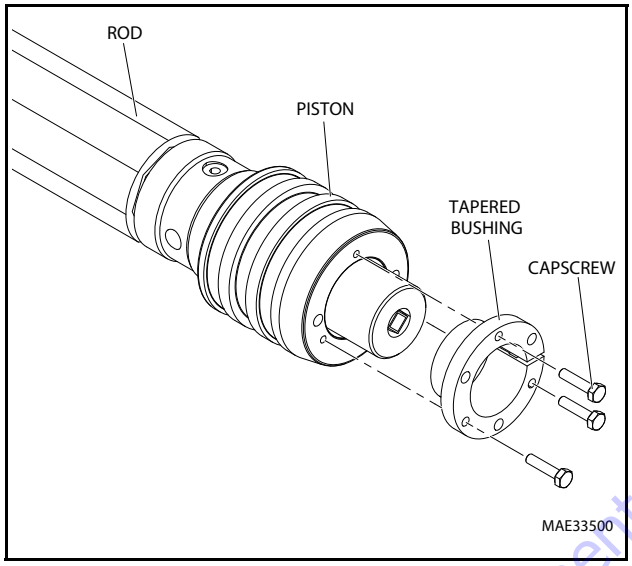



**Figure 5-183. Tapered Bushing Removal**

12. Screw the piston counterclockwise by hand and remove the piston from cylinder rod.
13. Remove and discard the piston o-rings, seal rings, wear rings and backup rings.
14. Remove setscrew from the piston spacer. Remove spacer from the rod.
15. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, wear rings 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, tapering, ovality or other damage. Replace if 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, tapering, ovality or other damage. Replace if 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 inner side 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.*

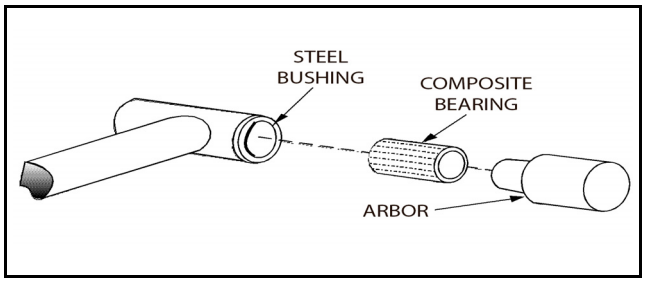



**Figure 5-184. Composite Bearing Installation**

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 if necessary.
14. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair if necessary.
15. If applicable, inspect piston rings for cracks or other damage. Replace if 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.

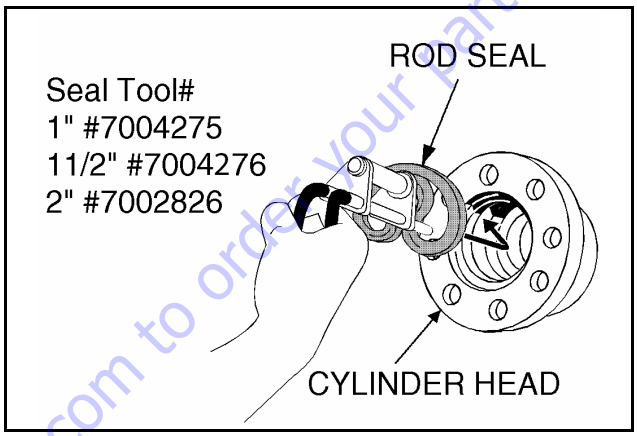



**Figure 5-185. Rod Seal Installation**

**NOTICE**

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

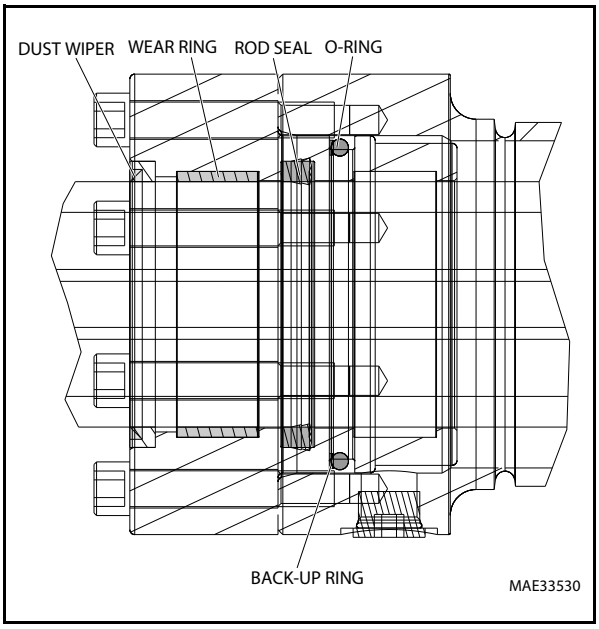



**Figure 5-186. Cylinder Head Seal Installation**

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

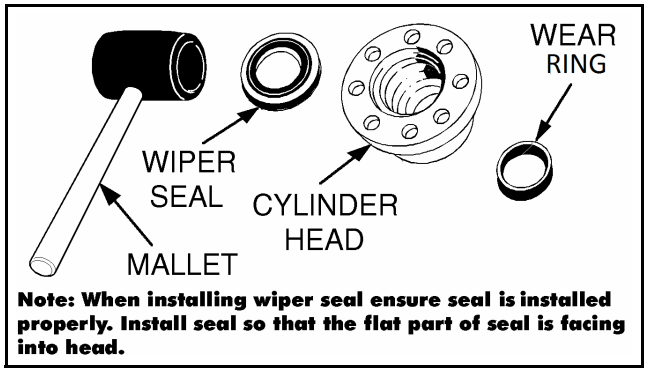



**Figure 5-187. Wiper Seal Installation**

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

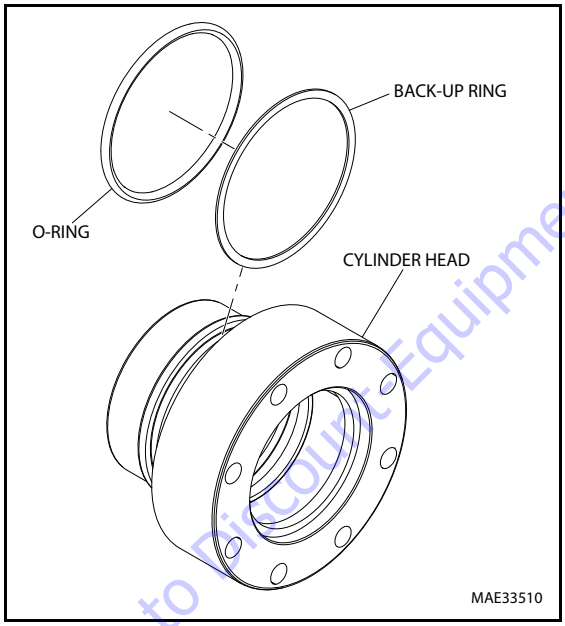



**Figure 5-188. Installation of Head Seal Kit**

4. Carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Carefully slide the piston spacer on the rod. Install setscrew on the spacer.

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 and backup rings in the inner piston diameter groove.

8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

9. Thread piston onto rod until it abuts the spacer end and install the tapered bushing.

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

10. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

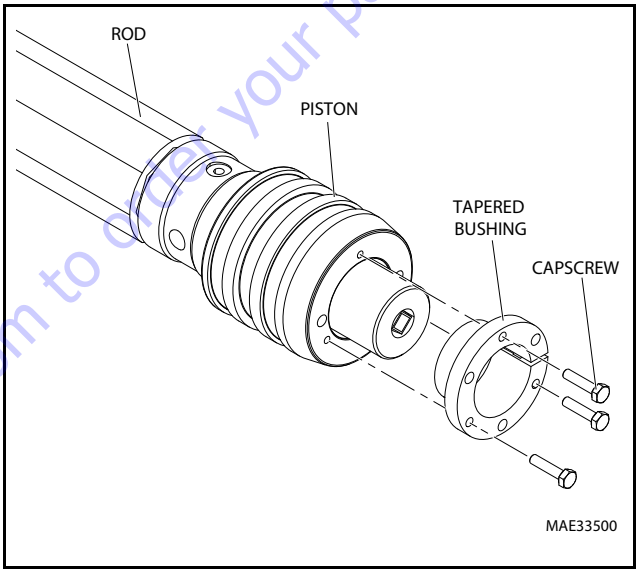



**Figure 5-189. Tapered Bushing Installation**

11. Tighten the capscrews evenly and progressively in rotation to 10 ft. lbs. (13 Nm).

12. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4 in. diameter) as follows:

    a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

    b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

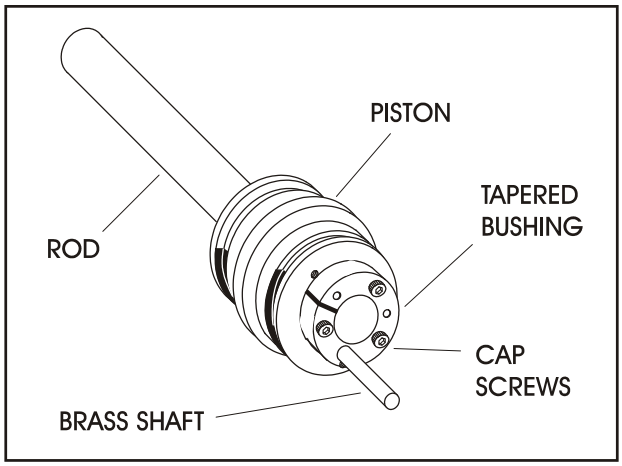



**Figure 5-190. Seating the Tapered Bearing**

13. Tighten the capscrews evenly and progressively in rotation to 10 ft. lbs. (13 Nm).

14. Remove the cylinder rod from the holding fixture.

15. Place new T-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).

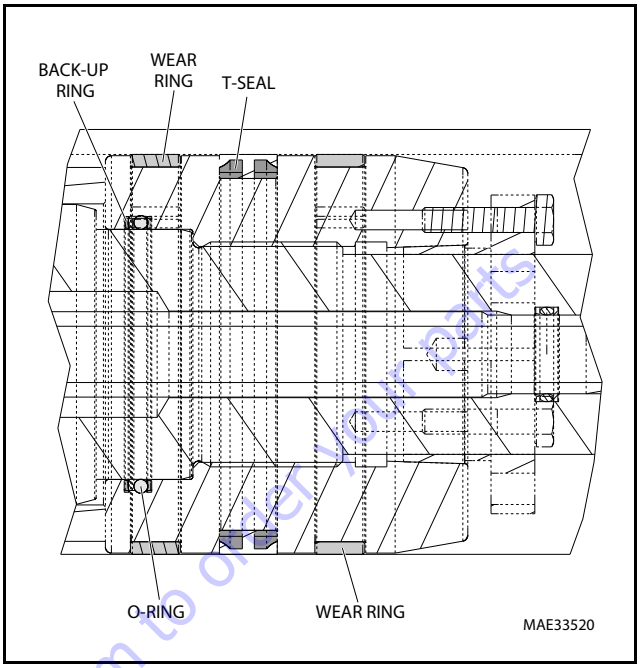



**Figure 5-191. Piston Seal Kit Installation**

16. 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.**

17. With barrel clamped secured, and 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.

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

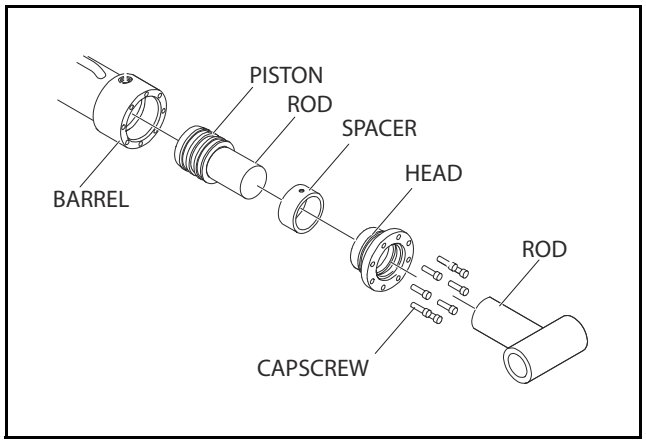
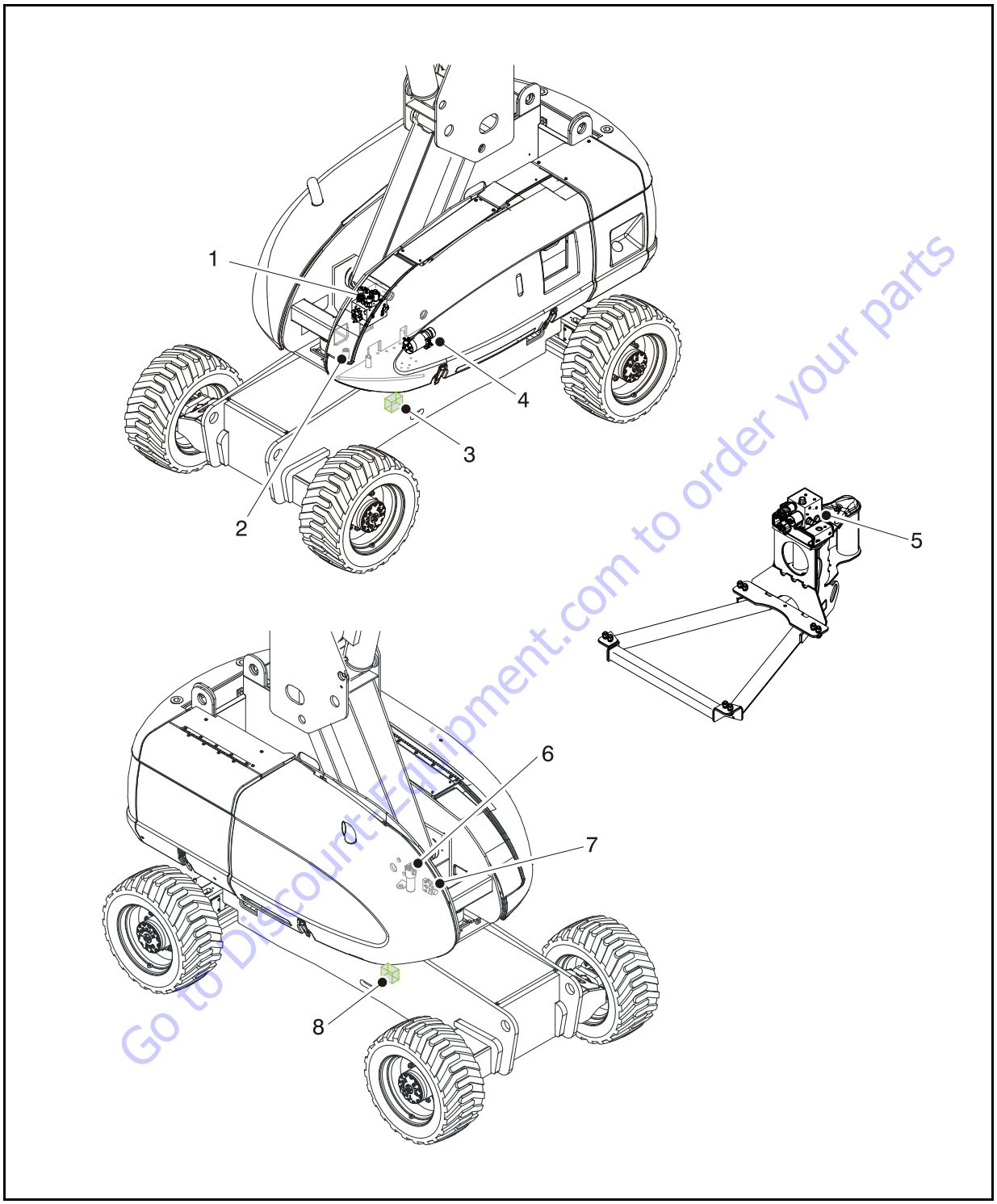



**Figure 5-192. Rod Assembly Installation**

**19.** Secure the cylinder head gland using the capscrews. For Torque capscrews Refer Figure 5-182., Telescopic Cylinder.

**20.** 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.

**21.** Install the valve assembly. For Torque capscrews Refer Figure 5-182., Telescopic Cylinder.






1. Main Valve
2. Platform Valve Filter
3. Dual Flow Divider (4WD)
4. Auxiliary Pump
5. Platform Valve
6. Hydraulic Filter
7. Dual Select Valve
8. Flow Divider (2WD)

**Figure 5-193. Control Valve Installation**

## 5.4 PRESSURE SETTING PROCEDURE

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

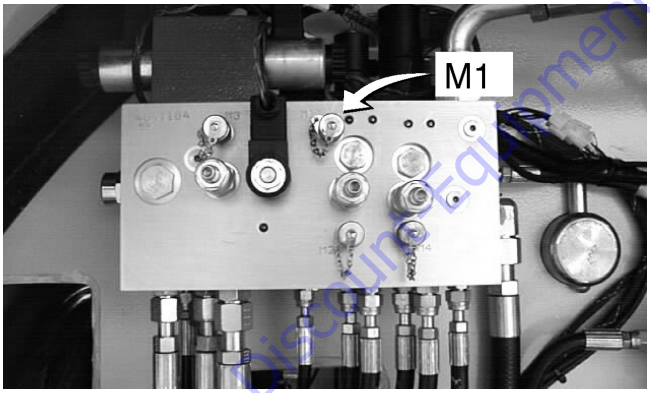
To ensure all pressures are set correctly, the following procedures must be followed in order.

1. All applicable steps in Section 5.5, Start Up Procedures must be followed.
2. Set up of the function pump.
3. Adjustments made at the main valve block.
4. Adjustments made at the platform valve.

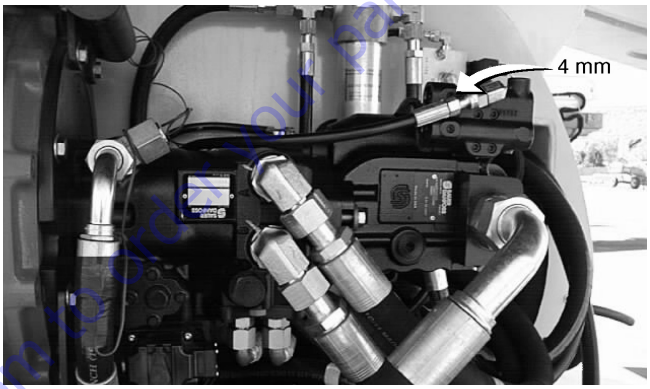
### Set Up of the Function Pump

#### STAND BY PRESSURE OR LOAD SENSE PRESSURE

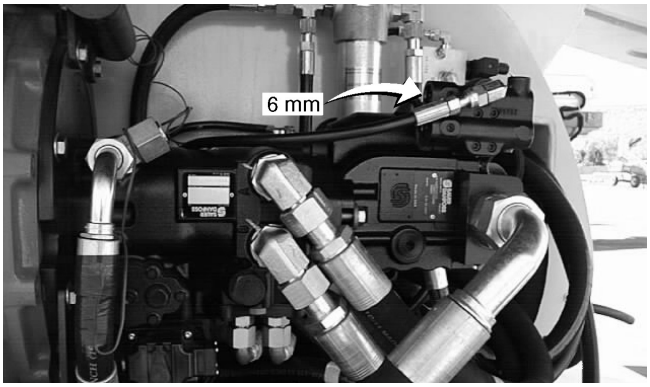
1. Install a low pressure gauge at port "M1" of the main valve block. A low pressure gauge capable of reading 500 psi.




2. Start the engine from the ground control. The gauge should read between 400-440 psi (27.5 to 30 Bar). To make an adjustment to this pressure, go to the engine compartment and locate the function pump.
3. There are (2) adjustments at the top of the pump. They are located on the pump compensator which has (4) bolts mounting it to the pump. The stand by adjustment is at the top. To adjust this, a 4 mm and 6 mm allen wrench will be needed. The adjustment screw is facing the front of the pump, or toward the engine.
   a. First, using the 4 mm wrench, loosen the setscrew on the side of the compensator (facing you) which is in line with the adjustment screw. This is a jam nut screw which holds the main adjustment from turning. Loosen it 1 turn.

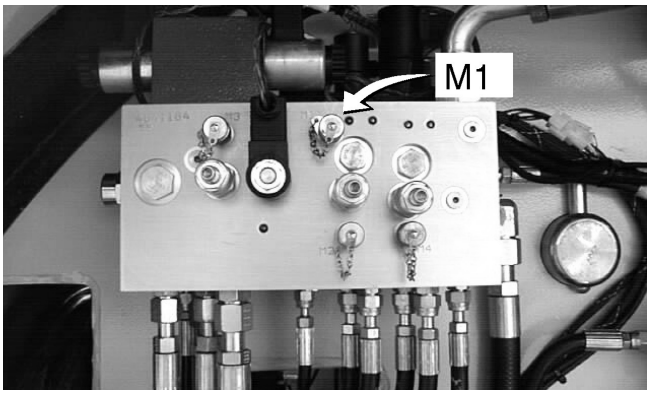



   b. Next, using the 6 mm wrench adjust the main adjustment clockwise to increase or counterclockwise to decrease. The pressure should read between 400-440 psi (27.5 to 30 Bar).



**HIGH PRESSURE RELIEF**

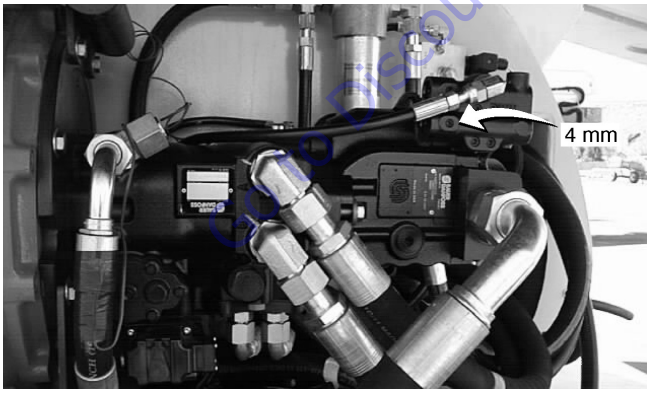
1. Install a high pressure gauge at the "M1" port of the main valve block.



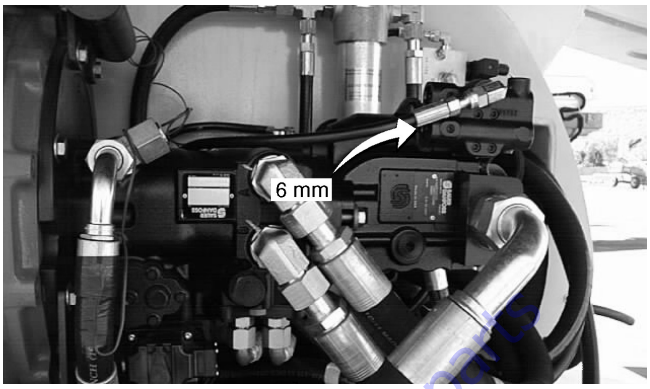

2. Activate telescope in and hold. The gauge should read 2600 psi.

3. To make an adjustment to this pressure, go back to the engine compartment to the function pump. The high pressure relief adjustment is the lower one of the (2) on the compensator. To adjust this, a 4 mm and 6 mm allen wrench will be needed. The adjustment screw is facing the shaft end of the pump, or toward the engine.

   a. First, using the 4 mm wrench, loosen the setscrew on the side of the compensator (facing you) which is in line with the adjustment screw. This is a jam nut screw which holds the main adjustment from turning. Loosen it 1 turn.




   b. Next, using the 6 mm wrench adjust the main adjustment clockwise to increase or counterclockwise to decrease. This adjustment will be reset at the end of this procedure to 2500 psi (172 Bar). This is the **maximum** relief pressure for all functions governed by this pump.




## Adjustments Made at the Main Valve Block

**SWING LEFT AND RIGHT**

1. Lock the Turntable lock pin.
2. Install the hi-pressure gauge at port M2.
3. From the ground control, activate swing RIGHT. the gauge should read 1700 psi (117 Bar).
4. The adjustment cartridge is located on the left face of the valve block. Turn clockwise to increase, counterclockwise to decrease.

**STEER**

1. Install a hi-pressure gauge at port M4. Activate steer left or right. The gauge should read 2500 psi (172 Bar).
2. The relief valve is located right above port M4. Turn clockwise to increase, counterclockwise to decrease.

## Adjustments Made at the Platform Valve Assembly

**PLATFORM JIB UP AND DOWN**

1. Install a high pressure gauge at port M of the platform valve. Activate jib down, you should read 1700 psi (117 Bar).
2. The jib down relief valve is located on the front face of the platform valve. Turn clockwise to increase, counterclockwise to decrease.

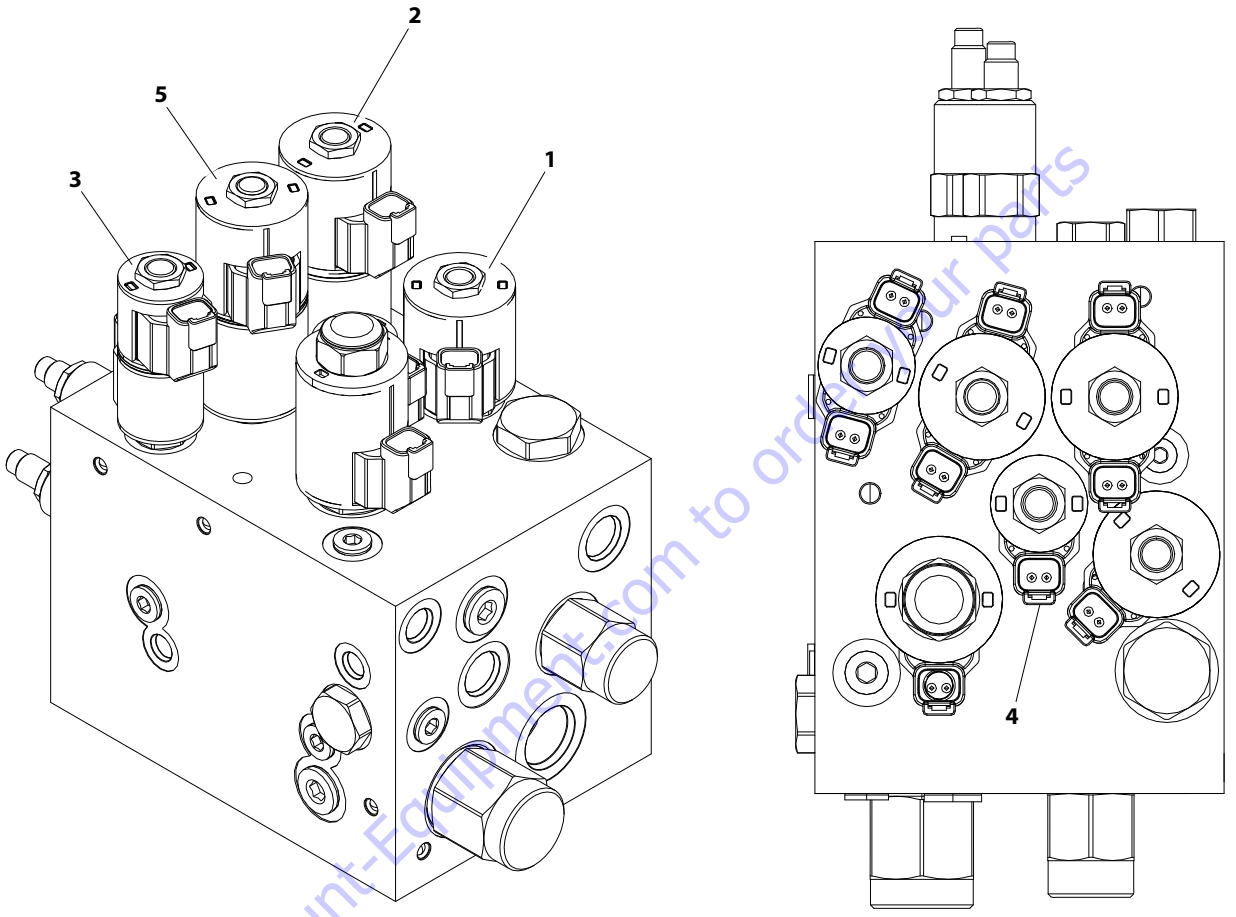





**Table 5-33. Main Valve Coil Resistance**

| # | Coil Resistance @ 20°C (Ohms) |
|---|---|
| 1 | 7.1 |
| 2 | 7.1 |
| 3 | 8.8 |
| 4 | 8.8 |
| 5 | 7.1 |

1. Main Dump Valve (Coil Resistance 7.1 Ohms @ 20°C) (53 ft. lb. (71 Nm))
2. Steer Valve (Coil Resistance 7.1 Ohms @ 20°C) (25 ft. lb. (34 Nm))
3. Tele Solenoid Valve (Coil resistance 8.8 Ohms @ 20°C) (20 ft. lb. (27 Nm))
4. Lift Valve (Coil resistance 8.8 Ohms @ 20°C) (20 ft. lb. (27 Nm))
5. Swing Valve (Coil Resistance 7.1 Ohms @ 20°C) (25 ft. lb. (34 Nm))

**Figure 5-194. Main Valve Identification**

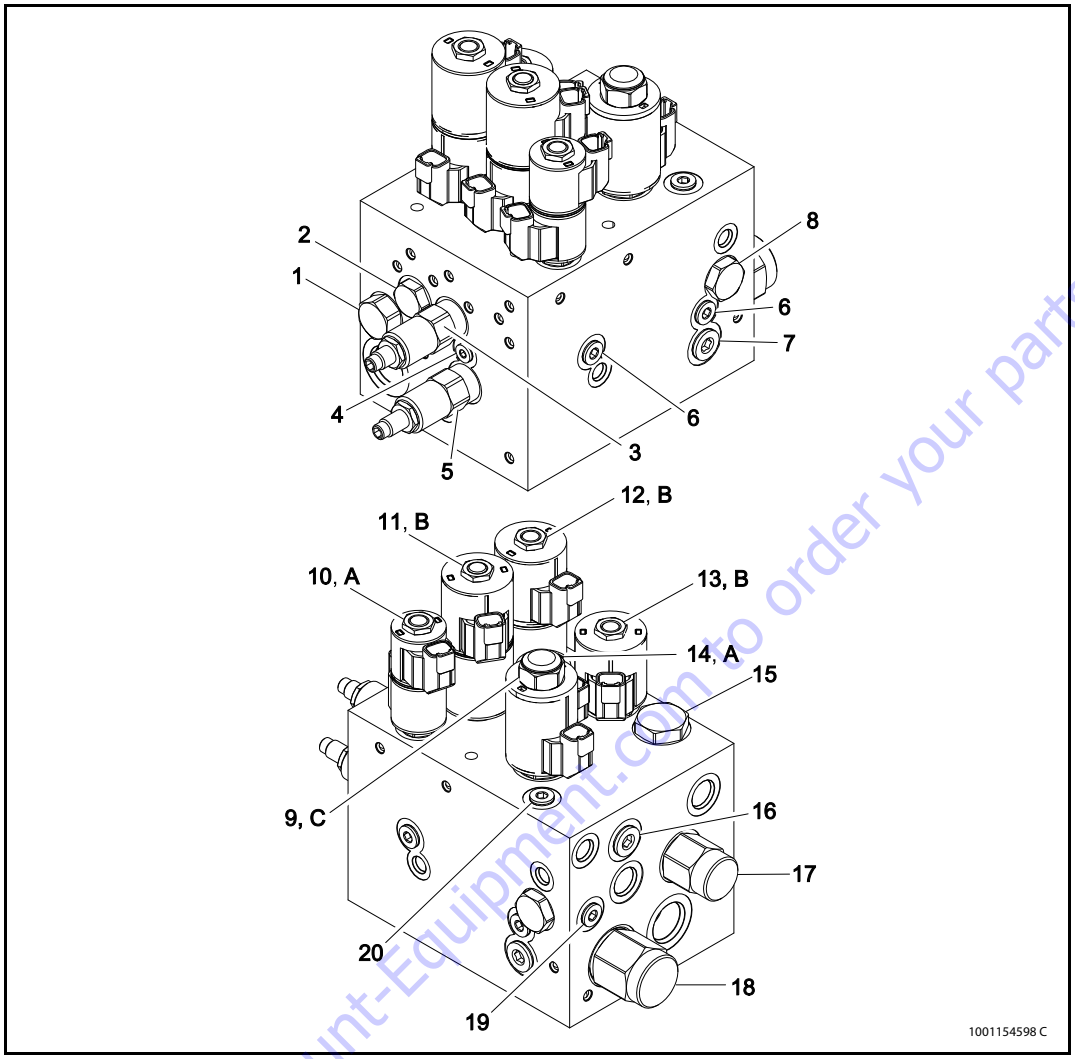



**Table 5-34. Cartridge Torque Values**

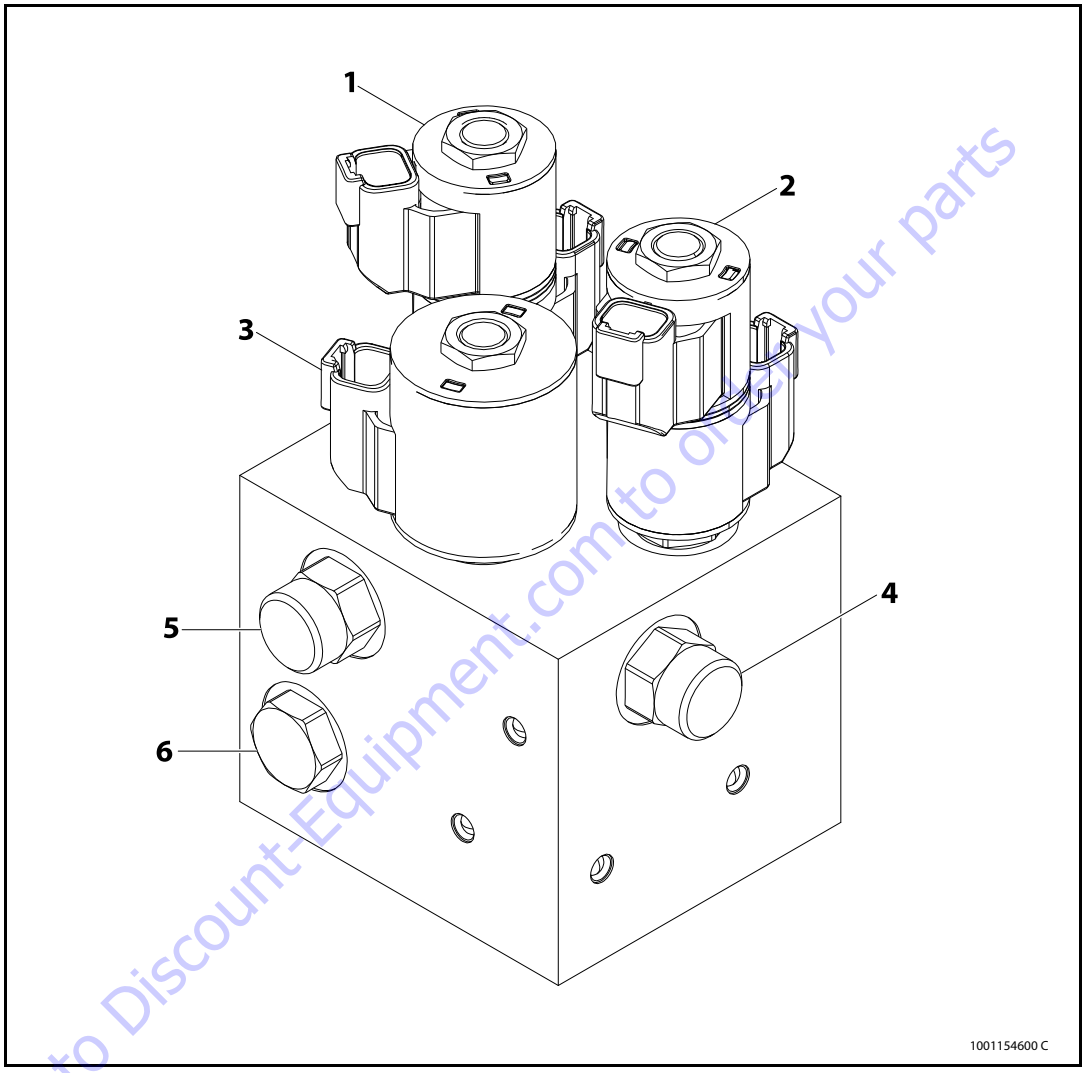
| | Ft-Lbs. | Nm | | Ft-Lbs. | Nm |
|---|---|---|---|---|---|
| 1 | 35 | 47.5 | 11 | 25 | 33.9 |
| 2 | 20 | 27.1 | 12 | 25 | 33.9 |
| 3 | 20 | 27.1 | 13 | 53 | 71.9 |
| 4 | 15 | 20.3 | 14 | 20 | 27.1 |
| 5 | 20 | 27.1 | 15 | 75 | 101.7 |
| 6 | 25 | 33.9 | 16 | 35 | 47.5 |
| 7 | 35 | 47.5 | 17 | 53 | 71.9 |
| 8 | 25 | 33.9 | 18 | 98 | 132.9 |
| 9 | 53 | 71.9 | 19 | 25 | 33.9 |
| 10 | 20 | 27.11 | 20 | 25 | 33.9 |

**Table 5-35. Coil Torque Values**

| | Ft-Lbs. | Nm |
|---|---|---|
| A | 6 | 4.4 |
| B | 6 | 4.4 |
| C | 6 | 4.4 |



**Figure 5-195. Main Valve Cartridge Torque Values**




1. Level Up and Down
2. Platform Rotate Valve
3. Platform Dump Valve
4. Rotate Orifice
5. Platform Level Orifice
6. Check Valve

**Figure 5-196. Platform Valve Identification (800S)**

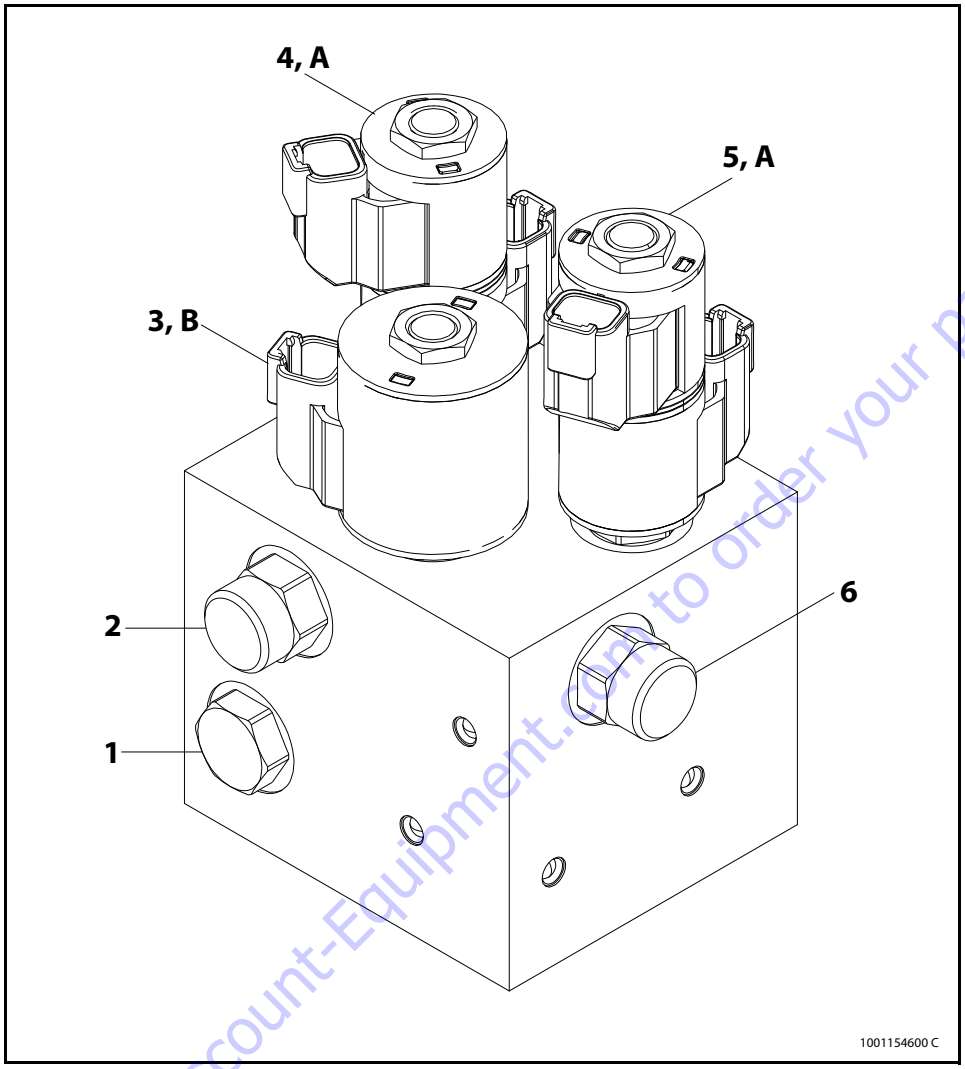




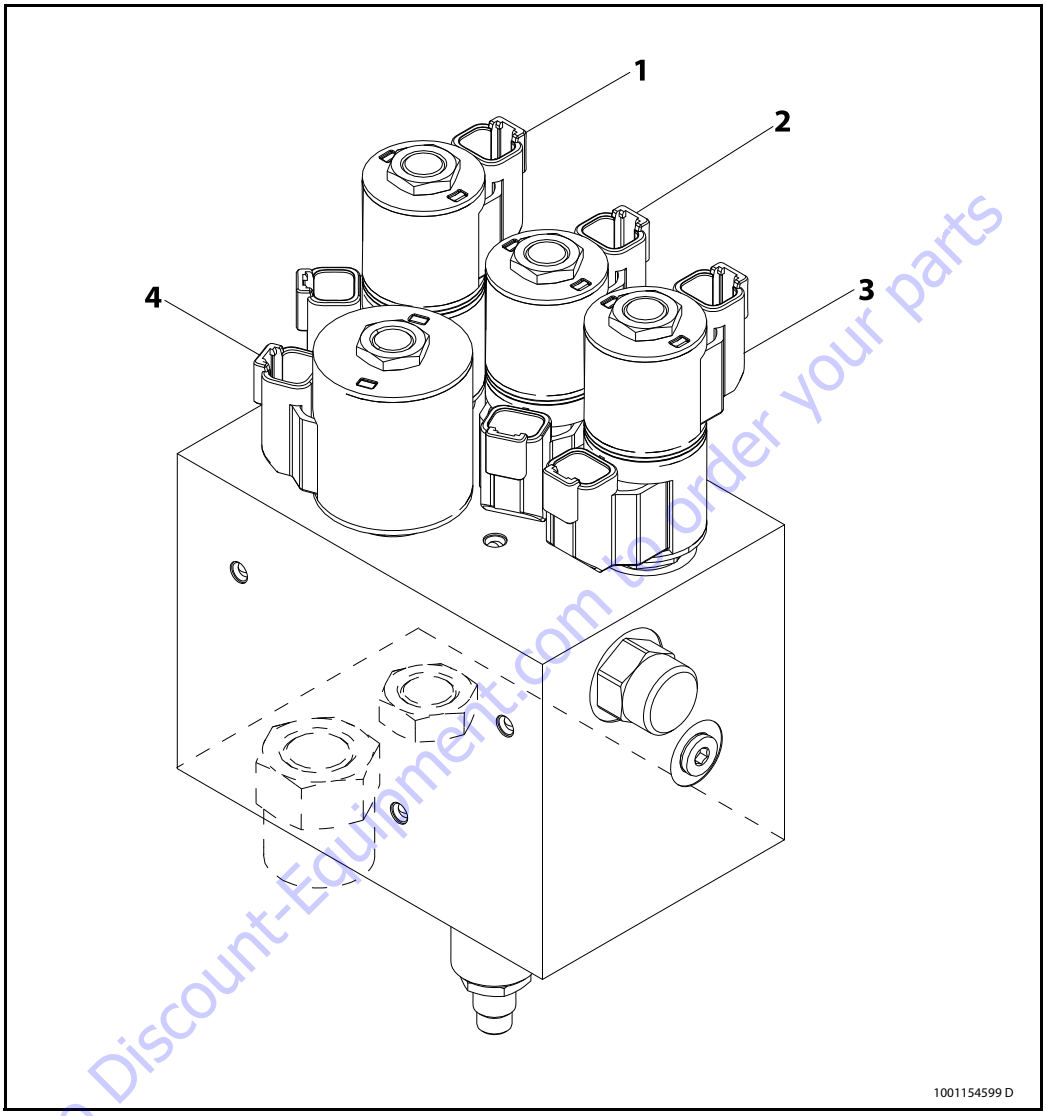

**Table 5-36. Cartridge Torque Values**

| | Ft-Lbs. | Nm |
|---|---|---|
| 1 | NA | NA |
| 2 | 20 | 27.1 |
| 3 | 25 | 33.9 |
| 4 | 20 | 27.1 |
| 5 | 20 | 27.1 |

**Table 5-37. Coil Torque Values**

| | Ft-Lbs. | Nm |
|---|---|---|
| A | 5 | 6.7 |
| B | 6 | 8 |

**Figure 5-197. Platform Valve Cartridge Torque Values (800S)**




1. Platform Level Solenoid Valve
2. Platform Jib Solenoid Valve
3. Platform Rotator Solenoid Valve
4. Platform Dump Valve

**Figure 5-198. Platform Valve Identification (860SJ)**

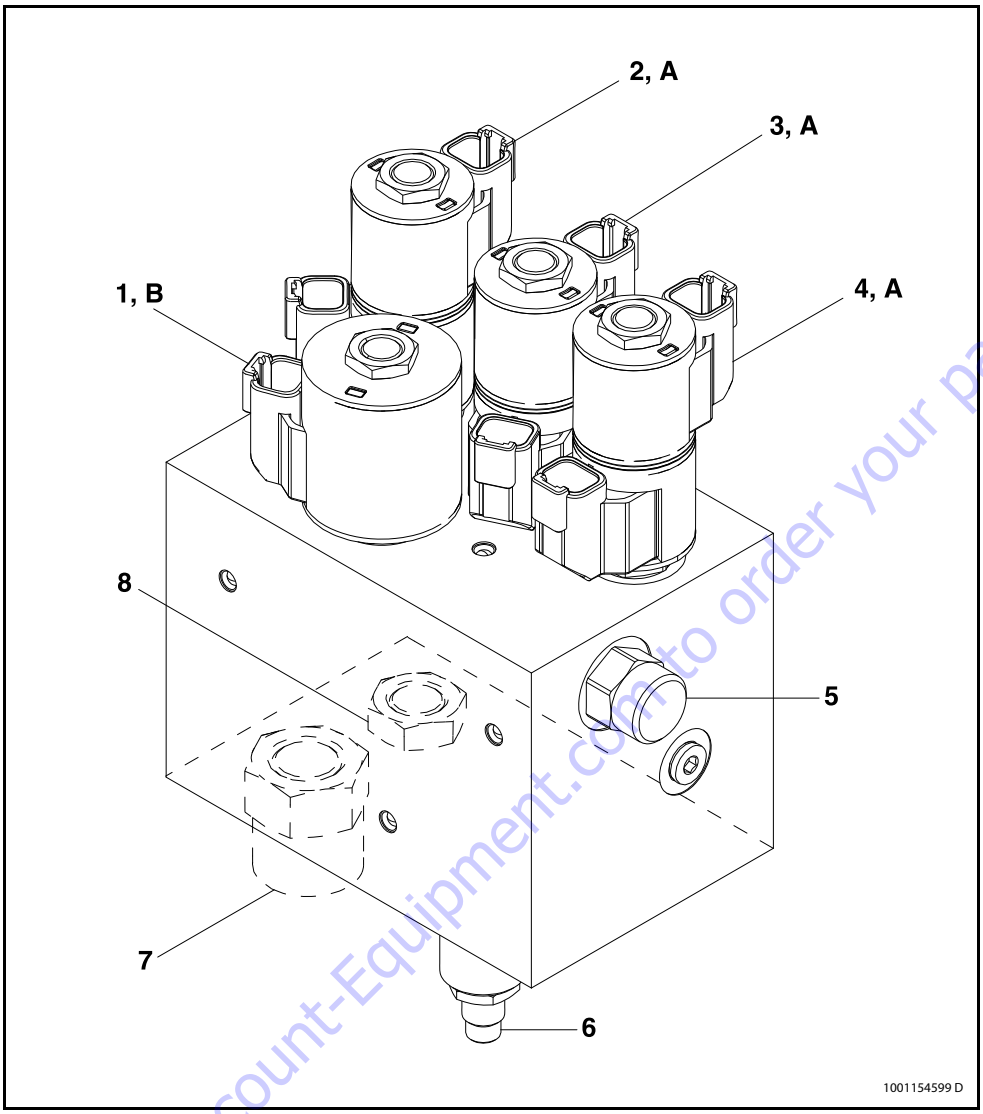





**Table 5-38. Cartridge Torque Values**

| | Ft-Lbs. | Nm |
|---|---|---|
| 1 | 25 | 33.9 |
| 2 | 20 | 27.1 |
| 3 | 20 | 27.1 |
| 4 | 20 | 27.1 |
| 5 | 20 | 27.1 |
| 6 | 20 | 27.1 |
| 7 | 20 | 27.1 |
| 8 | 20 | 27.1 |

**Table 5-39. Coil Torque Values**

| | Ft-Lbs. | Nm |
|---|---|---|
| A | 5 | 6.7 |
| B | 6 | 8 |

**Figure 5-199. Platform Valve Cartridge Torque Values (860SJ)**

## 5.5 START UP PROCEDURES

### Start Up After Overhaul or Replacement of Components

**PRE-FILL OF BOTH THE DRIVE AND FUNCTION PUMP**

**Machine without oil cooler:** When filling the oil tank, fill it to the very top of the tank. This will give you enough head pressure from the tank to gravity fill the case on both pumps. The excess oil will be used to fill the cylinders during start up. The top case port on the outside of the drive pump has a 3/4" tee fitting. Remove the cap from the end of the tee. You should see oil in 1-2 minutes, tighten up the cap. The drive pump case is done. Next, go the function pump, using a 3/8" allen wrench remove the plug on the inside of the pump next to the turn-table side sheet. When oil flows out of the pump, 2-3 minutes, re-install the plug. Both pumps are pre-filled. Not doing this causes the pumps to start dry, and reduces the efficiency of the pump and can cause premature failure.

**Machine with oil cooler:** When filling the oil tank, fill it to the very top of the tank. This will help give you enough head pressure from the tank to gravity fill the case on both pumps. The top case port on the outside of the pump has a 3/4" tee fitting. Remove the cap from the center of the tee. You should see oil in 1-2 minutes. If not, depending on hose routing, the drive pump may not gravity feed. Oil has to flow through the oil cooler to get to the pump. Hose up an external hand pump to this tee fitting, and give it about six pumps after it has started pumping oil. This should be sufficient. Install the cap back onto the tee fitting. The drive pump is done. Next, go the function pump, using a 3/8" allen wrench remove the plug on the inside of the pump next to the turn-table side sheet. When oil flows out of the pump, 2-3 minutes, re-install the plug. Both pumps are pre-filled. Not doing this causes the pumps to start dry, and reduces the efficiency of the pump and can cause premature failure.

**PURGING OF THE FUNCTION PUMP SUCTION HOSE.**

Large pockets of air get trapped in this line and must be removed at low pressure. Head pressure from the tank is not enough. Here are three methods of purging the air from the hose at low pressure.

1. At the main control valve, remove the 3/4 inch hose from port "P1" and remove the 1 inch hose from port "T" by using a 12-16 connector, connect them together. Start the machine and let it run for approx. 10 seconds. Shut off the machine, remove the 12-16 adapter and re-hose.
2. Remove the 3/4" hose from port "P1" and hold it into a 5 gallon bucket and start the machine. The air should purge very quickly, (seconds). Shut off the machine and re-hose.
3. Remove the 3/4" hose from port "P1", using a #12 male union add approx. 30" of 3/4" hose to it. Remove the return filter cap at the top of the tank, lift out the element making sure the canister stays in the tank. Hold the hose end down in the canister and start the machine and let it run approx. 10 seconds. Re-install the filter and re-hose the machine.

***NOTE:*** ***If using a shop vac to create suction on the oil tank while doing maintenance, both steps "1" and "2" will need done.*

***NOTE:*** ***If installing a new drive pump, step "1" will need done.*

***NOTE:*** ***If installing a new function pump, step "1" and "2" will need done.*

***NOTE:*** ***If installing a new function pump and the suction hose is capped without draining a lot of oil out of the hose, which creates a large air void, step "2" will not need to be done.*

***NOTE:*** ***When operating a function such as Lift Up, if the function pump makes a loud noise and the lift up stops and starts, that is a sign of cavitation, air going through the pump at high pressure. This will in a short time destroy the pump and contaminate the entire system. Make sure all suction hoses are tight and free of leaks at the tank and pump. A suction hose does not leak when the engine is running, it will allow air to be drawn into the pump causing cavitation. After the machine is shut down, then you will see a very slow leak.*

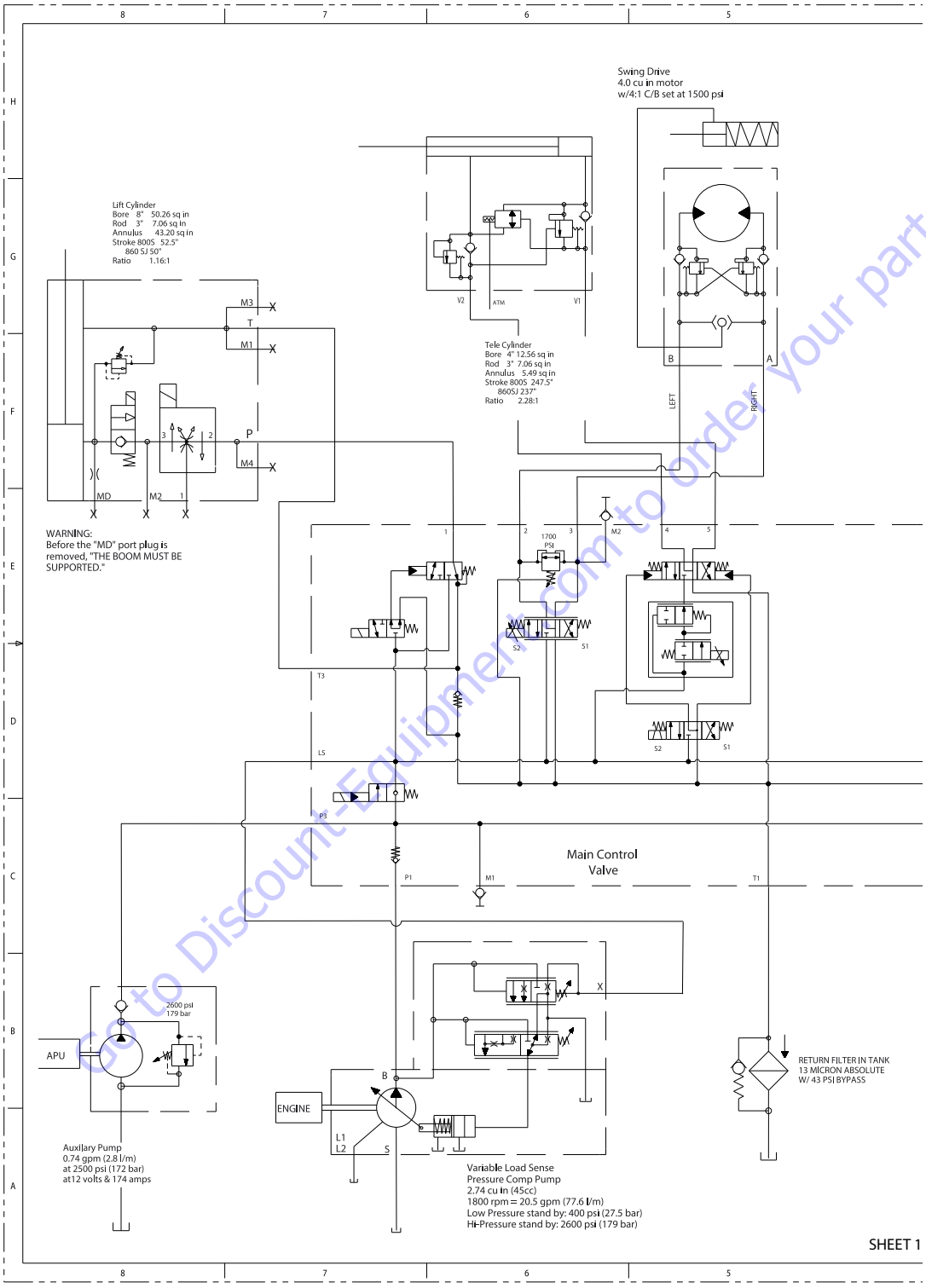





**Figure 5-200. Hydraulic Schematic - Sheet 1of 6**

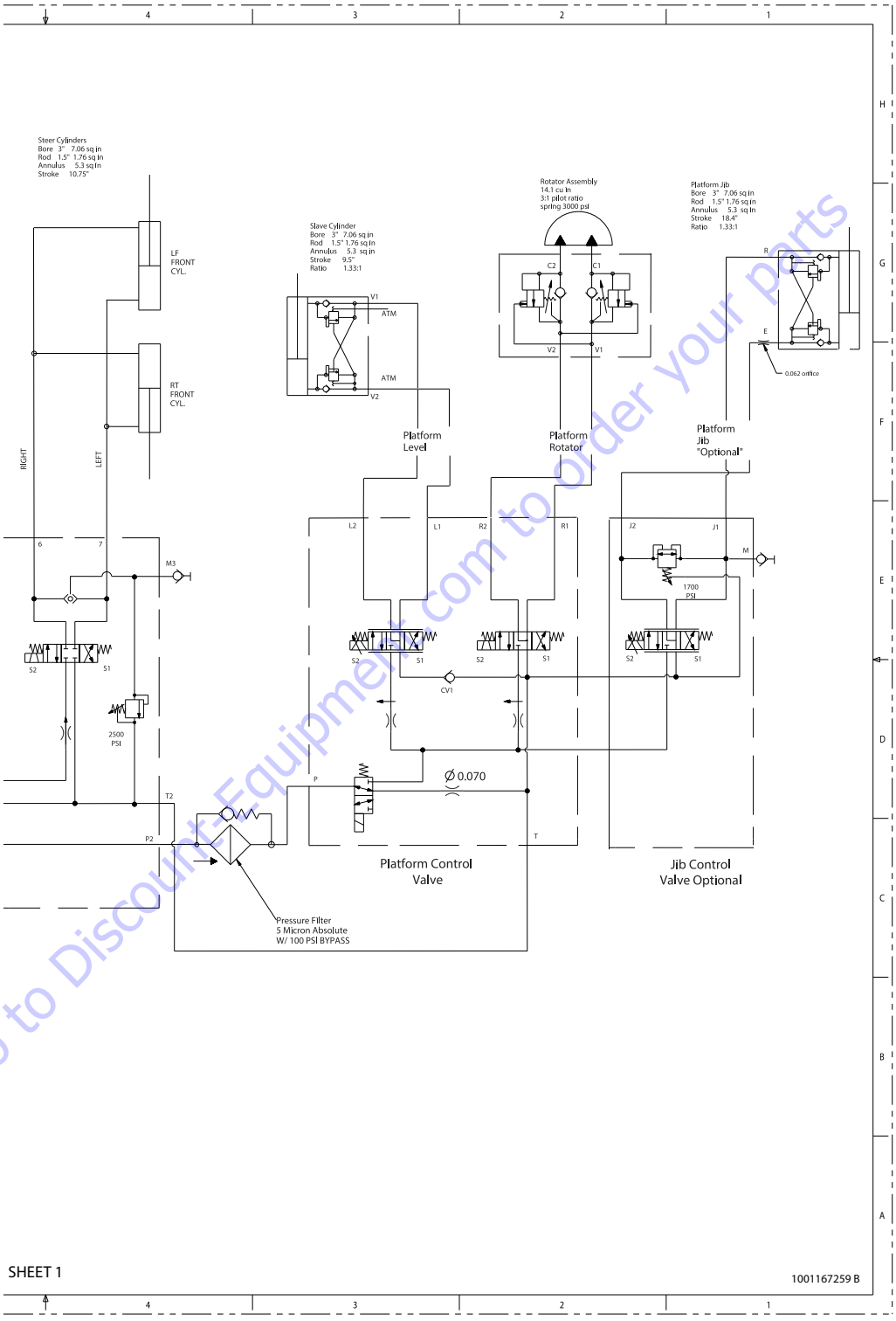





**Figure 5-201. Hydraulic Schematic - Sheet 2 of 6**

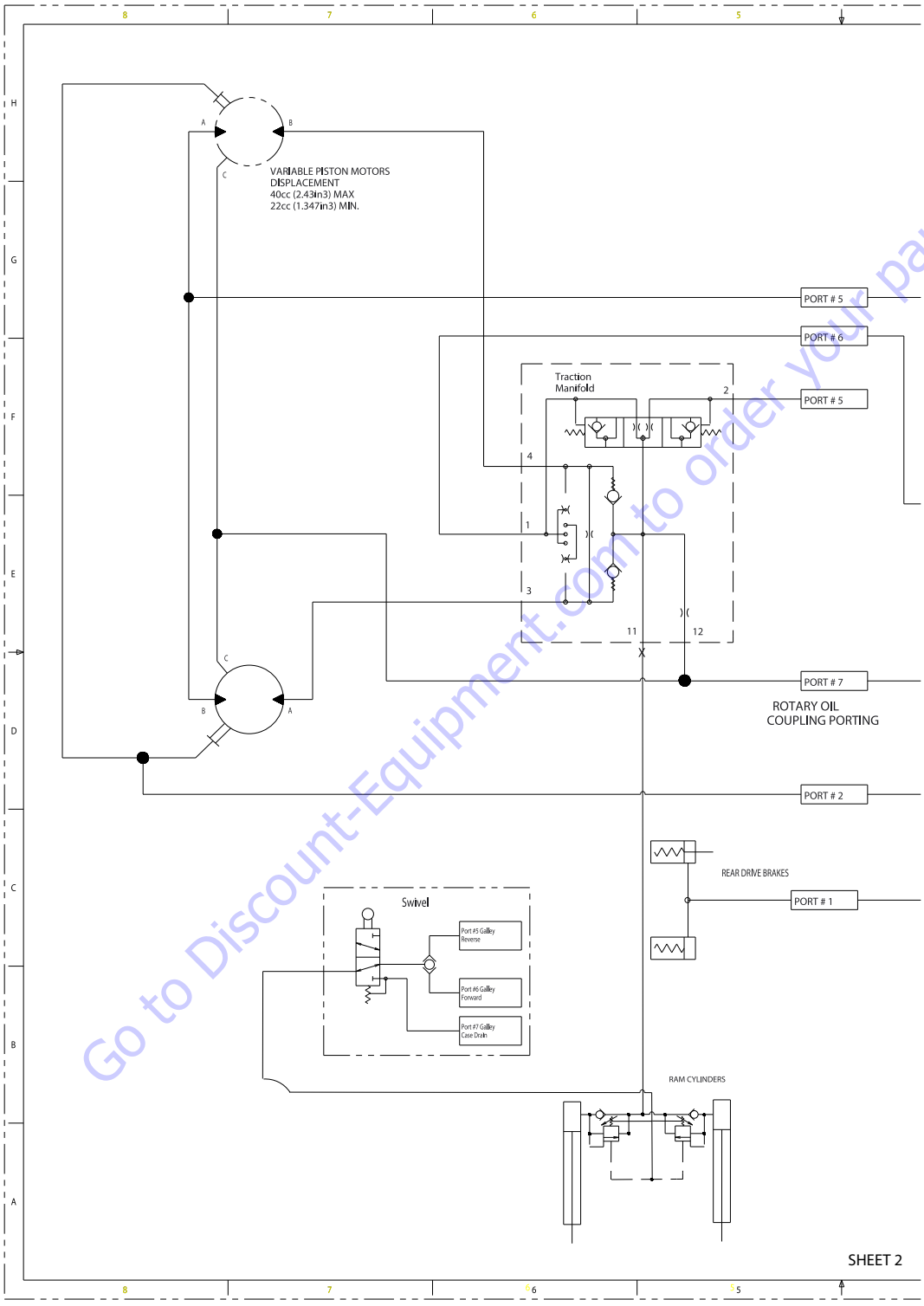





**Figure 5-202. Hydraulic Schematic - Sheet 3 of 6**

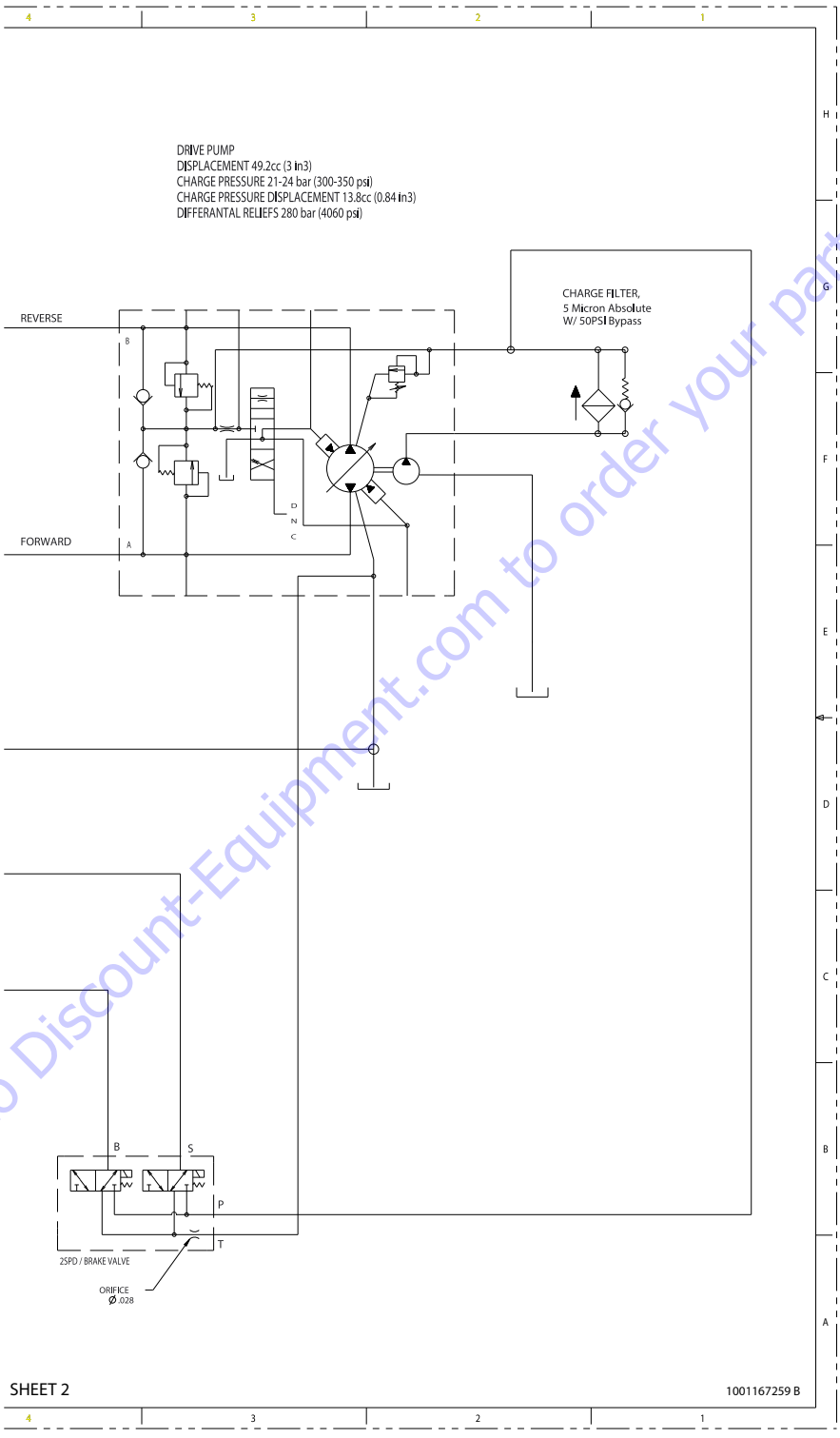





**Figure 5-203. Hydraulic Schematic - Sheet 4 of 6**

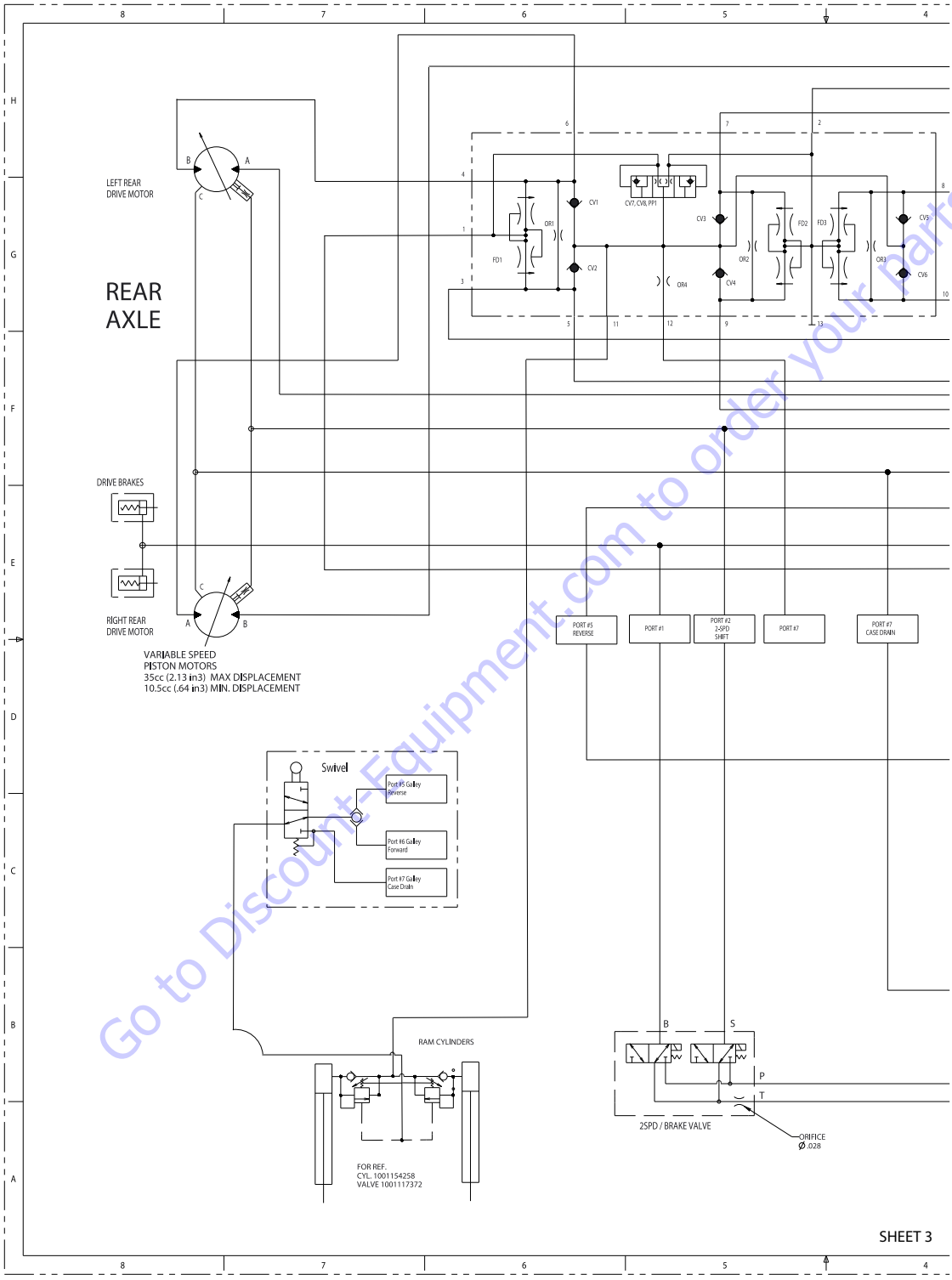





**Figure 5-204. Hydraulic Schematic - Sheet 5 of 6**

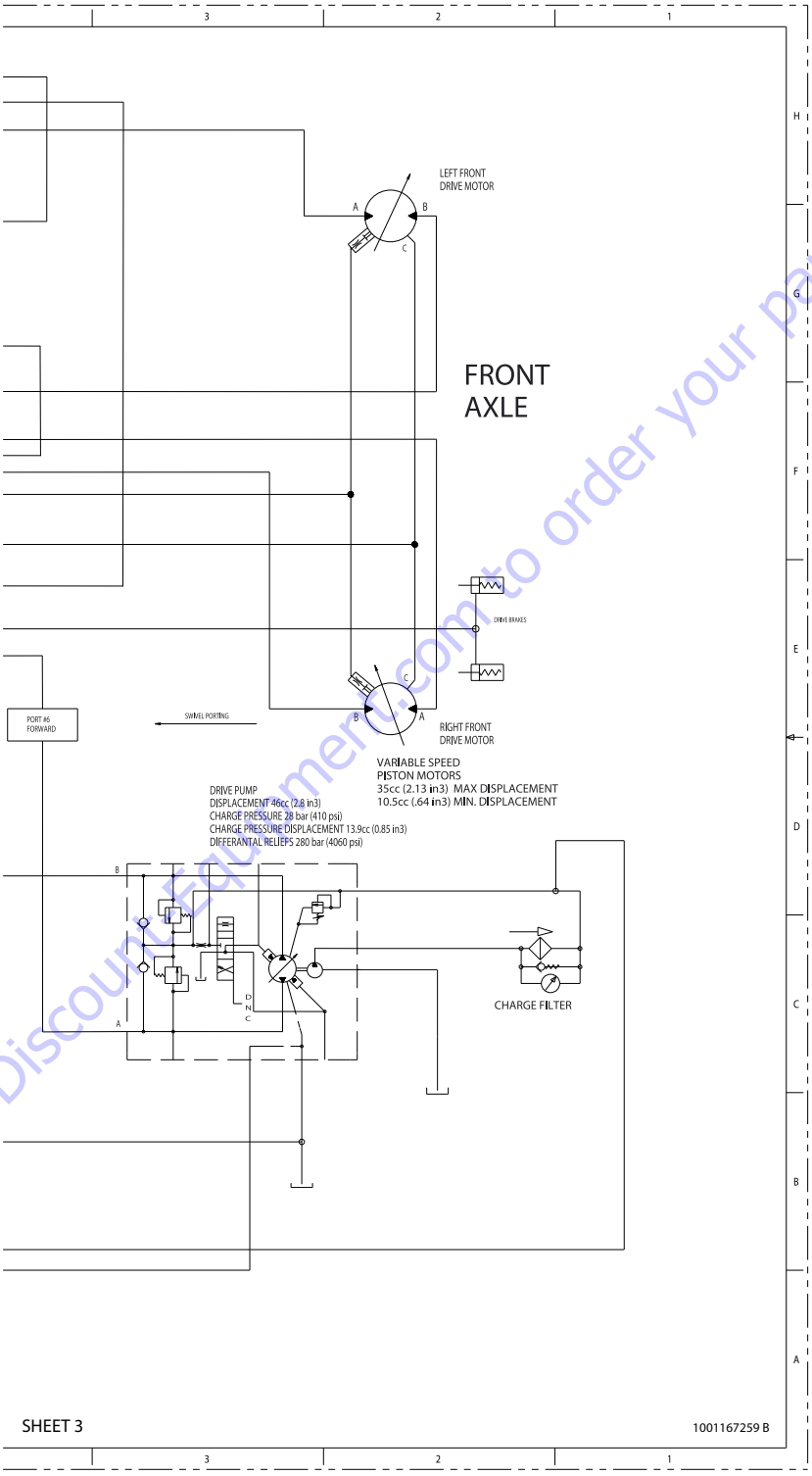
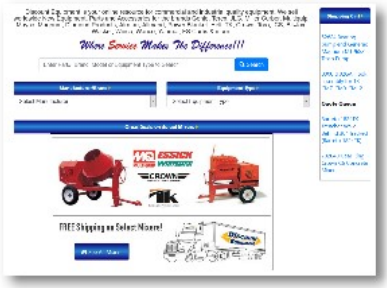



**Figure 5-205. Hydraulic Schematic - Sheet 6 of 6**

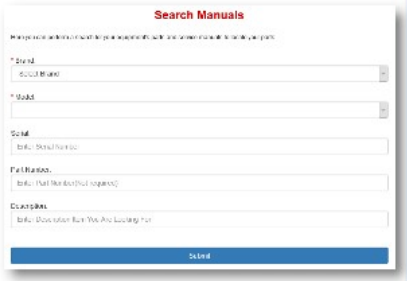
# PARTS FINDER

**Search Website by Part Number**

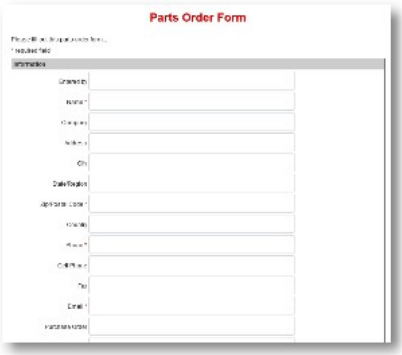
Discount Equipment



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




**Can't Find Part or Manual? Request Help by Manufacturer, Model & Description**

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

# SECTION 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 12 volt based control unit installed on the boom lift.

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

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

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

The Control System may be accessed 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.



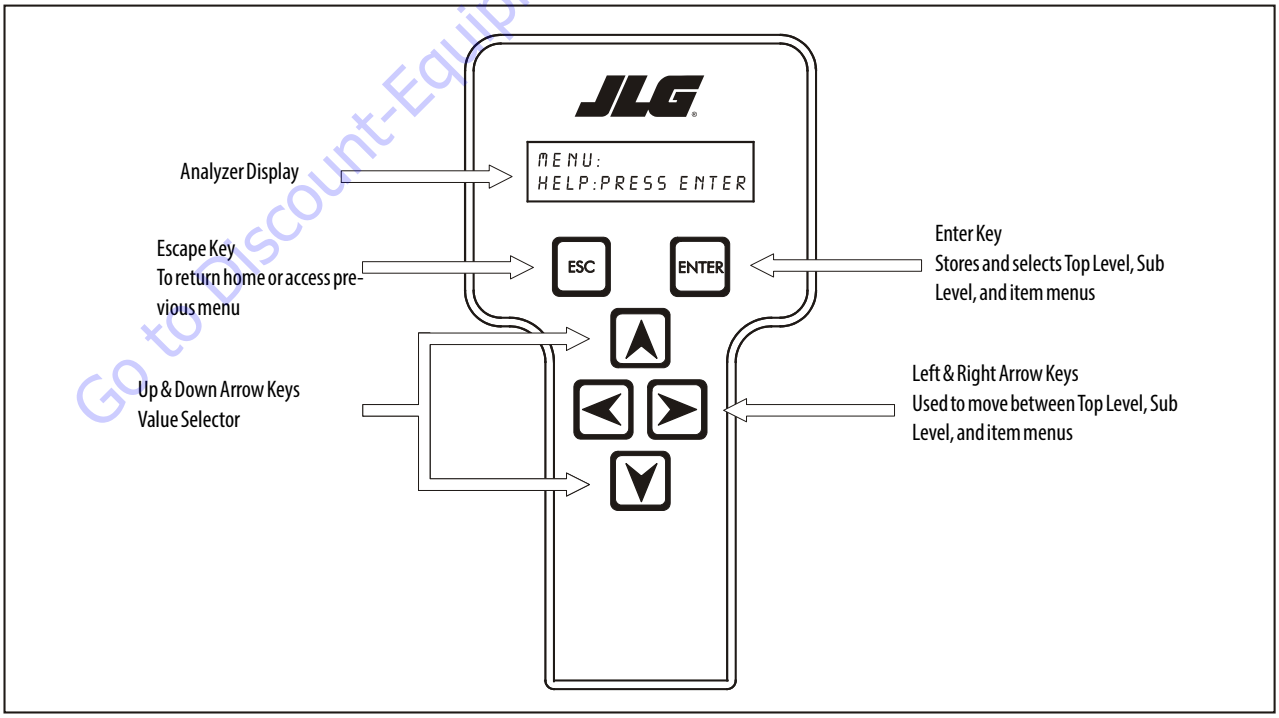



**Figure 6-1. Hand Held Analyzer**

## To Connect the JLG Control System Analyzer

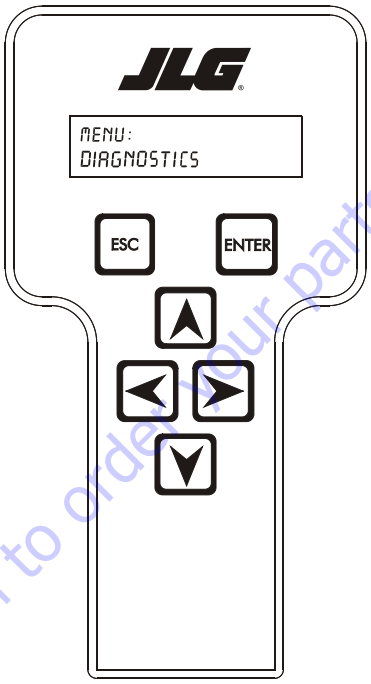
1. Connect one end of the cable, supplied with the analyzer, to the correct four pin connector on the motor control unit; there will be only one connector which correctly fits the cable.
2. Connect the other end of the cable to the analyzer.

***NOTE:*** *The ends of the cable are identical and can be reversed; the cable end can only be inserted one way into the matching connector.*

3. Power up the vehicle by turning the key to the platform or ground position and pulling the emergency stop buttons on; this will power the SMART System and the analyzer.

## Using the Analyzer

The analyzer will display the current top level menu item, for example::




**MENU:**
**DIAGNOSTICS**

Press LEFT & RIGHT (g, e) to move between menu items; press ENTER to select the displayed menu item.

When a top level menu item is selected, a new set of menu items may be offered; press **LEFT** & **RIGHT** arrows then **ENTER** again to select the required item.

To cancel a selected menu item, press **ESCAPE**; then a different menu item can be chosen.

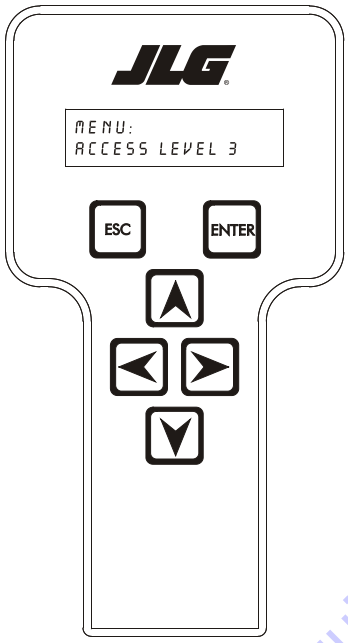
The available menu items will vary depending on the vehicle; check the vehicle manual for more information.

## Changing the Access Level of the Hand Held Analyzer

When the analyzer is first connected, its access level ensures that most configurations cannot be changed; this ensures that a setting cannot be accidentally altered.

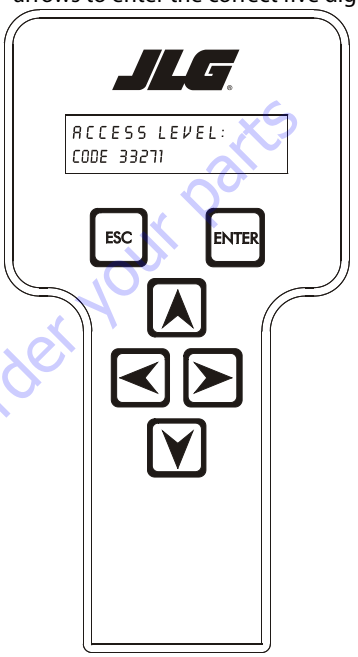
To change the access level, a PASSWORD must be entered; the password must be known.

To enter a password, first find the appropriate top level menu item:




**MENU:**
**ACCESS LEVEL 3**

Press **ENTER** ENTER to select the ACCESS LEVEL item; then press **UP** & **DOWN** arrows and **LEFT** & **RIGHT** arrows to enter the correct five digit password:



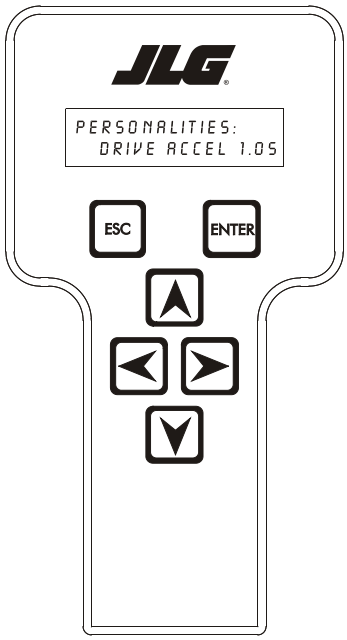

**ACCESS LEVEL:**
**CODE 33271**

When the correct password is displayed, press **ENTER** ENTER to confirm it; the access level will change to match the password (if not, press **ENTER** ENTER to check and correct the password).

The correct passwords will vary depending on the vehicle; check the vehicle manual for more information.

## Adjusting Configuration Using the Hand Held Analyzer

When a personality item is selected, press **UP** & **DOWN** arrows to adjust its value, for example:



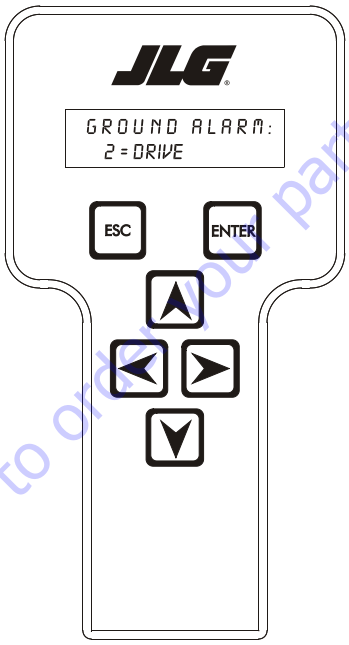

**PERSONALITIES:**
**DRIVE ACCEL 1.0s**

There will be a maximum and minimum for the value to ensure safe, operation; the value will not increase if **UP** is pressed when at the maximum, or if DOWN is pressed when at the minimum.

If the value does not change when **UP** or **DOWN** is pressed, check the access level.

## Machine Setup

When a machine digit item is selected, press **UP** & **DOWN** (e, e) to adjust its value, for example:




**GROUND ALARM:**
**2 = DRIVE**

The effect of the machine digit value is displayed along with its value; there will only be certain settings allowed to ensure safe operation.

If the value does not change when **UP** or **DOWN** is pressed, check the access level.

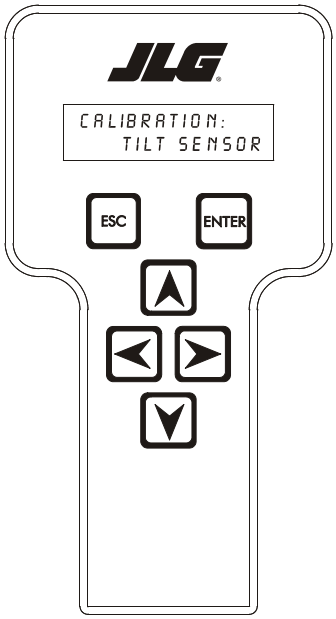
The available personality and machine digit items will vary depending on the vehicle; check the vehicle manual for more information.

## Level Vehicle Description

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

**⚠ WARNING**

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




Place machine in stowed position with the boom between the rear wheels.

To level machine chose:

**CALIBRATION:**
**TILT SENSOR**

Press ENTER (ENTER).

When prompted, swing machine 180°

Press ENTER (ENTER).

**Table 6-1. Analyzer Abbreviations**

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

**Table 6-1. Analyzer Abbreviations**

| ABBREVIATION | MEANING |
|---|---|
| G | GROUND |
| 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 |

**Table 6-1. Analyzer Abbreviations**

| ABBREVIATION | MEANING |
|---|---|
| RT | RIGHT |
| 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 | main or UP |
| V | VOLT |
| VER | VERSION |
| VLV | VALVE |
| WIT | WITNESS |
| YEL | YELLOW |

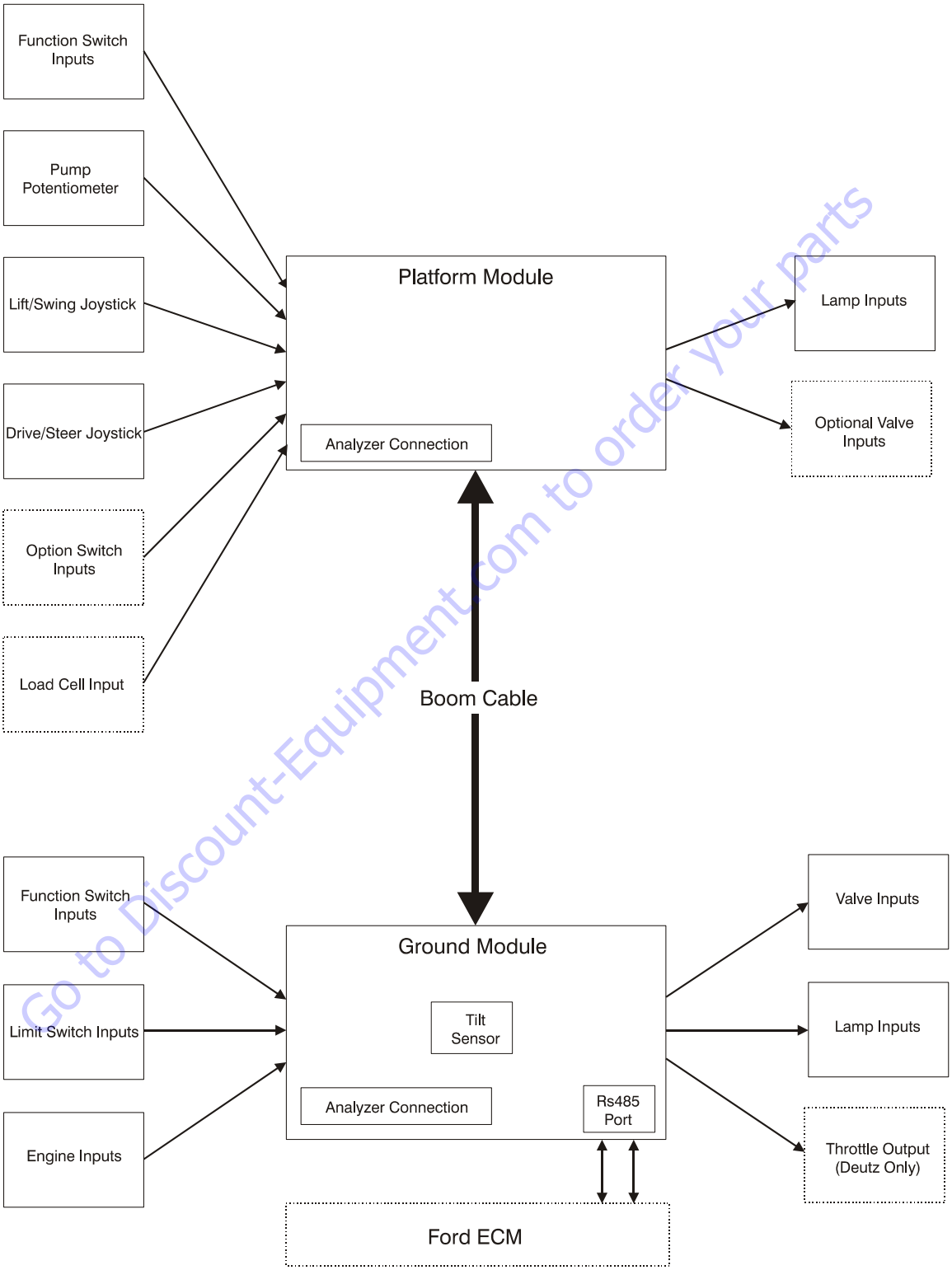





**Figure 6-2. ADE Block Diagram**

**Table 6-2. Machine Configuration Programming Information (Software Version P6.22)**

| Configuration Digit | Number | Description | Default Number |
|---|---|---|---|
| ***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.* | | | |
| MODEL NUMBER:<br>1 | 1 | 800A | |
| | **2** | **800S** | **2** |
| | | | |
| MARKET:<br>2 | **0** | **ANSI USA** | **0** |
| | 1 | ANSI EXPORT | |
| | 2 | CSA | |
| | 3 | CE | |
| | 4 | AUSTRALIA | |
| | 5 | JAPAN | |
| | 6 | GB | |
| | | | |

**Table 6-2. Machine Configuration Programming Information (Software Version P6.22)**

| Configuration Digit | Number | Description | Default Number |
|---|---|---|---|
| ENGINE:<br>3* | 1 | FORD EFI GAS: Ford LRG425 EFI Gas (Tier 1) | |
| | 2 | FORD EFI D/F: Ford LRG425 EFI dual fuel (Tier 1) | |
| | 3 | DEUTZ F4 TIER1: Deutz F4M1011F Diesel (Tier 1) | |
| | 4 | DEUTZ F3 TIER1: Deutz F3M1011F Diesel (Tier 1) | |
| | 5 | CAT. 3024C: CAT 3024C Diesel (Tier 2) | |
| | 6 | CAT. 3044C: CAT 3044C Diesel (Tier 2) | |
| | 7 | PERKINS 404C (Tier 2) | |
| | 8 | DEUTZ F4 TIER2: Deutz F4M2011 Diesel (Tier 2) | |
| | 9 | DEUTZ F3 TIER2: Deutz F3M2011 Diesel (Tier 2) | |
| | 10 | FORD GAS TIER2: Ford LRG425 EFI Gas (Tier 2) | |
| | 11 | FORD D/F TIER2: Ford LRG425 EFI Dual Fuel (Tier 2) | |
| | 12 | DEUTZ ECM: Engine Control Module - ECM (Tier 2 and Tier 3) | |
| | 13 | DUAL FUEL ECM: GM/PSI 3.0L Dual Fuel (Tier 2) | |
| | 14 | PERKINS ECM | |
| | 15 | CAT ECM | |
| | 16 | DEUTZ ECM T4F: Deutz Engine Control Module (Tier 4 Final) | |
| | **17** | **FORD DUAL FUEL** | **17** |
| * Engine selections vary depending on model selection. | | | |
| | | | |
| FLYWHEEL TEETH:<br>4* | 0 | 133 TEETH: 133 flywheel teeth. | |
| | **1** | **110 TEETH: 110 flywheel teeth.** | **1** |
| *This menu item is only visible if Deutz engine selections 3 or 4 are selected. | | | |
| | | | |
| GLOW PLUG:<br>5 | 0 | NO GLOW PLUGS: No glow plugs installed. | |
| | 1 | AIR INTAKE: Glow plugs installed in the air intake on the manifold. | |
| | **2** | **IN-CYLINDER: Glow plugs installed in each cylinder.** | **2** |
| | | | |

**Table 6-2. Machine Configuration Programming Information (Software Version P6.22)**

| Configuration Digit | Number | Description | Default Number |
|---|---|---|---|
| STARTER LOCKOUT:<br>6 | **0**<br><br>1 | **DISABLED: Automatic pre-glow time determined by ambient air temperature; engine start can be attempted at any time during pre-glow.**<br><br>ENABLED: Automatic pre-glow time determined by ambient air temperature; engine start is NOT permitted until pre-glow is finished. | **0** |
| | | | |
| FUEL CUTOUT<br>7* | **0**<br><br>1<br><br>2 | **RESTART: Engine allowed to be restarted multiple times when very low fuel level is reached.**<br><br>ONE RESTART: Engine allowed to be restarted once for 2 minutes when very low fuel level is reached.<br><br>ENGINE STOP: Engine not able to restart when very low fuel level is reached. | **0** |
| * This menu item is only visible if non dual fuel engines are selected. | | | |
| | | | |
| ENGINE SHUTDOWN:<br>8 | 0<br><br>**1** | DISABLED: No engine shutdown.<br><br>**ENABLED: Shutdown engine when coolant temperature is greater than 110 deg. C or the oil pressure is less than 8 PSI.** | **1** |
| | | | |

**Table 6-2. Machine Configuration Programming Information (Software Version P6.22)**

| Configuration Digit | Number | Description | Default Number |
|---|---|---|---|
| TILT:<br>9* | **1** | **5 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also reduces drive speed to creep.** | **1** |
| | 2 | 4 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also reduces drive speed to creep. | |
| | 3 | 3 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also reduces drive speed to creep. | |
| | 4 | 4 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up. | |
| | 5 | 3 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up. | |
| | 6 | 5 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up. | |
| | 7 | 5 DEGREES + DRV CUT Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also reduces drive speed to creep when drive reversal is allowed, drive is disallowed otherwise. | |
| | 8 | 4 DEGREES + DRV CUT Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also reduces drive speed to creep when drive reversal is allowed, drive is disallowed otherwise. | |
| | 9 | 3 DEGREES + DRV CUT Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also reduces drive speed to creep when drive reversal is allowed, drive is disallowed otherwise. | |
| * Certain market selections will limit tilt options and alter default setting.<br>*Note: Any of the selections above will light the tilt lamp when a tilted condition occurs and will sound the platform alarm when the machine is also above elevation.* | | | |

**Table 6-2. Machine Configuration Programming Information (Software Version P6.22)**

| Configuration Digit | Number | Description | Default Number |
|---|---|---|---|
| JIB:<br>10* | **0**<br>1 | **NO: No jib installed.**<br>YES: Jib installed which has up and down movements only. | **0** |
| * Only visible under certain model selections. | | | |
| | | | |
| 4 WHEEL STEER:<br>11* | **0**<br>1 | **NO: No four-wheel steer installed.**<br>YES: Four-wheel steer installed. | **0** |
| * Only visible under certain model selections. | | | |
| | | | |
| ST TOUCH / SKYGUARD:<br>12 | **0**<br>1<br>2<br>3 | **NONE: No soft touch or skyguard system installed.**<br>SOFT TOUCH - Soft touch only installed.<br>SKYGUARD - Skyguard only installed.<br>BOTH (CUTOUT) - Soft touch and Skyguard installed. | **0** |
| | | | |
| GEN SET/WELDER:<br>13 | **0**<br>1 | **NO: No generator installed.**<br>BELT DRIVE: Belt driven setup. | **0** |
| | | | |
| GEN SET CUTOUT:<br>14* | **0**<br>1 | **MOTION ENABLED: Motion enabled when generator is ON.**<br>MOTION CUTOUT: Motion cutout in platform mode only. | **0** |
| * Only visible if Gen Set / Welder Menu selection is not 0. | | | |
| | | | |
| H & T LIGHTS:<br>15 | **0**<br>1 | **NO: No head and tail lights installed.**<br>YES: Head and tail lights installed. | **0** |
| | | | |
| CABLE SWITCH:<br>16* | **0**<br>1 | **NO: No broken cable switch installed.**<br>YES: Broken cable switch installed. | **0** |
| * Only visible under certain model selections.<br>* Certain market and model selections will alter the default setting. | | | |
| | | | |

**Table 6-2. Machine Configuration Programming Information (Software Version P6.22)**

| Configuration Digit | Number | Description | Default Number |
|---|---|---|---|
| LOAD SYSTEM:<br>17* | **0** | **NO: No load sensor installed.** | **0** |
| | 1 | WARN ONLY: Functions in creep, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF). | |
| | 2 | CUTOUT PLATFORM: All functions cutout, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF). | |
| | 3 | CUTOUT ALL: All functions cutout, flash overload light (500mS on, 500mS off), platform alarm beeps (5 sec ON, 2 sec OFF). | |
| | 4 | SPECIAL 1: Functions in creep, overload lamp lit, disables main telescope out & main lift up, platform alarm beeps (5 sec ON, 2 sec OFF). | |
| * Only visible under certain market selections.<br>* Certain market selections will limit load system options or alter default setting.<br>* LOAD SYSTEM will not be visible in CE and defaulted to CUTOUT ALL for machines equipped with MSSO. | | | |
| | | | |
| LOAD SENSOR:<br>18* | 0 | 1 ON ROTATOR: Use the on-board load sensor for all models except those which use the Leveling Platform Module. | |
| | **1** | **4 UNDER PLATFORM: Use the EIM for load sensing.** | **1** |
| | **2** | **SINGLE CELL: Single Cell, CANBUS based sensor** | |
| * Only visible if Load Sensor Menu selection is not 0 and under certain market selections.<br>* Certain market selections will limit load sensor options. | | | |
| | | | |
| FUNCTION CUTOUT:<br>19* | **0** | **NO: No drive cutout.** | **0** |
| | 1 | BOOM CUTOUT: Boom function cutout while driving above elevation. | |
| | 2 | DRIVE CUTOUT: Drive & steer cutout above elevation. | |
| | 3 | DRIVE CUT E&T: Drive & steer cutout above elevation and tilted. | |
| * Only visible under certain market selections.<br>* Certain market selections will limit function cutout options or alter default setting. | | | |
| | | | |
| GROUND ALARM:<br>20* | 0 | NO: No ground alarm installed. | |
| | 1 | DRIVE: Travel alarm sounds when the drive function is active (Option). | |
| | 2 | DESCENT: Descent alarm sounds when lift down is active (Option). | |
| | **3** | **MOTION: Motion alarm sounds when any function is active (Option).** | **3** |
| * Certain market selections will alter default setting. | | | |
| | | | |

**Table 6-2. Machine Configuration Programming Information (Software Version P6.22)**

| Configuration Digit | Number | Description | Default Number |
|---|---|---|---|
| DRIVE:<br>21* | **0**<br>1<br>2 | **4WD: Four wheel drive.**<br>2WD: Two wheel drive.<br>2WD W/ 2-SPEED: Two wheel drive with 2-speed valve. | **0** |
| * Only visible under certain model selections. | | | |
| | | | |
| DISPLAY UNITS:<br>22* | **0**<br>1 | **IMPERIAL: DEG F , PSI, LBS.**<br>METRIC: DEG C, KPA, KGS | **0** |
| * Certain market selections will alter default setting. | | | |
| | | | |
| LEVELING MODE:<br>23* | **0**<br>1 | **ALL FUNCTIONS: Platform level with all functions.**<br>LEVEL LIFT/TELESCOPE: Platform level on lift and telescope only. | **0** |
| * Only visible on 800S models. | | | |
| | | | |
| DRIVE CONTROL:<br>24 | 0<br>1<br>**2** | NORMAL: Drive coils are energized from the Ground Module.<br>PROPULSION: Drive coils are energized from the Propulsion Module.<br>**ENHANCED: Drive coils are energized from the Ground Module and the ground side of the drive coils are brought back to current feedback returns.** | **2** |
| | | | |
| DRIVE PUMP<br>25* | **0**<br>1<br>2<br>3 | **SAUER DANFOSS: Machine equipped with Sauer Danfoss drive pump**<br>EATON: Machine equipped with Eaton drive pump<br>M46 - XXXX: Machine equipped with M46 - XXXX drive pump<br>830XXXXX: Machine equipped with 830XXXXX: drive pump | **0** |
| *Only visible on 600A, 600S, and 800S models. | | | |
| | | | |
| BOOM CONTROL:<br>26 | **0**<br>1 | **NORMAL: Boom function coils are energized from the Ground Module.**<br>ENHANCED: Boom function are energized from the Ground Module and the ground side of the drive coils and brought back to current feedback returns. | **0** |
| | | | |

**Table 6-2. Machine Configuration Programming Information (Software Version P6.22)**

| Configuration Digit | Number | Description | Default Number |
|---|---|---|---|
| FUNCTION SPEED KNOB<br>27 | **0**<br>1 | **YES: Machine is equipped with Function Speed Knob.**<br>NO: Machine is equipped with Operation Speed Switch. | **0** |
| | | | |
| CLEARSKY:<br>28 | **0**<br>1 | **NO: Clearsky (telematics) option is disabled.**<br>YES: Clearsky (telematics) option is enabled. | **0** |
| | | | |
| CRIBBING OPTION:<br>29 | **0**<br>1 | **NO: Cribbing Option is disabled.**<br>YES: Cribbing Option is enabled. | **0** |
| | | | |
| FUEL TANK SIZE:<br>30 | **0**<br>1 | **31 Gallon Tank**<br>52 Gallon Tank | **0** |
| | | | |
| ALARM / HORN:<br>31 | **0**<br>1 | **SEPERATE: Separate alarm and horn.**<br>COMBINED: Combination alarm / horn. | **0** |
| | | | |
| ALERT / BEACON:<br>32 | **0**<br>1 | **OFF FOR CREEP: Alert beacon will not flash while in Creep.**<br>20FPS FOR CREEP: Alert beacon will flash at 20FPS while in Creep. | **0** |
| | | | |
| TEMP CUTOUT:<br>33 | **0**<br>1 | **NO: Temp Cutout is Disabled**<br>YES: Temp Cutout is Enabled | **0** |
| | | | |
| PLAT LVL OVR CUT:<br>34 | **0**<br>1 | **NO: Platform Level Override will always be functional.**<br>YES: Platform Level Override will only be functional when In Transport. | **0** |
| | | | |
| WATER IN FUEL SENSOR:<br>35 | **0**<br>1 | **NO: Water in Fuel Sensor Disabled**<br>YES: Water in Fuel Sensor Enabled | **0** |
| | | | |

**Table 6-2. Machine Configuration Programming Information (Software Version P6.22)**

| Configuration Digit | Number | Description | Default Number |
|---|---|---|---|
| DUAL CAPACITY:<br>36 | **0**<br><br>1 | **NO: Dual Capacity is disabled.**<br><br>YES: Dual Capacity Enabled | **0** |
| * This menu item is only visible if Deutz EMR 4 engine is selected.<br>* Only visible under certain market selections. | | | |

4150364-U

**Table 6-3. 800S Machine Configuration Programming Settings (Software Version P6.22)**

| 800 S | ANSI USA | ANSI Export | CSA | CE | Australia | Japan | GB |
|---|---|---|---|---|---|---|---|
| Model Number | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Market | 0 | 1 | 2 | 3 | 4 | 5 | 3 |
| Engine | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Flywheel Teeth | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Glow Plugs | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Starter Lockout | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Fuel Cutout | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Engine Shut-down | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Tilt | 1 | 1 | 1 | X | X | 1 | X |
| | 2 | 2 | 2 | X | 2 | 2 | X |
| | 3 | 3 | 3 | X | 3 | 3 | X |
| | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| | 6 | 6 | 6 | X | X | 6 | X |
| | 7 | 7 | 7 | X | X | 7 | X |
| | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| Jib | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 Wheel Steer | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Soft Touch/ Skyguard | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Gen Set / Welder | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Gen Set Cutout | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Head & Tail-lights | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Cable Break Switch | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

**Table 6-3. 800S Machine Configuration Programming Settings (Software Version P6.22)**

| 800 S | ANSI USA | ANSI Export | CSA | CE | Australia | Japan | GB |
|---|---|---|---|---|---|---|---|
| Load System | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | X | 1 | X | X | X | 1 | X |
| | X | 2 | X | 2 | 2 | 2 | 2 |
| | X | 3 | X | 3 | X | 3 | 3 |
| | X | 4 | X | X | X | 4 | X |
| Load Sensor | X | 0 | X | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | X | 2 | X | 2 | 2 | 2 | 2 |
| Function Cut-out | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | X | 1 | 1 | 1 | 1 | 1 | 1 |
| | 2 | 2 | 2 | X | 2 | 2 | 2 |
| | X | 3 | 3 | X | 3 | 3 | 3 |
| Ground Alarm | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Drive Type | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Display Units | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Leveling Mode | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Drive Control | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Drive Pump | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | X | X | X | X | X | X | X |
| | X | X | X | X | X | X | X |
| Boom Control | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Function Speed Knob | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Clearsky | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Cribbing Option | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Fuel Tank Size | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Alarm / Horn | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

**Table 6-3. 800S Machine Configuration Programming Settings (Software Version P6.22)**

| 800 S | ANSI USA | ANSI Export | CSA | CE | Australia | Japan | GB |
|---|---|---|---|---|---|---|---|
| Alert Beacon | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Temp Cutout | X | **0** | X | **0** | X | X | **0** |
| | X | 1 | X | 1 | X | X | 1 |
| Plat Lvl Ovr Cut | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Water In Fuel Sensor | X | **0** | X | X | X | X | **0** |
| | X | 1 | X | X | X | X | 1 |
| Dual Capacity | 0 | 0 | 0 | **0** | **0** | 0 | **0** |
| | **1** | **1** | **1** | 1 | 1 | **1** | ***1*** |

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

**Table 6-4. 860SJ Machine Configuration Programming Settings (Software Version P6.22)**

| 860 SJ | ANSI USA | ANSI Export | CSA | CE | Australia | Japan | GB |
|---|---|---|---|---|---|---|---|
| Model Number | **10** | **10** | **10** | **10** | **10** | **10** | **10** |
| Market | **0** | **1** | **2** | **3** | **4** | **5** | **3** |
| Engine | **12** | **12** | **12** | **12** | **12** | **12** | **12** |
| Flywheel Teeth | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **1** | **1** | **1** | **1** | **1** | **1** | **1** |
| Glow Plugs | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | **2** | **2** | **2** | **2** | **2** | **2** | **2** |
| Starter Lockout | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Fuel Cutout | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Engine Shut-down | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **1** | **1** | **1** | **1** | **1** | **1** | **1** |
| Tilt | 1 | 1 | 1 | X | X | 1 | X |
| | 2 | 2 | 2 | X | 2 | 2 | X |
| | 3 | 3 | 3 | X | 3 | 3 | X |
| | 4 | 4 | 4 | **4** | 4 | 4 | 4 |
| | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| | 6 | 6 | 6 | X | X | 6 | X |
| | **7** | **7** | **7** | X | X | 8 | X |
| | 8 | 8 | 8 | **8** | **8** | **8** | **8** |
| | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| Jib | **1** | **1** | **1** | **1** | **1** | **1** | **1** |
| 4 Wheel Steer | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| Soft Touch/ Skyguard | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | **2** | **2** | **2** | **2** | **2** | **2** | **2** |
| | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Gen Set / Welder | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Gen Set Cutout | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Head & Tail-lights | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Cable Break Switch | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **1** | **1** | **1** | **1** | **1** | **1** | **1** |

**Table 6-4. 860SJ Machine Configuration Programming Settings (Software Version P6.22)**

| 860 SJ | ANSI USA | ANSI Export | CSA | CE | Australia | Japan | GB |
|---|---|---|---|---|---|---|---|
| Load System | **0** | **0** | **0** | 0 | 0 | 0 | 0 |
| | X | ***1*** | X | X | X | **1** | X |
| | X | 2 | X | 2 | **2** | 2 | **2** |
| | X | 3 | X | **3** | X | 3 | 3 |
| | X | 4 | X | X | X | 4 | X |
| Load Sensor | X | 0 | X | 0 | 0 | 0 | 0 |
| | **1** | **1** | **1** | **1** | **1** | **1** | **1** |
| | X | 2 | X | 2 | 2 | 2 | 2 |
| Function Cut-out | **0** | **0** | **0** | 0 | **0** | **0** | **0** |
| | X | 1 | 1 | **1** | 1 | 1 | 1 |
| | 2 | 2 | 2 | X | 2 | 2 | 2 |
| | X | 3 | 3 | X | 3 | 3 | 3 |
| Ground Alarm | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | **3** | **3** | **3** | **3** | **3** | **3** | **3** |
| Drive Type | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Display Units | **0** | **0** | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | **1** | **1** | **1** | **1** | **1** |
| Leveling Mode | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Drive Control | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | **2** | **2** | **2** | **2** | **2** | **2** | **2** |
| Drive Pump | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **1** | **1** | **1** | **1** | **1** | **1** | **1** |
| | X | X | X | X | X | X | X |
| | X | X | X | X | X | X | X |
| Boom Control | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Function Speed Knob | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Clearsky | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

**Table 6-4. 860SJ Machine Configuration Programming Settings (Software Version P6.22)**

| 860 SJ | ANSI USA | ANSI Export | CSA | CE | Australia | Japan | GB |
|---|---|---|---|---|---|---|---|
| Cribbing Option | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Fuel Tank Size | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Alarm / Horn | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Alert Beacon | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Temp Cutout | X | **0** | X | **0** | X | X | 0 |
| | X | 1 | X | 1 | X | X | 1 |
| Plat Lvl Ovr Cut | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Water In Fuel Sensor | X | **0** | X | X | X | X | **0** |
| | X | 1 | X | X | X | X | 1 |
| Dual Capacity | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 | ***1*** |

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

## 6.2 MACHINE PERSONALITY SETTINGS AND FUNCTION SPEEDS

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

**Table 6-5. Machine Personality Settings and Function Speeds.**

| FUNCTION | PERSONALITY | RANGE | SAUER DANFOSS | | | EATON | | |
|---|---|---|---|---|---|---|---|---|
| | | | DEFAULTS-800S | DEFAULTS-810SJ | DEFAULTS-860SJ | DEFAULTS-800S | DEFAULTS-810SJ | DEFAULTS-860SJ |
| DRIVE | ACCELeration | 0.1 to 5.0 s | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| | DECELeration | 0.1 to 3.0 s | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| | FORward MINimum speed | 0 to 35%% | 4 | 4 | 4 | 15 | 15 | 15 |
| | FORward MAXimum speed | 0 to 100% | 30 | 30 | 30 | 53 | 53 | 53 |
| | REVerse MINimum speed | 0 to 35% | 4 | 4 | 4 | 15 | 15 | 15 |
| | REVerse MAXimum speed | 0 to 100% | 30 | 30 | 30 | 53 | 53 | 53 |
| | ELEVATED MAXimum speed | 0 to 50% | 20 | 20 | 20 | 28 | 28 | 28 |
| | CREEP MAXimum speed | 0 to 50% | 20 | 20 | 20 | 30 | 30 | 30 |
| | Engine RPM | 800 to 2900 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| | | | | | | | | |
| STEER | MAXimum speed | 1 to 100% | 100 | 100 | 100 | 100 | 100 | 100 |
| | Engine RPM | 800 to 2900 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| | | | | | | | | |
| MAIN LIFT | ACCELeration | 0.1 to 5.0s | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| | DECELeration | 0.1 to 3.0s | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| | MINimum UP speed | 0 to 60% | 15 | 15 | 15 | 15 | 15 | 15 |
| | MAXimum UP speed | 0 to 100% | 80 | 80 | 80 | 80 | 80 | 80 |
| | CREEP maximum UP speed | 0 to 65% | 30 | 30 | 30 | 30 | 30 | 30 |
| | MINimum DOWN speed | 0 to 60% | 15 | 15 | 15 | 15 | 15 | 15 |
| | MAXimum DOWN speed | 0 to 100% | 80 | 80 | 80 | 80 | 80 | 80 |
| | CREEP maximum DOWN speed | 0 to 75% | 30 | 30 | 30 | 30 | 30 | 30 |
| | Engine RPM | 800 to 2900 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| | | | | | | | | |
| SWING | ACCELeration | 0.1to 5.0s | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 |
| | DECELeration | 0.1 to 3.0s | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 |
| | MINimum LEFT speed | 0 to 50% | 14 | 14 | 14 | 14 | 14 | 14 |
| | MAXimum LEFT speed | 0 to 100% | 65 | 65 | 65 | 65 | 65 | 65 |
| | CREEP maximum LEFT speed | 0 to 65% | 43 | 43 | 43 | 43 | 43 | 43 |
| | MINimum RIGHT speed | 0 to 50% | 14 | 14 | 14 | 14 | 14 | 14 |
| | MAXimum RIGHT speed | 0 to 100% | 68 | 68 | 68 | 68 | 68 | 68 |
| | CREEP maximum RIGHT speed | 0 to 65% | 49 | 49 | 49 | 49 | 49 | 49 |
| | Engine RPM | 800 to 2900 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| | | | | | | | | |

**Table 6-5. Machine Personality Settings and Function Speeds.**

| FUNCTION | PERSONALITY | RANGE | SAUER DANFOSS | | | EATON | | |
|---|---|---|---|---|---|---|---|---|
| | | | DEFAULTS-800S | DEFAULTS-810SJ | DEFAULTS-860SJ | DEFAULTS-800S | DEFAULTS-810SJ | DEFAULTS-860SJ |
| MAIN TELESCOPE | ACCELeration | 0.1 to 5.0s | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| | DECELeration | 0.1 to 3.0s | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| | MINimum IN speed | 0 to 65% | 24 | 24 | 24 | 24 | 24 | 24 |
| | MAXimum IN speed | 0 to 100% | 63 | 63 | 63 | 63 | 63 | 63 |
| | MINimum OUT speed | 0 to 65% | 26 | 26 | 26 | 26 | 26 | 26 |
| | MAXimum OUT speed | 0 to 100% | 65 | 65 | 65 | 65 | 65 | 65 |
| | Medium Speed | 0.01 to 1.00 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| | Engine RPM | 800 to 2900 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| | | | | | | | | |
| PLATFORM LEVEL | ACCELeration | 0.1to 5.0s | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| | DECELeration | 0.1to 3.0s | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| | MINimum UP speed | 0 to 65% | 48 | 48 | 48 | 48 | 48 | 48 |
| | MAXimum UP speed | 0 to 100% | 100 | 100 | 100 | 100 | 100 | 100 |
| | MINimum DOWN speed | 0 to 65% | 48 | 48 | 48 | 48 | 48 | 48 |
| | MAXimum DOWN speed | 0 to 100% | 100 | 100 | 100 | 100 | 100 | 100 |
| | Medium Speed | 0.01 to 1.00 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| | Engine RPM | 800 to 2900 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| | | | | | | | | |
| PLATFORM ROTATE | ACCELeration | 0.1to 5.0s | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| | DECELeration | 0.1to 3.0s | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| | MINimum LEFT speed | 0 to 65% | 69 | 69 | 69 | 69 | 69 | 69 |
| | MAXimum LEFT speed | 0 to 100% | 90 | 90 | 90 | 90 | 90 | 90 |
| | MINimum RIGHT speed | 0 to 65% | 69 | 69 | 69 | 69 | 69 | 69 |
| | MAXimum RIGHT speed | 0 to 100% | 90 | 90 | 90 | 90 | 90 | 90 |
| | Medium Speed | 0.01 to 1.00 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| | Engine RPM | 800 to 2900 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| | | | | | | | | |
| JIB LIFT | Lift ACCELeration | 0.1 to 5.0s | N/A | 3.3 | 3.3 | N/A | 3.3 | 3.3 |
| | Lift DECELeration | 0.1 to 3.0s | N/A | 0.8 | 0.8 | N/A | 0.8 | 0.8 |
| | MINimum UP speed | 0 to 65% | N/A | 43 | 43 | N/A | 43 | 43 |
| | MAXimum UP speed | 0 to 100% | N/A | 80 | 80 | N/A | 80 | 80 |
| | MINimum down | 0 to 65% | N/A | 40 | 40 | N/A | 40 | 40 |
| | MAXimum Down | 0 to 100% | N/A | 75 | 75 | N/A | 75 | 75 |
| | Medium Speed | 0.01 to 1.00 | N/A | 0.60 | 0.60 | N/A | 0.60 | 0.60 |
| | Engine RPM | 800 to 2900 | N/A | 1800 | 1800 | N/A | 1800 | 1800 |
| | | | | | | | | |

**Table 6-5. Machine Personality Settings and Function Speeds.**

| FUNCTION | PERSONALITY | RANGE | SAUER DANFOSS | | | EATON | | |
|---|---|---|---|---|---|---|---|---|
| | | | DEFAULTS-800S | DEFAULTS-810SJ | DEFAULTS-860SJ | DEFAULTS-800S | DEFAULTS-810SJ | DEFAULTS-860SJ |
| GROUND MODE | Tower LIFT UP speed | 0 to 100% | N/A | N/A | N/A | N/A | N/A | N/A |
| | Tower LIFT DOWN speed | 0 to 100% | N/A | N/A | N/A | N/A | N/A | N/A |
| | Main LIFT UP speed | 0 to 100% | 63 | 63 | 63 | 63 | 63 | 63 |
| | Main LIFT DOWN speed | 0 to 100% | 63 | 63 | 63 | 63 | 63 | 63 |
| | SWING speed | 0 to 100% | 64 | 64 | 64 | 64 | 64 | 64 |
| | Main TELEscope speed | 0 to 100% | 62 | 62 | 62 | 62 | 62 | 62 |
| | Tower TELEscope speed | 0 to 100% | N/A | N/A | N/A | N/A | N/A | N/A |
| | BASKET ROTATE speed | 0 to 100% | 89 | 89 | 89 | 89 | 89 | 89 |
| | BASKET LEVEL speed | 0 to 100% | 99 | 99 | 99 | 99 | 99 | 99 |
| | Jib LIFT (UP/DOWN) speed | 0 to 100% | N/A | 79 | 79 | N/A | 79 | 79 |
| | Jib LIFT (LEFT/RIGHT) speed | 0 to 100% | N/A | N/A | N/A | N/A | N/A | N/A |
| | | | | | | | | |

**Note**: Ground Mode speed are automatically limited to being lower than platform speed for a given function.

4150384-L

## 6.3 MACHINE ORIENTATION WHEN DOING SPEED TESTS

**Lift**: Telescope Retracted, Lift Up and Record Time, Lift Down and Record Time. Do not include end of travel slow down in recorded speed.

**Swing**: Boom at Full Elevation. Telescope Retracted. Swing the Turntable 360 degrees, Record Time. Swing the Opposite Direction, Record Time.

**Telescope**: Boom at Full Elevation; Telescope Retracted; Telescope Out, Record Time. Telescope In, Record Time.

**Drive (Forward/Reverse)**: Test should be done on a smooth level surface. Drive Select Switch should be set to High Engine. Results should be recorded for a 200 ft. course. Drive Forward, Record Time.

**Drive (Elevated)**: Test should be done on a smooth level surface. Drive Select Switch should be set to High Engine. Results should be recorded for a 50 ft. course. Drive Forward, Record Time.

**Platform Rotate**: Platform level and completely rotated one direction. Rotate the opposite direction, Record Time. Rotate the other direction, Record Time.

**Articulating Jib**: Platform level and centered with the boom. Start with the Jib down. Jib Up, Record Time. Jib Down, Record Time.

### Test Notes

1. Stop watch should be started with the function, not with the controller or switch.
2. All speed tests are run from the platform. These speeds do not reflect the ground control operation.
3. The platform speed knob control must be at full speed (turned clockwise completely).
4. Function speeds may vary due to cold, thick hydraulic oil. Test should be run with the oil temperature above 100° F (38° C).
5. Some flow control functions may not work with the speed knob clicked into the creep position.

**Table 6-6. Function Speeds (In Seconds)**

| Function | 800S | 810SJ | 860SJ |
|---|---|---|---|
| Lift Up | 59-75 | 54-70 | 56-73 |
| Lift Down | 57-75 | 54-72 | 56-75 |
| Swing Right & Left* | 110-135 | 110-135 | 110-135 |
| ***NOTE:*** *No more than 10% difference between swing left and swing right.* | | | |
| Telescope Out | 59-65 | 55-64 | 56-65 |
| Telescope In | 45-57 | 43-59 | 44-60 |
| Platform Rotate Right & Left** | 18-30 | 18-30 | 18-30 |
| ***NOTE:*** *No more than 15% difference between rotate left and rotate right.* | | | |
| Jib Up | N/A | 33-47 | 33-47 |
| Jib Down | N/A | 29-39 | 29-39 |
| Drive (Forward) | 33-45 | 33-45 | 33-45 |
| Drive (Reverse) | 33-45 | 33-45 | 33-45 |
| Drive (Elevated) | 46-75 | 46-75 | 46-75 |

## 6.4 CANBUS COMMUNICATIONS

CANbus: CAN (Control Area Network) is a two wire differential serial link between the Platform Module, Jib Module, Ground Module, Boom Length Angle Module and the Chassis Module providing bi-directional communications.

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

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

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

A complete CANbus circuit is approximately 60 ohms, which can be verified at the "T" fitting inside the ground station or below the BLAM. Each individual circuit from the modules is approximately 120 ohms.

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

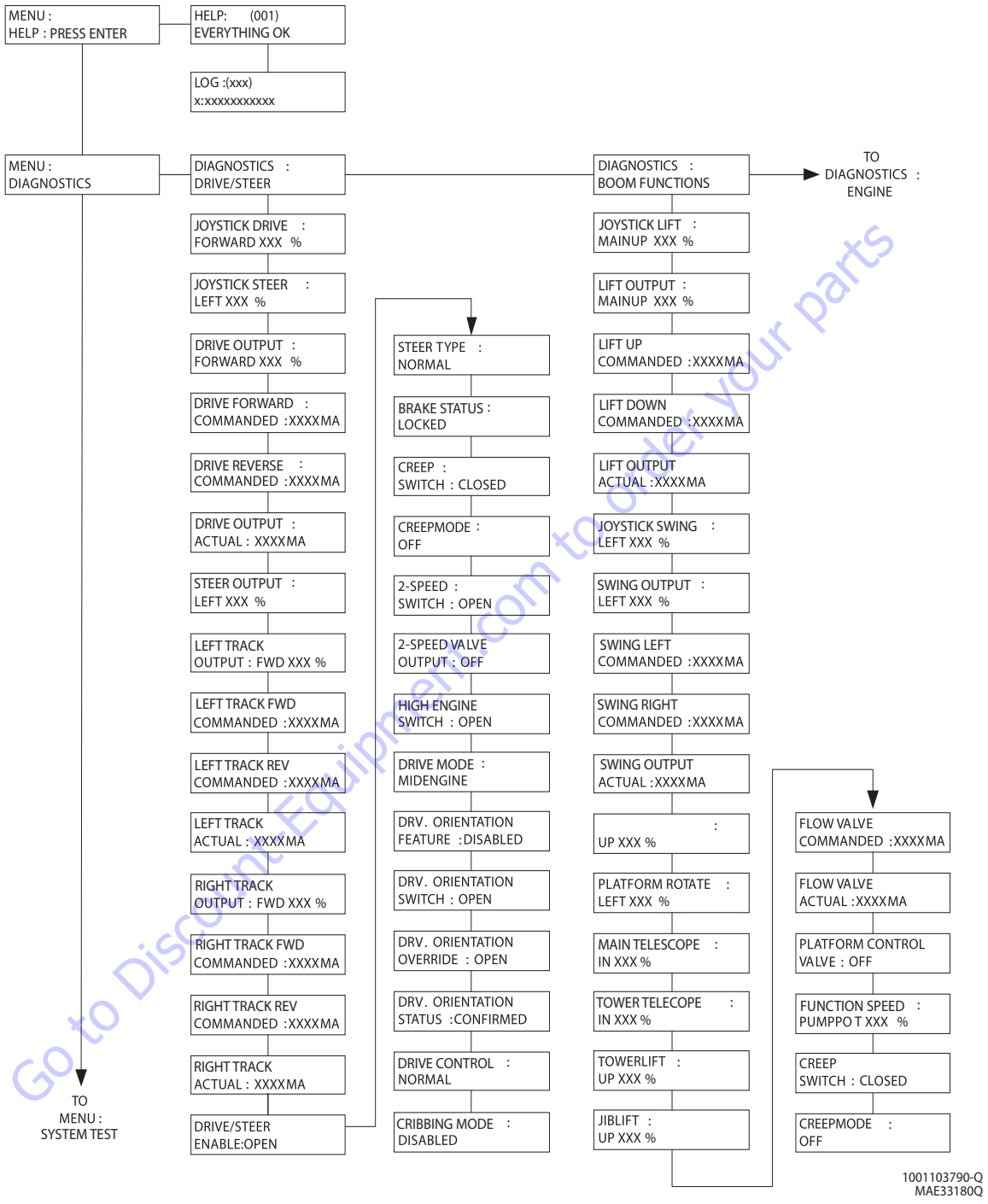
**Interlocks**: Any device that sends an electrical input. (For an example a limit switch, proximity switch, etc).

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

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

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

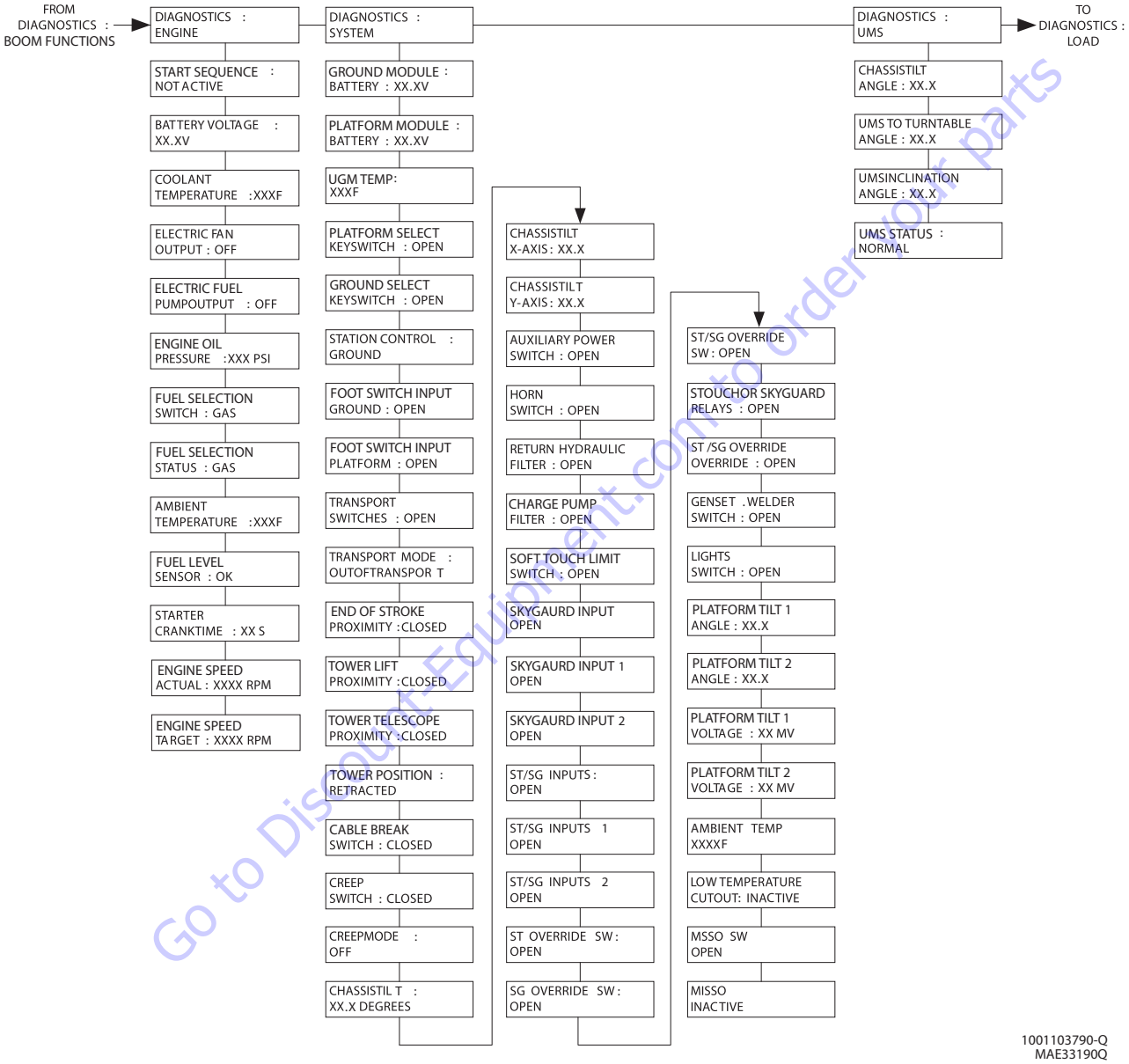
**Lift, Tele, & Swing**: The GROUND MODULE stores default values and handles interlocks and calibration information. Lift, Telescope and Swing commands are dependent upon interlocks through out the machine. Boom angle, length and swing are controlled by the GROUND MODULE.






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

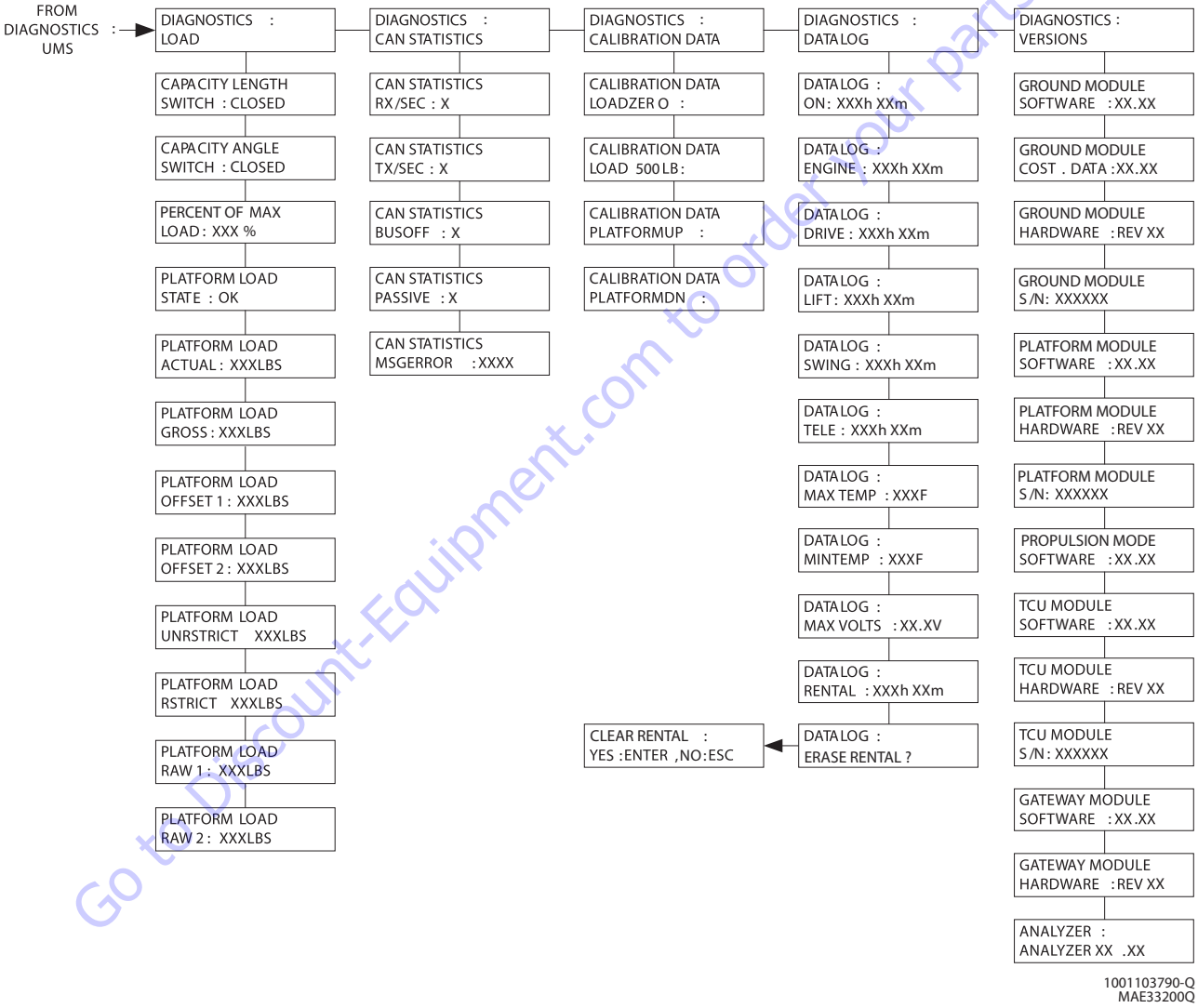
**Figure 6-3. Analyzer Flow Chart - Diagnostics (Software Version P6.22) - Sheet 1 of 9**






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

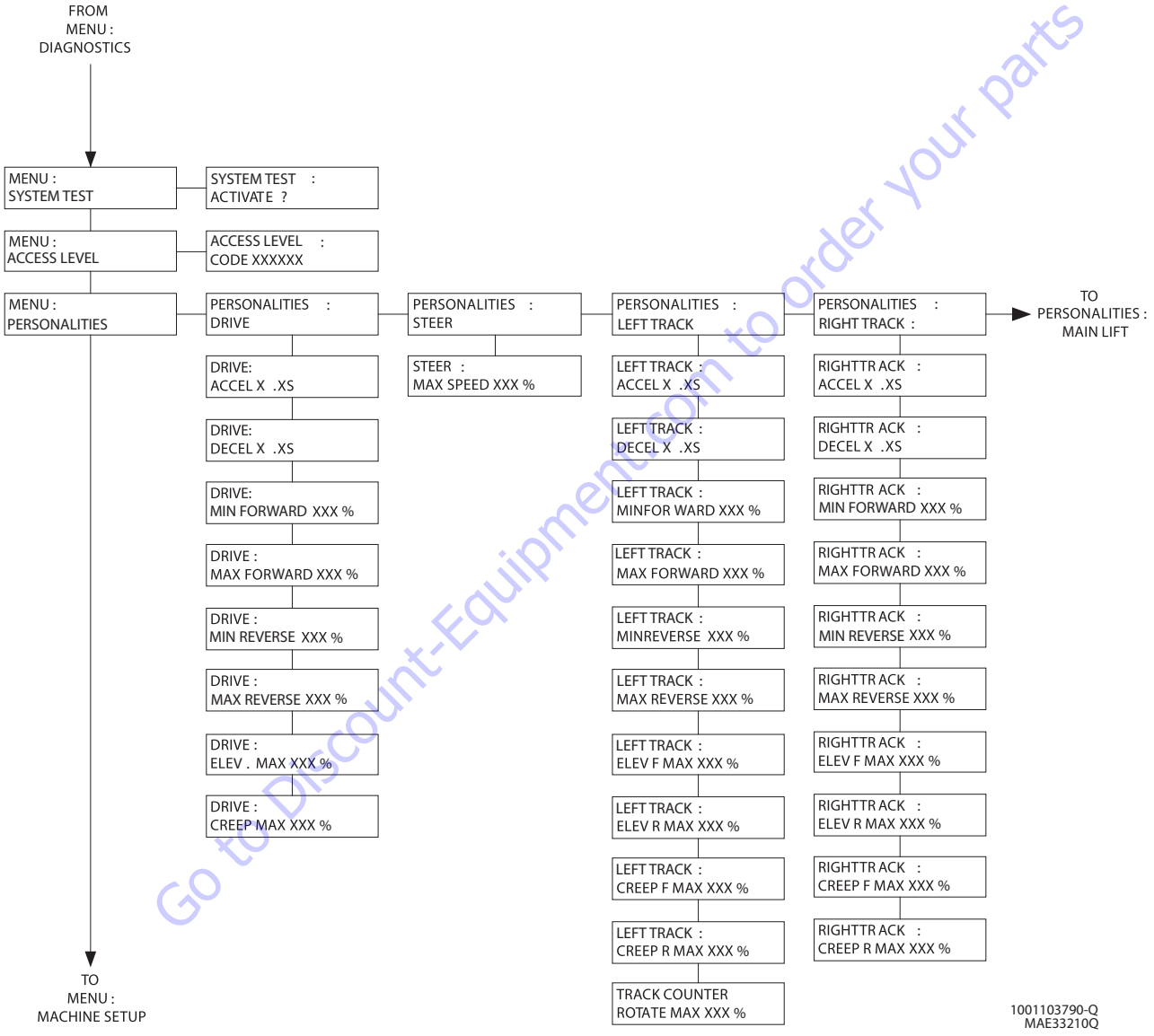
**Figure 6-4. Analyzer Flow Chart - Diagnostics (Software Version P6.22) - Sheet 2 of 9**






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

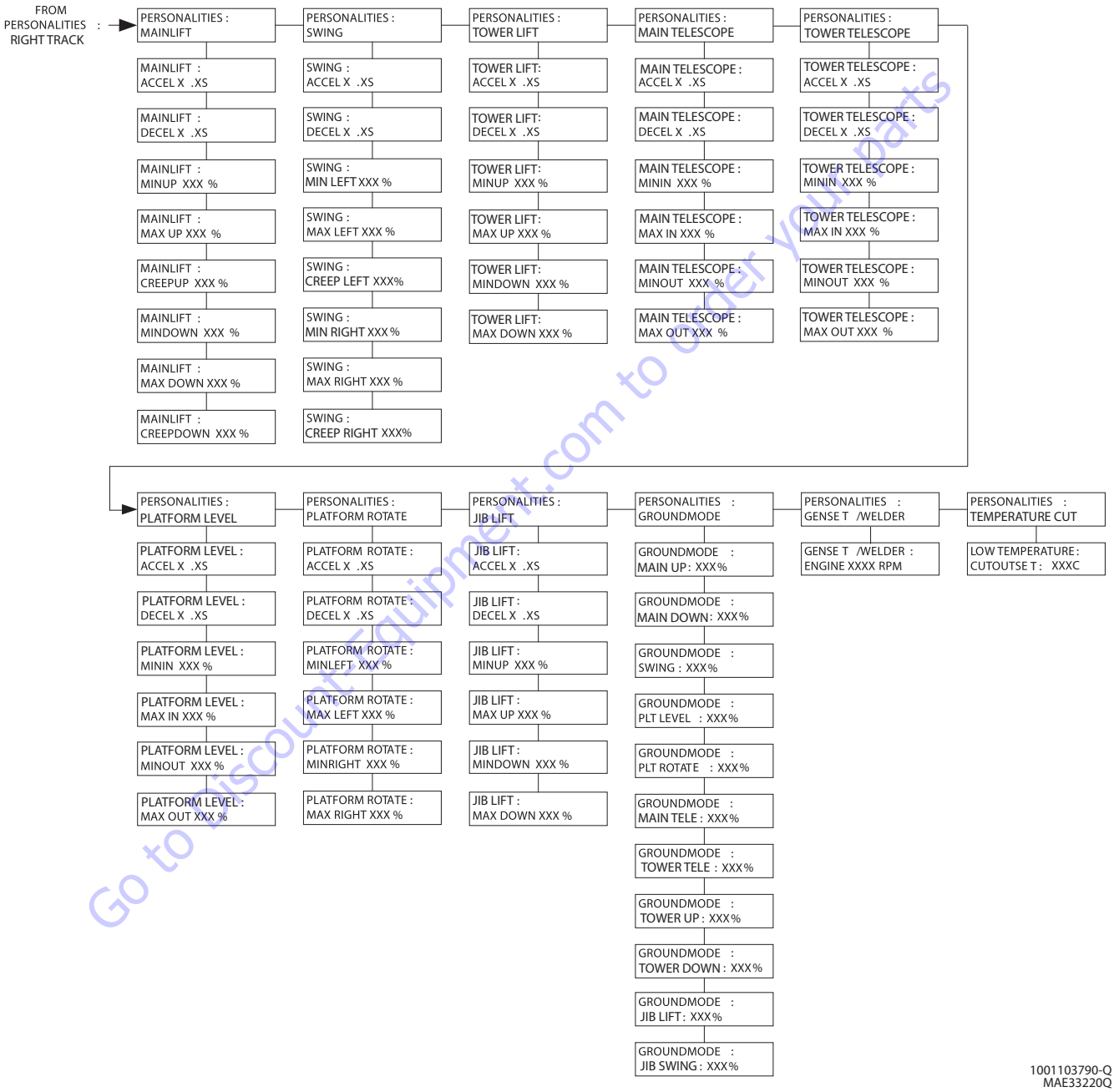
**Figure 6-5. Analyzer Flow Chart - Diagnostics (Software Version P6.22) - Sheet 3 of 9**






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

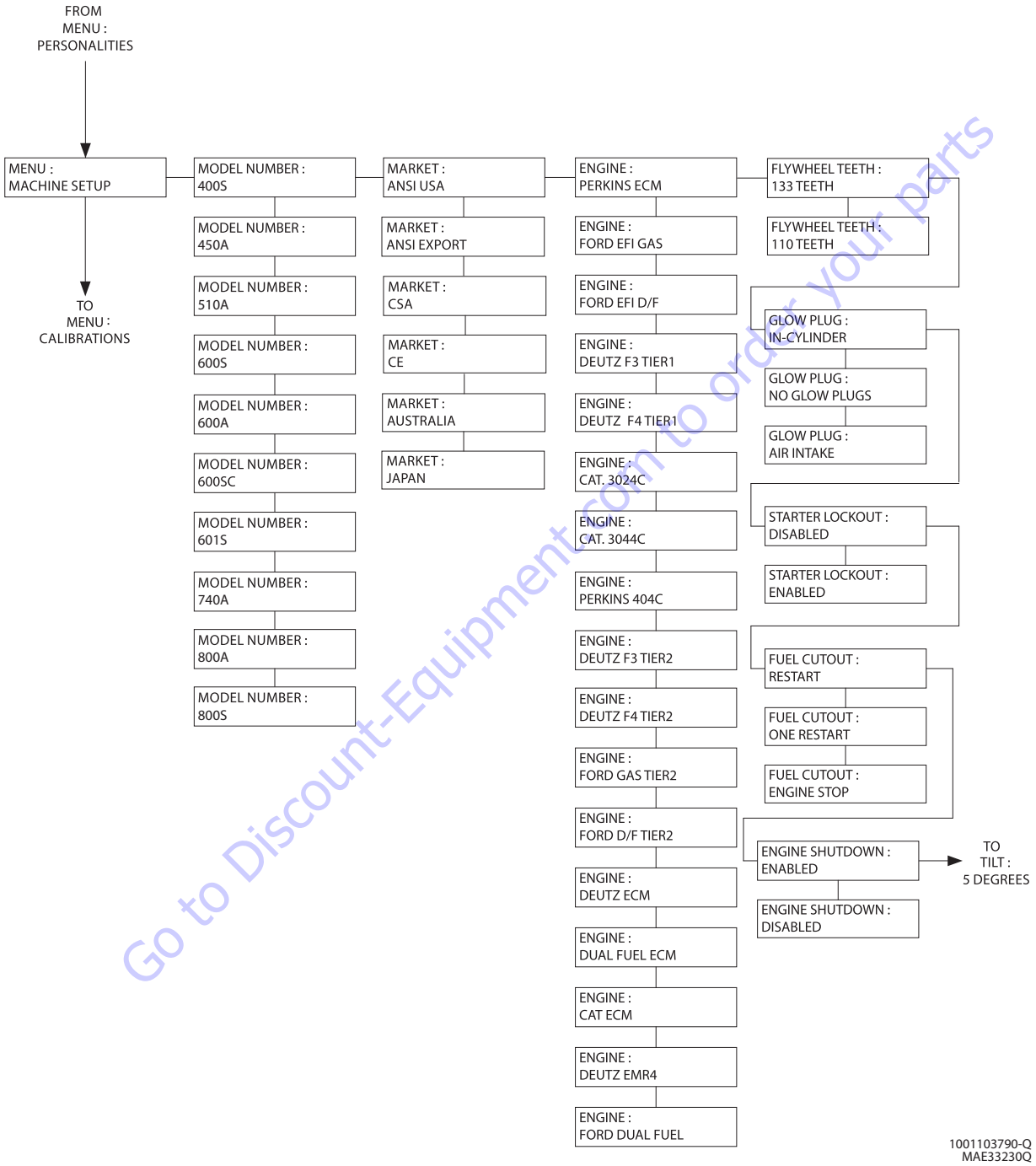
**Figure 6-6. Analyzer Flow Chart - Diagnostics (Software Version P6.22) - Sheet 4 of 9**






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

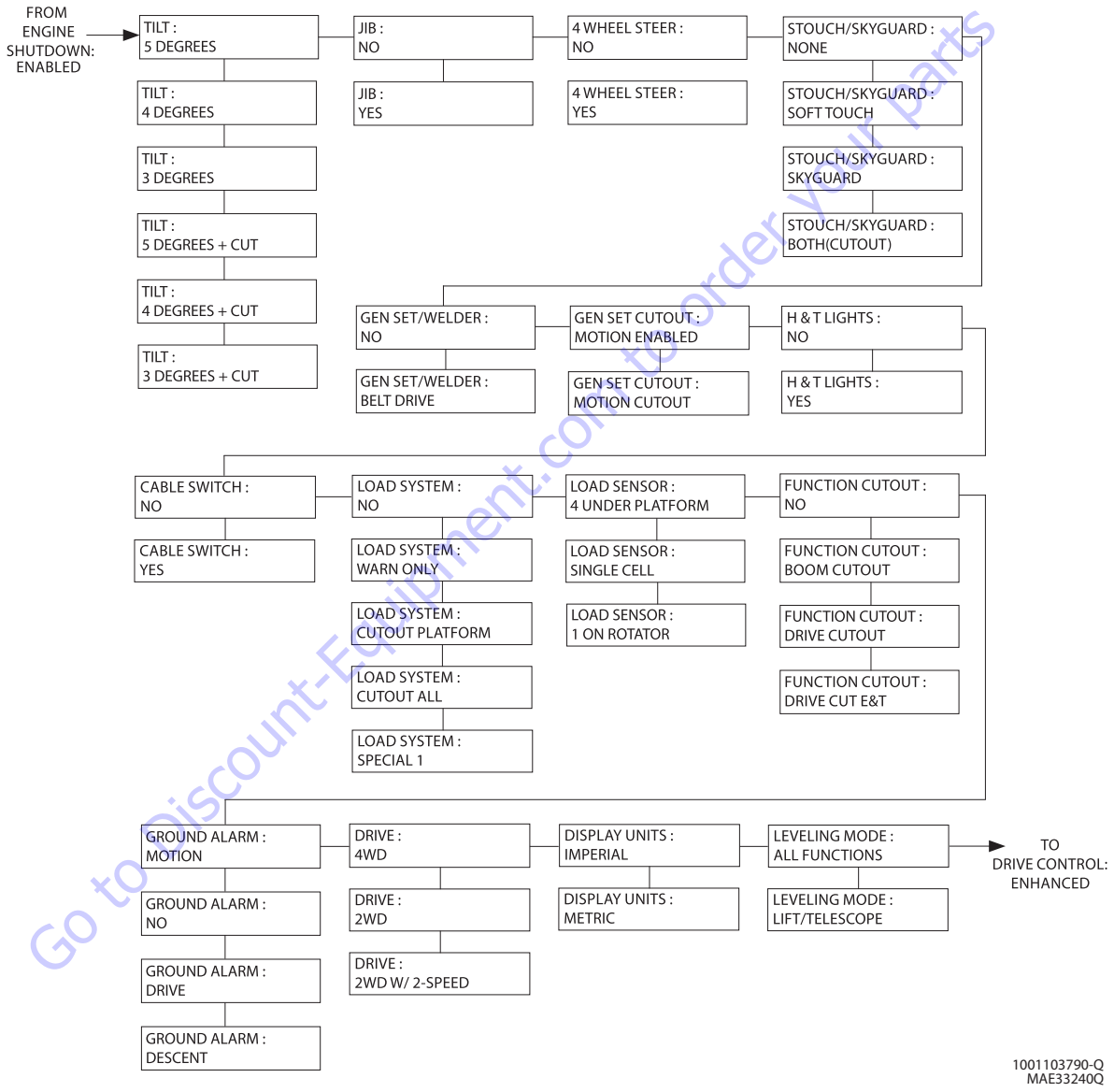
**Figure 6-7. Analyzer Flow Chart - Diagnostics (Software Version P6.22) - Sheet 5 of 9**






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

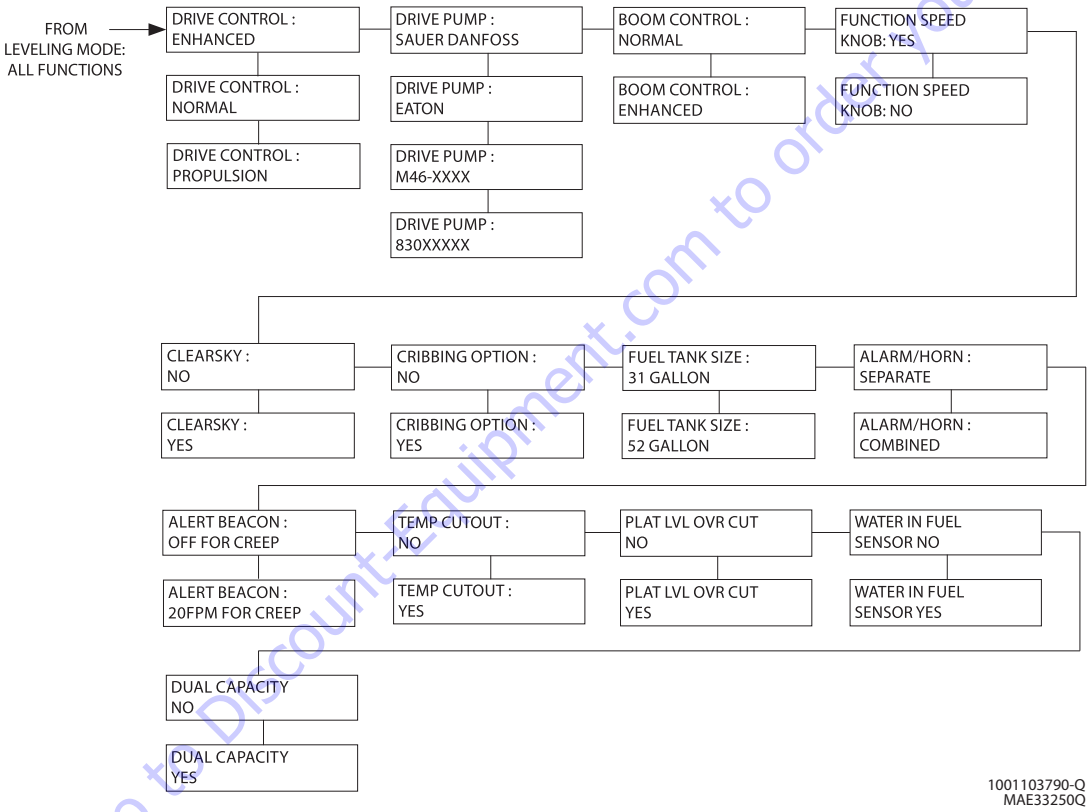
**Figure 6-8. Analyzer Flow Chart - Diagnostics (Software Version P6.22) - Sheet 6 of 9**






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

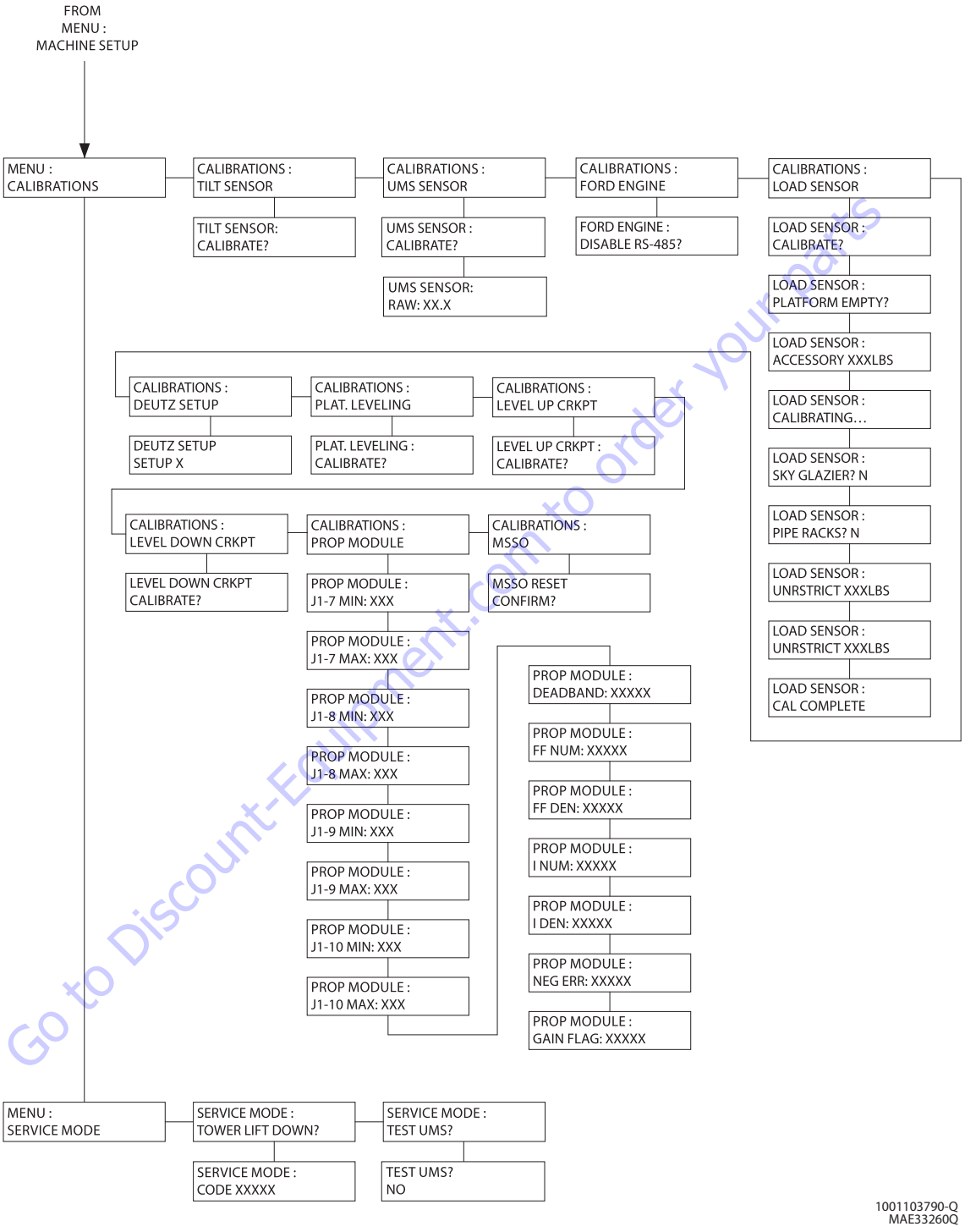
**Figure 6-9. Analyzer Flow Chart - Diagnostics (Software Version P6.22) - Sheet 7 of 9**






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

**Figure 6-10. Analyzer Flow Chart - Diagnostics (Software Version P6.22) - Sheet 8 of 9**






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

**Figure 6-11. Analyzer Flow Chart - Diagnostics (Software Version P6.22) - Sheet 9 of 9**

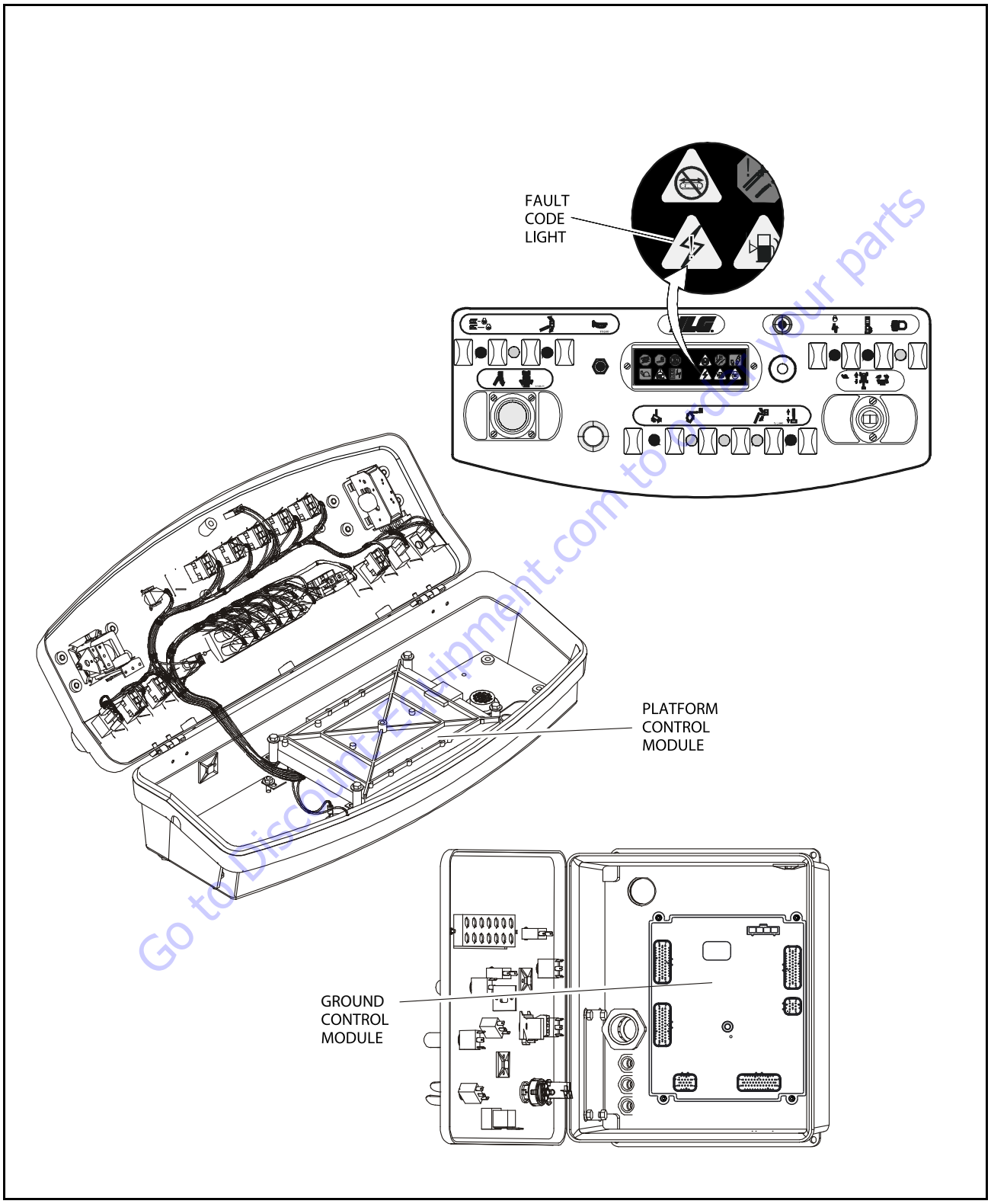
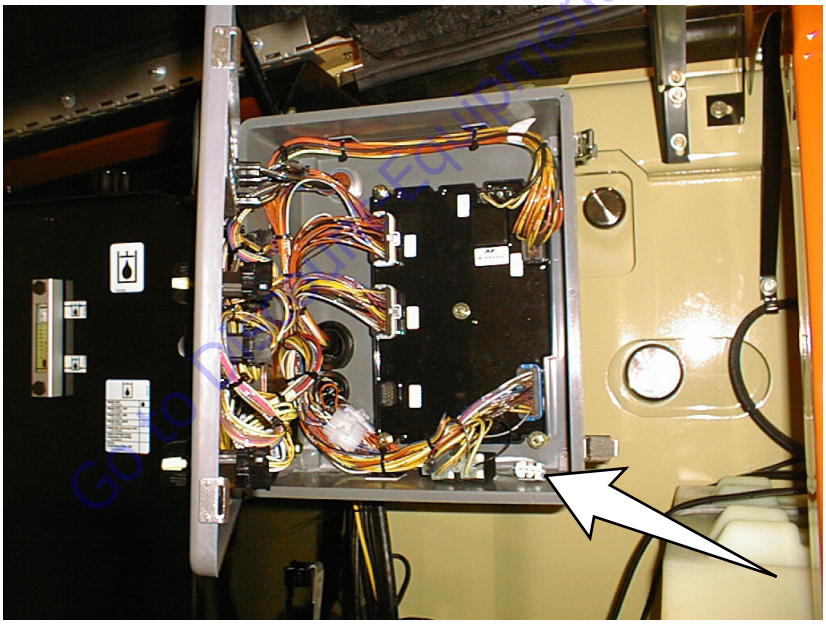





**Figure 6-12. Fault Code Light and module Location**


PLATFORM CONNECTION



GROUND CONTROL CONNECTION



**Figure 6-13. Analyzer Connecting Points**

| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| J1 (Natural) | 1 | ENGINE THROTTLE ACTUATOR | DIGITAL | OUTPUT |
| | 2 | LP START ASSIST | DIGITAL | OUTPUT |
| | 3 | DRIVE / LEFT TRACK FORWARD COIL | DIGITAL | OUTPUT |
| | 4 | GROUND | GROUND | INPUT |
| | 5 | GROUND | GROUND | INPUT |
| | 6 | DRIVE / LEFT TRACK REVERSE COIL | DIGITAL | OUTPUT |
| | 7 | LP LOCK / ELECTRIC FAN DRIVE | DIGITAL | OUTPUT |
| | 8 | GROUND | GROUND | INPUT |
| | 9 | GROUND | GROUND | INPUT |
| | 10 | IGNITION ON RELAY / ALTERNATOR EXCITATION / FUEL ON SOLENOID | DIGITAL | OUTPUT |
| | 11 | START SOLENOID | DIGITAL | OUTPUT |
| | 12 | ENGAGE GLOW PLUGS | DIGITAL | OUTPUT |
| | 13 | APU ENABLE RELAY | DIGITAL | OUTPUT |
| | 14 | ENGINE COOLANT TEMPERATURE | ANALOG | INPUT |
| | 15 | ENGINE OIL PRESSURE | ANALOG | INPUT |
| | 16 | ENGINE SPEED | FREQUENCY | INPUT |
| | 17 | GROUND | GROUND | INPUT |
| | 18 | GROUND | GROUND | INPUT |
| | 19 | GROUND | GROUND | INPUT |
| | 20 | 2-SPEED VALVE | DIGITAL | OUTPUT |
| | 21 | CHARGE PUMP FILTER BY-PASS | DIGITAL | INPUT |
| | 22 | GENERATOR ENABLE RELAY | DIGITAL | OUTPUT |
| | 23 | BRAKE VALVE | DIGITAL | OUTPUT |
| | 24 | NOT CONNECTED | N/C | N/C |
| | 25 | RS-485 HIGH | SERIAL | I/O |
| | 26 | RS-485 LOW | SERIAL | I/O |
| | 27 | GROUND | GROUND | INPUT |
| | 28 | ANALYZER POWER | VOLTAGE | OUTPUT |
| | 29 | ANALYZER RS-232 RX | SERIAL | INPUT |
| | 30 | ANALYZER RS-232 TX | SERIAL | OUTPUT |
| | 31 | ANALYZER GROUND | GROUND | INPUT |
| | 32 | ALTERNATOR EXCITATION | DIGITAL | OUTPUT |
| | 33 | RS-485 GROUND | GROUND | INPUT |
| | 34 | AIR FILTER BY-PASS | DIGITAL | INPUT |
| | 35 | NOT CONNECTED | DIGITAL | INPUT |

| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| J2 (Gray) | 1 | STEER DUMP VALVE | DIGITAL | OUTPUT |
| | 2 | HORN OUTPUT | DIGITAL | OUTPUT |
| | 3 | TOWER TELESCOPE IN SOLENOID | DIGITAL | OUTPUT |
| | 4 | MAIN TELESCOPE IN SOLENOID | DIGITAL | OUTPUT |
| | 5 | PLATFORM LEVEL UP SOLENOID | DIGITAL | OUTPUT |
| | 6 | GROUND | GROUND | INPUT |
| | 7 | PLATFORM LEVEL DOWN SOLENOID | DIGITAL | OUTPUT |
| | 8 | RIGHT TRACK REVERSE COIL | DIGITAL | OUTPUT |
| | 9 | NOT ALLOCATED | DIGITAL | OUTPUT |
| | 10 | PLATFORM ROTATE LEFT SOLENOID | DIGITAL | OUTPUT |
| | 11 | MAIN LIFT UP SOLENOID | DIGITAL | OUTPUT |
| | 12 | JIB UP SOLENOID | DIGITAL | OUTPUT |
| | 13 | MAIN DUMP VALVE | DIGITAL | OUTPUT |
| | 14 | GROUND | GROUND | INPUT |
| | 15 | TOWER TELESCOPE OUT SOLENOID | DIGITAL | OUTPUT |
| | 16 | MAIN TELESCOPE OUT SOLENOID | DIGITAL | OUTPUT |
| | 17 | GROUND | GROUND | INPUT |
| | 18 | GROUND | GROUND | INPUT |
| | 19 | RIGHT TRACK FORWARD COIL | DIGITAL | OUTPUT |
| | 20 | NOT ALLOCATED | DIGITAL | OUTPUT |
| | 21 | PLATFORM ROTATE RIGHT SOLENOID | DIGITAL | OUTPUT |
| | 22 | MAIN LIFT DOWN SOLENOID | DIGITAL | OUTPUT |
| | 23 | JIB DOWN SOLENOID | DIGITAL | OUTPUT |
| | 24 | RETURN FILTER BY-PASS | DIGITAL | INPUT |
| | 25 | FUEL LEVEL SENSOR | ANALOG | INPUT |
| | 26 | HEAD / TAIL LIGHT ENABLE RELAY | DIGITAL | OUTPUT |
| | 27 | ALARM OUTPUT | DIGITAL | OUTPUT |
| | 28 | GROUND | GROUND | INPUT |
| | 29 | GROUND | GROUND | INPUT |
| | 30 | GROUND | GROUND | INPUT |
| | 31 | FLOW CONTROL VALVE | DIGITAL | OUTPUT |
| | 32 | TOWER LIFT DOWN SOLENOID | DIGITAL | OUTPUT |
| | 33 | TOWER LIFT UP SOLENOID | DIGITAL | OUTPUT |
| | 34 | SWING LEFT SOLENOID | DIGITAL | OUTPUT |
| | 35 | SWING RIGHT SOLENOID | DIGITAL | OUTPUT |

| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| J3 (Black) | 1 | DRIVE / LEFT TRACK CURRENT FEEDBACK | GROUND | INPUT |
| | 2 | RIGHT TRACK CURRENT FEEDBACK | GROUND | INPUT |
| | 3 | GROUND | GROUND | INPUT |
| | 4 | SWING CURRENT FEEDBACK | GROUND | INPUT |
| | 5 | NOT CONNECTED | GROUND | INPUT |
| | 6 | FLOW CONTROL CURRENT FEEDBACK | GROUND | INPUT |
| | 7 | BATTERY VOLTAGE | VBAT | OUTPUT |
| | 8 | UMS ANGLE SENSOR | DIGITAL | INPUT |
| | 9 | CRIBBING ENGAGE SWITCH | DIGITAL | INPUT |
| | 10 | NOT CONNECTED | DIGITAL | INPUT |
| | 11 | CONFIGURATION #1 | DIGITAL | INPUT |
| | 12 | NOT CONNECTED | VOLTAGE | OUTPUT |
| | 13 | NOT CONNECTED | ANALOG | INPUT |
| | 14 | LIFT CURRENT FEEDBACK | GROUND | INPUT |

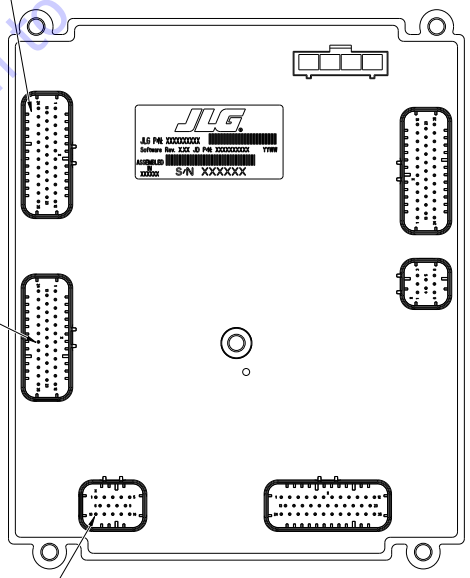



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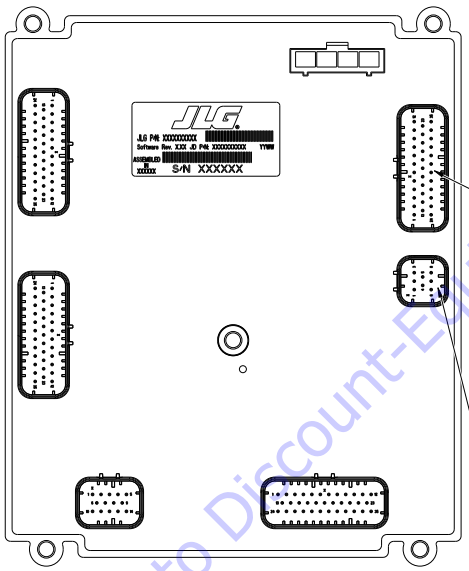
**Figure 6-14. Ground Control Module - Sheet 1 of 3**




| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| J7 (Black) | 1 | PLATFORM EMS | DIGITAL | INPUT |
| | 2 | PLATFORM MODE | DIGITAL | INPUT |
| | 3 | GROUND MODE | DIGITAL | INPUT |
| | 4 | CAPACITY ANGLE SWITCH | ANALOG | INPUT |
| | 5 | +5 VOLTS | VOLTAGE | OUTPUT |
| | 6 | CAN1 TERMINATOR | TERM | I/O |
| | 7 | CAPACITY LENGTH SWITCH | ANALOG | INPUT |
| | 8 | NOT CONNECTED | ANALOG | INPUT |
| | 9 | GROUND | GROUND | INPUT |
| | 10 | GROUND | GROUND | INPUT |
| | 11 | IN/OUT OF TRANSPORT SWITCHES | DIGITAL | INPUT |
| | 12 | BROKEN CABLE SWITCH | DIGITAL | INPUT |
| | 13 | CAN1 HIGH | SERIAL | I/O |
| | 14 | GROUND MODE POWER TO PLATFORM | DIGITAL | INPUT |
| | 15 | FOOTSWITCH | DIGITAL | INPUT |
| | 16 | +5 VOLTS | VOLTAGE | OUTPUT |
| | 17 | CAN1 TERMINATOR | TERM | I/O |
| | 18 | CAN1 SHEILD | GROUND | INPUT |
| | 19 | GROUND | GROUND | INPUT |
| | 20 | NOT CONNECTED | ANALOG | INPUT |
| | 21 | TOWER TELESCOPE PROXIMITY (800A ONLY)/DRIVE ORIENTATION SWITCH | DIGITAL | INPUT |
| | 22 | TOWER LIFT PROXIMITY (800A ONLY) | DIGITAL | INPUT |
| | 23 | GROUND FUNCTION ENABLE AVAILABLE | DIGITAL | INPUT |
| | 24 | CAN1 LOW | SERIAL | I/O |
| | 25 | GROUND | GROUND | INPUT |
| | 26 | +5 VOLTS | VOLTAGE | OUTPUT |
| | 27 | +5 VOLTS | VOLTAGE | OUTPUT |
| | 28 | GROUND | GROUND | INPUT |
| | 29 | BATTERY VOLTAGE | VBAT | OUTPUT |
| | 30 | BATTERY VOLTAGE | VBAT | OUTPUT |
| | 31 | BATTERY VOLTAGE | VBAT | OUTPUT |
| | 32 | BATTERY VOLTAGE | VBAT | OUTPUT |
| | 33 | BATTERY VOLTAGE | VBAT | OUTPUT |
| | 34 | BATTERY VOLTAGE (PROPULSION MODULE) | VBAT | OUTPUT |
| | 35 | BOOM ANGLE PROXIMITY SWITCH (800S ONLY)/DRIVE ORIENTATION SWITCH | DIGITAL | INPUT |

| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| J12 (Black) | 1 | NOT CONNECTED | FREQUENCY | INPUT |
| | 2 | NOT CONNECTED | FREQUENCY | INPUT |
| | 3 | CAN2 HIGH (TELEMATICS) | SERIAL | I/O |
| | 4 | CAN2 LOW (TELEMATICS) | SERIAL | I/O |
| | 5 | CAN2 SHIELD (TELEMATICS) | GROUND | INPUT |
| | 6 | CAN2 TERMINATOR | TERM | I/O |
| | 7 | CAN2 TERMINATOR | TERM | I/O |
| | 8 | MSSO | DIGITAL | INPUT |

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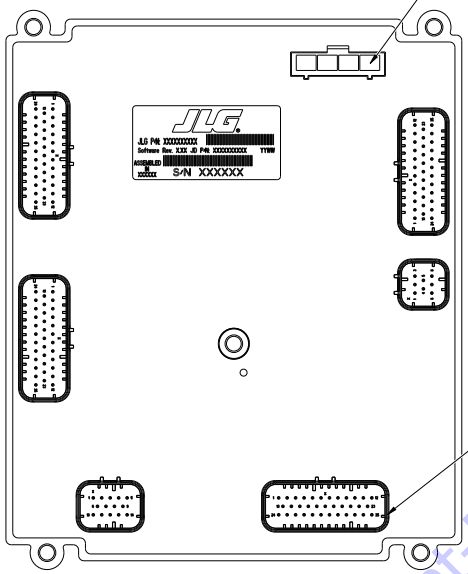
**Figure 6-15. Ground Control Module - Sheet 2 of 3**




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

| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| J4 (Blue) | 1 | CRIBBING ENGAGED INDICATOR | DIGITAL | OUTPUT |
| | 2 | 500 LB CAPACITY LAMP | DIGITAL | OUTPUT |
| | 3 | GLOWPLUG INDICATOR | DIGITAL | OUTPUT |
| | 4 | ENGINE START | DIGITAL | INPUT |
| | 5 | PLATFORM LEVEL DOWN | DIGITAL | INPUT |
| | 6 | PLATFORM ROTATE LEFT | DIGITAL | INPUT |
| | 7 | MAIN TELESCOPE IN | DIGITAL | INPUT |
| | 8 | JIB DOWN | DIGITAL | INPUT |
| | 9 | JIB LEFT | DIGITAL | INPUT |
| | 10 | TOWER LIFT UP | DIGITAL | INPUT |
| | 11 | TOWER TELESCOPE IN | DIGITAL | INPUT |
| | 12 | HOURMETER | DIGITAL | OUTPUT |
| | 13 | RETURN FILTER BY-PASS LAMP | DIGITAL | OUTPUT |
| | 14 | PLATFORM OVERLOADED INDICATOR | DIGITAL | OUTPUT |
| | 15 | BOOM MALFUNCTION INDICATOR | DIGITAL | OUTPUT |
| | 16 | AUXILIARY POWER / FUNCTION ENABLE | DIGITAL | INPUT |
| | 17 | PLATFORM LEVEL UP | DIGITAL | INPUT |
| | 18 | PLATFORM ROTATE RIGHT | DIGITAL | INPUT |
| | 19 | JIB UP | DIGITAL | INPUT |
| | 20 | JIB RIGHT | DIGITAL | INPUT |
| | 21 | TOWER LIFT DOWN | DIGITAL | INPUT |
| | 22 | TOWER TELESCOPE OUT | DIGITAL | INPUT |
| | 23 | MAIN LIFT UP | DIGITAL | INPUT |
| | 24 | BATTERY VOLTAGE | VBAT | OUTPUT |
| | 25 | BATTERY VOLTAGE - (GROUND ENABLE PRESENT) | VBAT | OUTPUT |
| | 26 | BATTERY LOW / NOT CHARGING INDICATOR | DIGITAL | OUTPUT |
| | 27 | CHARGE PUMP FILTER BY-PASS LAMP | DIGITAL | OUTPUT |
| | 28 | ENGINE HIGH COOLANT TEMPERATURE INDICATOR | DIGITAL | OUTPUT |
| | 29 | ENGINE LOW OIL PRESSURE INDICATOR | DIGITAL | OUTPUT |
| | 30 | MAIN TELESCOPE OUT | DIGITAL | INPUT |
| | 31 | GROUND | GROUND | INPUT |
| | 32 | GROUND | GROUND | INPUT |
| | 33 | MAIN LIFT DOWN | DIGITAL | INPUT |
| | 34 | SWING LEFT | DIGITAL | INPUT |
| | 35 | SWING RIGHT | DIGITAL | INPUT |

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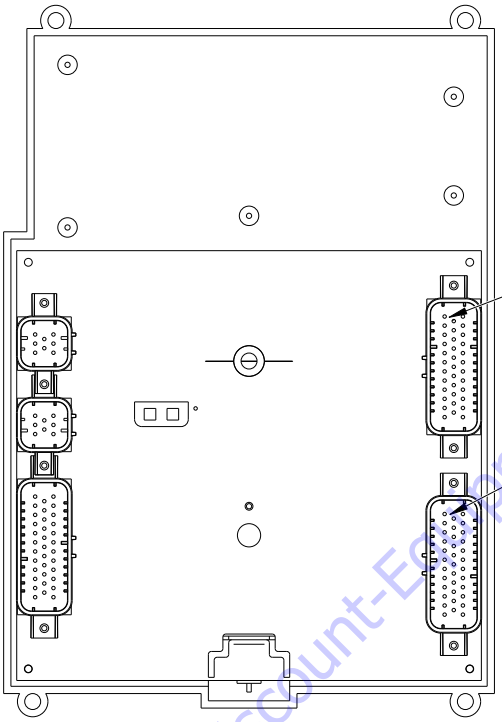
**Figure 6-16. Ground Control Module - Sheet 3 of 3**



| CONNECTOR | PIN | ASSIGNMENT | FUNCTION |
|---|---|---|---|
| J2 BLUE | 1 | SPARE PIN | HS DIGITAL INPUT |
| | 2 | SPARE PIN | HS DIGITAL INPUT |
| | 3 | BATTERY VOLTAGE | BATTERY VOLTAGE |
| | 4 | DRIVE ORIENTATION SYSTEM OVERRIDE SWITCH | HS DIGITAL INPUT |
| | 5 | PLATFORM STOWED | HS DIGITAL INPUT |
| | 6 | CHASSIS TILTED INDICATOR | LAMP OUTPUT |
| | 7 | FUNCTION ENABLE INDICATOR | LAMP OUTPUT |
| | 8 | VEHICLE SYSTEM DISTRESS INDICATOR | LAMP OUTPUT |
| | 9 | CREEP SPEED INDICATOR | LAMP OUTPUT |
| | 10 | BROKEN CABLE INDICATOR | LAMP OUTPUT |
| | 11 | PLATFORM OVERLOADED INDICATOR | LAMP OUTPUT |
| | 12 | 500 LB CAPACITY INDICATOR | LAMP OUTPUT |
| | 13 | 1000 LB CAPACITY INDICATOR | LAMP OUTPUT |
| | 14 | DRIVE ORIENTATION SYSTEM INDICATOR | LAMP OUTPUT |
| | 15 | GENERATOR ON INDICATOR | LAMP OUTPUT |
| | 16 | SOFT TOUCH TRIGGERED INDICATOR | LAMP OUTPUT |
| | 17 | GLOW PLUG ENGAGED INDICATOR | LAMP OUTPUT |
| | 18 | LAMP RETURN | GROUND |
| | 19 | SPARE PIN | LAMP OUTPUT |
| | 20 | UPRIGHT TILTED INDICATOR | LAMP OUTPUT |
| | 21 | LOW FUEL INDICATOR | LAMP OUTPUT |
| | 22 | 1/4 FUEL LEVEL INDICATOR | LAMP OUTPUT |
| | 23 | 3/4 FUEL LEVEL INDICATOR | LAMP OUTPUT |
| | 24 | 1/2 FUEL LEVEL INDICATOR | LAMP OUTPUT |
| | 25 | FUEL LEVEL INDICATORS RETURN | GROUND |
| | 26 | ANALYZER POWER | ANALYZER POWER |
| | 27 | ANALYZER GROUND | ANALYZER GROUND |
| | 28 | ANALYZER RX | ANALYZER RX |
| | 29 | ANALYZER TX | ANALYZER TX |
| | 30 | SPARE PIN | LAMP OUTPUT |
| | 31 | SPARE PIN | DIGITAL OUTPUT |
| | 32 | BATTERY VOLTAGE | BATTERY VOLTAGE |
| | 33 | BATTERY VOLTAGE | BATTERY VOLTAGE |
| | 34 | SWITCH POWER | BATTERY VOLTAGE |
| | 35 | FULL FUEL LEVEL INDICATOR | LAMP OUTPUT |

| CONNECTOR | PIN | ASSIGNMENT | FUNCTION |
|---|---|---|---|
| J1 NATURAL | 1 | TOWER LIFT UP | HS DIGITAL INPUT |
| | 2 | TOWER LIFT DOWN | HS DIGITAL INPUT |
| | 3 | TOWER TELESCOPE IN | HS DIGITAL INPUT |
| | 4 | TOWER TELESCOPE OUT | HS DIGITAL INPUT |
| | 5 | MAIN TELESCOPE IN | HS DIGITAL INPUT |
| | 6 | MAIN TELESCOPE OUT | HS DIGITAL INPUT |
| | 7 | PLATFORM ROTATE RIGHT | HS DIGITAL INPUT |
| | 8 | PLATFORM ROTATE LEFT | HS DIGITAL INPUT |
| | 9 | PLATFORM LEVEL UP | HS DIGITAL INPUT |
| | 10 | PLATFORM LEVEL DOWN | HS DIGITAL INPUT |
| | 11 | JIB UP | HS DIGITAL INPUT |
| | 12 | JIB DOWN | HS DIGITAL INPUT |
| | 13 | SPEED PUMP POTENTIOMETER GROUND | GROUND |
| | 14 | ENGINE START | HS DIGITAL INPUT |
| | 15 | AUXILIARY POWER | HS DIGITAL INPUT |
| | 16 | CRAB STEER SELECT | HS DIGITAL INPUT |
| | 17 | COORDINATED STEER SELECT | HS DIGITAL INPUT |
| | 18 | SWITCH POWER | BATTERY VOLTAGE |
| | 19 | JIB 1000LB ENABLE | HS DIGITAL INPUT |
| | 20 | EIM PLATFORM OVERLOAD | HS DIGITAL INPUT |
| | 21 | 500/1000 LB. CAPACITY SELECT | HS DIGITAL INPUT |
| | 22 | DRIVE ORIENTATION SYSTEM FEATURE ENABLE | HS DIGITAL INPUT |
| | 23 | SPARE PIN | HS DIGITAL INPUT |
| | 24 | SPARE PIN | HS DIGITAL INPUT |
| | 25 | LEVEL SENSOR 1 SIGNAL | HS DIGITAL INPUT |
| | 26 | LEVEL SENSOR 2 SIGNAL | HS DIGITAL INPUT |
| | 27 | TWO SPEED VALVE (HIGH ENGINE) | HS DIGITAL INPUT |
| | 28 | TORQUE MODE | HS DIGITAL INPUT |
| | 29 | SOFT TOUCH OVERRIDE | HS DIGITAL INPUT |
| | 30 | HEAD/TAIL LIGHT | HS DIGITAL INPUT |
| | 31 | HORN | HS DIGITAL INPUT |
| | 32 | CREEP MODE | HS DIGITAL INPUT |
| | 33 | DUAL-FUEL SELECT | HS DIGITAL INPUT |
| | 34 | SPEED PUMP POTENTIOMETER REFERENCE VOLTAGE | +7 REFERENCE VOLTAGE |
| | 35 | SPEED PUMP POTENTIOMETER | ANALOG INPUT |

1001141138-E
MAE33270E



**Figure 6-17. Platform Control Module - Sheet 1 of 2**

| CONNECTOR | PIN | ASSIGNMENT | FUNCTION |
|---|---|---|---|
| J5 NATURAL | 1 | LIFT / SWING JOYSTICK SUPPLY VOLTAGE | SUPPLY VOLTAGE |
| | 2 | LIFT CENTER TAP | ANALOG INPUT |
| | 3 | LIFT SIGNAL | ANALOG INPUT |
| | 4 | SWING SIGNAL | ANALOG INPUT |
| | 5 | SWING CENTER TAP | ANALOG INPUT |
| | 6 | NOT CONNECTED | ANALOG INPUT |
| | 7 | LIFT / SWING JOYSTICK RETURN | GROUND |
| | 8 | SPARE PIN | BLANK |

| CONNECTOR | PIN | ASSIGNMENT | FUNCTION |
|---|---|---|---|
| J6 BLACK | 1 | DRIVE / STEER JOYSTICK SUPPLY VOLTAGE | SUPPLY VOLTAGE |
| | 2 | DRIVE CENTER TAP | ANALOG INPUT |
| | 3 | DRIVE SIGNAL | ANALOG INPUT |
| | 4 | STEER SIGNAL | ANALOG INPUT |
| | 5 | STEER LEFT | ANALOG INPUT |
| | 6 | STEER RIGHT | ANALOG INPUT |
| | 7 | DRIVE / STEER JOYSTICK RETURN | GROUND |
| | 8 | SPARE PIN | BLANK |

| CONNECTOR | PIN | ASSIGNMENT | FUNCTION |
|---|---|---|---|
| J7 BLACK | 1 | GROUND MODE | GROUND MODE |
| | 2 | PLATFORM EMS | PLATFORM EMS |
| | 3 | PLATFORM EMS TO GROUND MODULE | PLATFORM MODE |
| | 4 | FOOTSWITCH (FUNCTION ENABLE SWITCH) POWER | BATTERY VOLTAGE |
| | 5 | PLATFORM ROTATE LEFT | ME DIGITAL OUTPUT |
| | 6 | PLATFORM ROTATE RIGHT | ME DIGITAL OUTPUT |
| | 7 | SOFT TOUCH LIMIT SWITCH POWER | BATTERY VOLTAGE |
| | 8 | FOOTSWITCH SIGNAL | DIGITAL INPUT |
| | 9 | GENERATOR ON SIGNAL | DIGITAL INPUT |
| | 10 | +7 REFERENCE VOLTAGE | +7 REFERENCE VOLTAGE |
| | 11 | SPARE PIN | +5V REFERENCE VOLTAGE |
| | 12 | SPARE PIN | +5V REFERENCE VOLTAGE |
| | 13 | SPARE PIN | ANALOG INPUT |
| | 14 | GROUND RETURN | GROUND |
| | 15 | PLATFORM LEVEL UP | HS DIGITAL OUTPUT |
| | 16 | PLATFORM LEVEL DOWN | HS DIGITAL OUTPUT |
| | 17 | JIB BLOCK LIMIT SWITCH | HS DIGITAL INPUT |
| | 18 | SOFT TOUCH LIMIT SWITCH | HS DIGITAL INPUT |
| | 19 | PLATFORM ALARM | LAMP OUTPUT |
| | 20 | ALARM RETURN | GROUND |
| | 21 | SPARE PIN | GROUND |
| | 22 | SPARE PIN | GROUND |
| | 23 | SPARE PIN | ANALOG INPUT |
| | 24 | SPARE PIN | DIGITAL OUTPUT |
| | 25 | JIB UP | ME DIGITAL OUTPUT |
| | 26 | JIB DOWN | ME DIGITAL OUTPUT |
| | 27 | JIB RIGHT | ME DIGITAL OUTPUT |
| | 28 | JIB LEFT | ME DIGITAL OUTPUT |
| | 29 | GROUND RETURN | GROUND |
| | 30 | CAN LOW | CAN LOW |
| | 31 | CAN HIGH | CAN HIGH |
| | 32 | CAN SHIELD | CAN SHIELD |
| | 33 | SPARE PIN | GROUND |
| | 34 | SPARE PIN | GROUND |
| | 35 | SPARE PIN | ANALOG INPUT |

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

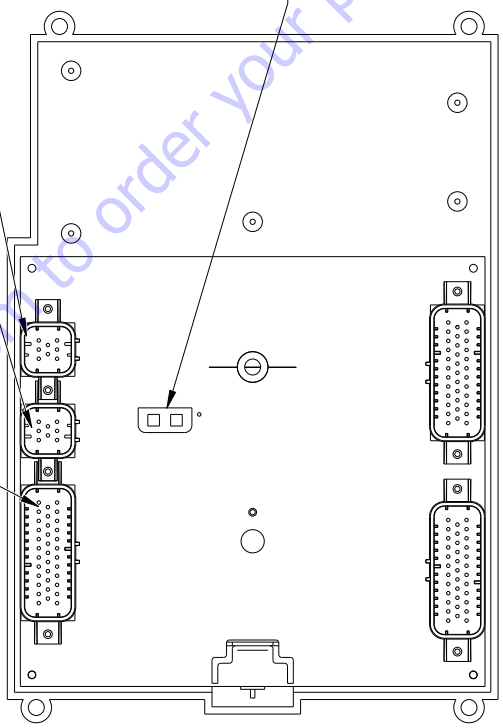


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**Figure 6-18. Platform Control Module - Sheet 2 of 2**

## Analyzer Diagnostics Menu Structure

In the following structure descriptions, an intended item is selected by pressing ENTER; pressing **ESC** steps back to the next outer level. The **LEFT**/**RIGHT** arrow keys move between items in the same level. The **UP** / **DOWN** arrow keys alter a value if allowed.

**Table 6-7. ADJUSTMENTS - Personality Descriptions**

| | |
|---|---|
| DRIVE | |
| ACCEL | Displays/adjusts drive acceleration |
| DECEL | Displays/adjusts drive deceleration |
| MIN FORWARD | Displays/adjusts minimum forward drive speed |
| MAX FORWARD | Displays/adjusts maximum forward drive speed |
| MIN REVERSE | Displays/adjusts minimum reverse drive speed |
| MAX REVERSE | Displays/adjusts maximum reverse drive speed |
| ELEVATED MAX | Displays/adjusts maximum drive speed<br>NOTE: used when elevation cutout switches are limiting maximum speed |
| CREEP MAX | Displays/adjusts maximum drive speed<br>NOTE: used when creep switch on pump pot is active |
| STEER MAX | Displays/adjusts the maximum steer speed |
| LIFT | |
| ACCEL | Displays/adjusts upper lift acceleration |
| DECEL | Displays/adjusts upper lift deceleration |
| MIN UP | Displays/adjusts minimum upper lift up speed |
| MAX UP | Displays/adjusts maximum upper lift up speed |
| CREEP UP | Displays/adjusts maximum upper lift up speed<br>NOTE: used when creep switch on pump pot is active |
| MIN DOWN | Displays/adjusts minimum upper lift down speed |
| MAX DOWN | Displays/adjusts maximum upper lift down speed |
| CREEP DOWN | Displays/adjusts maximum upper lift down speed<br>NOTE: used when creep switch on pump pot is active |
| SWING | |
| ACCEL | Displays/adjusts swing acceleration |
| DECEL | Displays/adjusts swing deceleration |
| MIN LEFT | Displays/adjusts minimum swing left speed |
| MAX LEFT | Displays/adjusts maximum swing left speed |
| CREEP LEFT | Displays/adjusts maximum swing left speed<br>NOTE: used when creep switch on pump pot is active |
| MIN RIGHT | Displays/adjusts minimum swing right speed |
| MAX RIGHT | Displays/adjusts maximum swing right speed |
| CREEP RIGHT | Displays/adjusts maximum swing right speed<br>NOTE: used when creep switch on pump pot is active |
| MAIN TELESCOPE | |
| ACCEL | Displays/adjusts telescope acceleration |
| DECEL | Displays/adjusts telescope deceleration |
| MIN IN | Displays/adjusts minimum telescope in speed |

**Table 6-7. ADJUSTMENTS - Personality Descriptions**

| | |
|---|---|
| MAX IN | Displays/adjusts maximum telescope in speed |
| MIN OUT | Displays/adjusts minimum telescope out speed |
| MAX OUT | Displays/adjusts maximum telescope out speed |
| BASKET LEVEL | |
| ACCEL | Displays/adjusts basket level acceleration |
| DECEL | Displays/adjusts basket level deceleration |
| MIN UP | Displays/adjusts minimum basket level up speed |
| MAX UP | Displays/adjusts maximum basket level up speed |
| MIN DOWN | Displays/adjusts minimum basket level down speed |
| MAX DOWN | Displays/adjusts maximum basket level down speed |
| BASKET ROTATE | |
| ACCEL | Displays/adjusts basket rotate acceleration |
| DECEL | Displays/adjusts basket rotate deceleration |
| MIN LEFT | Displays/adjusts minimum basket rotate left speed |
| MAX LEFT | Displays/adjusts maximum basket rotate left speed |
| MIN RIGHT | Displays/adjusts minimum basket rotate right speed |
| MAX RIGHT | Displays/adjusts maximum basket rotate right speed |
| JIB LIFT | Not displayed if JIB = NO |
| ACCEL | Displays/adjusts jib acceleration |
| DECEL | Displays/adjusts jib deceleration |
| MIN UP | Displays/adjusts minimum jib up speed |
| MAX UP | Displays/adjusts maximum jib up speed |
| MIN DOWN | Displays/adjusts minimum jib down speed |
| MAX DOWN | Displays/adjusts maximum jib down speed |
| MIN LEFT | Displays/adjusts minimum jib left speed |
| MAX LEFT | Displays/adjusts maximum jib left speed |
| MIN RIGHT | Displays/adjusts minimum jib right speed |
| MAX RIGHT | Displays/adjusts maximum jib right speed |
| STEER | |
| MAX SPEED | Displays/adjusts maximum steer speed, which applies when vehicle speed is at minimum |
| GROUND MODE | |
| LIFT UP | Displays/adjusts fixed lift up speed |
| LIFT DOWN | Displays/adjusts fixed lift down speed |
| SWING | Displays/adjusts fixed swing speed |
| TELE | Displays/adjusts fixed telescope speed |
| BASKETLEVEL | Displays/adjusts fixed basket level speed |
| BASKETROTATE | Displays/adjusts fixed basket rotate speed |
| JIB (U/D) | Displays/adjusts jib lift speed<br>Not displayed if JIB = NO |
| JIB (L/R) | Displays/adjusts jib swing speed<br>Not displayed if JIB = NO |

**Table 6-8. Diagnostic Menu Descriptions**

| | |
|---|---|
| DRIVE | |
| DRIVE FOR . . . | Displays drive joystick direction & demand |
| STEER . . . | Displays steer switch direction & demand<br>NOTE: steer demand is inversely proportional to vehicle speed |
| BRAKES . . . | Displays brake control system status |
| CREEP . . . | Displays pump pot creep switch status |
| TWO SPEED... | Displays two speed switch status |
| 2 SPEED MODE | Displays status of two speed valve |
| HIGH ENGINE | Displays high engine switch status |
| BOOM | |
| U LIFT UP . . . | Displays lift joystick direction & demand |
| SWING LEFT . . . | Displays swing joystick direction & demand |
| LEVEL UP . . . | Displays basket level switch direction & demand<br>NOTE: demand is controlled by the pump pot |
| ROT. LEFT . . . | Displays basket rotate switch direction & demand<br>NOTE: demand is controlled by the pump pot |
| U TELE IN . . . | Displays telescope switch direction & demand<br>NOTE: demand is controlled by the pump pot |
| JIB UP . . . | Displays jib lift switch direction & demand<br>NOTE: demand is controlled by the pump pot<br>Not displayed if JIB = NO |
| JIB LEFT . . . | Displays jib swing switch direction & demand<br>NOTE: demand is controlled by the pump pot<br>Not displayed if JIB = NO |
| PUMP POT . . . | Displays pump pot demand |
| ENGINE | |
| START . . . | Displays start switch status |
| AIR FILTER . . . | Displays air filter status |
| BATTERY . . . | Displays measured battery voltage |
| COOLANT . . . | Displays coolant temperature |
| OIL PRS . . . | Displays oil pressure status |
| FUEL SELECT . . . | Displays selected fuel (Dual Fuel only) |
| FUEL LEVEL . . . | Displays fuel level status |
| RPM | Displays Engine RPM |
| GM BATTERY | Displays battery voltage at ground module |
| PM BATTERY . . . | Displays battery voltage at platform module |
| TEMP... | Displays ground module temperature |
| ELEV. CUTOUT . . . | Displays elevation cutout switch status |
| FUNC. CUTOUT . . . | Displays function cutout switch status |
| CREEP. . . | Displays creep switch status |
| TILT . . . | Displays measured vehicle tilt |
| AUX POWER . . . | Displays status of auxiliary power switch |
| HORN . . . | Displays status of horn switch |
| R FILTER . . . | Displays status of return filter switch |
| C FILTER . . . | Displays status of charge pump filter |
| LOAD LENGTH . . . | Displays length switch status |

**Table 6-8. Diagnostic Menu Descriptions**

| | |
|---|---|
| ANGLE . . . | Displays angle switch status |
| LOAD . . . | Displays load sensor value<br>NOTE: Not displayed if load = 0. |
| DATALOG | |
| ON . . . | Displays total controller on (EMS) time |
| ENGINE . . . | Displays engine run time |
| DRIVE . . . | Displays total controller drive operation time |
| LIFT . . . | Displays total controller lift operation time |
| SWING . . . | Displays total controller swing operation time |
| TELE . . . | Displays total controller tele operation time |
| MAX.TEMP . . . | Displays maximum measured heatsink temp. |
| MIN.TEMP . . . | Displays minimum measured heatsink temp. |
| MAX.VOLTS . . . | Displays maximum measured battery voltage |
| RENTAL . . . | Displays total controller operation time<br>NOTE: can be reset |
| ERASE RENTAL | Not available at password level 2 |
| YES:ENTER, NO:ESC | ENTER resets rental datalog time to zero |
| VERSIONS | |
| GROUND . . . | Displays ground module software version |
| PLATFORM . . . | Displays platform module software version |
| ANALYSER . . . | Displays Analyzer software version |

**Table 6-9. Diagnostic Trouble Code Chart (DTC)**

| DTC | Flash Code | Fault Message | Check |
|---|---|---|---|
| 001 | 00 | EVERYTHING OK | No response required for this DTC. |
| 002 | 00 | GROUND MODE OK | No response required for this DTC. |
| 0010 | 00 | RUNNING AT CUTBACK - OUT OF TRANSPORT POSITION | Response described in Drive Modes section. |
| 000 | 00 | <<< HELP COMMENT >>> | |
| 0011 | 00 | FSW OPEN (Foot switch open) | The UGM shall not Enable the Machine. |
| 0012 | 00 | RUNNING AT CREEP - CREEP SWITCH OPEN | The UGM shall limit the machine to Creep speed. |
| 0013 | 00 | RUNNING AT CREEP - TILTED AND ABOVE ELEVATION | |
| 0014 | 00 | CHASSIS TILT SENSOR OUT OF RANGE | Not reported during power-up. |
| 0015 | 00 | LOAD SENSOR READING UNDER WEIGHT | |
| 0031 | 00 | FUEL LEVEL LOW - ENGINE SHUTDOWN | Response described in Fuel Shutdown section. |
| 0035 | 00 | APU ACTIVE | Response described in Auxiliary Power/Emergency Descent Mode section. |
| 0039 | 00 | SKYGUARD ACTIVE - FUNCTIONS CUTOUT | Response described in Sky-Guard section. |
| 0040 | 00 | RUNNING AT CREEP - CREEP SWITCH CLOSED | |
| 210 | 21 | <<< POWER-UP >>> | |
| 211 | 21 | POWER CYCLE | |
| 212 | 21 | KEYSWITCH FAULTY | The UGM shall assume a station selection of Ground. |
| 213 | 21 | FSW FAULTY | The UGM shall not Enable the Machine. |
| 220 | 22 | <<< PLATFORM CONTROLS >>> | |
| 227 | 22 | STEER SWITCHES FAULTY | The UGM shall prohibit Steer;<br>The UGM shall limit Drive to Creep<br>The Steer Left switch input = Low;<br>The Steer Right switch input = Low;<br>Steer and full Drive speed permitted after controls are initialized |
| 2211 | 22 | FSW INTERLOCK TRIPPED | Can be reported during power-up. |
| 2212 | 22 | DRIVE LOCKED - JOYSTICK MOVED BEFORE FOOTSWITCH | Can be reported during power-up. |
| 2213 | 22 | STEER LOCKED - SELECTED BEFORE FOOTSWITCH | The UGM shall not Enable the Machine. |
| 2214 | 22 | DRIVE/STEER LOCKED - JOYSTICK MOVED BEFORE ENABLE | |
| 2216 | 22 | D/S JOY. OUT OF RANGE HIGH | Resistive joysticks.<br>If the reference voltage is > 7.7V then the reference voltage is out of tolerance of a short to battery has occurred. |
| 2217 | 22 | D/S JOY. CENTER TAP BAD | Resistive joysticks.<br>- There is a +/-.1V range. around these values due to resistor tolerances. |
| 2219 | 22 | L/S JOY. OUT OF RANGE HIGH | Resistive joysticks.<br>- If the reference voltage is > 7.7V then the reference voltage is out of tolerance of a short to battery has occurred. |

**Table 6-9. Diagnostic Trouble Code Chart (DTC)**

| DTC | Flash Code | Fault Message | Check |
|---|---|---|---|
| 2220 | 22 | L/S JOY. CENTER TAP BAD | Resistive joysticks.<br>- There is a +/- .1V range. around these values due to resistor tolerances. |
| 2221 | 22 | LIFT/SWING LOCKED - JOYSTICK MOVED BEFORE FOOT-SWITCH | If triggered by the Lift and/or Swing joystick not being in the neutral position at Startup, the UGM shall prohibit Lift and Swing. If triggered by Lift and/or Swing joystick is not in the neutral position when Footswitch becomes active or while DTC 2212, 2213 or 2223 is active, the UGM shall not Enable the Machine. |
| 2222 | 22 | WAITING FOR FSW TO BE OPEN | Can be reported during power- up. |
| 2223 | 22 | FUNCTION SWITCHES LOCKED - SELECTED BEFORE ENABLE | The UGM shall not Enable the Machine. |
| 2224 | 22 | FOOTSWITCH SELECTED BEFORE START | The UGM shall prohibit Engine Start. |
| 2269 | 22 | FUNCTION PROBLEM - HIGH SPEED & CREEP ACTIVE TOGETHER | |
| 234 | 23 | FUNCTION SWITCHES FAULTY - CHECK DIAGNOSTICS/BOOM | Disable whichever boom functions whose boom control inputs are triggering the fault. If Engine Start/ Aux at fault, disable Engine Start but permit Auxiliary Power/ Emergency Descent. |
| 235 | 23 | FUNCTION SWITCHES LOCKED - SELECTED BEFORE AUX POWER | |
| 236 | 23 | FUNCTION SWITCHES LOCKED - SELECTED BEFORE START SWITCH | |
| 237 | 23 | START SWITCH LOCKED - SELECTED BEFORE KEYSWITCH | The UGM shall prohibit Engine Start. |
| 23163 | 23 | FUNCTION PROBLEM - MSSO PERMANENTLY SELECTED | No response required for this DTC Power Cycled. |
| 240 | 24 | <<< OTHER CONTROLS >>> | |
| 241 | 24 | AMBIENT TEMPERATURE SENSOR - OUT OF RANGE LOW | The UGM shall set Low Temperature Cutout state = Faulty If the Machine is in Platform Mode and if the Boom is Above Elevation; The UGM shall suspend motion; If the Machine is in Ground Mode; No response required for this DTC. |
| 242 | 24 | AMBIENT TEMPERATURE SENSOR - OUT OF RANGE HIGH | Check Ambient Temperature sensor reading < 85C. |
| 250 | 25 | <<< FUNCTION PREVENTED >>> | |
| 259 | 25 | MODEL CHANGED - HYDRAULICS SUSPENDED - CYCLE EMS | Disable all machine and engine functions (i.e., command engine shutdown and do not permit start). |
| 2513 | 25 | GENERATOR MOTION CUTOUT ACTIVE | The UGM shall not Enable the Machine. |
| 2514 | 25 | BOOM PREVENTED - DRIVE SELECTED | The UGM shall prohibit all boom functions. |

**Table 6-9. Diagnostic Trouble Code Chart (DTC)**

| DTC | Flash Code | Fault Message | Check |
|---|---|---|---|
| 2516 | 25 | DRIVE PREVENTED - ABOVE ELEVATION | The UGM shall prohibit Drive and Steer. |
| 2517 | 25 | DRIVE PREVENTED - TILTED & ABOVE ELEVATION | The UGM shall prohibit Drive and Steer. |
| 2518 | 25 | DRIVE PREVENTED - BOOM SELECTED | The UGM shall prohibit Drive and Steer. |
| 2519 | 25 | DRIVE PREVENTED - TILTED & EXTENDED OR HIGH ANGLE | |
| 2520 | 25 | FUNCTIONS LOCKED OUT - CONSTANT DATA VERSION IMPROPER | |
| 2530 | 25 | UMS SENSOR FORWARD LIMIT REACHED | |
| 2531 | 25 | UMS SENSOR OUT OF USABLE RANGE | |
| 2532 | 25 | UMS SENSOR BACKWARD LIMIT REACHED | |
| 2563 | 25 | SKYGUARD SWITCH - DISAGREEMENT | Response detailed in Sky-Guard section. |
| 2568 | 25 | TEMPERATURE CUTOUT ACTIVE - AMBIENT TEMPERATURE TOO LOW | If the Boom is Above Elevation; The UGM shall suspend motion; The UGM shall limit the machine to Creep speed after controls initialized If the Machine is in Platform Mode and if the Boom is not Above Elevation. |
| 2576 | 25 | PLATFORM LEVEL PREVENTED - ABOVE ELEVATION | The UGM shall suspend Platform Level Up and Down commands; The UGM shall prohibit Platform Level Up and Down |
| 2577 | 25 | DRIVE PREVENTED - START BATTERY CONNECTED | Check the battery. |
| 330 | 33 | <<< GROUND OUTPUT DRIVER >>> | |
| 331 | 33 | BRAKE - SHORT TO BATTERY | Check Harness for damage. |
| 332 | 33 | BRAKE - OPEN CIRCUIT | Check Harness for damage. |
| 3311 | 33 | GROUND ALARM - SHORT TO BATTERY | Ground Alarm equipped vehicles only. |
| 3336 | 33 | ALTERNATOR POWER - SHORT TO GROUND | Check Harness for damage. |
| 3340 | 33 | AUX POWER - SHORT TO GROUND | Check Harness for damage. |
| 3341 | 33 | AUX POWER - OPEN CIRCUIT | Check Harness for damage. |
| 3342 | 33 | AUX POWER - SHORT TO BATTERY | Check Harness for damage. |
| 3346 | 33 | ELECTRIC FAN - SHORT TO GROUND | Check Harness for damage. |
| 3347 | 33 | ELECTRIC FAN - OPEN CIRCUIT | Check Harness for damage. |
| 3348 | 33 | ELECTRIC FAN - SHORT TO BATTERY | Check Harness for damage. |
| 3349 | 33 | ELECTRIC PUMP - SHORT TO GROUND | Check Harness for damage. |
| 3350 | 33 | ELECTRIC PUMP - OPEN CIRCUIT | Check Harness for damage. |
| 3351 | 33 | ELECTRIC PUMP - SHORT TO BATTERY | Check Harness for damage. |
| 3352 | 33 | LP LOCK - SHORT TO GROUND | Check Harness for damage. |
| 3353 | 33 | LP LOCK - OPEN CIRCUIT | Check Harness for damage. |
| 3354 | 33 | LP LOCK - SHORT TO BATTERY | Check Harness for damage. |
| 3355 | 33 | LP START ASSIST - SHORT TO GROUND | Check Harness for damage. |
| 3356 | 33 | LP START ASSIST - OPEN CIRCUIT | Check Harness for damage. |
| 3357 | 33 | LP START ASSIST - SHORT TO BATTERY | Check Harness for damage. |
| 3358 | 33 | MAIN DUMP VALVE - SHORT TO GROUND | Check Harness for damage. |

**Table 6-9. Diagnostic Trouble Code Chart (DTC)**

| DTC | Flash Code | Fault Message | Check |
|---|---|---|---|
| 3359 | 33 | MAIN DUMP VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 3360 | 33 | MAIN DUMP VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 3361 | 33 | BRAKE - SHORT TO GROUND | Check Harness for damage. |
| 3362 | 33 | START SOLENOID - SHORT TO GROUND | Check Harness for damage. |
| 3363 | 33 | START SOLENOID - OPEN CIRCUIT | Check Harness for damage. |
| 3364 | 33 | START SOLENOID - SHORT TO BATTERY | Check Harness for damage. |
| 3365 | 33 | STEER DUMP VALVE - SHORT TO GROUND | Check Harness for damage. |
| 3366 | 33 | STEER DUMP VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 3367 | 33 | STEER DUMP VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 3368 | 33 | TWO SPEED VALVE - SHORT TO GROUND | Check Harness for damage. |
| 3369 | 33 | TWO SPEED VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 3370 | 33 | TWO SPEED VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 3371 | 33 | GROUND ALARM - SHORT TO GROUND | Check Harness for damage. |
| 3372 | 33 | GROUND ALARM - OPEN CIRCUIT | Check Harness for damage. |
| 3373 | 33 | GEN SET/WELDER - SHORT TO GROUND | Check Harness for damage. |
| 3374 | 33 | GEN SET/WELDER - OPEN CIRCUIT | Check Harness for damage. |
| 3375 | 33 | GEN SET/WELDER - SHORT TO BATTERY | Check Harness for damage. |
| 3376 | 33 | HEAD TAIL LIGHT - SHORT TO GROUND | Check Harness for damage. |
| 3377 | 33 | HEAD TAIL LIGHT - OPEN CIRCUIT | Check Harness for damage. |
| 3378 | 33 | HEAD TAIL LIGHT - SHORT TO BATTERY | Check Harness for damage. |
| 3379 | 33 | HOUR METER - SHORT TO GROUND | Check Harness for damage. |
| 3382 | 33 | PLATFORM LEVEL UP VALVE - SHORT TO GROUND | Check Harness for damage. |
| 3383 | 33 | PLATFORM LEVEL UP VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 3384 | 33 | PLATFORM LEVEL UP VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 3388 | 33 | PLATFORM LEVEL DOWN VALVE - SHORT TO GROUND | Check Harness for damage. |
| 3389 | 33 | PLATFORM LEVEL DOWN VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 3390 | 33 | PLATFORM LEVEL DOWN VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 3394 | 33 | PLATFORM ROTATE LEFT VALVE - SHORT TO GROUND | Check Harness for damage. |
| 3395 | 33 | PLATFORM ROTATE LEFT VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 3396 | 33 | PLATFORM ROTATE LEFT VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 3397 | 33 | PLATFORM ROTATE RIGHT VALVE - SHORT TO GROUND | Check Harness for damage. |
| 3398 | 33 | PLATFORM ROTATE RIGHT VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 3399 | 33 | PLATFORM ROTATE RIGHT VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 33100 | 33 | JIB LIFT UP VALVE - SHORT TO GROUND | Check Harness for damage. |
| 33101 | 33 | JIB LIFT UP VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 33102 | 33 | JIB LIFT UP VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 33103 | 33 | JIB LIFT DOWN VALVE - SHORT TO GROUND | Check Harness for damage. |
| 33104 | 33 | JIB LIFT DOWN VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 33105 | 33 | JIB LIFT DOWN VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 33106 | 33 | TOWER LIFT UP VALVE - SHORT TO GROUND | Check Harness for damage. |
| 33107 | 33 | TOWER LIFT UP VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 33108 | 33 | TOWER LIFT UP VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 33109 | 33 | TOWER LIFT DOWN VALVE - SHORT TO GROUND | Check Harness for damage. |

**Table 6-9. Diagnostic Trouble Code Chart (DTC)**

| DTC | Flash Code | Fault Message | Check |
|---|---|---|---|
| 33110 | 33 | TOWER LIFT DOWN VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 33111 | 33 | TOWER LIFT DOWN VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 33112 | 33 | TOWER TELESCOPE IN VALVE - SHORT TO GROUND | Check Harness for damage. |
| 33113 | 33 | TOWER TELESCOPE IN VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 33114 | 33 | TOWER TELESCOPE IN VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 33115 | 33 | TOWER TELESCOPE OUT VALVE - SHORT TO GROUND | Check Harness for damage. |
| 33116 | 33 | TOWER TELESCOPE OUT VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 33117 | 33 | TOWER TELESCOPE OUT VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 33118 | 33 | SWING RIGHT VALVE - SHORT TO GROUND | Check Harness for damage. |
| 33119 | 33 | SWING RIGHT VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 33120 | 33 | TELESCOPE IN VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 33121 | 33 | SWING RIGHT VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 33122 | 33 | SWING LEFT VALVE - SHORT TO GROUND | Check Harness for damage. |
| 33123 | 33 | TELESCOPE OUT VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 33130 | 33 | THROTTLE ACTUATOR - SHORT TO GROUND | Check Harness for damage. |
| 33131 | 33 | THROTTLE ACTUATOR - OPEN CIRCUIT | Check Harness for damage. |
| 33132 | 33 | THROTTLE ACTUATOR - SHORT TO BATTERY | Check Harness for damage. |
| 33170 | 33 | LIFT DOWN VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 33171 | 33 | LIFT DOWN VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 33172 | 33 | LIFT DOWN VALVE - SHORT TO GROUND | Check Harness for damage. |
| 33175 | 33 | JIB ROTATE LEFT VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 33176 | 33 | JIB ROTATE LEFT VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 33177 | 33 | JIB ROTATE LEFT VALVE - SHORT TO GROUND | Check Harness for damage. |
| 33178 | 33 | JIB ROTATE RIGHT VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 33179 | 33 | JIB ROTATE RIGHT VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 33180 | 33 | JIB ROTATE RIGHT VALVE - SHORT TO GROUND | Check Harness for damage. |
| 33182 | 33 | LIFT VALVES - SHORT TO BATTERY | Check Harness for damage. |
| 33186 | 33 | TELESCOPE OUT VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 33188 | 33 | TELESCOPE OUT VALVE - SHORT TO GROUND | Check Harness for damage. |
| 33189 | 33 | TELESCOPE IN VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 33190 | 33 | TELESCOPE IN VALVE - SHORT TO GROUND | Check Harness for damage. |
| 33207 | 33 | HORN - OPEN CIRCUIT | Check Harness for damage. |
| 33208 | 33 | HORN - SHORT TO BATTERY | Check Harness for damage. |
| 33209 | 33 | HORN - SHORT TO GROUND | Check Harness for damage. |
| 33279 | 33 | GLOWPLUG - OPEN CIRCUIT | Check Harness for damage. |
| 33280 | 33 | GLOWPLUG - SHORT TO BATTERY | Check Harness for damage. |
| 33281 | 33 | GLOWPLUG - SHORT TO GROUND | Check Harness for damage. |

**Table 6-9. Diagnostic Trouble Code Chart (DTC)**

| DTC | Flash Code | Fault Message | Check |
|---|---|---|---|
| 33287 | 33 | LIFT - CURRENT FEEDBACK READING TOO LOW | The UGM shall suspend Lift Up and Down command and revert to Open Loop Current control for Lift; The UGM shall limit Lift Up and Down to Creep speed after controls initialized |
| 33295 | 33 | SWING LEFT VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 33306 | 33 | SWING LEFT VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 33314 | 33 | FLOW CONTROL VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 33315 | 33 | FLOW CONTROL VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 33316 | 33 | FLOW CONTROL VALVE - SHORT TO GROUND | Check Harness for damage. |
| 33317 | 33 | DRIVE FORWARD VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 33318 | 33 | DRIVE FORWARD VALVE - SHORT TO BATTER | Check Harness for damage. |
| 33319 | 33 | DRIVE FORWARD VALVE - SHORT TO GROUND | Check Harness for damage. |
| 33320 | 33 | DRIVE REVERSE VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 33321 | 33 | DRIVE REVERSE VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 33322 | 33 | DRIVE REVERSE VALVE - SHORT TO GROUND | Check Harness for damage. |
| 33323 | 33 | LIFT UP VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 33324 | 33 | LIFT UP VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 33325 | 33 | LIFT UP VALVE - SHORT TO GROUND | Check Harness for damage. |
| 33331 | 33 | DRIVE - CURRENT FEEDBACK READING TOO LOW | The UGM shall suspend Drive Forward and Reverse command and revert to Open Current loop control for Drive; The UGM shall limit Drive Forward and Reverse to Creep speed after controls initialized |
| 33410 | 33 | DRIVE - CURRENT FEEDBACK READING LOST | The UGM shall suspend Drive Forward and Reverse command and revert to Open Current loop control for Drive; The UGM shall limit Drive Forward and Reverse to Creep speed after controls initialized |
| 33412 | 33 | SWING VALVES - SHORT TO BATTERY | Check Harness for damage. |
| 33414 | 33 | SWING - CURRENT FEEDBACK READING TOO LOW | Check wiring and coil. |
| 33415 | 33 | FLOW CONTROL VALVE - CURRENT FEEDBACK READING TOO LOW | The UGM shall suspend Flow Control and revert to Open Current loop control for Flow Control. |
| 33417 | 33 | LIFT - CURRENT FEEDBACK READING LOST | The UGM shall suspend Lift Up and Down command and revert to Open Loop Current control for Lift; The UGM shall limit Lift Up and Down to Creep speed after controls initialized. |
| 33418 | 33 | SWING - CURRENT FEEDBACK READING LOST | Check wiring and coil. |

**Table 6-9. Diagnostic Trouble Code Chart (DTC)**

| DTC | Flash Code | Fault Message | Check |
|---|---|---|---|
| 33419 | 33 | FLOW CONTROL VALVE - CURRENT FEEDBACK READING LOST | The UGM shall suspend Flow Control and revert to Open Current loop control for Flow Control. |
| 33488 | 33 | SWING FLOW CONTROL VALVE - SHORT TO GROUND | Check Harness for damage. |
| 33575 | 33 | ECM PULL DOWN RESISTOR - OPEN CIRCUIT | Check Harness for damage. |
| 340 | 34 | <<< PLATFORM OUTPUT DRIVER >>> | |
| 341 | 34 | PLATFORM LEVEL UP VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 342 | 34 | PLATFORM LEVEL UP VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 343 | 34 | PLATFORM LEVEL UP VALVE - SHORT TO GROUND | Check Harness for damage. |
| 344 | 34 | PLATFORM LEVEL UP VALVE - SHORT TO BATTERY OR OPEN CIRCUIT | Check Harness for damage. |
| 345 | 34 | PLATFORM LEVEL DOWN VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 346 | 34 | PLATFORM LEVEL DOWN VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 347 | 34 | PLATFORM LEVEL DOWN VALVE - SHORT TO GROUND | Check Harness for damage. |
| 348 | 34 | PLATFORM LEVEL DOWN VALVE - SHORT TO BATTERY OR OPEN CIRCUIT | Check Harness for damage. |
| 349 | 34 | PLATFORM ROTATE LEFT VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 3410 | 34 | PLATFORM ROTATE LEFT VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 3411 | 34 | PLATFORM ROTATE LEFT VALVE - SHORT TO GROUND | Check Harness for damage. |
| 3412 | 34 | PLATFORM ROTATE RIGHT VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 3413 | 34 | PLATFORM ROTATE RIGHT VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 3414 | 34 | PLATFORM ROTATE RIGHT VALVE - SHORT TO GROUND | Check Harness for damage. |
| 3415 | 34 | JIB LIFT UP VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 3416 | 34 | JIB LIFT UP VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 3417 | 34 | JIB LIFT UP VALVE - SHORT TO GROUND | Check Harness for damage. |
| 3418 | 34 | JIB LIFT DOWN VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 3419 | 34 | JIB LIFT DOWN VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 3420 | 34 | JIB LIFT DOWN VALVE - SHORT TO GROUND | Check Harness for damage. |
| 3421 | 34 | JIB ROTATE LEFT VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 3422 | 34 | JIB ROTATE LEFT VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 3423 | 34 | JIB ROTATE LEFT VALVE - SHORT TO GROUND | Check Harness for damage. |
| 3424 | 34 | JIB ROTATE RIGHT VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 3425 | 34 | JIB ROTATE RIGHT VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 3426 | 34 | JIB ROTATE RIGHT VALVE - SHORT TO GROUND | Check Harness for damage. |
| 430 | 43 | <<< ENGINE >>> | |
| 431 | 43 | FUEL SENSOR - SHORT TO BATTERY OR OPEN CIRCUIT | Energize fuel sensor per System Indicators |
| 432 | 43 | FUEL SENSOR - SHORT TO GROUND | Energize fuel sensor per System Indicators |
| 433 | 43 | OIL PRESSURE - SHORT TO BATTERY | Deutz engine only. |
| 434 | 43 | OIL PRESSURE - SHORT TO GROUND | Deutz engine only.<br>- Not reported during engine start. |
| 435 | 43 | COOLANT TEMPERATURE - SHORT TO GROUND | Deutz engine only. |
| 436 | 43 | FORD FAULT CODE ## | |

**Table 6-9. Diagnostic Trouble Code Chart (DTC)**

| DTC | Flash Code | Fault Message | Check |
|---|---|---|---|
| 437 | 43 | ENGINE TROUBLE CODE | Report and log in Help<br>If [(MACHINE SETUP > DEUTZ EMR2) or (MACHINE SETUP > DEUTZ EMR4) and SPN:FMI = 535:7], prohibit engine cranking. |
| 438 | 43 | HIGH ENGINE TEMP | Ford / Deutz engine only. |
| 439 | 43 | AIR FILTER BYPASSED | Check Airfilter for clogging |
| 4310 | 43 | NO ALTERNATOR OUTPUT | Activate the No Charge indicator J4-26 per System Indicators. |
| 4311 | 43 | LOW OIL PRESSURE | Ford / Deutz engine only. |
| 4312 | 43 | 485 COMMUNICATIONS LOST | |
| 4313 | 43 | THROTTLE ACTUATOR FAILURE | |
| 4314 | 43 | WRONG ENGINE SELECTED - ECM DETECTED | |
| 4322 | 43 | LOSS OF ENGINE SPEED SENSOR | Diesel engine only. |
| 4323 | 43 | SPEED SENSOR READING INVALID SPEED | Diesel engine only. |
| 4331 | 43 | SOOT LOAD WARNING - LOW | Check Engine. |
| 4332 | 43 | SOOT LOAD WARNING - HIGH | Check Engine. |
| 4333 | 43 | SOOT LOAD WARNING - SEVERE | Check Engine. |
| 4334 | 43 | ENGINE COOLANT - LOW LEVEL | MACHINE SETUP > ENGINE SHUTDOWN = ENABLED then shutdown the engine;<br>Activate High Engine Temperature indicator J4-28. |
| 440 | 44 | <<< BATTERY SUPPLY >>> | |
| 441 | 44 | BATTERY VOLTAGE TOO LOW - SYSTEM SHUTDOWN | |
| 442 | 44 | BATTERY VOLTAGE TOO HIGH - SYSTEM SHUTDOWN | |
| 445 | 44 | BATTERY VOLTAGE LOW | |
| 660 | 66 | <<< COMMUNICATION >>> | |
| 662 | 66 | CANBUS FAILURE - PLATFORM MODULE | |
| 664 | 66 | CANBUS FAILURE - ACCESSORY MODULE | Check the Wiring. |
| 666 | 66 | CANBUS FAILURE - ENGINE CONTROLLER | ECM equipped engine only. |
| 6620 | 66 | CANBUS FAILURE - UMS SENSOR | |
| 6622 | 66 | CANBUS FAILURE - TCU MODULE | |
| 6623 | 66 | CANBUS FAILURE - GATEWAY MODULE | |
| 6629 | 66 | CANBUS FAILURE - TELEMATICS CANBUS LOADING TOO HIGH | |

**Table 6-9. Diagnostic Trouble Code Chart (DTC)**

| DTC | Flash Code | Fault Message | Check |
|---|---|---|---|
| 6657 | 66 | CANBUS FAILURE - TEMPERATURE SENSOR | The UGM shall set Low Temperature Cutout state = Faulty If the Machine is in Platform Mode and if the Boom is Above Elevation; The UGM shall suspend motion; The UGM shall limit the machine to Creep speed after controls initialized If the Machine is in Platform Mode and if the Boom is not Above Elevation. |
| 671 | 67 | ACCESSORY FAULT | |
| 680 | 68 | <<< TELEMATICS >>> | |
| 681 | 68 | REMOTE CONTRACT MANAGEMENT OVERRIDE - ALL FUNCTIONS IN CREEP | |
| 810 | 81 | <<< TILT SENSOR >>> | |
| 813 | 81 | CHASSIS TILT SENSOR NOT CALIBRATED | |
| 815 | 81 | CHASSIS TILT SENSOR DISAGREEMENT | |
| 816 | 81 | UMS SENSOR NOT CALIBRATED | |
| 817 | 81 | UMS SENSOR FAULT | |
| 820 | 82 | <<< PLATFORM LOAD SENSE >>> | |
| 825 | 82 | LSS HAS NOT BEEN CALIBRATED | UGM to set Platform Load State = Overloaded |
| 826 | 82 | RUNNING AT CREEP - PLATFORM OVERLOADED | |
| 827 | 82 | DRIVE & BOOM PREVENTED - PLATFORM OVERLOADED | |
| 828 | 82 | LIFT UP & TELE OUT PREVENTED - PLATFORM OVERLOADED | |
| 8639 | 86 | FRONT LEFT STEER VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 8640 | 86 | FRONT LEFT STEER VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 8641 | 86 | FRONT LEFT STEER VALVE - SHORT TO GROUND | Check Harness for damage. |
| 8642 | 86 | FRONT RIGHT STEER VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 8643 | 86 | FRONT RIGHT STEER VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 8644 | 86 | FRONT RIGHT STEER VALVE - SHORT TO GROUND | Check Harness for damage. |
| 8645 | 86 | REAR LEFT STEER VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 8646 | 86 | REAR LEFT STEER VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 8647 | 86 | REAR LEFT STEER VALVE - SHORT TO GROUND | Check Harness for damage. |
| 8648 | 86 | REAR RIGHT STEER VALVE - OPEN CIRCUIT | Check Harness for damage. |
| 8649 | 86 | REAR RIGHT STEER VALVE - SHORT TO BATTERY | Check Harness for damage. |
| 8650 | 86 | REAR RIGHT STEER VALVE - SHORT TO GROUND | Check Harness for damage. |

**Table 6-9. Diagnostic Trouble Code Chart (DTC)**

| DTC | Flash Code | Fault Message | Check |
|---|---|---|---|
| 871 | 87 | RETURN FILTER BYPASSED | Check Hydraulic Return Filter. |
| 872 | 87 | CHARGE PUMP FILTER BYPASSED | Check Charge Pump Filter. |
| 873 | 87 | MACHINE SAFETY SYSTEM OVERRIDE OCCURRED | Response described in MSSO Influence on Machine Operation section. |
| 998 | 99 | EEPROM FAILURE - CHECK ALL SETTINGS | Disable all machine and engine functions (i.e., command engine shutdown and do not permit start); reset the section of EEPROM where the failure occurred to defaults. |
| 9910 | 99 | FUNCTIONS LOCKED OUT - PLATFORM MODULE SOFTWARE VERSION IMPROPER | Activate the platform alarm continuously Creep mode is active If Platform Mode is active, disable all Drive, Steer, and Boom functions and do not permit Machine Enable. |
| 9914 | 99 | PLATFORM MODULE SOFTWARE UPDATE REQUIRED | |
| 9915 | 99 | CHASSIS TILT SENSOR NOT GAIN CALIBRATED | |
| 9916 | 99 | CHASSIS TILT SENSOR GAIN OUT OF RANGE | |
| 9919 | 99 | GROUND SENSOR REF VOLTAGE OUT OF RANGE | Not reported during power-up. |
| 9920 | 99 | PLATFORM SENSOR REF VOLTAGE OUT OF RANGE | Not reported during power-up. |
| 9921 | 99 | GROUND MODULE FAILURE - HIGH SIDE DRIVER CUTOUT FAULTY | |
| 9922 | 99 | PLATFORM MODULE FAILURE - HWFS CODE 1 | |
| 9923 | 99 | GROUND MODULE FAILURE - HWFS CODE 1 | |
| 9924 | 99 | FUNCTIONS LOCKED OUT - MACHINE NOT CONFIGURED | Display ??? or NO MODEL at Analyzer MACHINE SETUP menu MACHINE SETUP- >MODEL NUMBER Do not report any other faults Disable all machine and engine functions (i.e., command engine shutdown and do not permit start). |
| 9944 | 99 | CURRENT FEEDBACK GAINS OUT OF RANGE | A gain of 1 is used for the factory gain(s) that was out of range; all functions shall be placed in Creep mode. |
| 9945 | 99 | CURRENT FEEDBACK CALIBRATION CHECKSUM INCORRECT | |
| 9979 | 99 | FUNCTIONS LOCKED OUT - GROUND MODULE SOFTWARE VERSION IMPROPER | Disable all machine and engine functions (i.e., command engine shutdown and do not permit start). |

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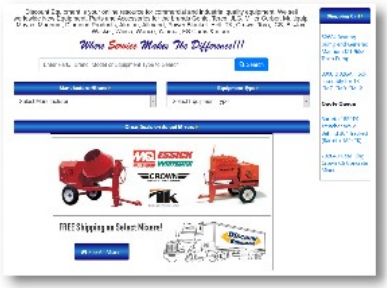

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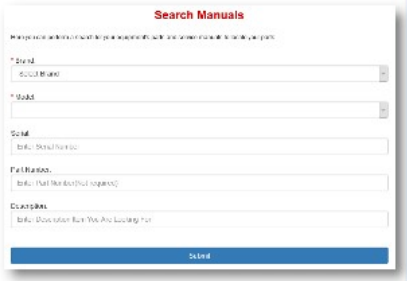


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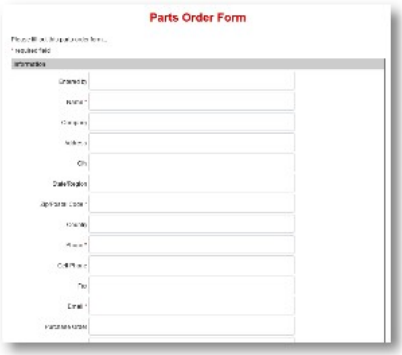


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# SECTION 7. BASIC ELECTRICAL INFORMATION & SCHEMATICS

## 7.1 GENERAL

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

***NOTE:*** *Some of the procedures/connectors shown in this section may not be applicable to all models.*

## 7.2 MULTIMETER BASICS

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

### Grounding

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

### Backprobing

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

### Min/Max

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

### Polarity

Getting a negative Voltage or current reading when expecting a positive reading frequently means the leads are reversed. Check what reading is expected, the location of the signal and that the leads are connected to the device under test correctly.

Also check that the lead on the "COM" port goes to the Ground or negative side of the signal and the lead on the other port goes to the positive side of the signal.

### Scale

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

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

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

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

Example: 1.2 kW = 1200 W
Example: 50 mA = 0.05 A

### Voltage Measurement

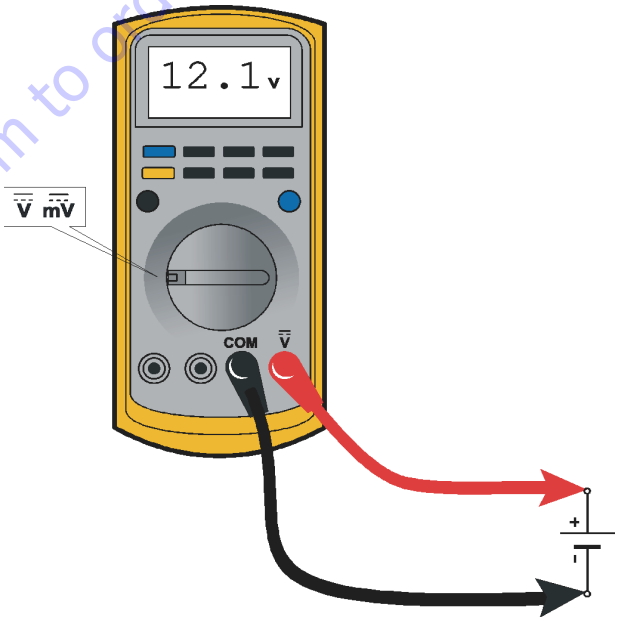



**Figure 7-1. Voltage Measurement (DC)**

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

## Resistance Measurement

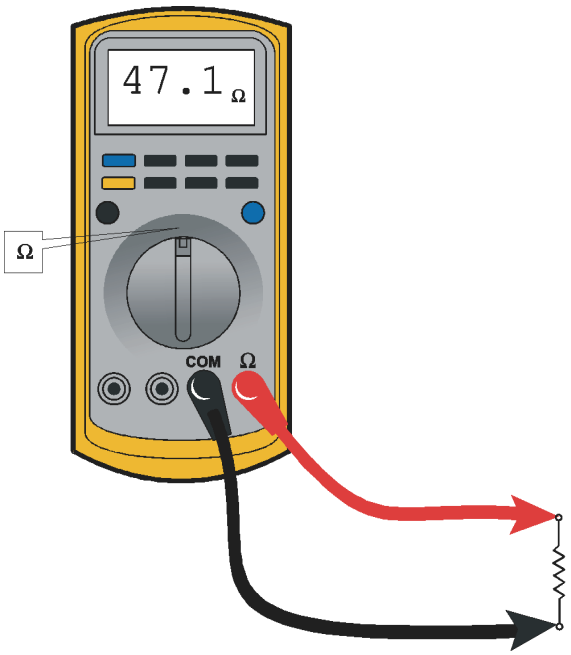



**Figure 7-2. Resistance Measurement**

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

## Continuity Measurement

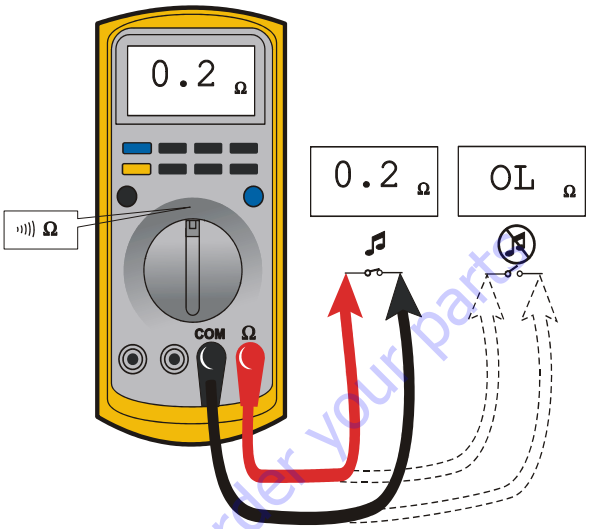



**Figure 7-3. Continuity Measurement**

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

## Current Measurement

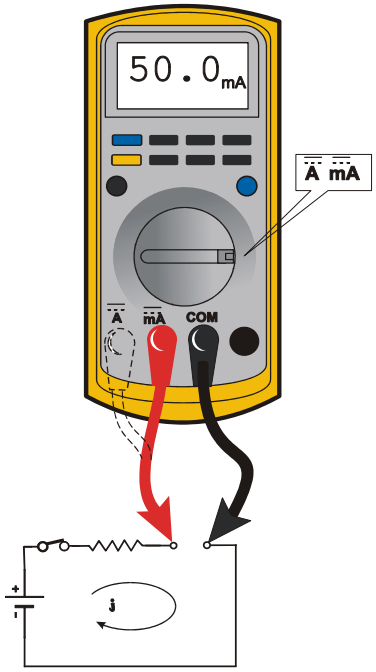



**Figure 7-4. Current Measurement (DC)**

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

## 7.3 APPLYING SILICONE DIELECTRIC COMPOUND TO ELECTRICAL CONNECTIONS

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

**NOTICE**

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

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

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

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

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

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

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

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

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

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

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

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

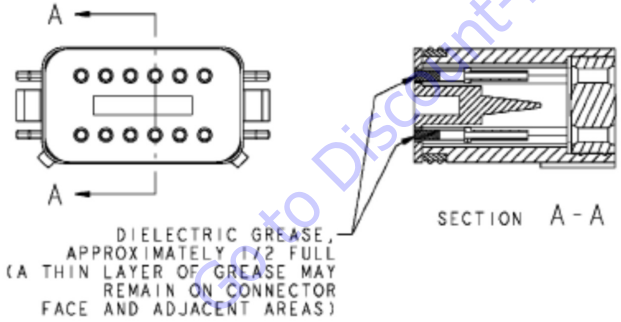
When applied to electrical connections, dielectric grease helps to prevent corrosion of electrical contacts and improper conductivity between contacts from moisture intrusion. Open and sealed connectors benefit from the application of dielectric grease.

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

## Installation of Dielectric Grease

Before following these instructions, refer to excluded connector types (See Exclusions below).

1. Use dielectric grease in a tube for larger connection points or apply with a syringe for small connectors.
2. Apply dielectric grease to the female contact (fill it approximately ½ full; see example below).
3. Leave a thin layer of dielectric grease on the face of the connector.
4. Assemble the connector system immediately to prevent moisture ingress or dust contamination.
5. Pierce one of the unused wire seals prior to assembly if the connector system tends to trap air (i.e. AMP Seal) and then install a seal plug.




## Deutsch HD, DT, DTM, DRC Series

The Deutsch connector system is commonly used for harsh environment interconnect. Follow the installation instructions.


## AMP Seal

The AMP Seal connector system is used on the Control ADE Platform and Ground Modules.

Apply dielectric grease to the plug/male connector housing which typically contains socket contacts/female terminals. If trapped air prevents the connector from latching, pierce one of the unused wire seals. After assembly, install a seal plug (JLG #4460905) in that location to prevent moisture ingress.

Note that seal plugs may be installed by the wire harness manufacturer if an unused wire seal becomes compromised (wire inserted in the wrong cavity during assembly and then corrected).

**Figure 7-5. Application to plug/male connector housing**

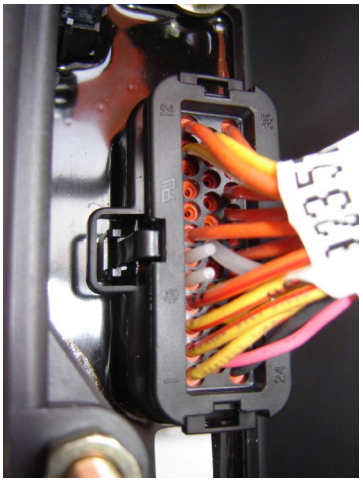
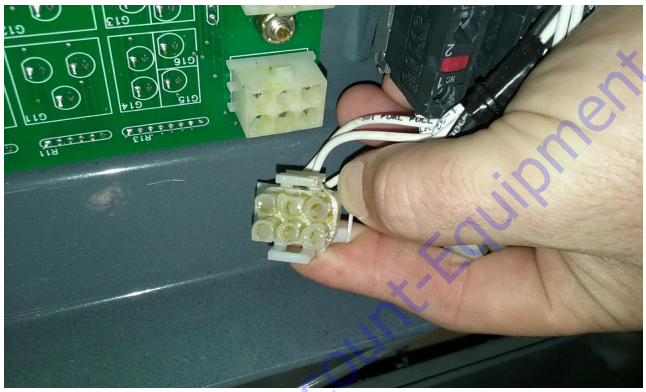


**Figure 7-6. Use of Seal Plugs**

## AMP Mate-N-Lok

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



## DIN Connectors

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

## Exclusions

A limited number of connectors do not benefit from dielectric grease, or may be permanently damaged by application. Dielectric grease may not be required in properly sealed enclosures.

### BRAD HARRISON / PHOENIX CONTACT M12

The connector uses gold contact material to resist corrosion and an o-ring seal for moisture integrity. If dielectric grease is mistakenly applied to this connector system, the low-force contacts cannot displace the grease to achieve electrical contact. Once contaminated, there is no practical way to remove the dielectric grease (replacement of female contacts required). The JLG Load Sensing System and 1250AJP Rotary Angle Sensors are examples of components with the M12 connector system.

**Figure 7-7. Brad-Harrison M12**

**Figure 7-8. Phoenix Contact M12**

### AMP JUNIOR TIMER

This type of connector uses back-seals for moisture integrity. However, the low-force contacts cannot displace dielectric grease and create electrical contact. It is possible to use solvents (i.e. contact cleaner or mineral spirits) for the removal of improperly applied dielectric grease. The EMR2 engine control module from Deutz employs this connector system (for example).

### SEALED ENCLOSURES

Application of dielectric grease is not required in properly sealed enclosures. To meet criteria, the enclosure must be rated to at least IP66 (dust tight; protected from powerful jets of water). The enclosure must be fitted with a high quality, continuous gasket and all wiring must pass through cable entrances.

### MIL-C-5015 SPEC CONNECTOR'S

Crown Connector Inc's recommendation is to not use dielectric grease for this series connector. For similar model series connectors, the manufacturer should be contacted for confirmation before applying dielectric grease. A typical application for this connector is on David Clark Intercom connections in Aerial Work Platforms.

### MOLEX CMC SERIES CONNECTORS

The CMC connector family is a sealed, high-density connection system using matte-seal technology for CP 0.635 and 1.50 mm terminals. To guarantee IP6K7 and IP6K9 sealing, a seal plug option is used. However, the low-force contacts cannot displace dielectric grease and create electrical contact. It is possible to use solvents (i.e. contact cleaner or mineral spirits) for the removal of improperly applied dielectric grease. The flexbox control modules from JDES employ this connector system (for example).

## 7.4 AMP CONNECTOR

### Assembly

Check to be sure the wedge lock is in the open, or as-shipped, position (See Figure 7-9.). Proceed as follows:

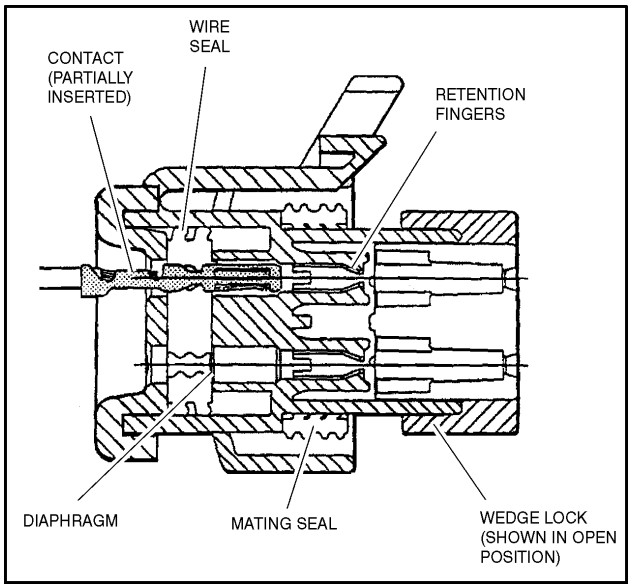



**Figure 7-9. Connector Assembly Figure 1**

1. To insert a contact, push it straight into the appropriate circuit cavity as far as it will go (See Figure 7-11.).

2. Pull back on the contact wire with a force of 1 or 2 lbs. to be sure the retention fingers are holding the contact (See Figure 7-11.).



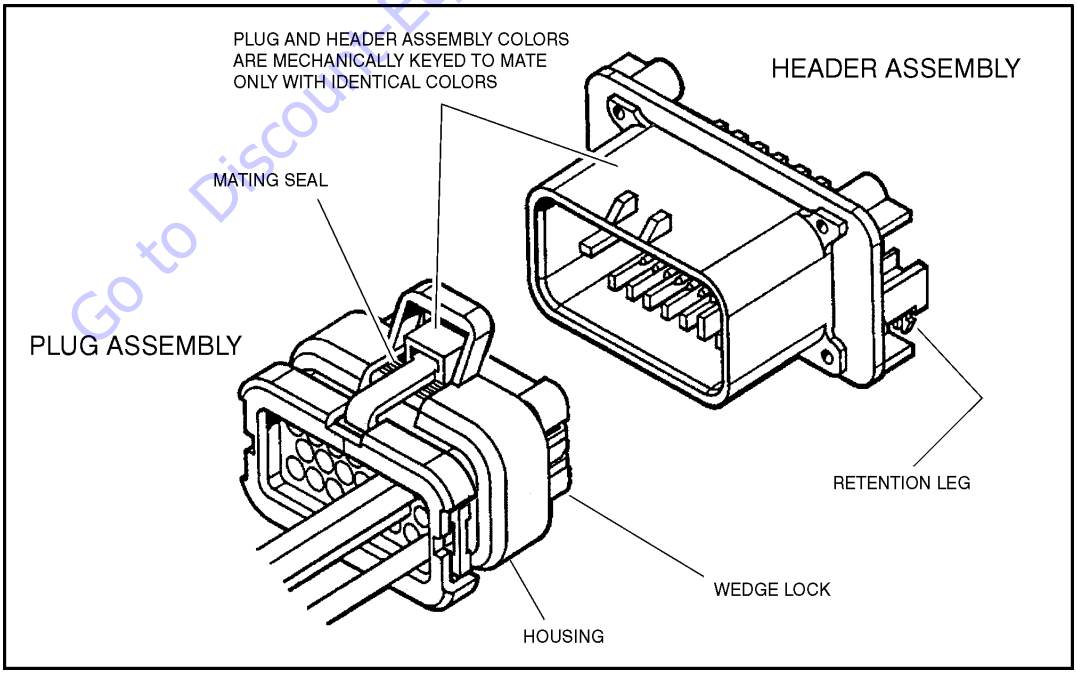



**Figure 7-10. AMP Connector**

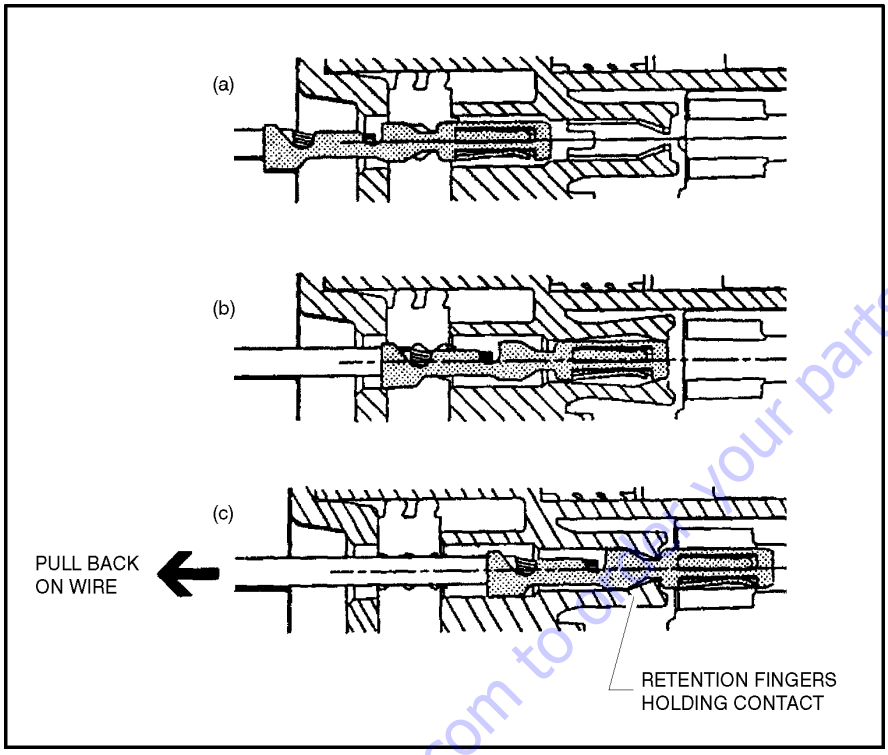



**Figure 7-11. Connector Assembly Figure 2**

**3.** After all required contacts have been inserted, the wedge lock must be closed to its locked position. Release the locking latches by squeezing them inward (See Figure 7-12.).

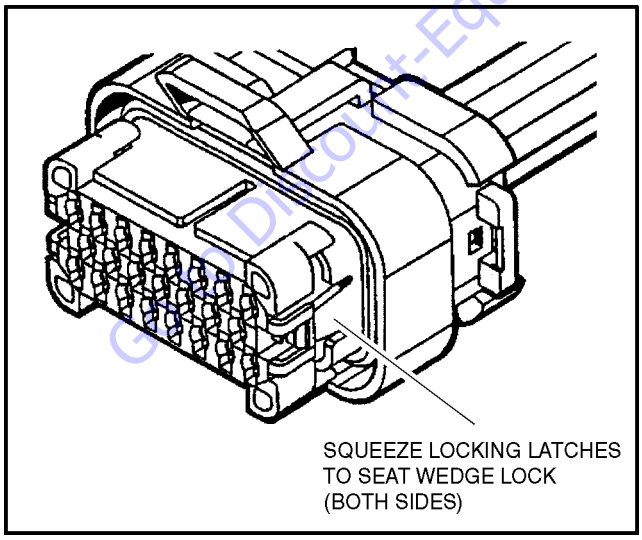



**Figure 7-12. Connector Assembly Figure 3**

**4.** Slide the wedge lock into the housing until it is flush with the housing (See Figure 7-13.).

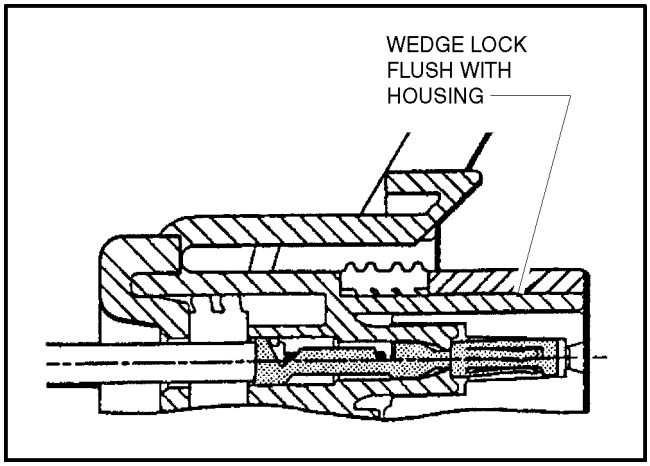



**Figure 7-13. Connector Assembly Figure 4**

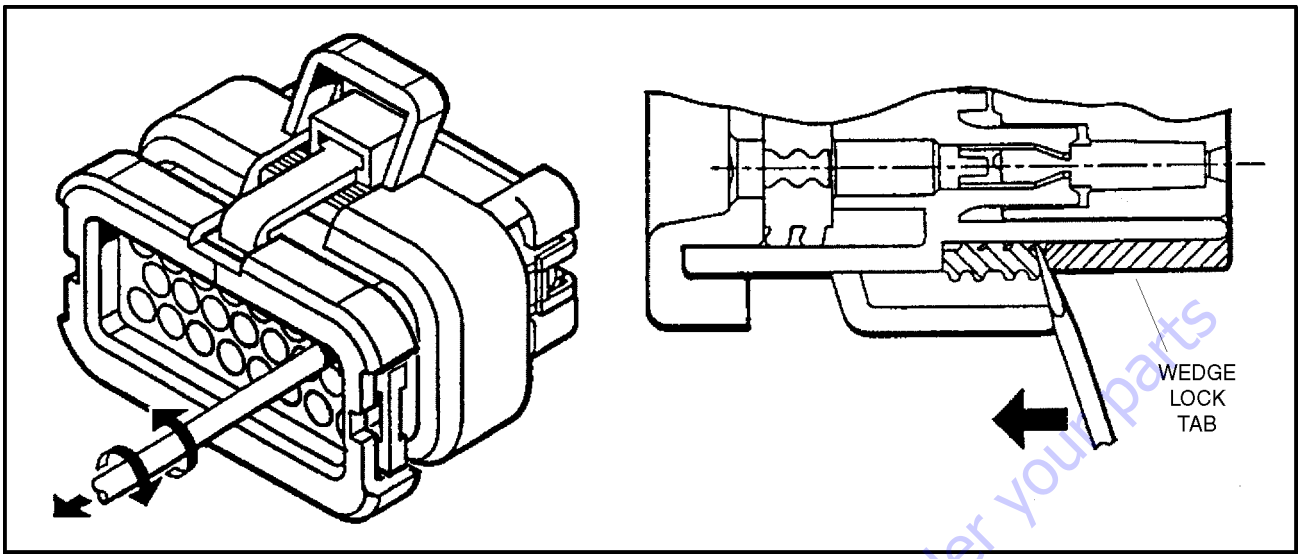



**Figure 7-14. Connector Disassembly**

## Disassembly

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

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

## Wedge Lock

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

## Service - Voltage Reading

***NOTICE***

**DO NOT PIERCE WIRE INSULATION TO TAKE VOLTAGE READINGS.**

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

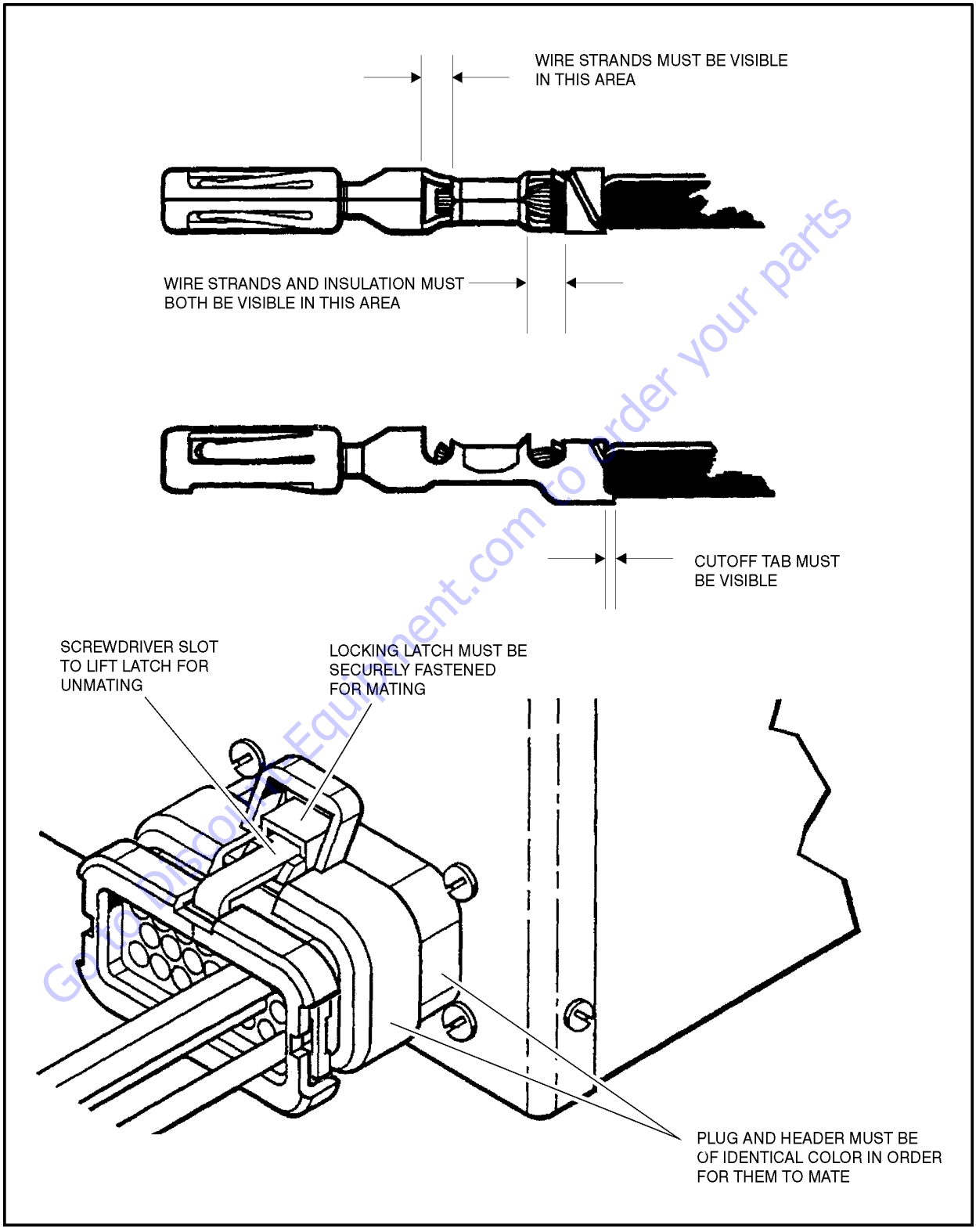





**Figure 7-15. Connector Installation**

## 7.5 DEUTSCH CONNECTORS

### DT/DTP Series Assembly

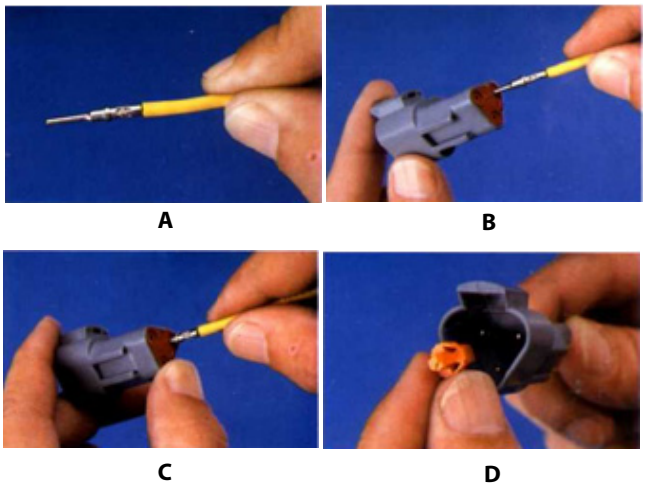



**Figure 7-16. DT/DTP Contact Installation**

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

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

### DT/DTP Series Disassembly

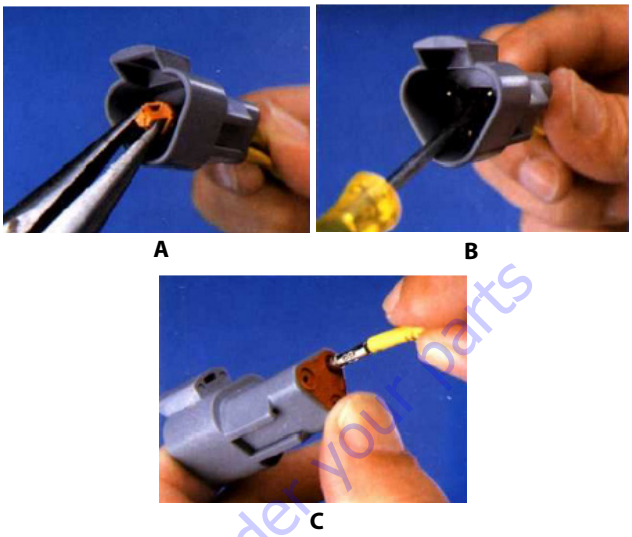



**Figure 7-17. DT/DTP Contact Removal**

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

## HD30/HDP20 Series Assembly

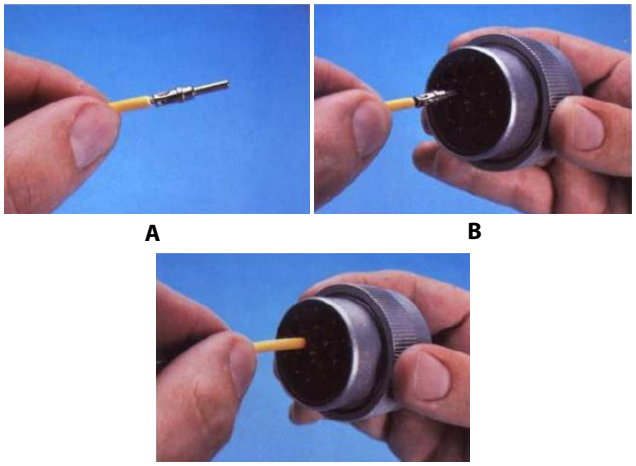



**Figure 7-18. HD/HDP Contact Installation**

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

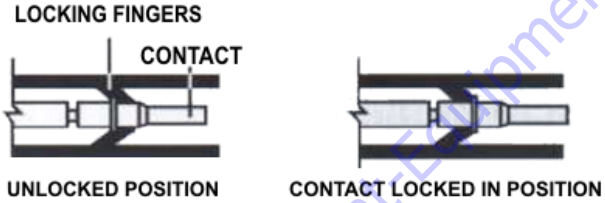



**Figure 7-19. HD/HDP Locking Contacts Into Position**

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

## HD30/HDP20 Series Disassembly

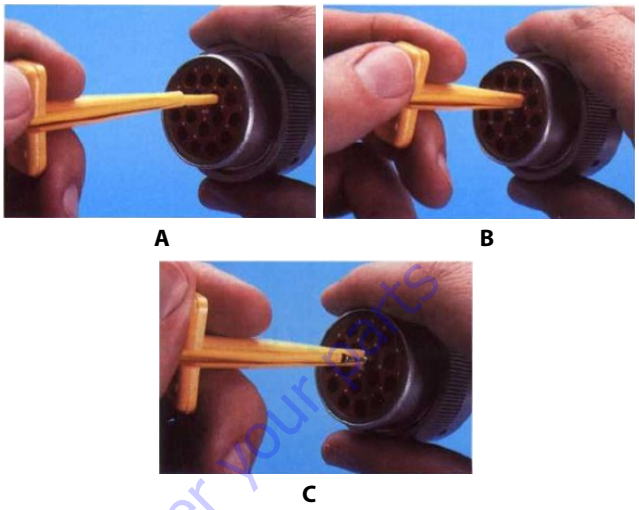



**Figure 7-20. HD/HDP Contact Removal**

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

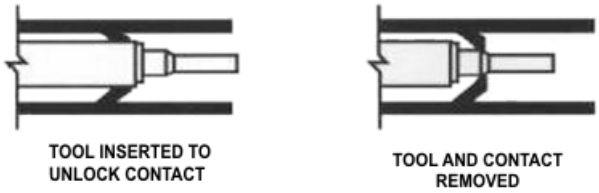


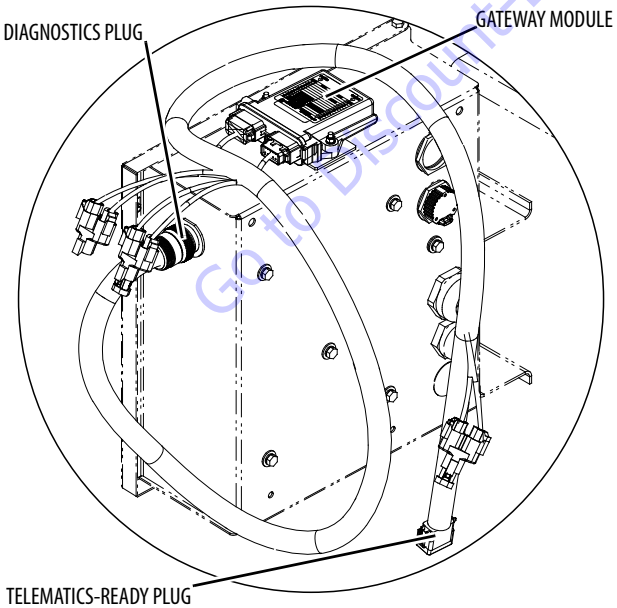

**Figure 7-21. HD/HDP Unlocking Contacts**

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

## 7.6 TELEMATICS GATEWAY

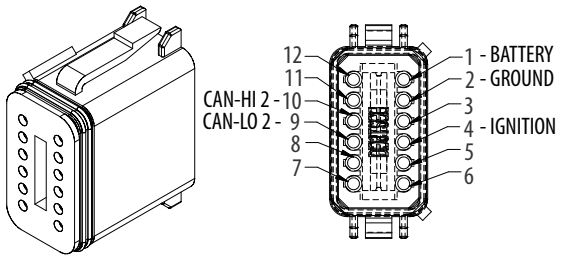
Personnel using machines equipped with an optional telematics gateway will be able to view the following data through their telematics device:

| JLG LABEL | DESCRIPTION | UNIT |
|---|---|---|
| Engine Speed | Actual engine speed. | RPM |
| DEF Tank Level (If Equipped) | Indicates the level of DEF (diesel exhaust fluid) within the DEF tank if the machine is equipped with DEF tank.<br>• 0% = Empty<br>• 100% = Full | Percentage (%) |
| JLG Machine Faults: Active / Not-Active | • 00 - No Machine Faults<br>• 01 - Active Machine Fault<br>• 10 - Error<br>• 11 - Not available | Bit |
| Total Idle Fuel Used | Total amount of fuel used during vehicle operation during idle conditions. | Liters |
| Total Idle Hours | Total time of engine operation during idle conditions. | Seconds |
| Total Engine Hours | Total time of engine operation. | Seconds |
| Total Fuel Used | Total amount of fuel used during vehicle operation. | Liters |
| Fuel Rate | Amount of fuel consumed by engine per unit of time. | Liters/Hour |
| Fuel Level | Ratio of fuel volume to the total volume of the fuel storage container. When a low fuel limit switch is present, the fuel level will indicate "full" until the switch opens, which will then indicate 10% fuel remaining.<br>When Fuel Level 2 (SPN 38) is not used, Fuel Level 1 represents the total fuel in all fuel storage containers. When Fuel Level 2 is used, Fuel Level 1 represents the fuel level in the primary or left side fuel storage container. | Percentage (%) |
| DM1 Engine Faults | Shows actual engine fault codes. | N/A |




### Telematics-Ready (TCU) Plug

The telematics-ready (TCU) plug is a standard 12-pin Deutsch connector. Pin-out locations are shown below:



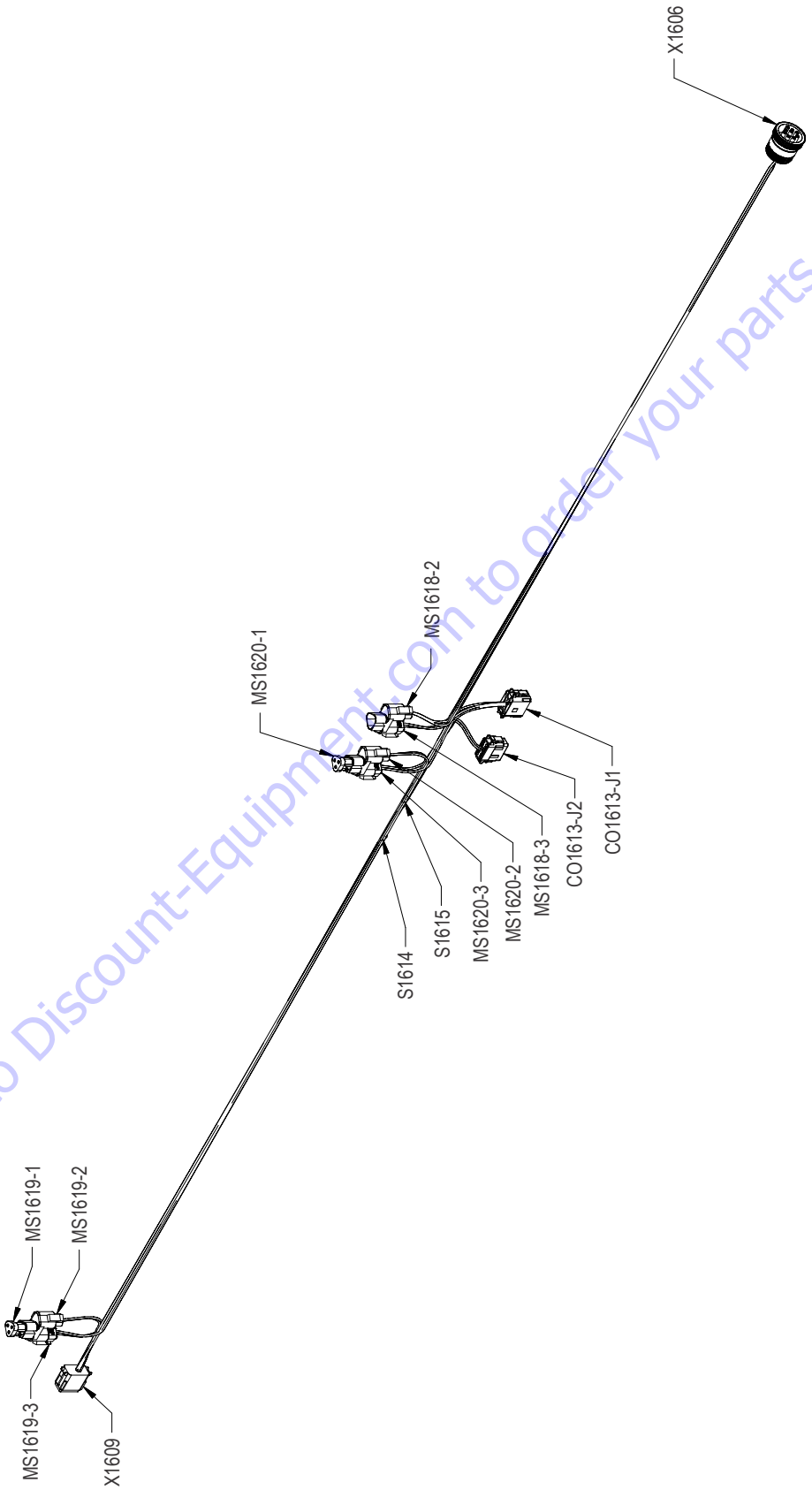



**Figure 7-22. Telematics Gateway Harness - Sheet 1 of 3**

| X1609 (TCU) | | | | | |
|---|---|---|---|---|---|
| CONN POS | WIRE COLOR | WIRE LABEL | GAUGE | JACKET | TO |
| 1 | RED | 1-0 BAT | 16 AWG | GXL | X1606 (B) |
| 2 | BLK | 0-0 GND | 16 AWG | GXL | S1615 (1) |
| 4 | ORN | 2-0 IGN | 16 AWG | GXL | S1614 (1) |
| 9 | GRN | CANL2 | 18 AWG | GXL | MS1619-2 (B) |
| 10 | YEL | CANH2 | 18 AWG | GXL | MS1619-2 (A) |

| MS1619-2 (CAN-T 2) | | | | | |
|---|---|---|---|---|---|
| CONN POS | WIRE COLOR | WIRE LABEL | GAUGE | JACKET | TO |
| A | YEL | CANH2 | 18 AWG | GXL | X1609 (10) |
| B | GRN | CANL2 | 18 AWG | GXL | X1609 (9) |

| MS1619-3 (CAN-T 2) | | | | | |
|---|---|---|---|---|---|
| CONN POS | WIRE COLOR | WIRE LABEL | GAUGE | JACKET | TO |
| A | YEL | CANH2 | 18 AWG | GXL | MS1620-2 (A) |
| B | GRN | CANL2 | 18 AWG | GXL | MS1620-2 (B) |

| CO1613-J1 (GATEWAY 1) | | | | | |
|---|---|---|---|---|---|
| CONN POS | WIRE COLOR | WIRE LABEL | GAUGE | JACKET | TO |
| 9 | GRN | CAN1 | 18 AWG | GXL | MS1618-2 (B) |
| 10 | YEL | CANH1 | 18 AWG | GXL | MS1618-2 (A) |
| 11 | BLK | 0-2 GND | 16 AWG | GXL | S1615 (2) |
| 12 | ORN | 2-2 IGN | 16 AWG | GXL | S1614 (2) |

| CO1613-J2 (GATEWAY 2) | | | | | |
|---|---|---|---|---|---|
| CONN POS | WIRE COLOR | WIRE LABEL | GAUGE | JACKET | TO |
| 9 | GRN | CANL2 | 18 AWG | GXL | MS1620-3 (B) |
| 10 | YEL | CANH2 | 18 AWG | GXL | MS1620-3 (A) |

| MS1620-2 (CAN-T 2) | | | | | |
|---|---|---|---|---|---|
| CONN POS | WIRE COLOR | WIRE LABEL | GAUGE | JACKET | TO |
| A | YEL | CANH2 | 18 AWG | GXL | MS1619-3 (A) |
| B | GRN | CANL2 | 18 AWG | GXL | MS1619-3 (B) |

| MS1620-3 (CAN-T 2) | | | | | |
|---|---|---|---|---|---|
| CONN POS | WIRE COLOR | WIRE LABEL | GAUGE | JACKET | TO |
| A | YEL | CANH2 | 18 AWG | GXL | CO1613-J2 (10) |
| B | GRN | CANL2 | 18 AWG | GXL | CO1613-J2 (9) |

| S1614 | | | | | |
|---|---|---|---|---|---|
| CONN POS | WIRE COLOR | WIRE LABEL | GAUGE | JACKET | TO |
| 1 | ORN | 2-0 IGN | 16 AWG | GXL | X1609 (4) |
| 2 | ORN | 2-1 IGN | 16 AWG | GXL | X1606 (H) |
| 2 | ORN | 2-2 IGN | 16 AWG | GXL | CO1613-J1 (12) |

| S1615 | | | | | |
|---|---|---|---|---|---|
| CONN POS | WIRE COLOR | WIRE LABEL | GAUGE | JACKET | TO |
| 1 | BLK | 0-0 GND | 16 AWG | GXL | X1609 (2) |
| 2 | BLK | 0-1 GND | 16 AWG | GXL | X1606 (A) |
| 2 | BLK | 0-2 GND | 16 AWG | GXL | CO1613-J1 (11) |

| MS1618-2 (CAN-T 1) | | | | | |
|---|---|---|---|---|---|
| CONN POS | WIRE COLOR | WIRE LABEL | GAUGE | JACKET | TO |
| A | YEL | CANH1 | 18 AWG | GXL | CO1613-J1 (10) |
| B | GRN | CANL1 | 18 AWG | GXL | CO1613-J1 (9) |

| MS1618-3 (CAN-T 1) | | | | | |
|---|---|---|---|---|---|
| CONN POS | WIRE COLOR | WIRE LABEL | GAUGE | JACKET | TO |
| A | YEL | CANH1 | 18 AWG | GXL | X1606 (C) |
| B | GRN | CANL1 | 18 AWG | GXL | X1606 (D) |

| X1606 (DIAG) | | | | | |
|---|---|---|---|---|---|
| CONN POS | WIRE COLOR | WIRE LABEL | GAUGE | JACKET | TO |
| A | BLK | 0-1 GND | 16 AWG | GXL | S1615 (2) |
| B | RED | 1-0 BAT | 16 AWG | GXL | X1609 (1) |
| C | YEL | CANH1 | 18 AWG | GXL | MS1618-3 (A) |
| D | GRN | CANL1 | 18 AWG | GXL | MS1618-3 (B) |
| H | ORN | 2-1 IGN | 16 AWG | GXL | S1614 (2) |



**Figure 7-23. Telematics Gateway Harness - Sheet 2 of 3**

| | | | | | FROM | | TO | |
|---|---|---|---|---|---|---|---|---|
| WIRE NO. | COLOR | WIRE GAUGE | LENGTH (mm) | JACKET | REFERENCE | PIN | REFERENCE | PIN |
| CAN L2 | GRN | 18 AWG | 1151 | GXL | MS1619-3 | B | MS1620-2 | B |
| CAN L2 | GRN | 18 AWG | 151 | GXL | X1609 | 9 | MS1619-2 | B |
| CAN L1 | GRN | 18 AWG | 157 | GXL | MS1618-2 | B | CO1613-J1 | 9 |
| CAN L2 | GRN | 18 AWG | 225 | GXL | MS1620-3 | B | CO1613-J2 | 9 |
| CAN L1 | GRN | 18 AWG | 1076 | GXL | MS1618-3 | B | X1606 | D |
| CAN H2 | YEL | 18 AWG | 155 | GXL | X1609 | 10 | MS1619-2 | A |
| CAN H2 | YEL | 18 AWG | 233 | GXL | MS1620-3 | A | CO1613-J2 | 10 |
| CAN H1 | YEL | 18 AWG | 157 | GXL | MS1618-2 | A | CO1613-J1 | 10 |
| CAN H2 | YEL | 18 AWG | 1150 | GXL | MS1619-3 | A | MS1620-2 | A |
| CAN H1 | YEL | 18 AWG | 1079 | GXL | MS1618-3 | A | X1606 | C |
| 0-0 GND | BLK | 16 AWG | 1006 | GXL | X1609 | 2 | S1615 | 1 |
| 0-1 GND | BLK | 16 AWG | 1145 | GXL | X1606 | A | S1615 | 2 |
| 0-2 GND | BLK | 16 AWG | 223 | GXL | CO1613-J1 | 11 | S1615 | 2 |
| 1-0 BAT | RED | 16 AWG | 2150 | GXL | X1609 | 1 | X1606 | B |
| 2-0 IGN | ORN | 16 AWG | 939 | GXL | X1609 | 4 | S1614 | 1 |
| 2-1 IGN | ORN | 16 AWG | 1212 | GXL | S1614 | 2 | X1606 | H |
| 2-2 IGN | ORN | 16 AWG | 287 | GXL | CO1613-J1 | 12 | S1614 | 2 |



**Figure 7-24. Telematics Gateway Harness - Sheet 3 of 3**

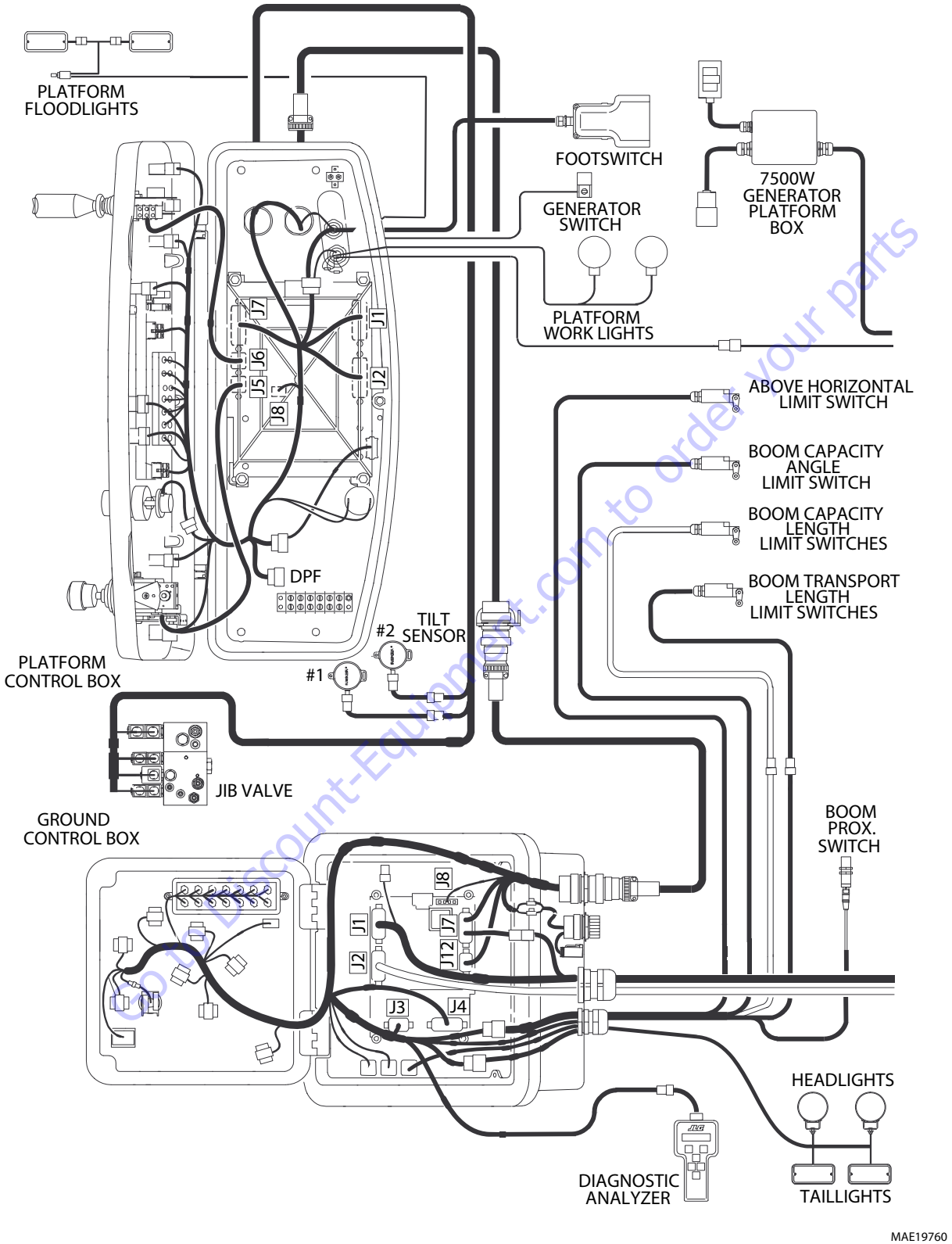



**Figure 7-25. Electrical Components Installation - Sheet 1 of 2**

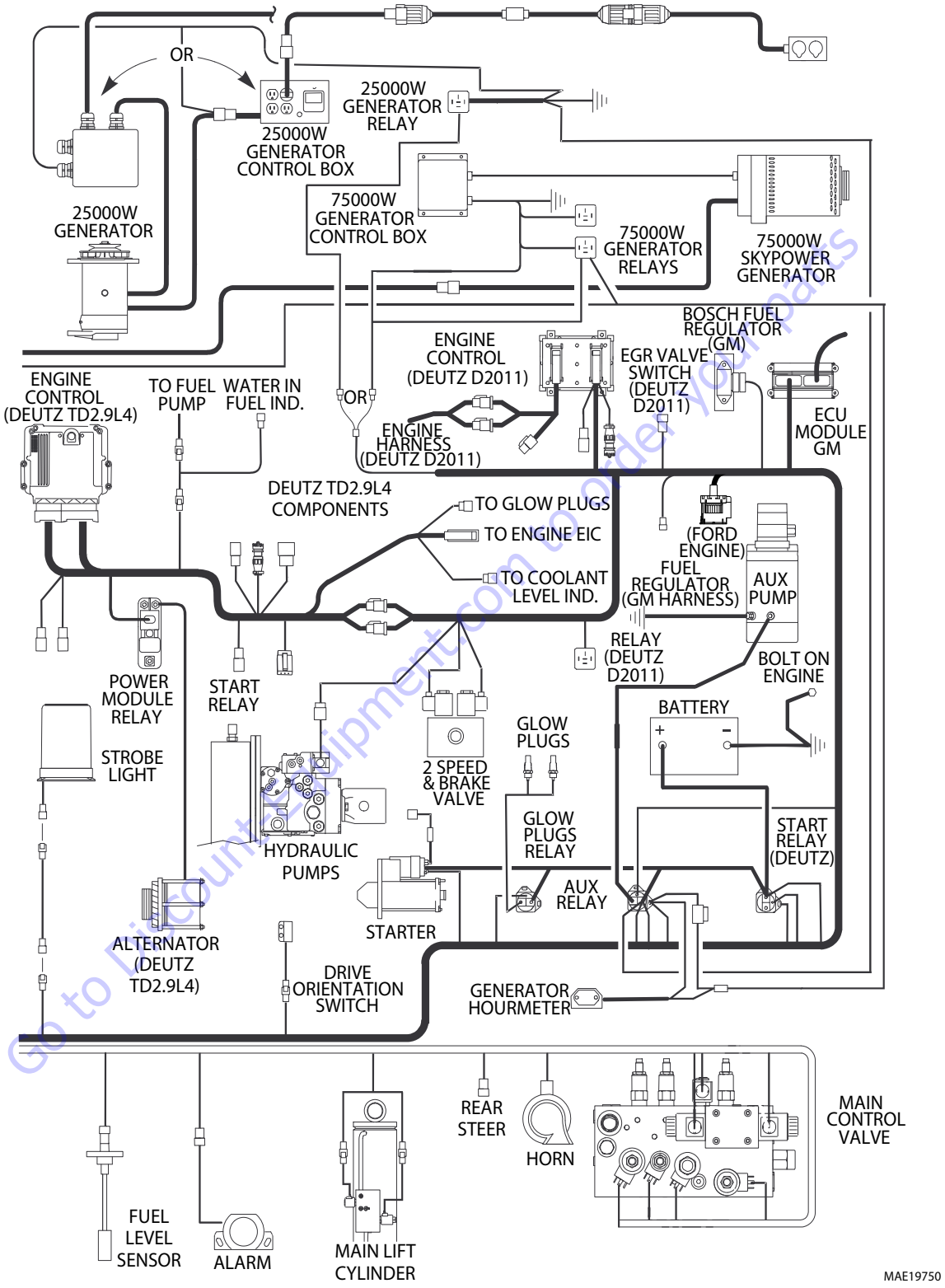





**Figure 7-26. Electrical Components Installation - Sheet 2 of 2**

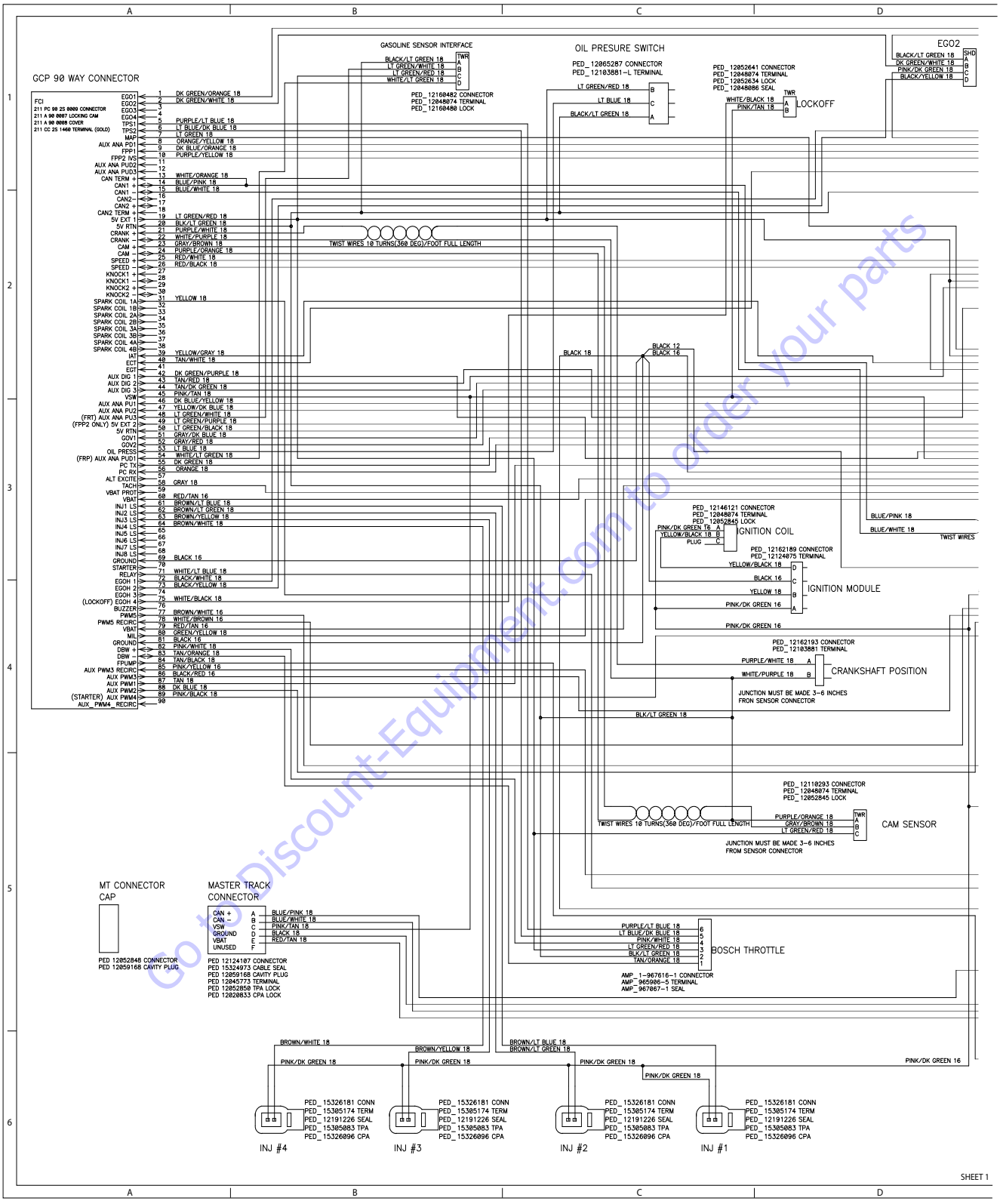



**Figure 7-27. Electrical Schematic GM - Sheet 1 of 2**

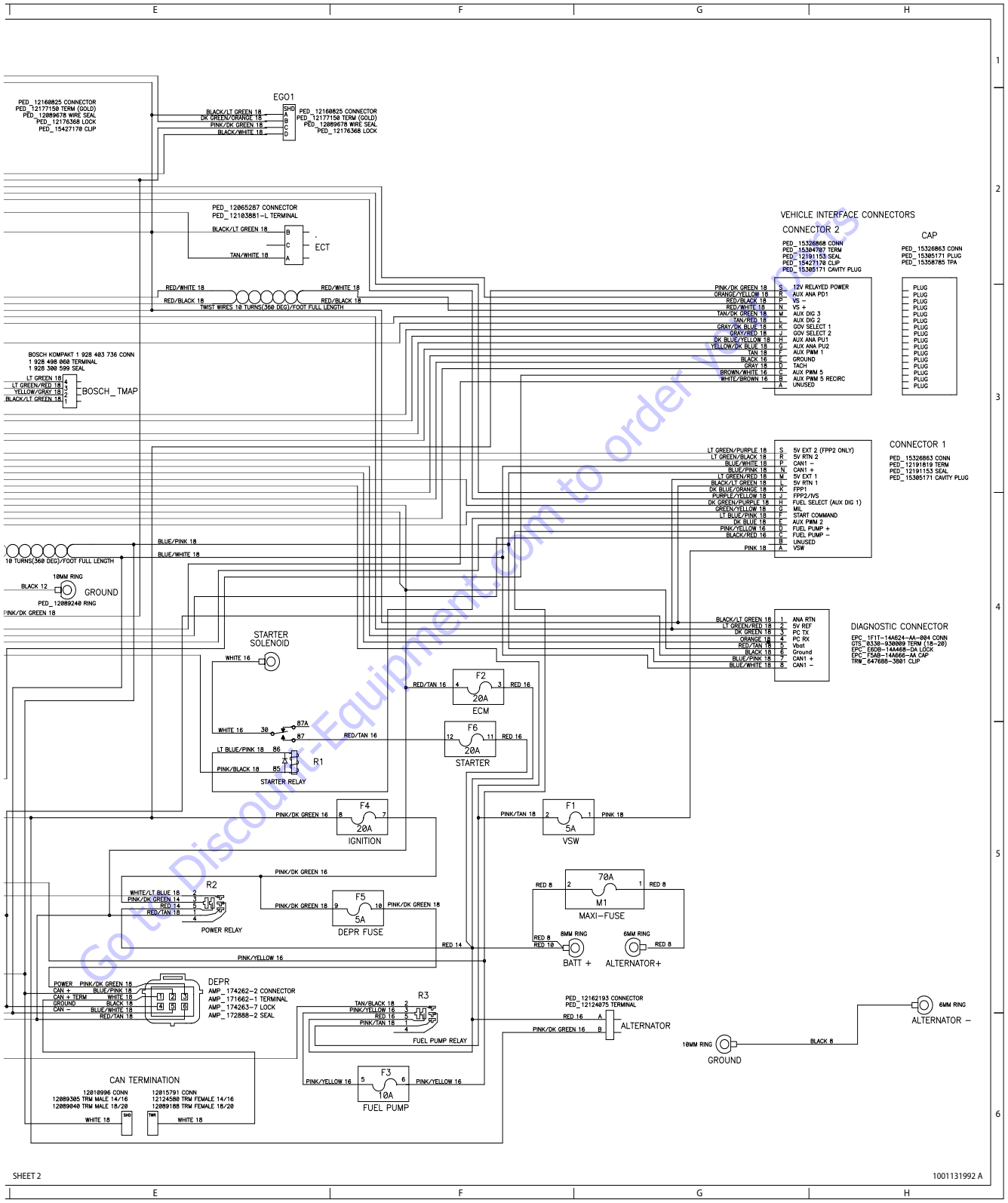



**Figure 7-28. Electrical Schematic GM - Sheet 2 of 2**

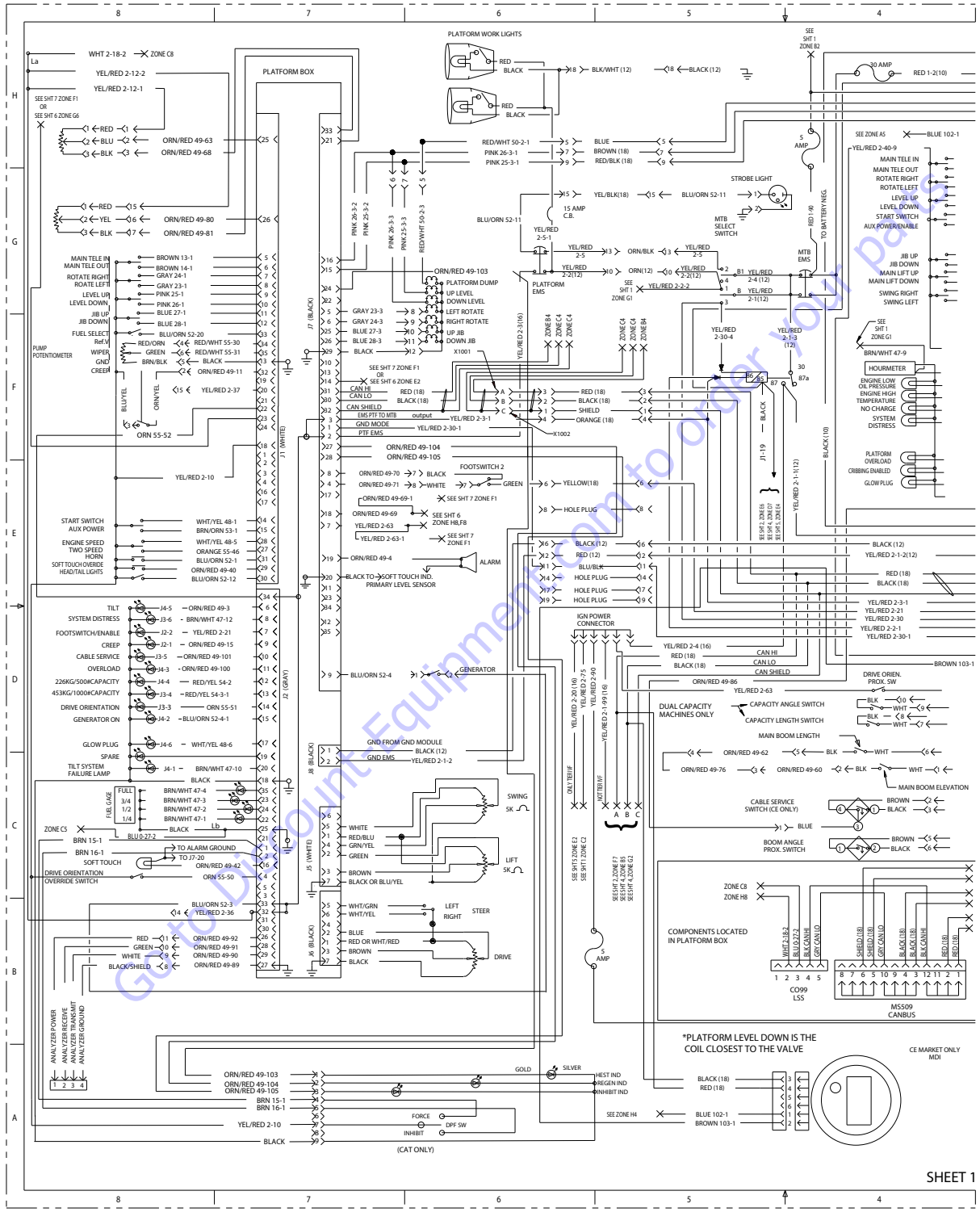



**Figure 7-29. Electrical Schematic - Sheet 1 of 17**

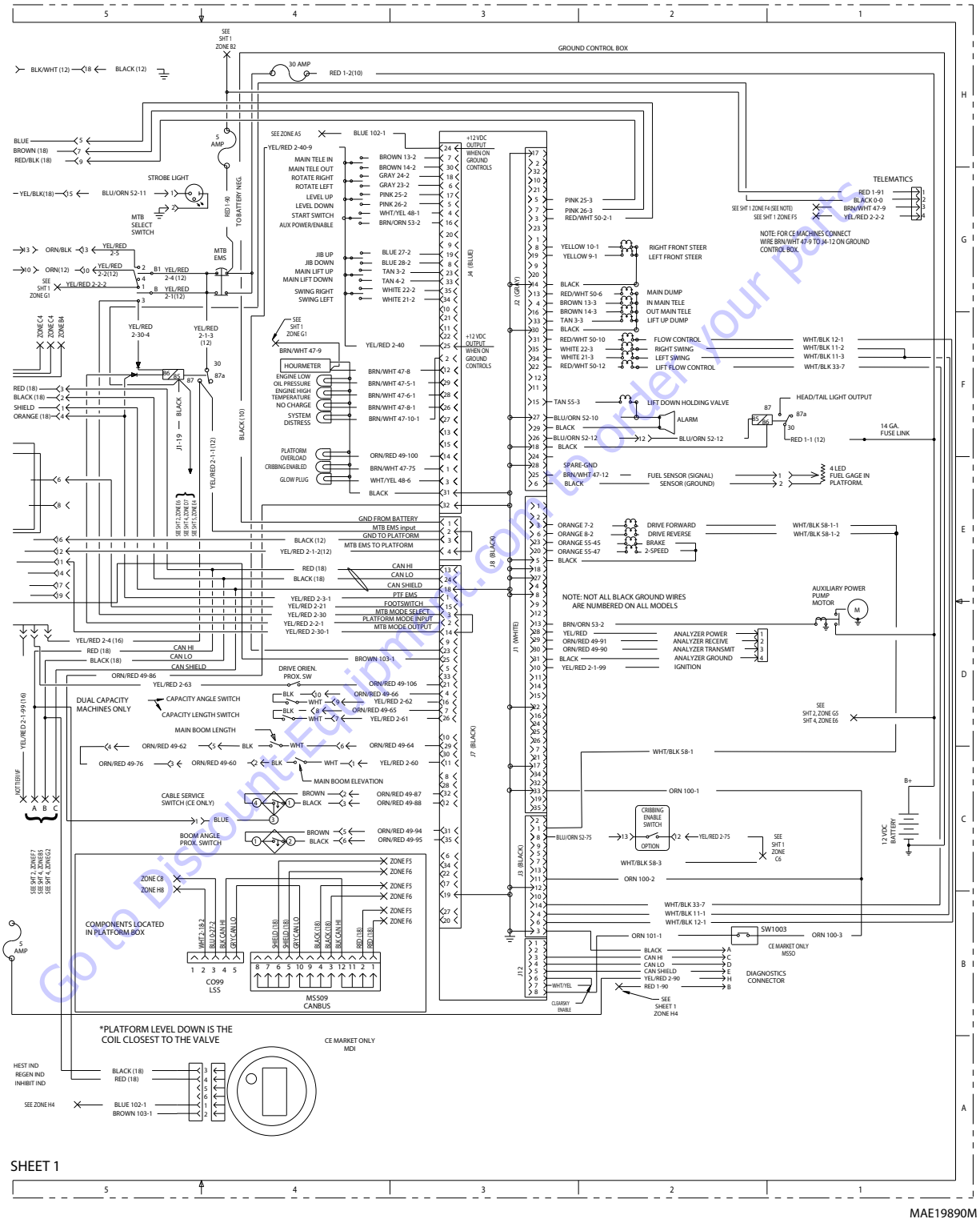



**Figure 7-30. Electrical Schematic - Sheet 2 of 17**

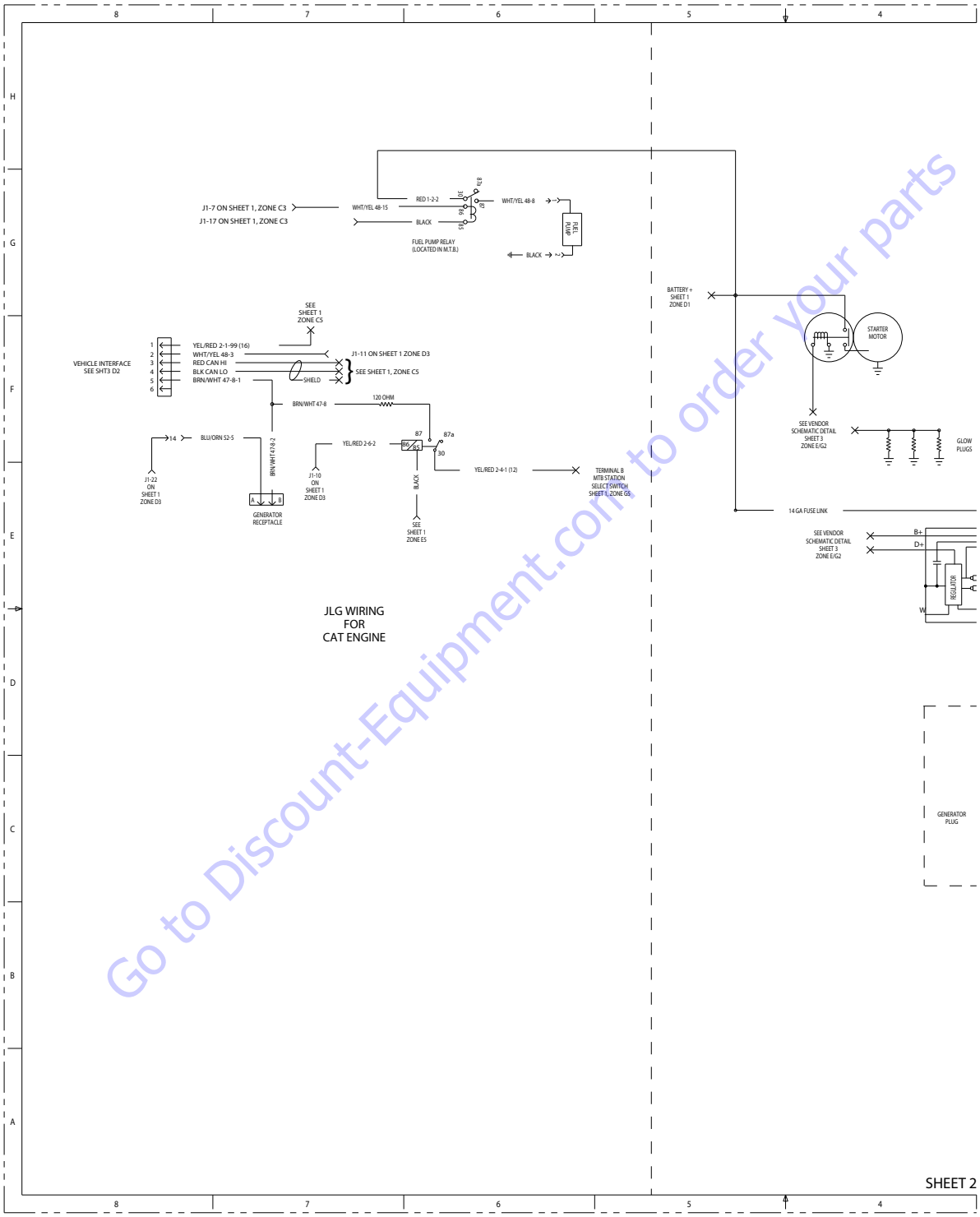





**Figure 7-31. Electrical Schematic - Sheet 3 of 17**

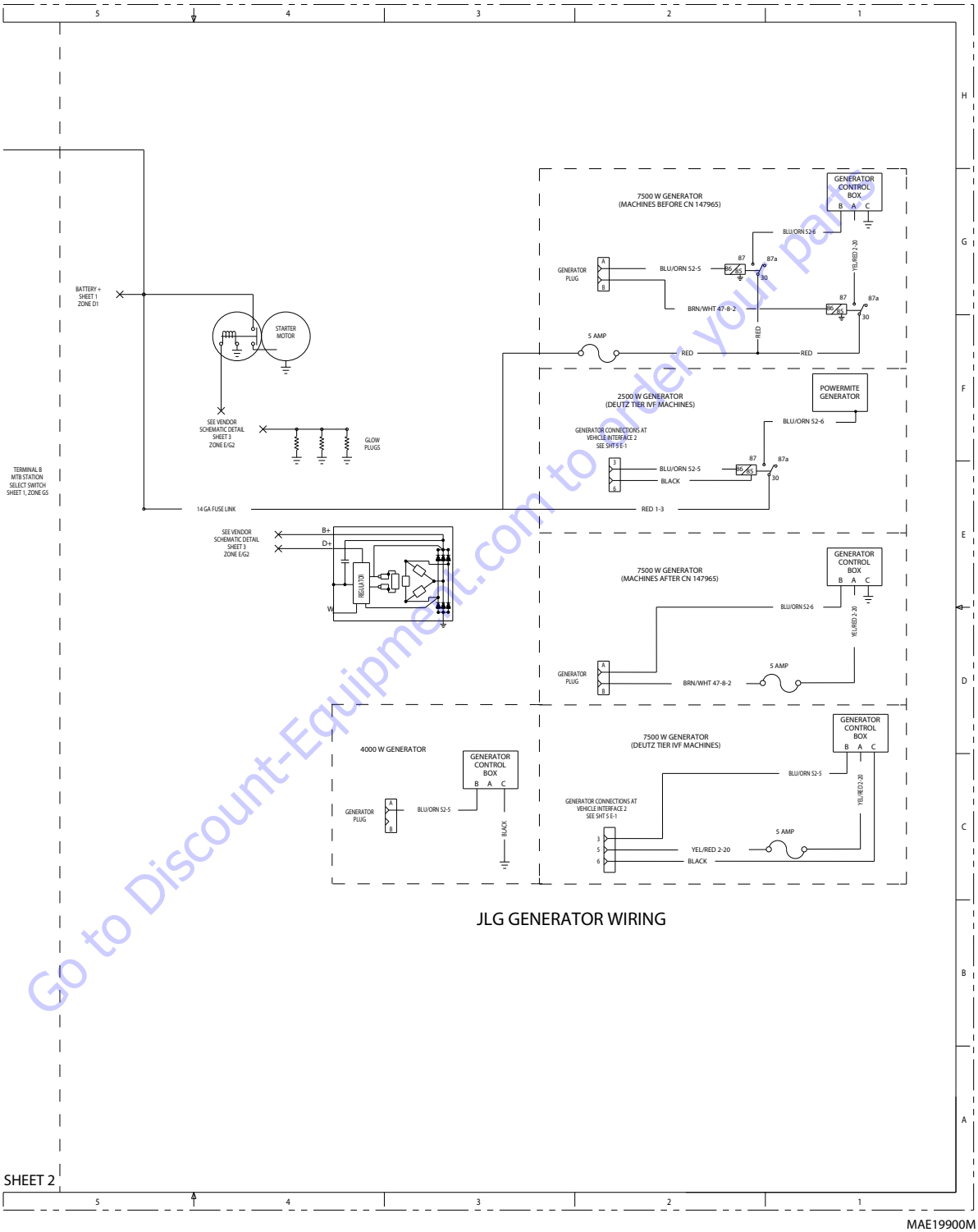



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**Figure 7-32. Electrical Schematic - Sheet 4 of 17**

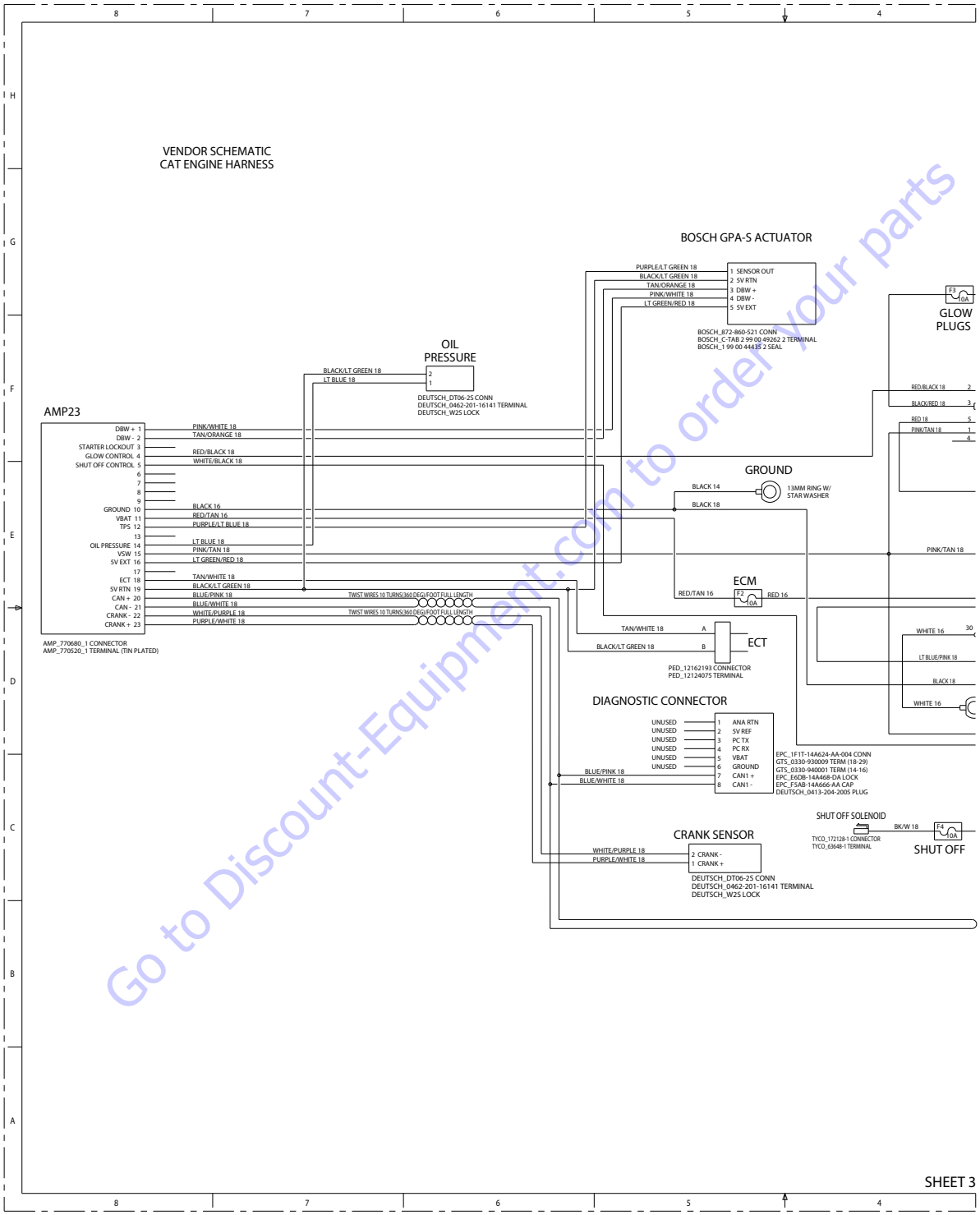




**Figure 7-33. Electrical Schematic - Sheet 5 of 17**

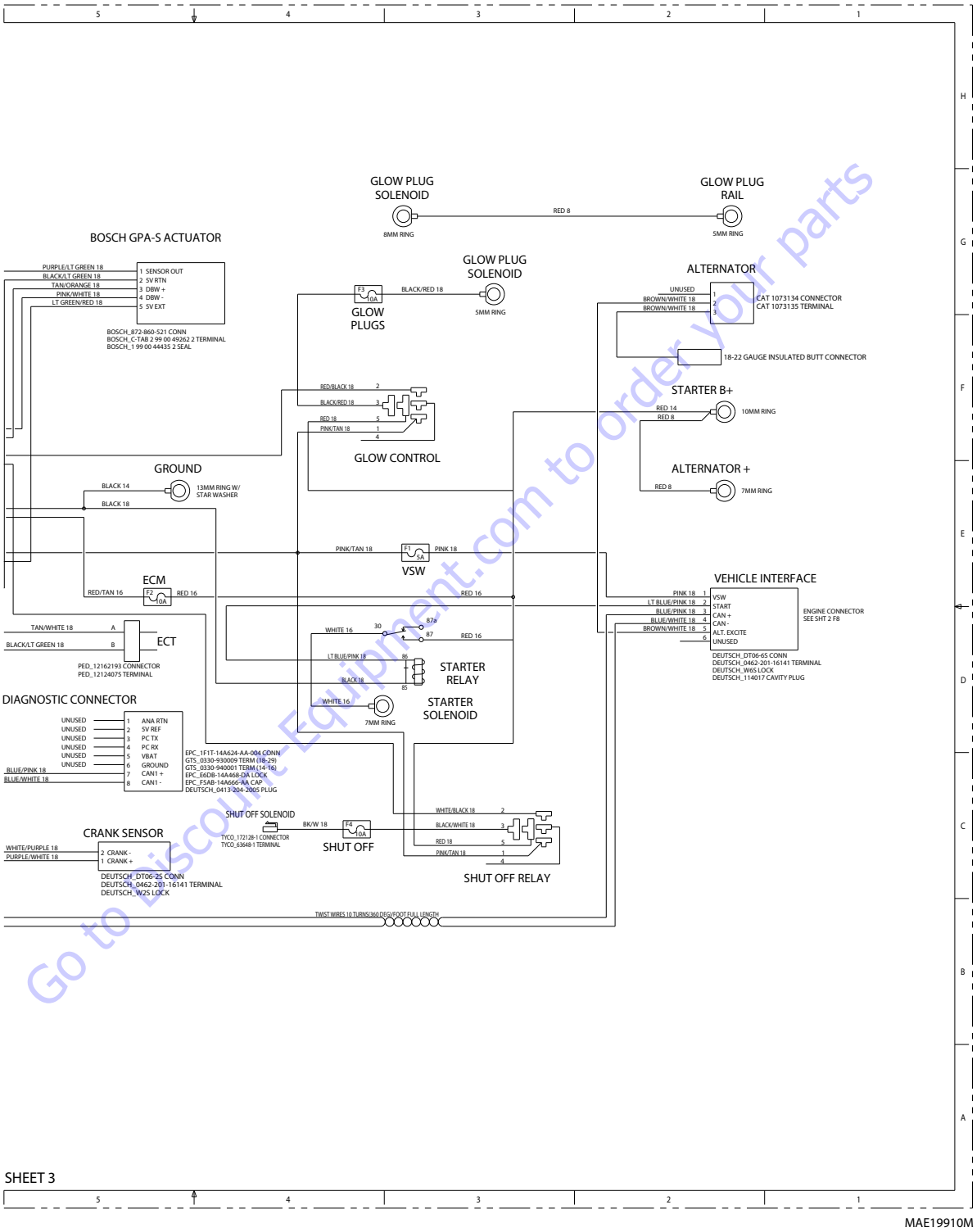




**Figure 7-34. Electrical Schematic - Sheet 6 of 17**

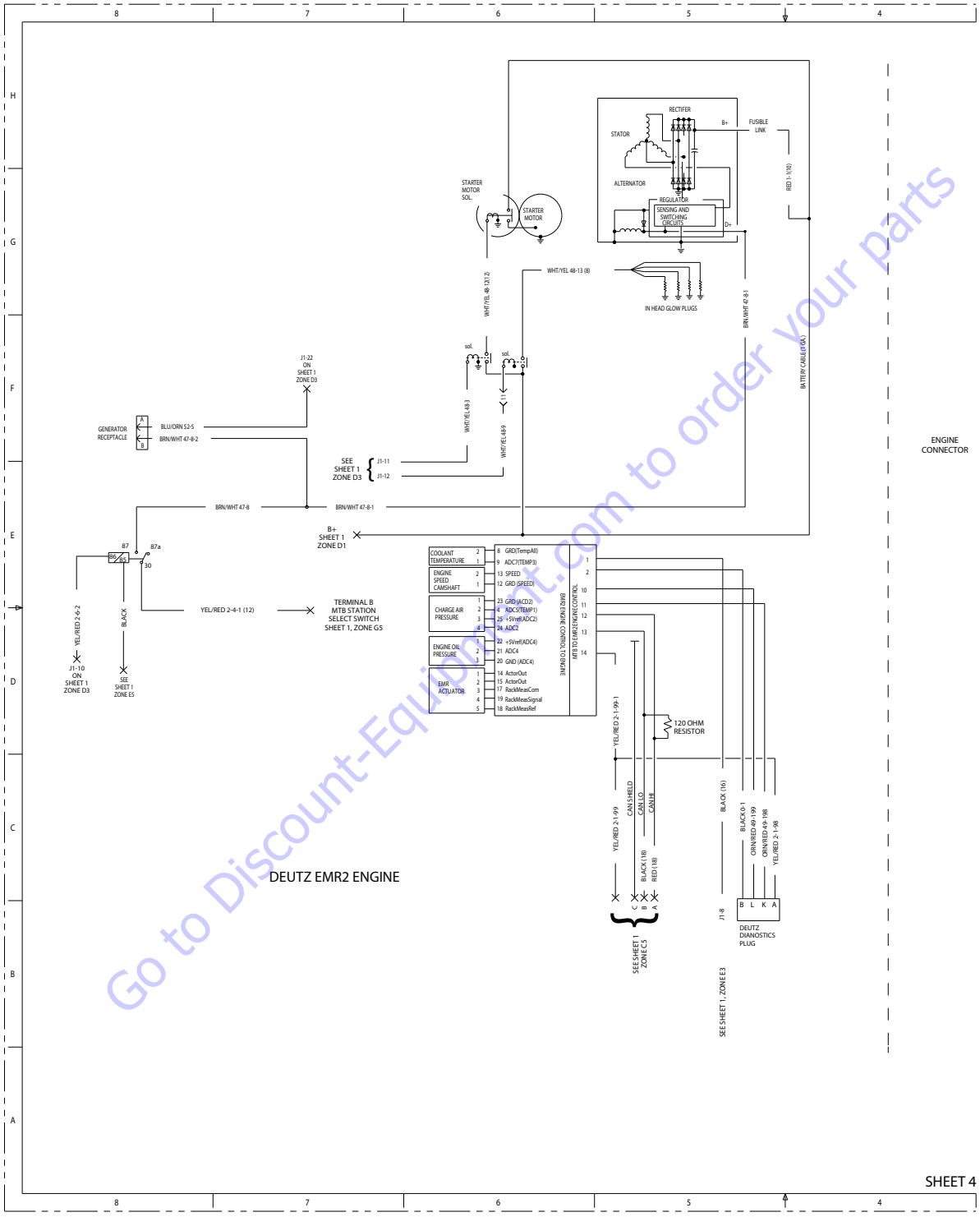




**Figure 7-35. Electrical Schematic - Sheet 7 of 17**

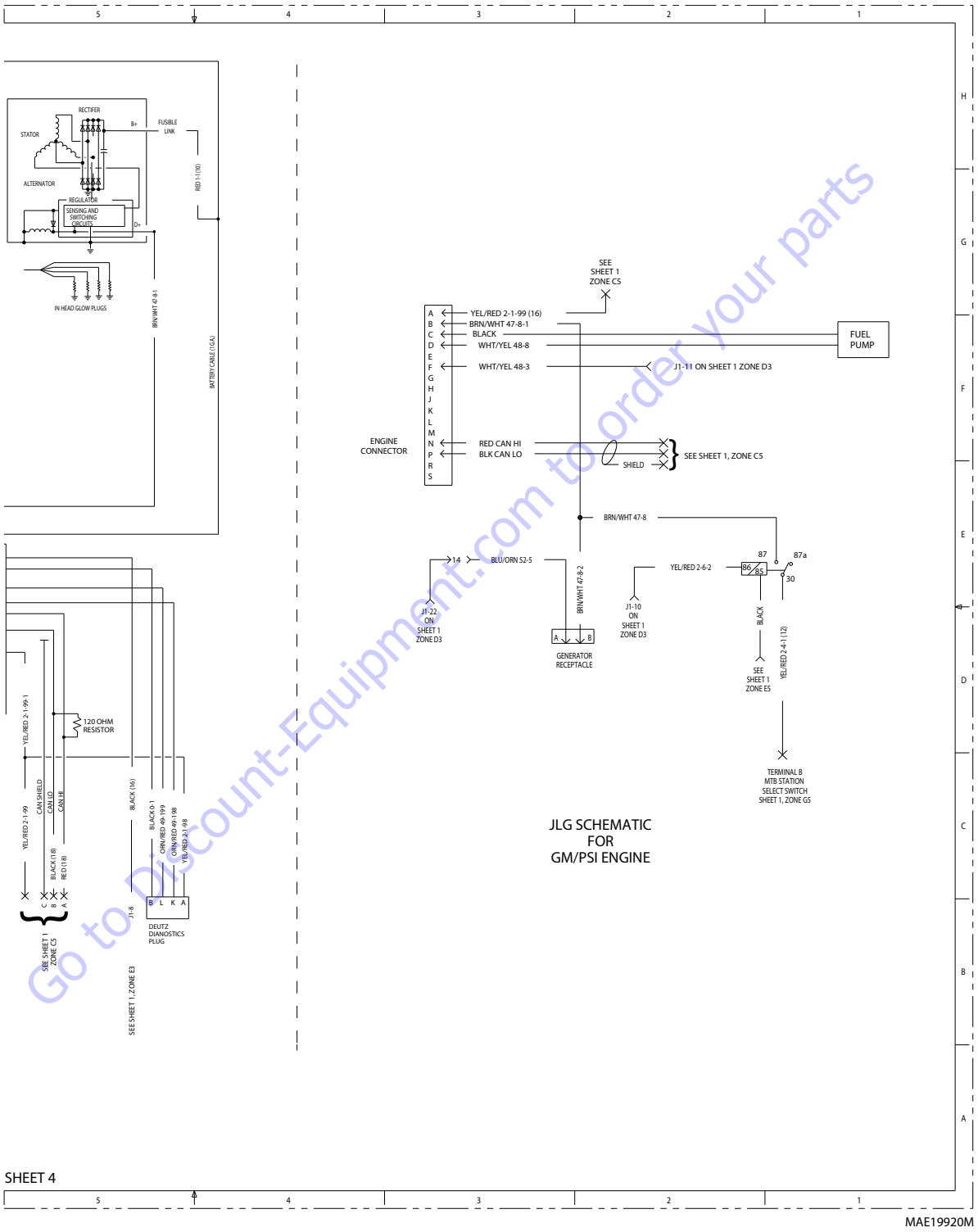




**Figure 7-36. Electrical Schematic - Sheet 8 of 17**

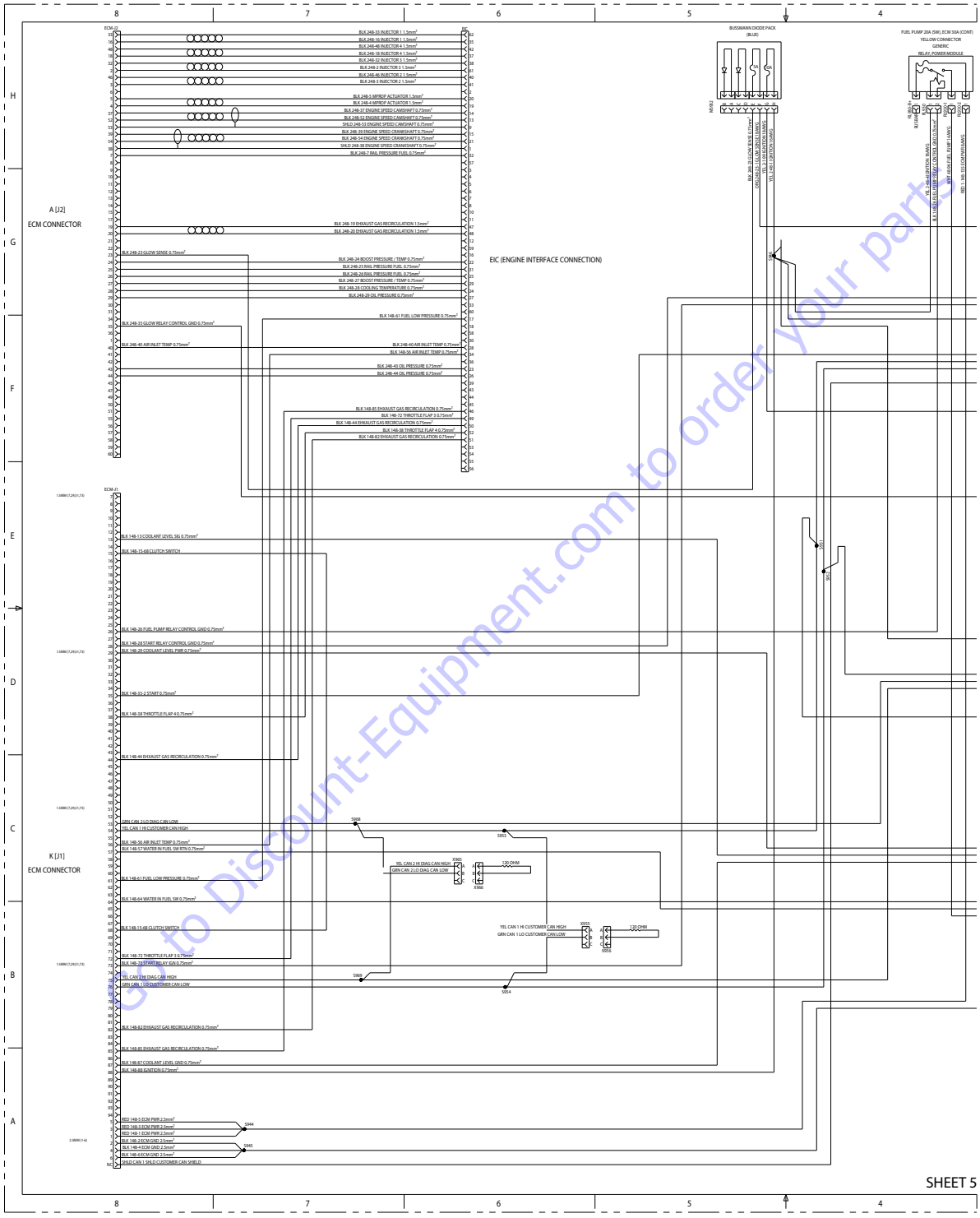




**Figure 7-37. Electrical Schematic - Sheet 9 of 17**

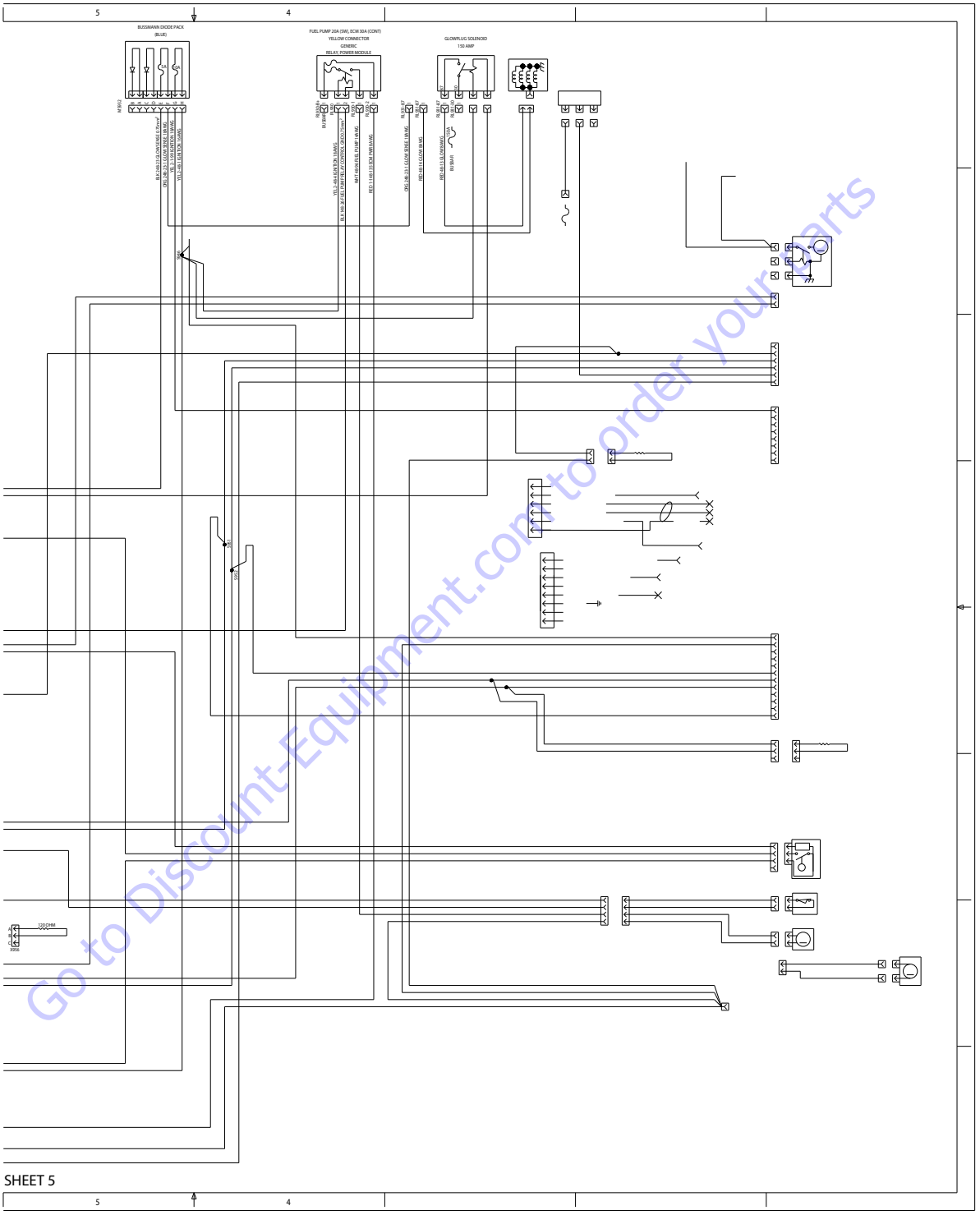




**Figure 7-38. Electrical Schematic - Sheet 10 of 17**

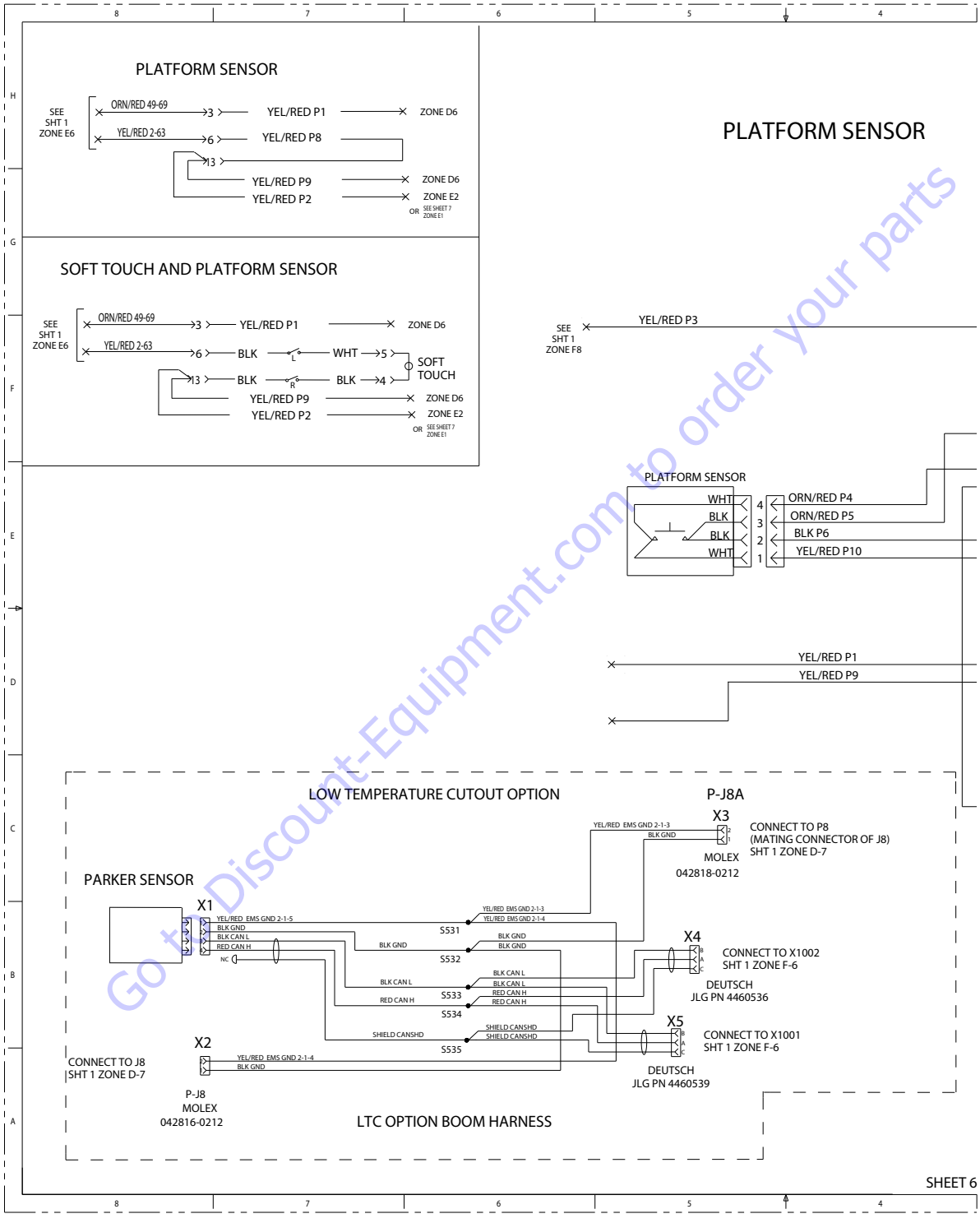




**Figure 7-39. Electrical Schematic - Sheet 11 of 17**

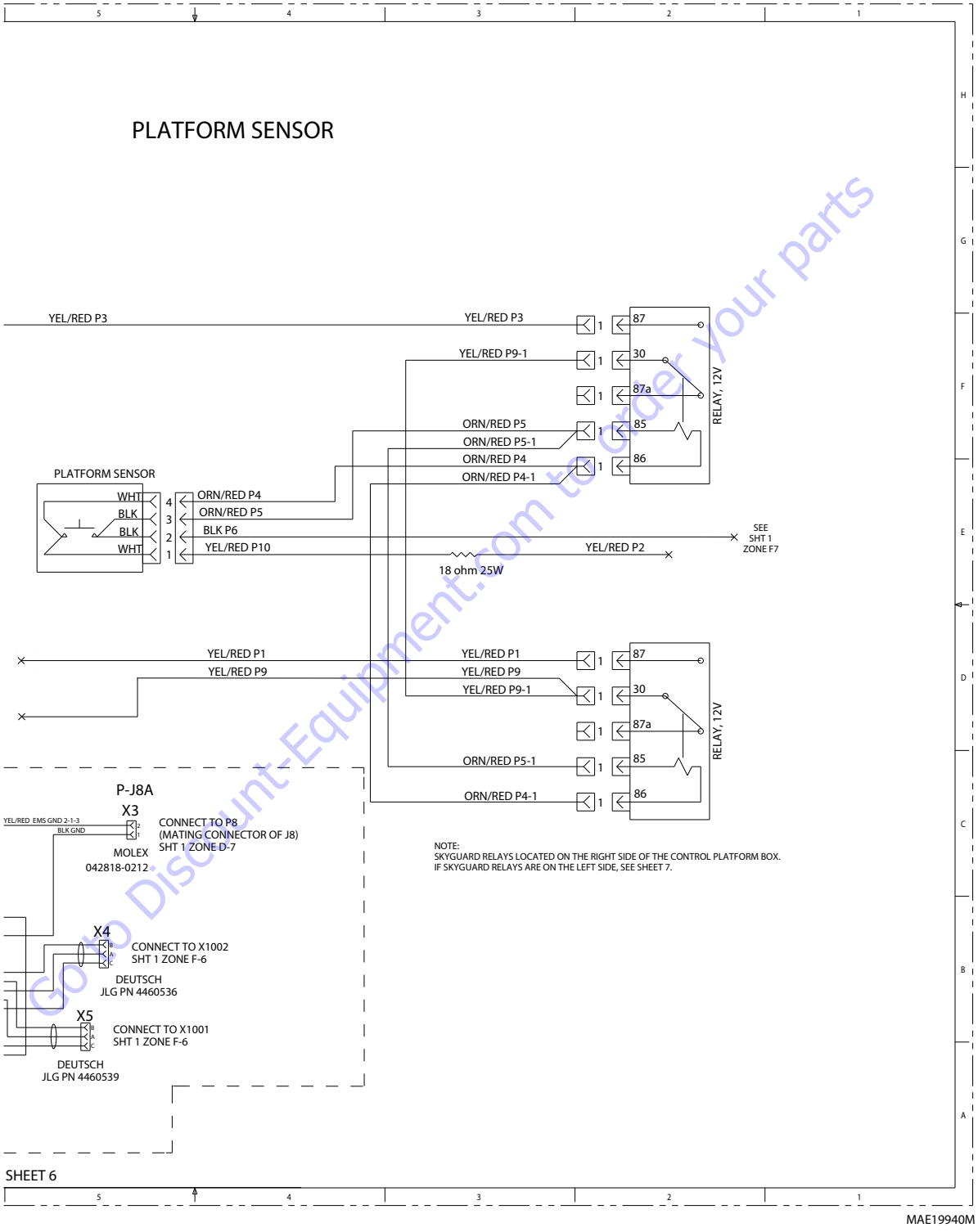




**Figure 7-40. Electrical Schematic - Sheet 12 of 17**

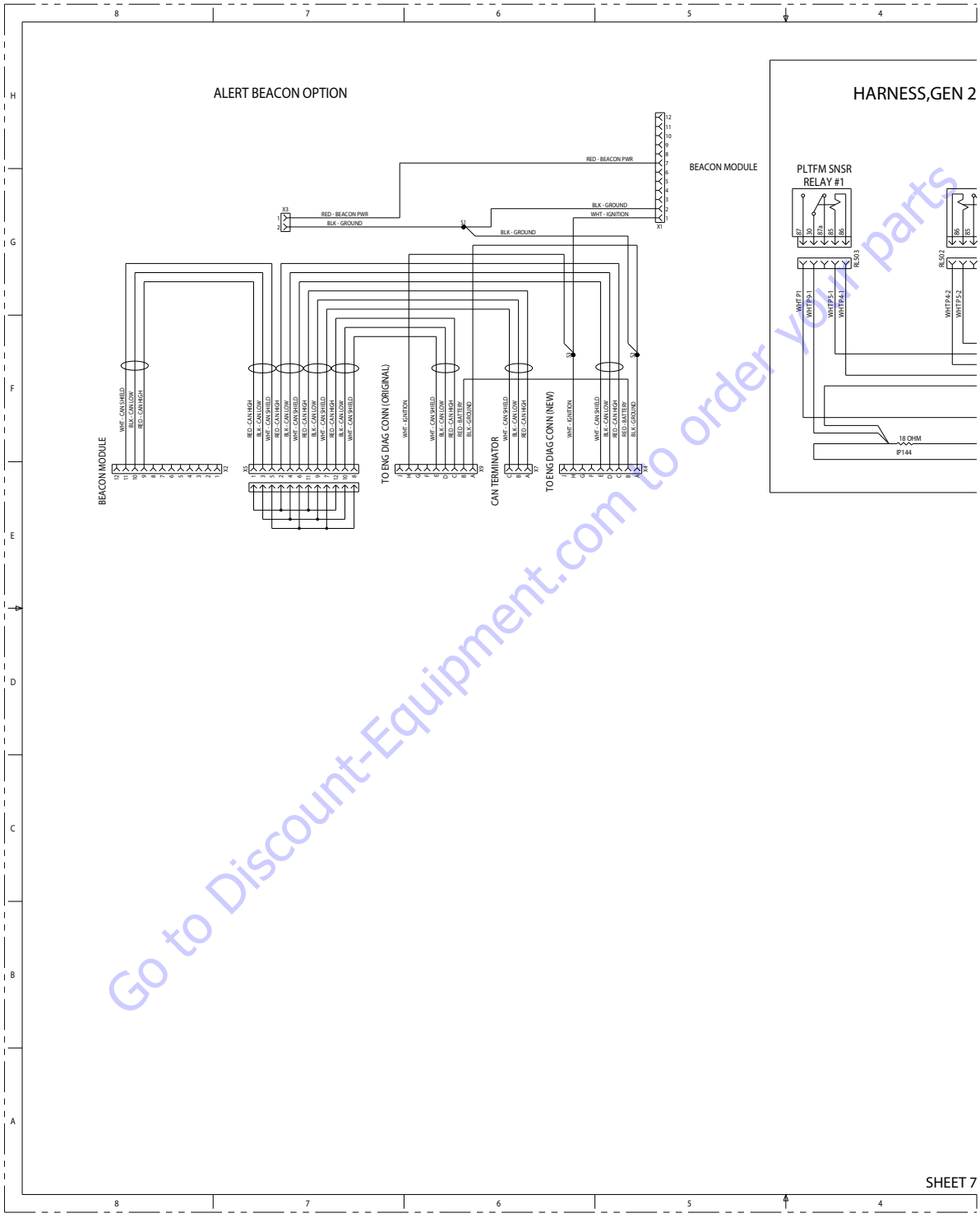




**Figure 7-41. Electrical Schematic - Sheet 13 of 17**

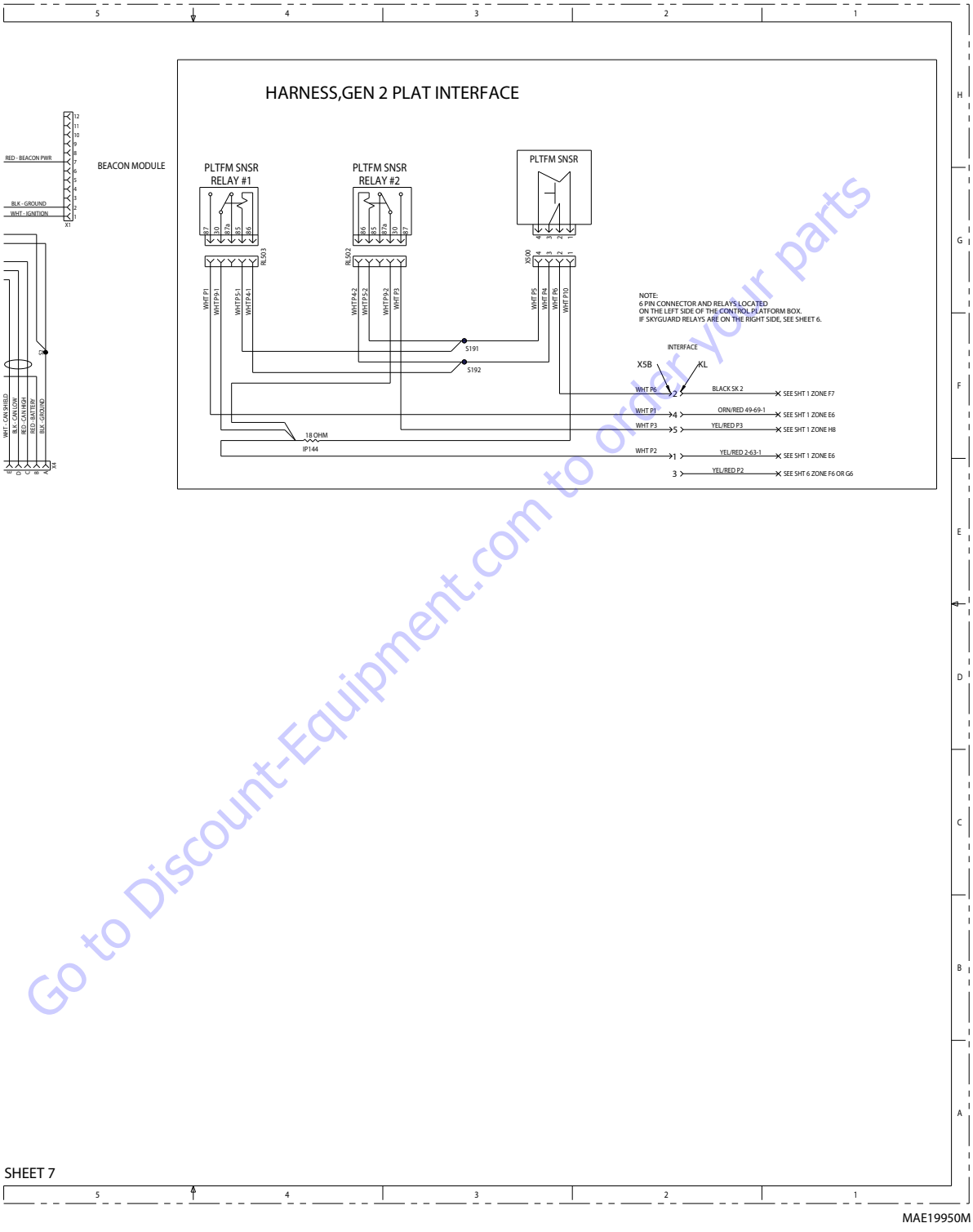




**Figure 7-42. Electrical Schematic - Sheet 14 of 17**

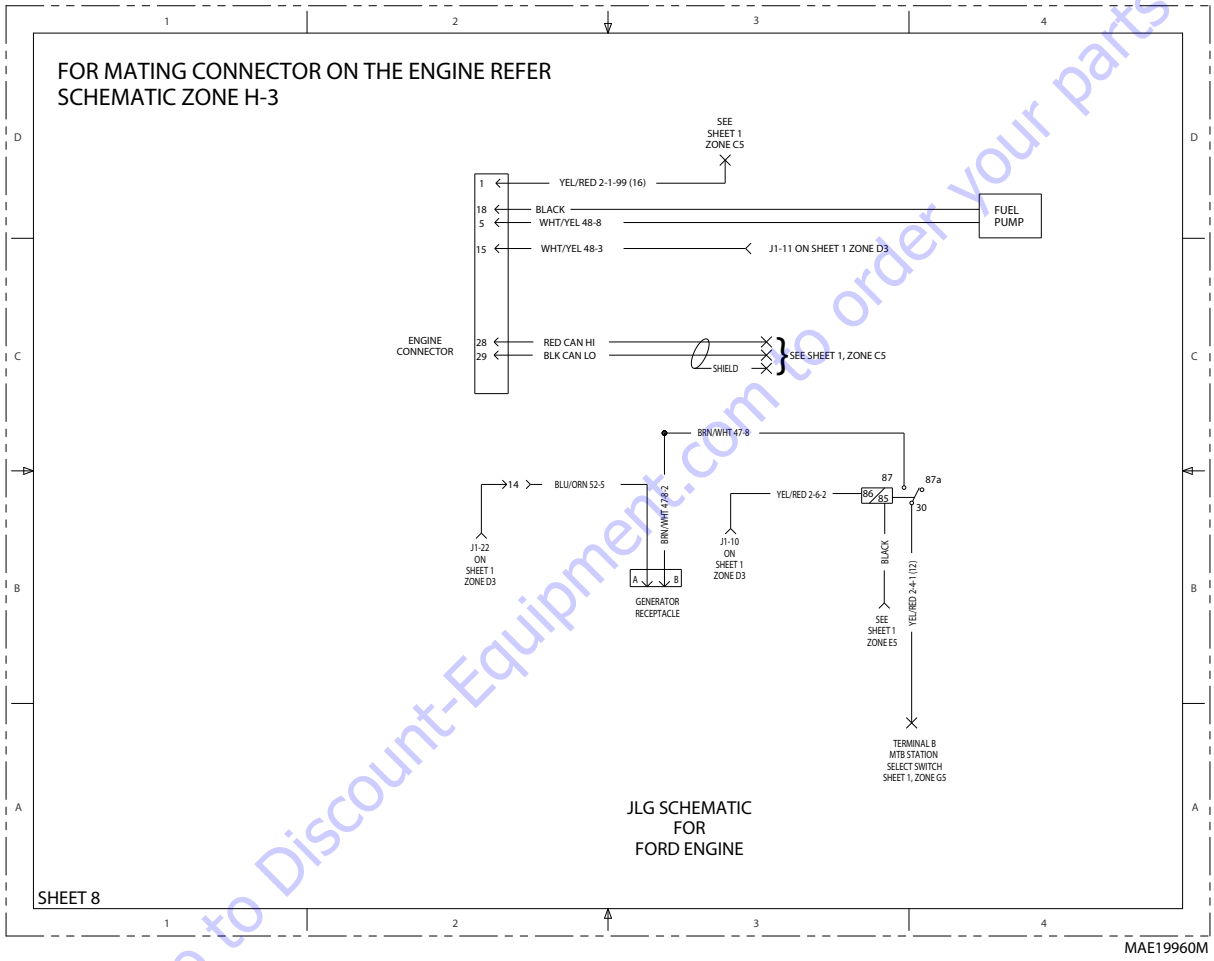




**Figure 7-43. Electrical Schematic - Sheet 15 of 17**

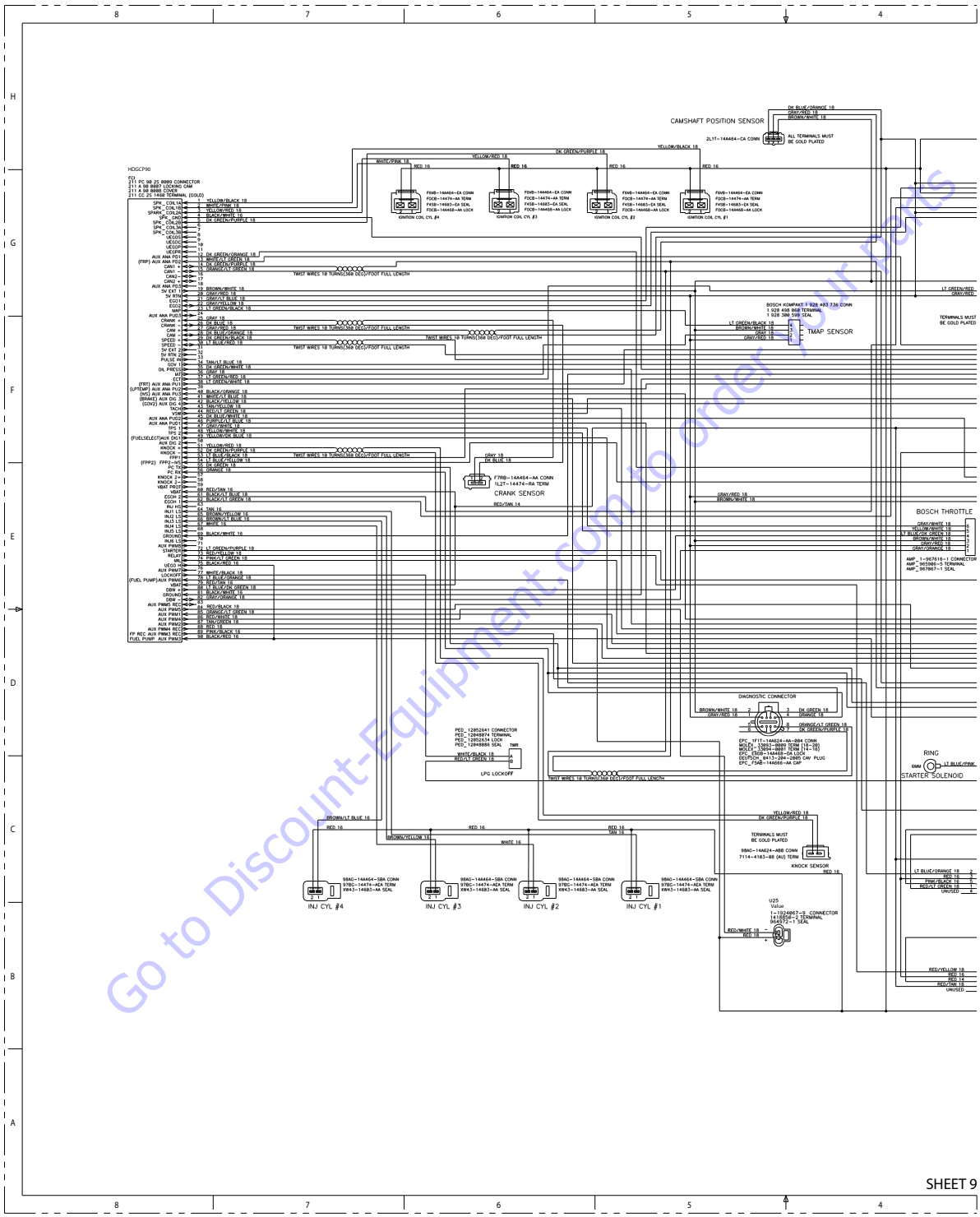


**Figure 7-44. Electrical Schematic - Sheet 16 of 17**

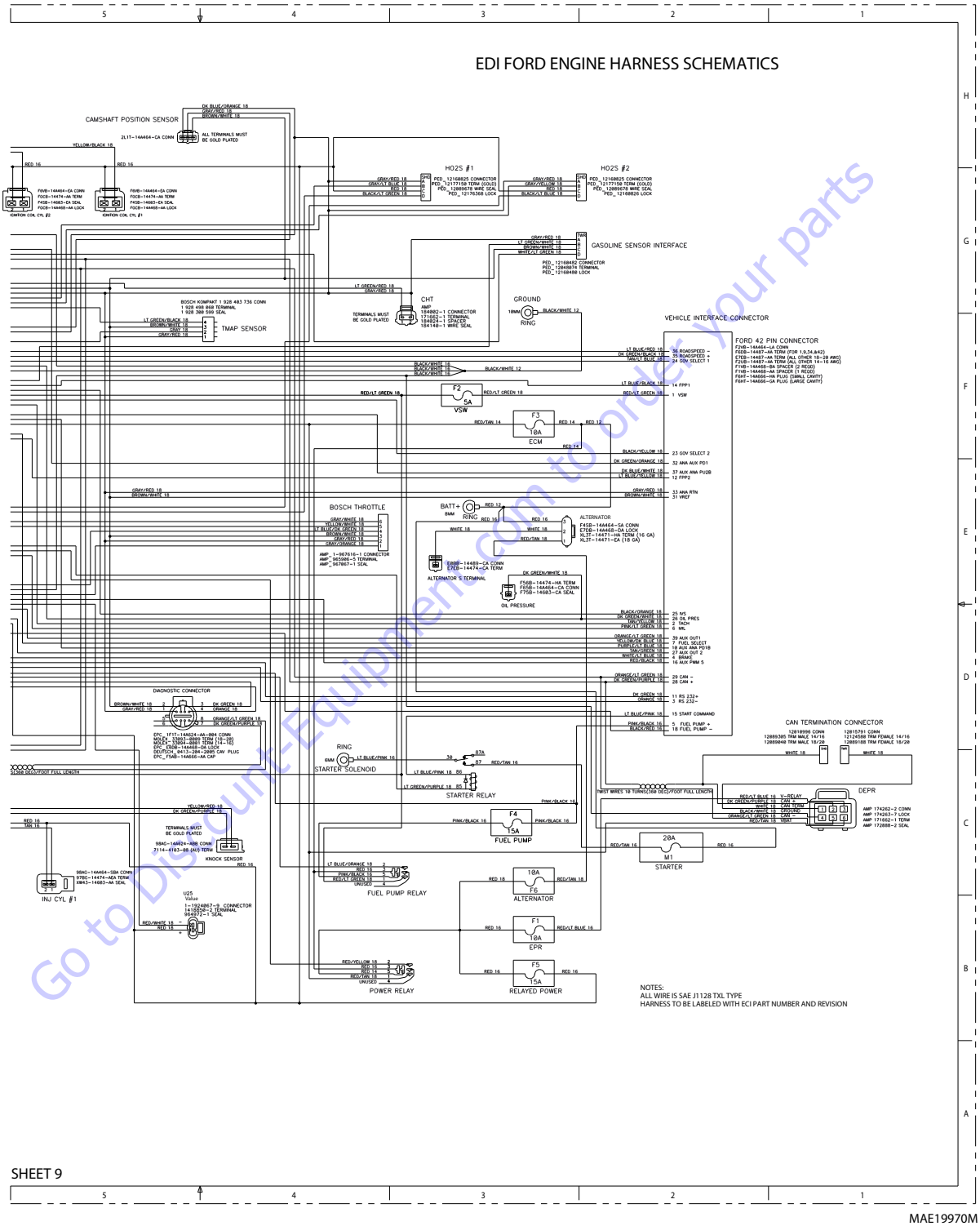




**Figure 7-45. Electrical Schematic - Sheet 17 of 17**

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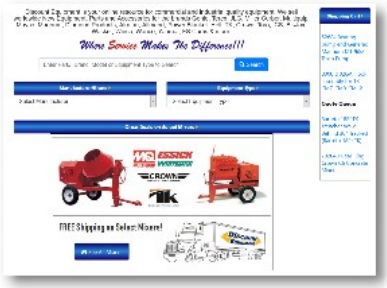
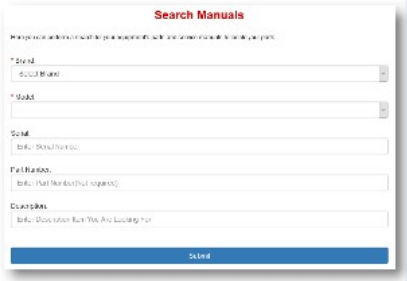


**Search Manual Library For Parts Manual & Lookup Part Numbers – Purchase or Request Quote**

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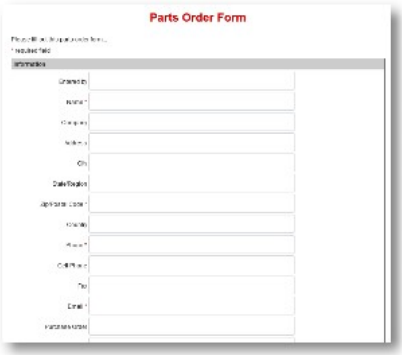


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