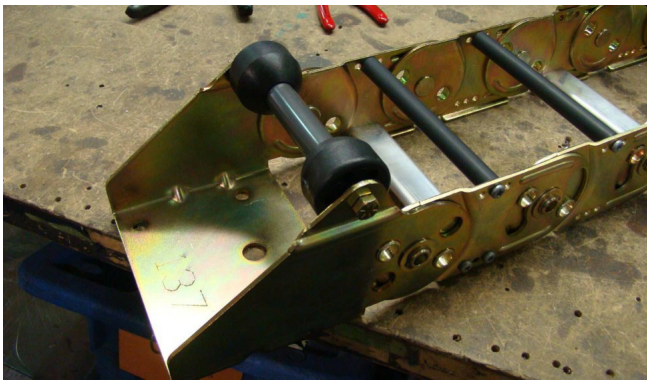
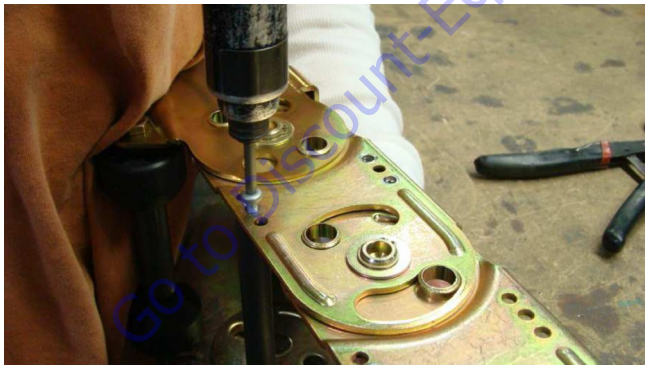
4.5 POWERTRACK MAINTENANCE

One Piece Bracket Maintenance

1. Place the powertrack on a workbench.



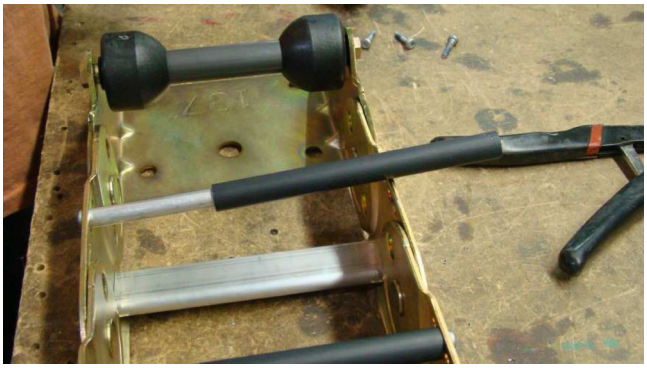
2. Remove the screws from the bars on one side of the powertrack on the first link.

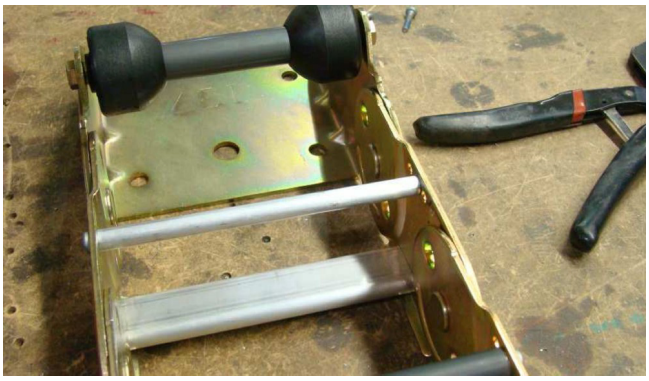


3. Remove the screws from the flat bar on the other side of the powertrack.

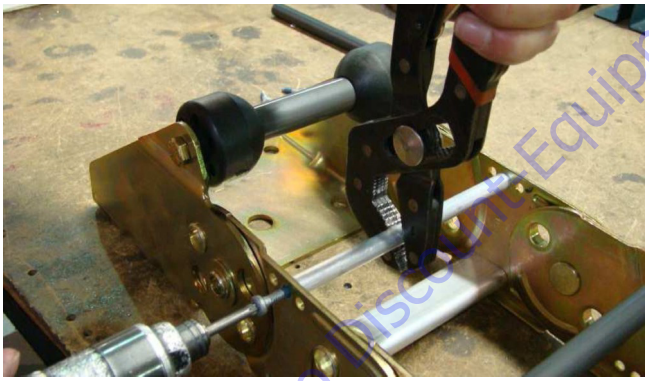
4. Pull up on the loose side of the round bar to allow the poly roller to slide off.

5. Slide the poly roller off of the round bar.

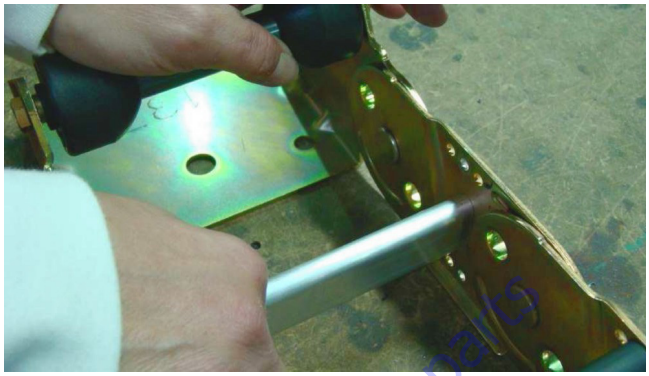


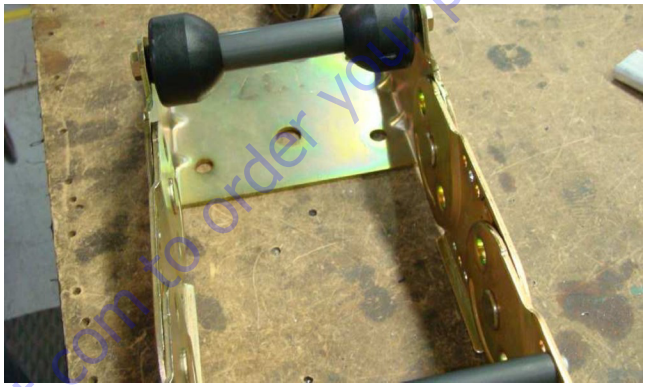


6. Hold the round bar to remove the other screw.

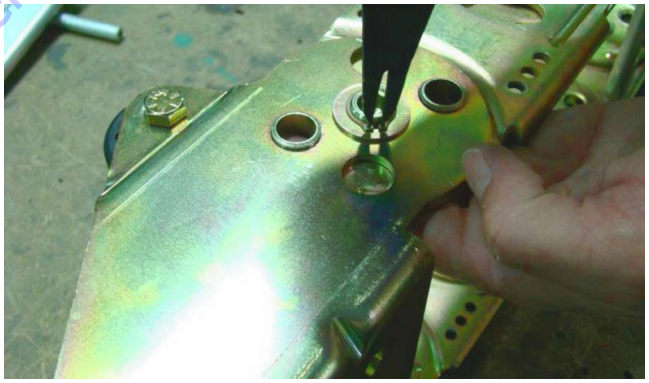


7. Slide the flat bar out.



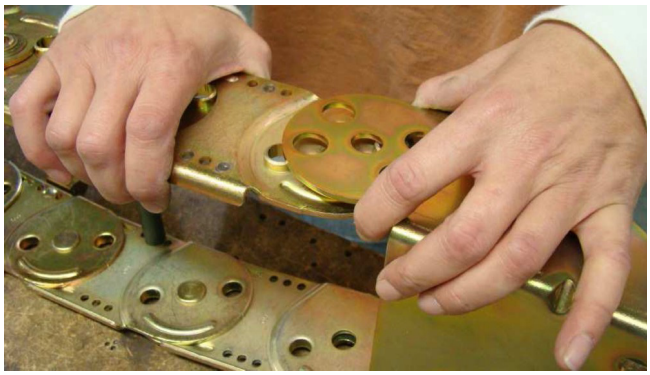


8. Remove the snap ring from one side of the bracket.



9. Remove the snap ring from the other side of the bracket.

10. Push down with slight pressure on the link and slide the bracket side up and over the extrusion on the link.

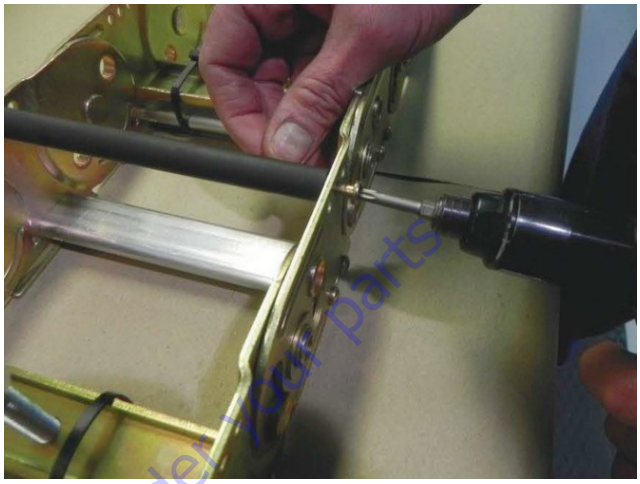


11. Repeat the previous step on the other side.

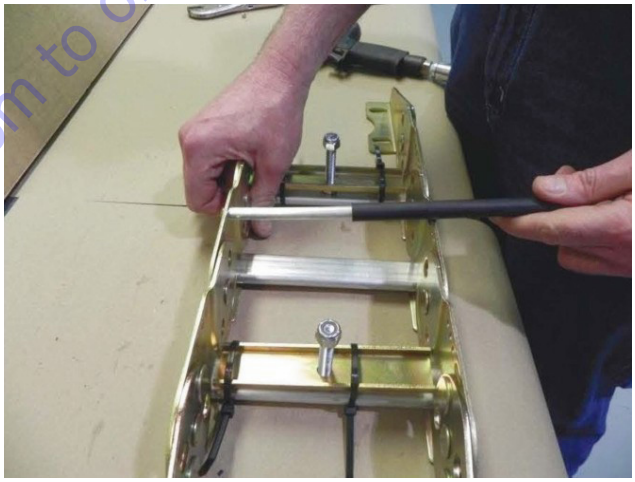
12. Slide the bracket off of the powertrack.

Two Piece Bracket Maintenance

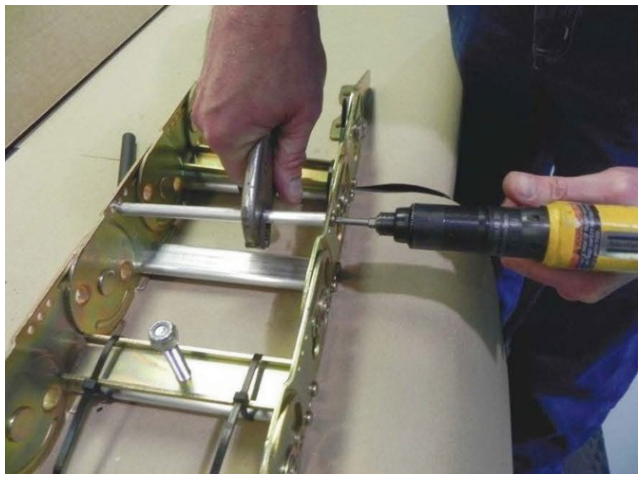
1. Loosen the screw.



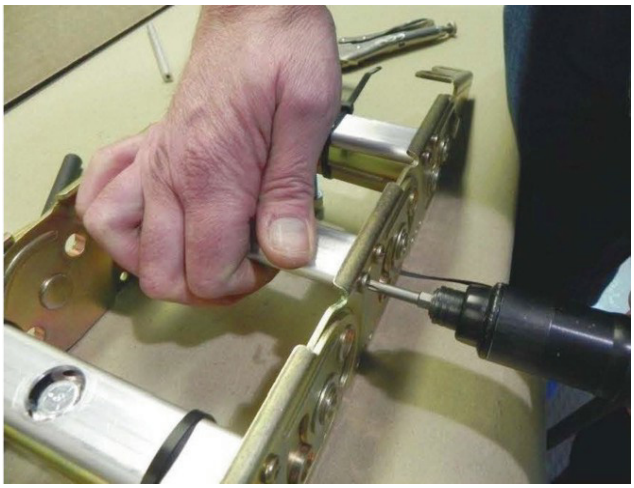
2. Slide the roller off the bar.



3. Hold the bar tightly and remove the other screw.

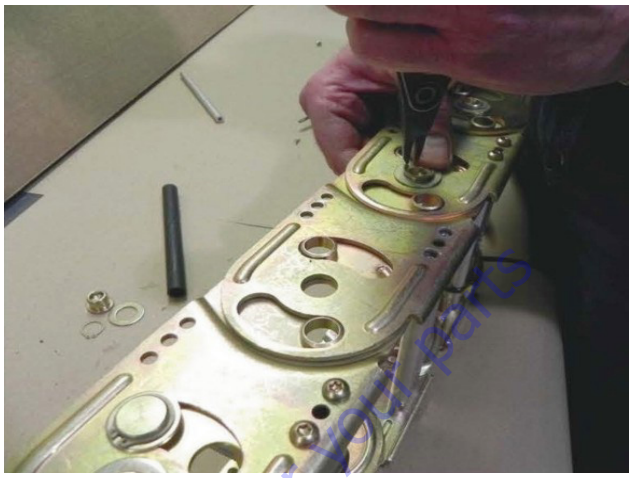


4. Hold the flat bar and remove the screws.

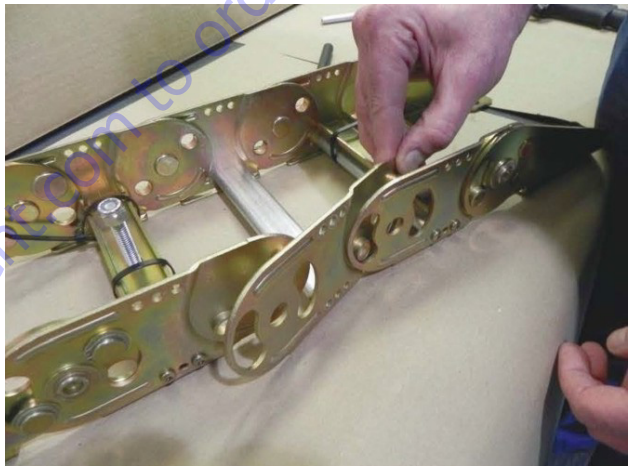


5. Remove the snap rings and pins.

6. Remove the screws from the bar. Remove the snap ring and pin.



7. Slide the link out.

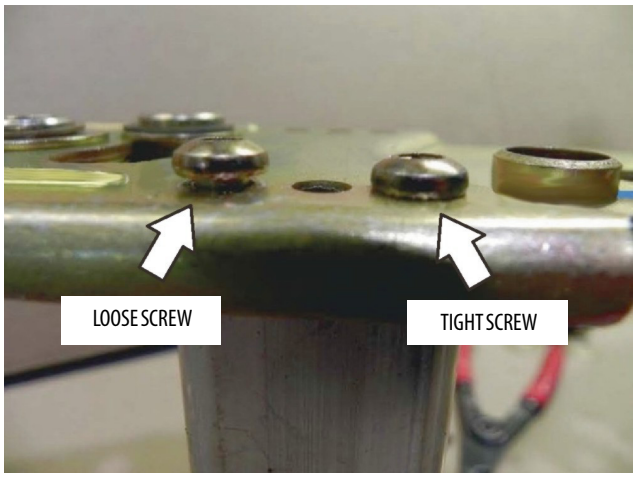


Snap Rings and Screws

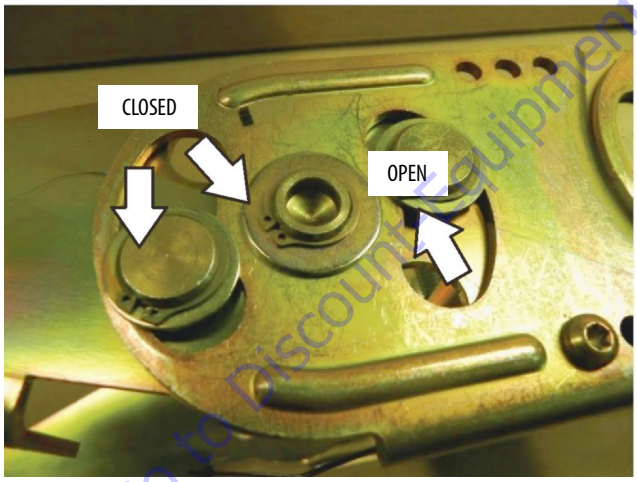
NOTICE

WHEN PERFORMING MAINTENANCE ON THE POWERTRACK, MAKE SURE TO DISCARD AND REPLACE ALL OLD SCREWS.

Make sure screws are tight and installed properly.

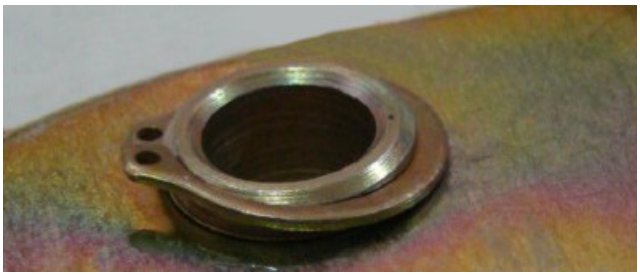


Make sure that all snap rings are closed and seated.

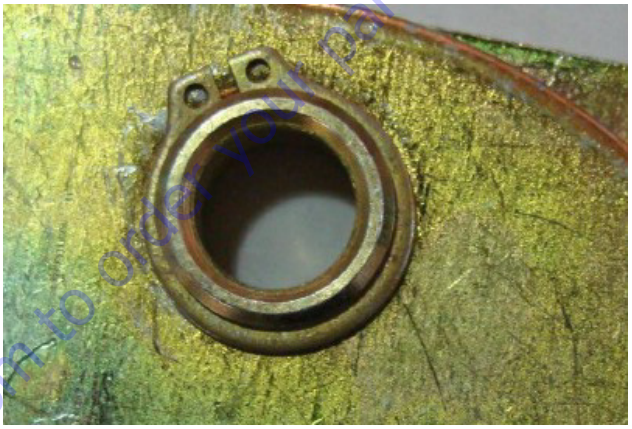


An open snap ring is shown below.

A snap ring that is not seated is shown below.



A seated and closed snap ring is shown below.



10-24 x 0.812 button torx socket head with blue locking patch:

- Tighten to 45-50 in. lbs. (5-5.6 Nm).
- Use T-25 torx bit.
- Do not reuse this screw. After removing replace with a new one.

4.6 MAIN BOOM ASSEMBLY

Removal

1. Using suitable lifting equipment, adequately support boom assembly weight along entire length.

NOTICE

HYDRAULIC LINES AND PORTS SHOULD BE CAPPED IMMEDIATELY AFTER DISCONNECTING LINES TO AVOID ENTRY OF CONTAMINANTS INTO SYSTEM.

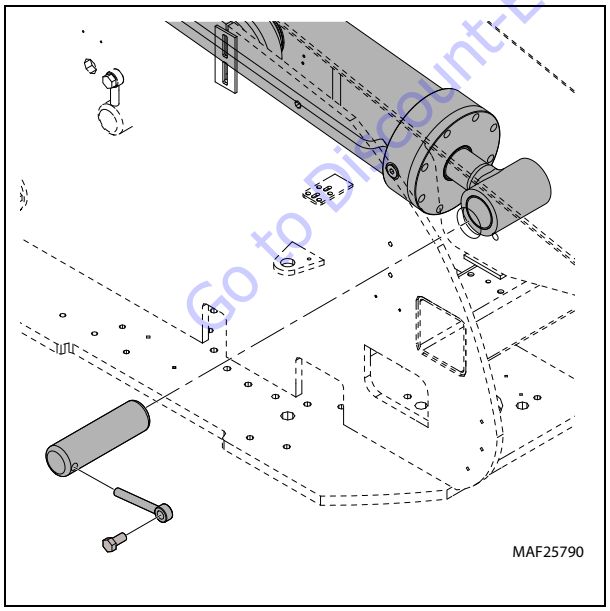
2. Tag and disconnect hydraulic lines from telescope cylinder. Use a suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.

3. Use an adequate support for the main boom lift cylinder. Extend main boom cylinder with auxiliary power switch to gain access to remove rod end pin.

NOTE: *The main boom lift cylinder weighs approximately 600 lb to 692 lb (271 kg to 314 kg).*

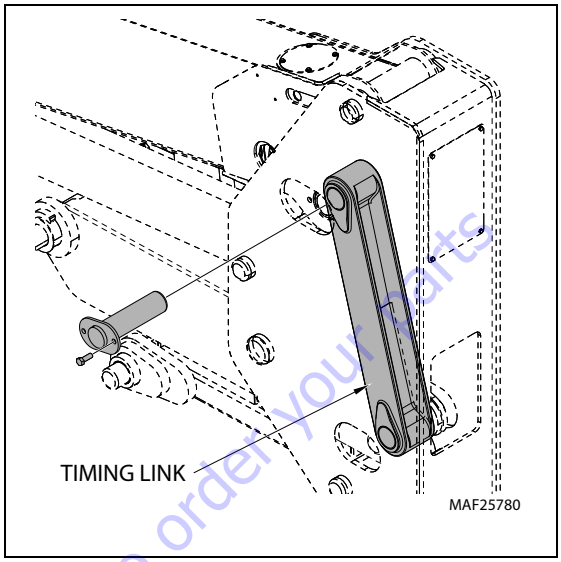
4. Using a suitable brass drift and hammer, remove hardware securing the main boom lift cylinder rod end pin to the base boom section.

5. Remove the main boom lift cylinder pin from base boom. Retract the main boom lift cylinder by using the auxiliary power switch.

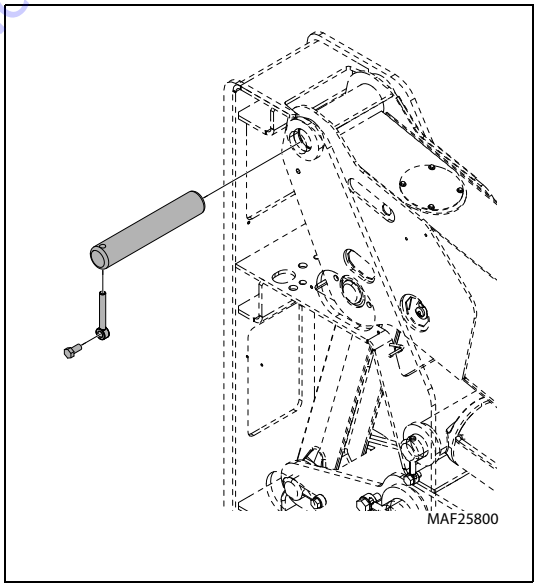


6. Using an adequate supporting device, support the timing link so it doesn't fall when the pin is removed.

7. Remove hardware securing timing link to boom assembly. Remove pin from boom assembly.



8. Using a suitable brass drift and hammer, remove hardware securing the main boom section to the upright.

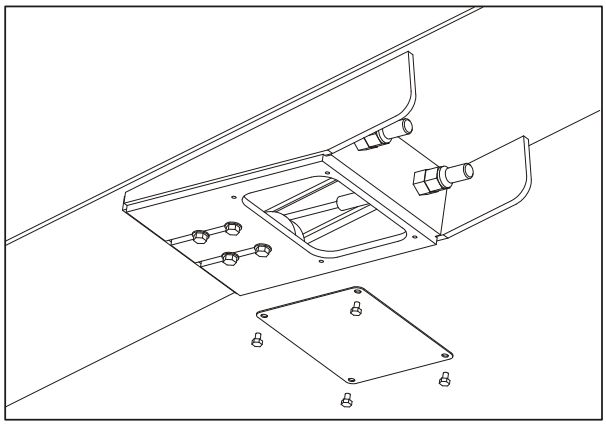


9. Using all applicable safety precautions, carefully lift boom assembly clear of upright and lower to ground or suitably supported work surface.

Boom Disassembly

NOTE: *The following procedure assumes the boom is removed from the machine.*

1. 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.
2. Remove hardware securing the telescope cylinder.
3. Remove hardware securing the cover plate on the bottom front of the base boom section.

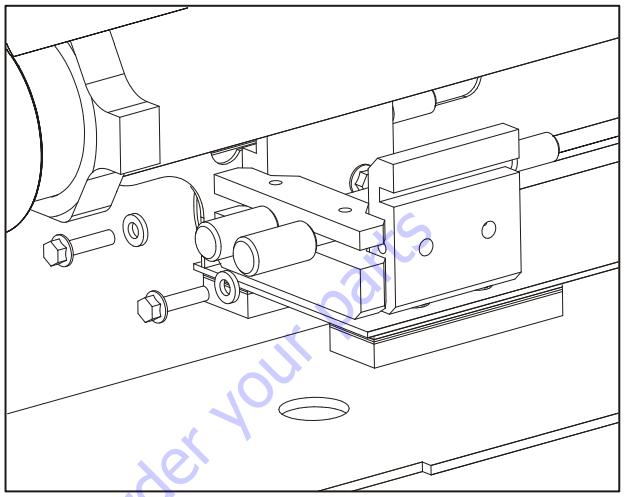


NOTE: *Do not allow wire rope to rotate. This may damage the wire rope.*

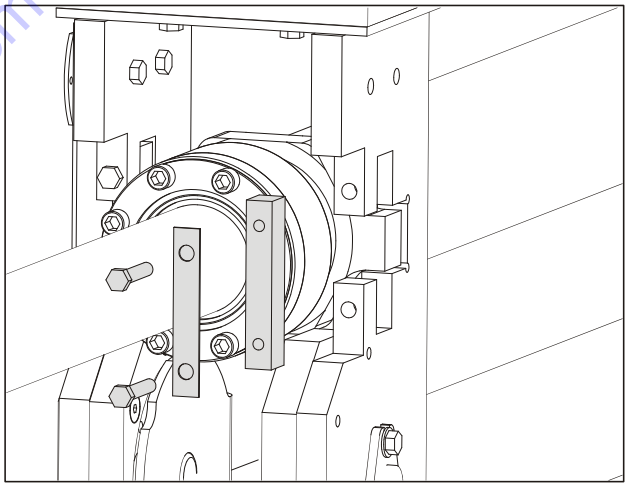
4. Clamp both threaded ends of wire rope to prevent rotation. Remove jam nuts and nuts which secure the wire rope adjustments to the bottom front of the base boom section.

NOTE: *Do not clamp on threads.*

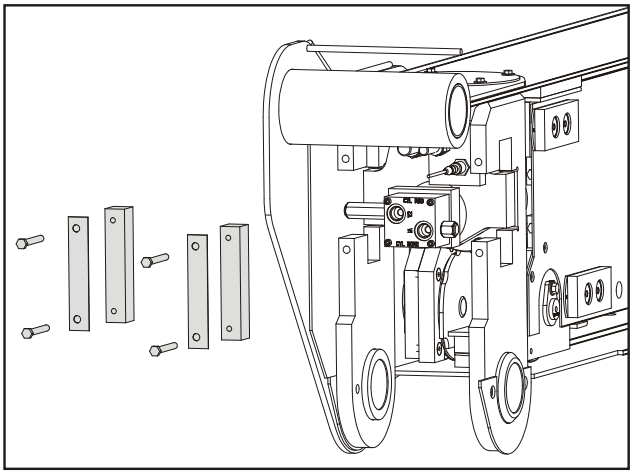
5. Remove jam nuts and nuts which secure the wire rope adjustments to the bottom front of the base boom section.
6. Using a 3/8 drive extension approximately 4 ft. (1.2 m) long, remove the bolts and washers securing the cable mount block to the boom fly section.



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



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

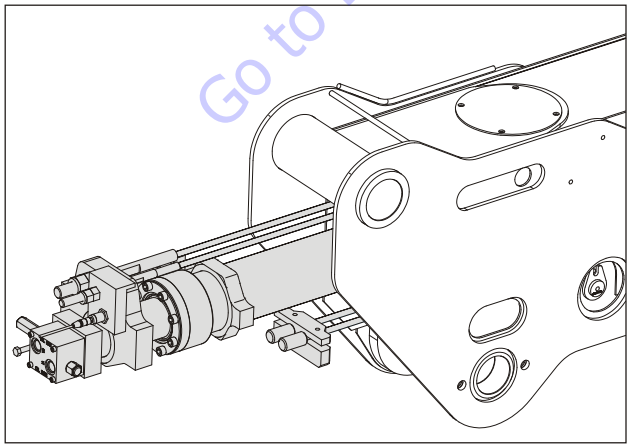


NOTICE

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 lb (272 kg).*

9. 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.



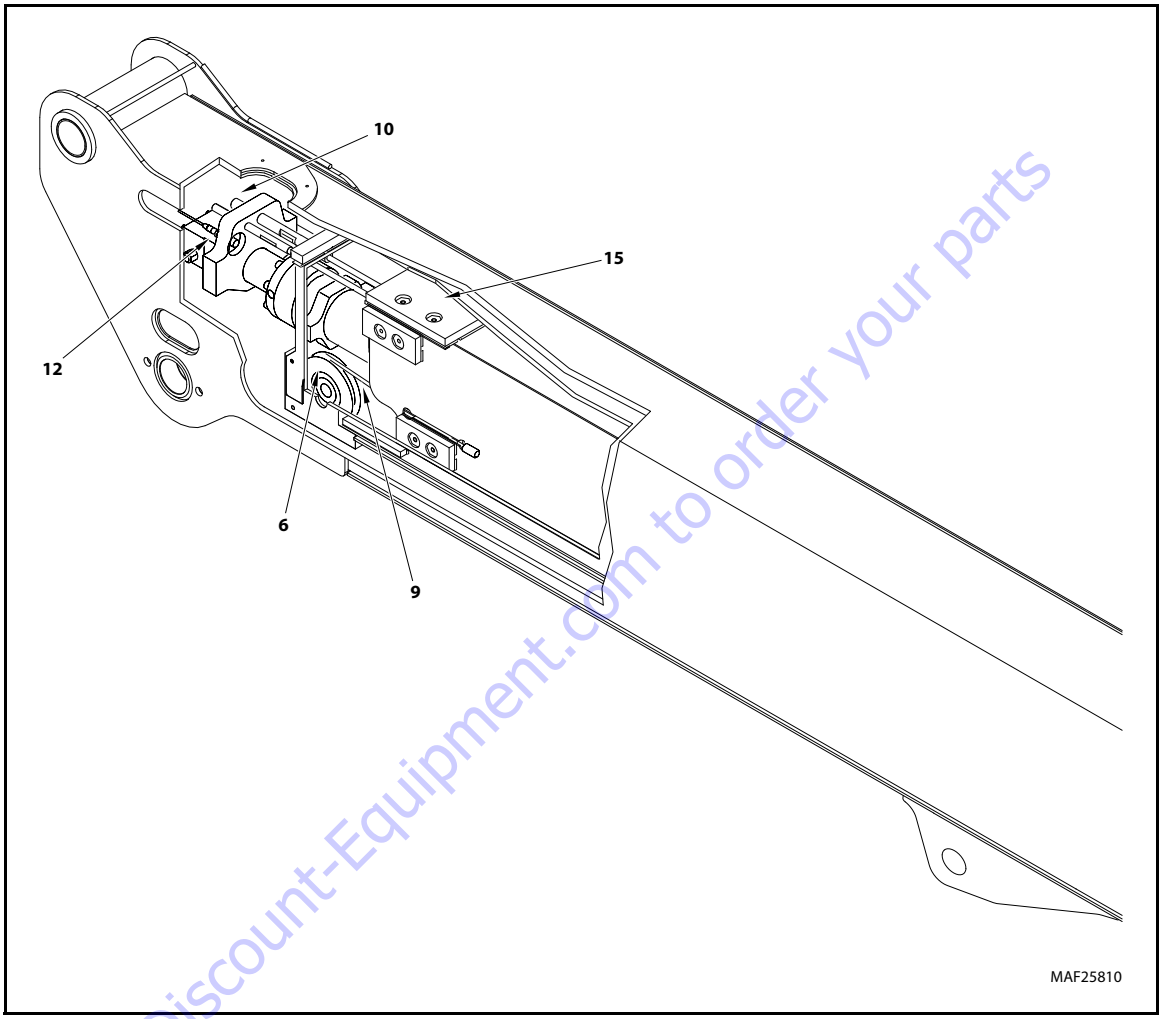
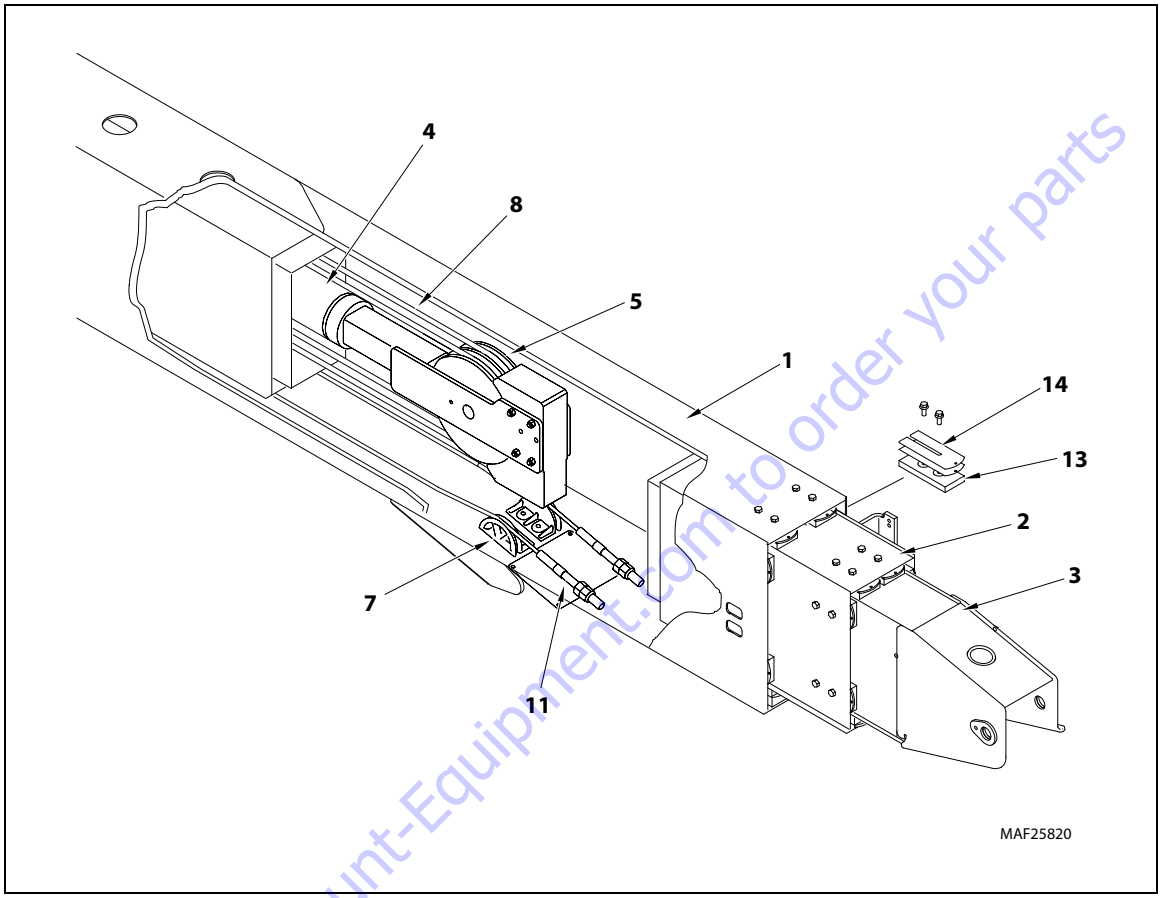
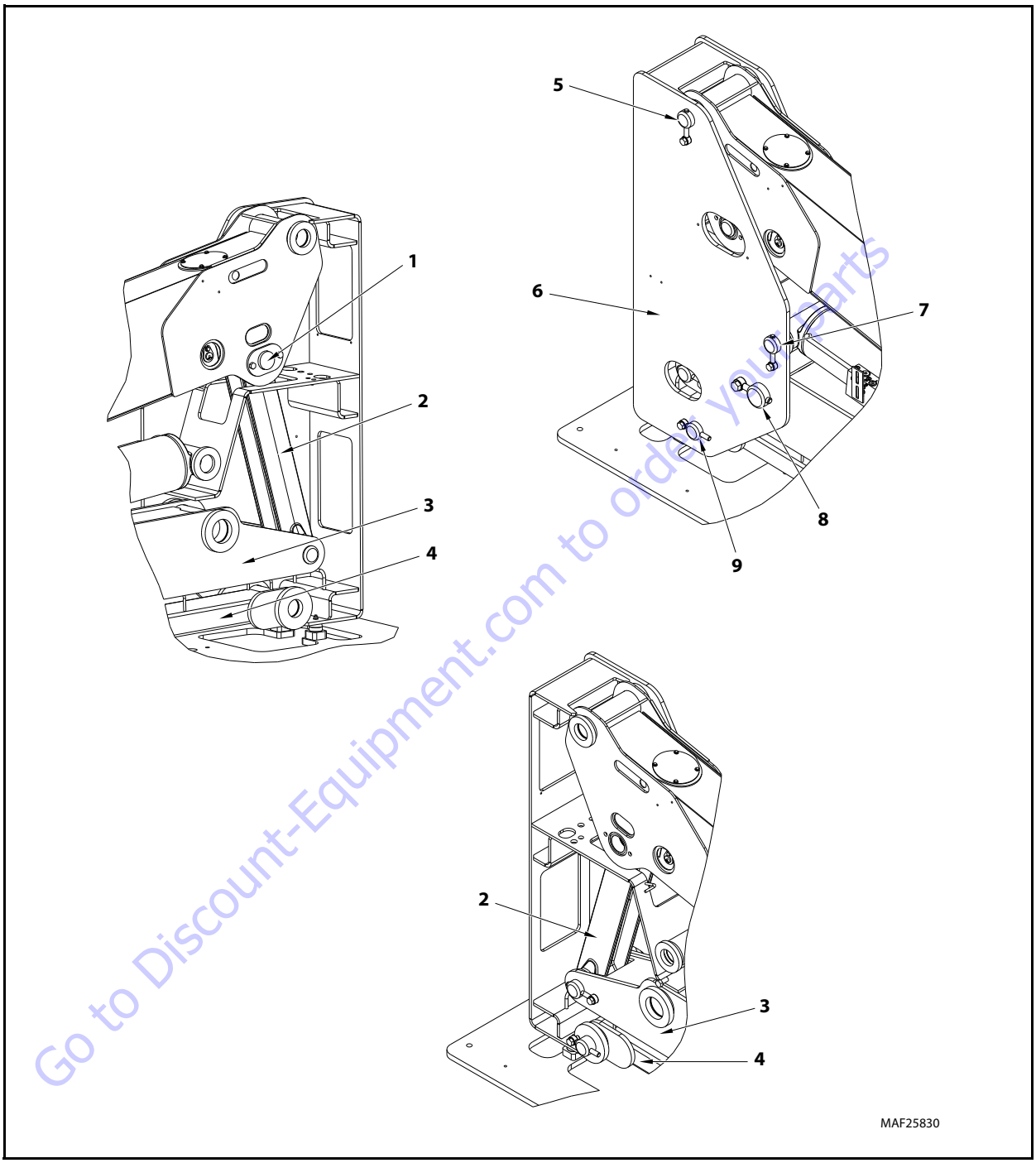


Figure 4-5. Boom Assembly Cutaway - Sheet 1 of 2



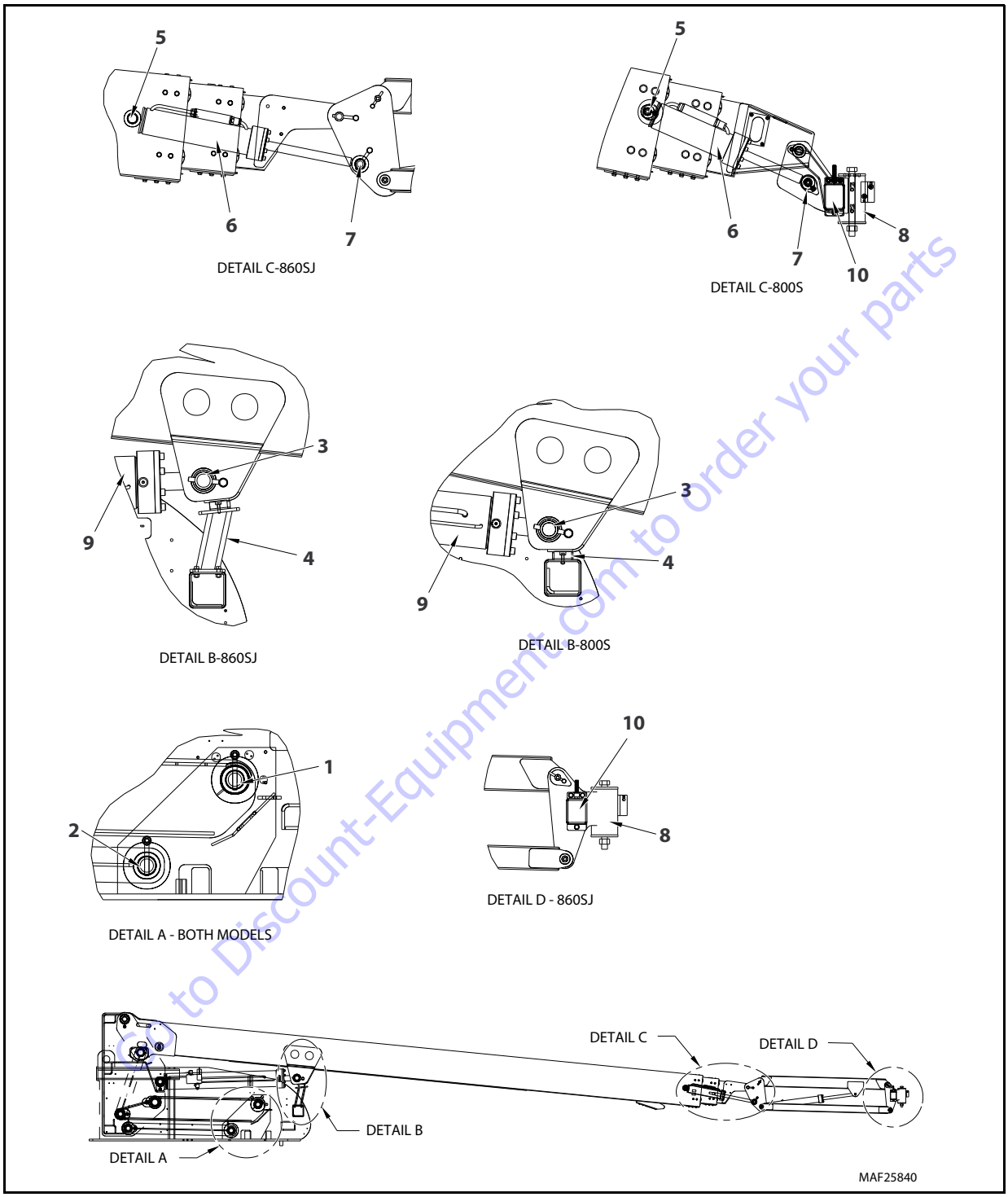
1. Base Boom
2. Mid Boom
3. Fly Boom
4. Telescope Cylinder
5. Extend Sheave
6. Retract Sheave
7. Sheave Block
8. Extend Cable
9. Retract Cable
10. Extend Cable Adjustment
11. Retract Cable Adjustment
12. Proximity Switch
13. Wear Pad
14. Shims
15. Wear Pad

Figure 4-6. Boom Assembly Cutaway - Sheet 2 of 2



1. Pivot Pin
2. Power Link
3. Tower
4. Level Link
5. Boom Pivot Pin
6. Upright
7. Lift Cylinder Pivot Pin
8. Tower Pin
9. Level Link Pin

Figure 4-7. Boom Components - Sheet 1 of 2



1. Pivot Pin
2. Level Link Pivot Pin
3. Lift Cylinder Pivot Pin
4. Boom Rest
5. Level Cylinder Attach Pin
6. Level Cylinder
7. Level Cylinder Pivot Pin
8. Rotator
9. Lift Cylinder
10. Level Switch

Figure 4-8. Boom Components - Sheet 2 of 2

10. Carefully remove the telescope cylinder and sheave assembly. Place telescope cylinder on a suitable trestle.

- **a.** Remove hardware from the wear pads; remove wear pads from cylinder.
- **b.** Remove hardware from the wire rope guard; remove guard from cylinder.
- **c.** Remove hardware from the sheave pin; remove pin and sheave from cylinder.

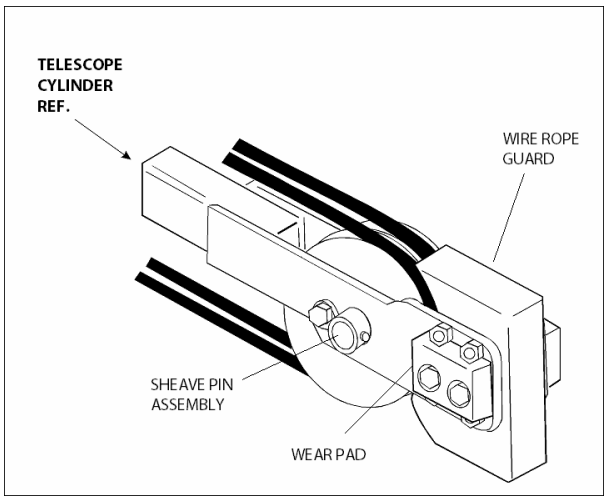


Figure 4-9. Disassembly of Sheave Assembly

9. Remove hardware which secures the wear pads to the front of base boom section; remove wear pads from the top, sides and bottom of the base boom section.

10. Using an overhead crane or suitable lifting device, remove mid and fly boom sections from base section. Note: When removing mid and fly boom sections from base boom section, retract wire rope must be dragged along with boom sections.

11. Remove hardware which secures the wear pads to the rear end of mid boom section; remove the wear pads from the top, sides and bottom of the mid boom section.

12. Remove hardware which secures the sheave guards and sheave assemblies to mid boom section, remove sheave assemblies from mid boom section.

13. Remove hardware which secures the wear pads to the front of mid boom section; remove wear pads from the top, sides and bottom of the mid boom section.

14. Using an overhead crane or suitable lifting device, remove fly boom section from mid section. Note: When removing fly boom section from mid boom section, retract wire rope must be dragged along with fly boom section.

15. Remove hardware which secures the wear pads to the rear end of fly boom section; remove wear pads from the top, sides and bottom of the fly boom section.

16. When removing wire rope from fly boom section, push the cable into fly boom. Route wire rope back through holes in the side of the fly boom section.

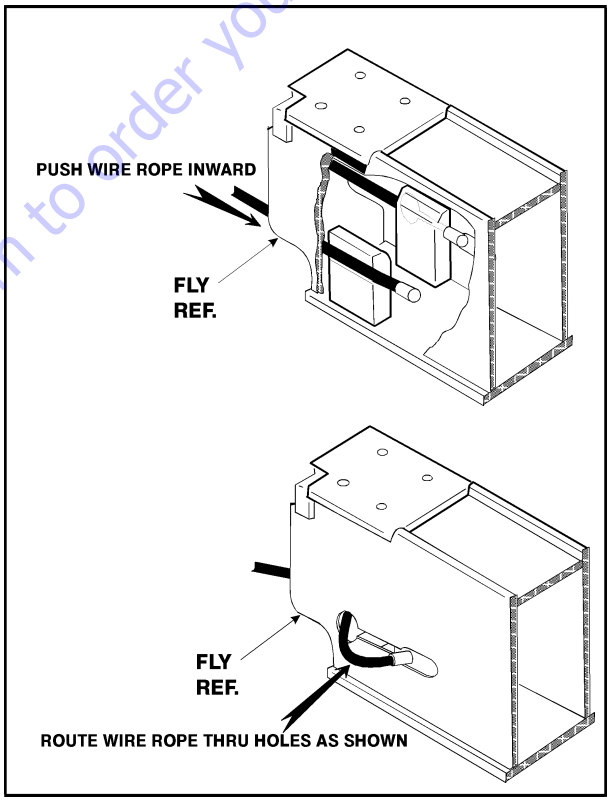


Figure 4-10. Disassembly Wire Rope Routing Procedure

Inspection

NOTE: *When inspecting pins and bearings Refer to the guidelines established in Section 2.5, Pins and Composite Bearing Repair Guidelines.*

1. Inspect all sheaves (extend and retract wire ropes and telescope cylinder) for excessive groove wear, burrs or other damage. Replace sheaves as necessary.

NOTE: *To check the size, contour and amount of wear, a groove gauge is used. Replace the sheave if worn as shown in the following drawing.*

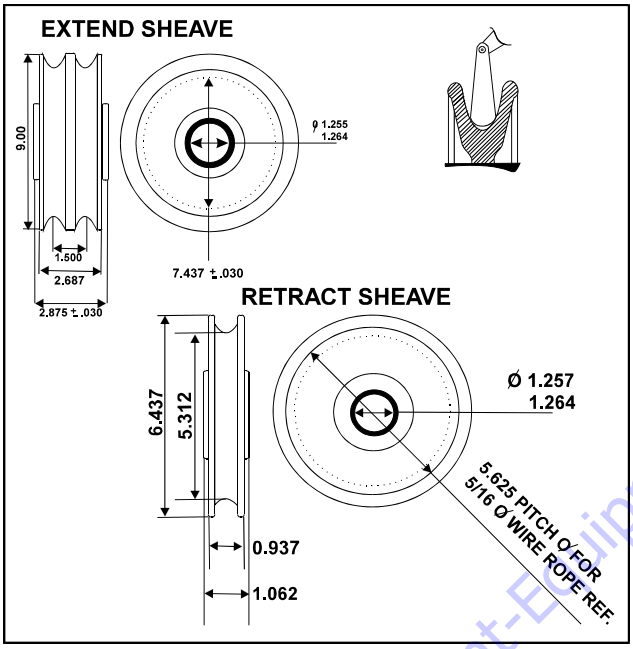


Figure 4-11. Dimension of Sheaves When New

2. Inspect extend and retract wire rope sheave bearings for wear, scoring, or other damage, and for ovality.
3. Inspect extend wire rope and retract wire rope sheave pins for scoring, tapering and ovality. Replace pins as necessary.
4. Inspect telescope cylinder sheave pin for scoring, tapering and ovality. Replace pins as necessary.
5. Inspect boom pivot pin for wear, scoring, tapering and ovality, or other damage. Replace pins as necessary.
6. Inspect telescope cylinder attach point for scoring, tapering and ovality. Replace pins as necessary.
7. Inspect main lift cylinder attach pin for wear, scoring, tapering and ovality, or other damage. Ensure pin surfaces are protected prior to installation. Replace pins as necessary.
8. Inspect inner diameter of boom pivot bushing for scoring, distortion, wear, or other damage. Replace bearing as necessary.
9. Inspect all wear pads for excessive wear or other damage. Replace pads when worn to within 1/8 inch (3.2 mm) of threaded insert.
10. Inspect extend and retract wire rope attach point components for cracks, stretching, distortion, or other damage. Replace components as necessary.
11. Inspect all threaded components for damage such as stretching, thread deformation, or twisting. Replace as necessary.
12. Inspect structural units of boom assembly for bending, cracking, separation of welds, or other damage. Replace boom sections as necessary.

Boom Assembly

NOTE: *When installing fly section wear pads, install same number and thickness of shims as were removed during disassembly.*

1. Measure inside dimensions of the base and mid sections to determine the number of shims required for proper lift.
2. Measure inside dimensions of the mid section to determine the number of shims required for proper lift.
3. Install side, top and bottom wear pads to the rear end of fly section; shim evenly to the measurements of the inside of mid section.

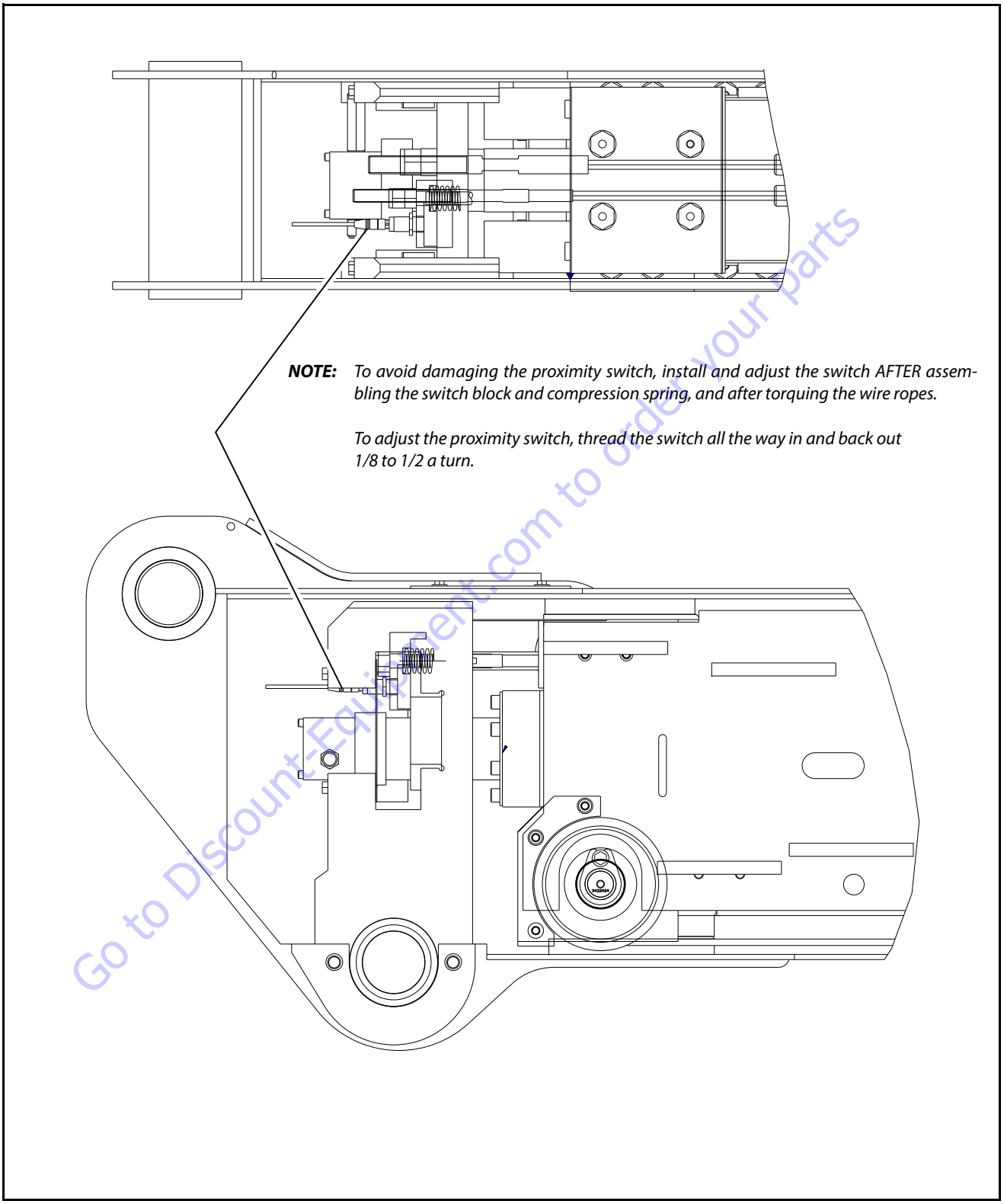


Figure 4-12. Proximity Switch Adjustment

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.

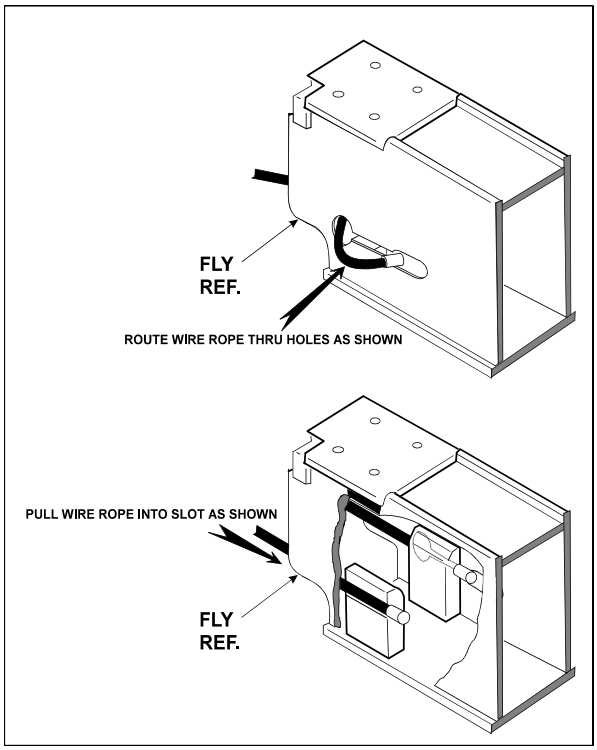


Figure 4-13. Routing Installation of Retract Wire Ropes

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.

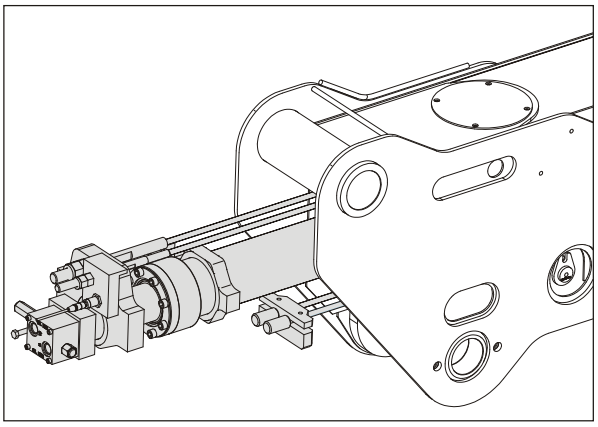
6. Shim the insides of the boom sections for a total of 1/16 inch (0.062) clearance (if the action is centered, there will be 1/32 clearance on each side).
7. Slide fly boom section into the mid boom section. Shim boom, if necessary, for a total of 1/16 inch (0.062) clearance.
8. Install wear pads into 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

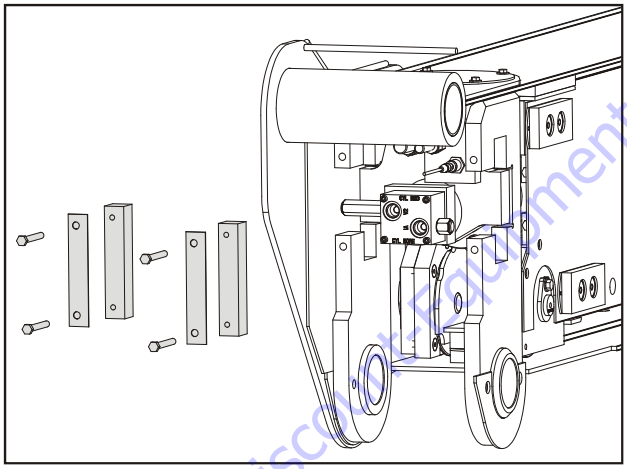
WHEN PUSHING THE TELESCOPE CYLINDER INTO THE BOOM, IT MAY BE NECESSARY AT SOME POINT TO TURN THE CYLINDER SLIGHTLY IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY INTO THE BOOM. DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.

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

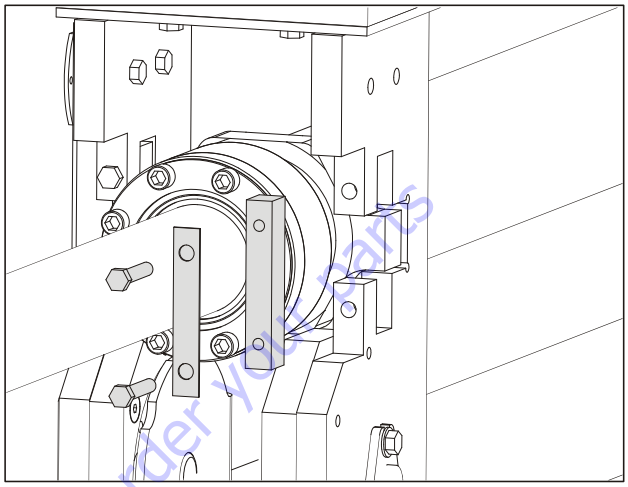
19. Using adequate lifting equipment, carefully push the telescope cylinder assembly and cables back into the boom.



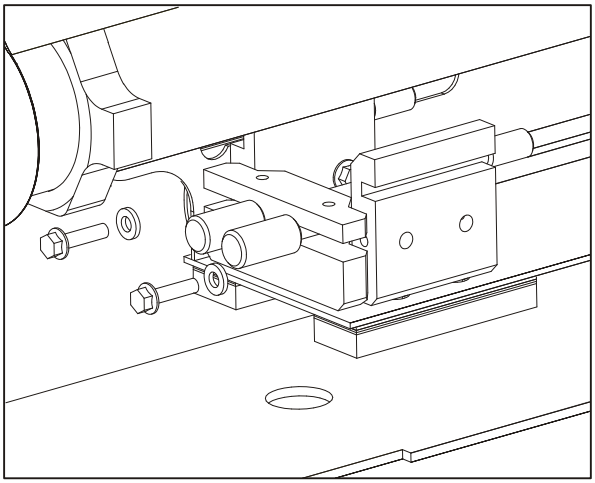
20. Apply Medium Strength Threadlocking Compound to the bolts and fasten the telescope cylinder rod to the boom base section with the bolts, shims, mounting blocks.



21. Apply Medium Strength Threadlocking Compound 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.

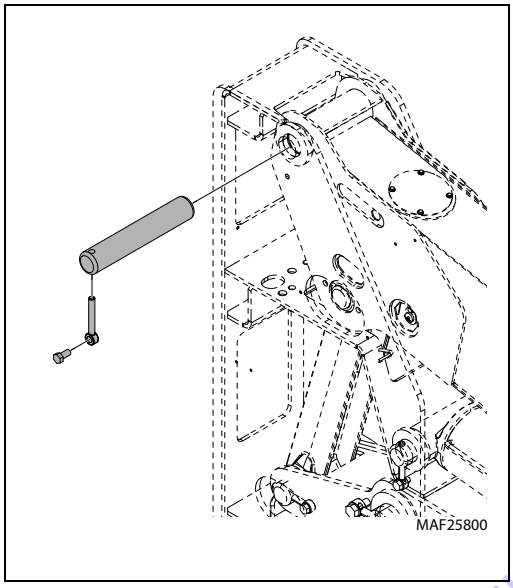


23. Connect all the hydraulic lines to the cylinder as tagged during the removal procedure.

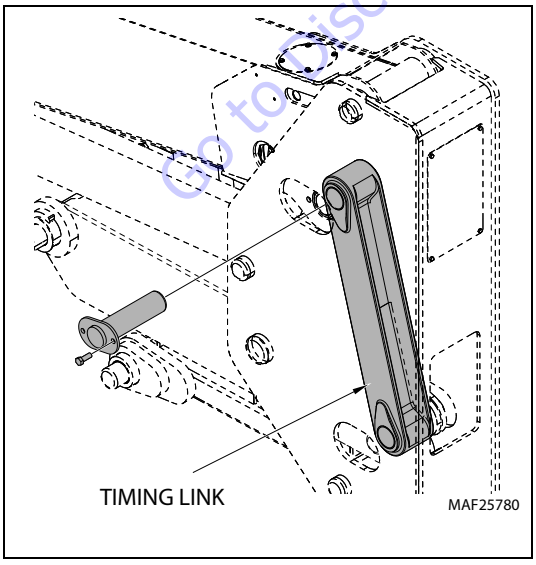
24. Adjust the boom cables as outlined under Section 4.9, Boom Rope Torquing Procedures.

Installation

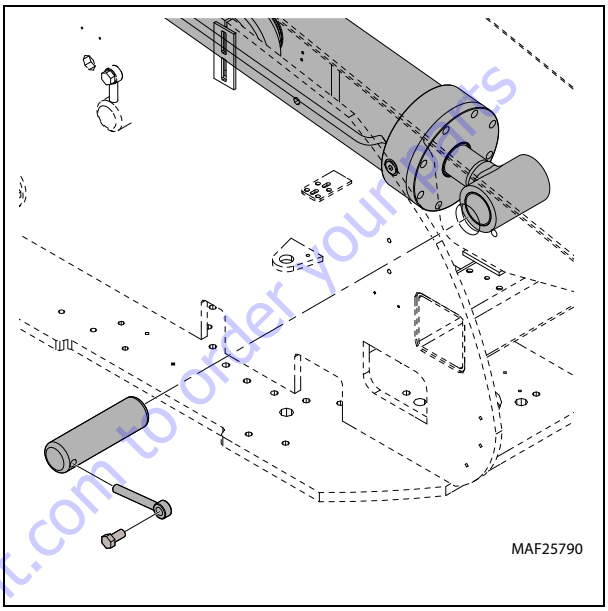
1. Using a suitable lifting device, position boom assembly on upright so that the pivot holes in both boom and upright are aligned.
2. Install boom pivot pin, ensuring that location of hole in pin is aligned with attach point on upright.
3. If necessary, gently tap pin into position with soft headed mallet. Secure pin mounting hardware.



4. Align holes of boom assembly and timing link, install pivot pin, ensuring that location of hole in pin is aligned with attach point of timing link.



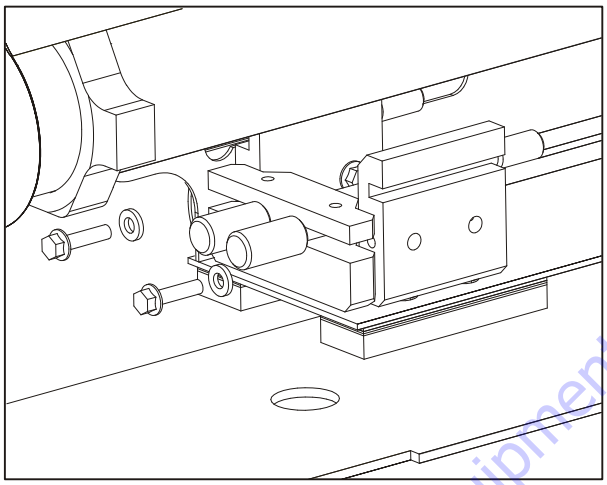
5. Using suitable lifting device, align main lift cylinder rod end with mounting holes on boom assembly.
6. Extend the main lift cylinder by using the auxiliary power switch. Using a suitable brass drift and hammer, install hardware secured to the main lift cylinder rod end pin into the base boom section.



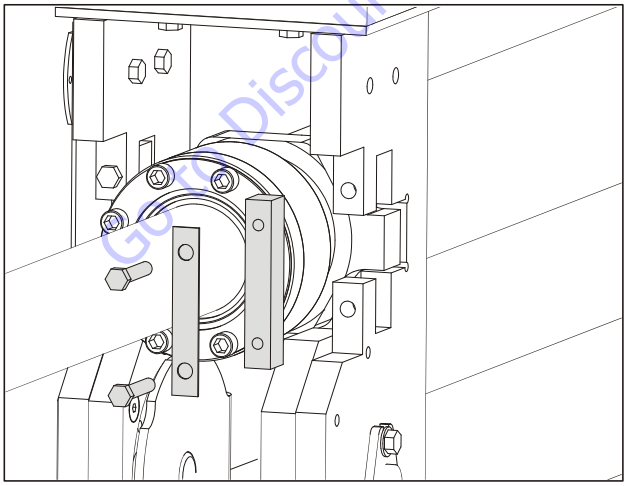
7. Connect all wiring to the ground control box.
8. Connect all hydraulic lines running along side of boom assembly.
9. Adjust retract and extend cables to the proper torque. Refer to Section 4.9, Boom Rope Torquing Procedures.
10. Using all applicable safety precautions, operate machine systems and raise and extend boom fully, noting the performance of the extension cycle.
11. Retract and lower boom, noting the performance of the retraction cycle.

Telescope Cylinder/Boom Cable Removal

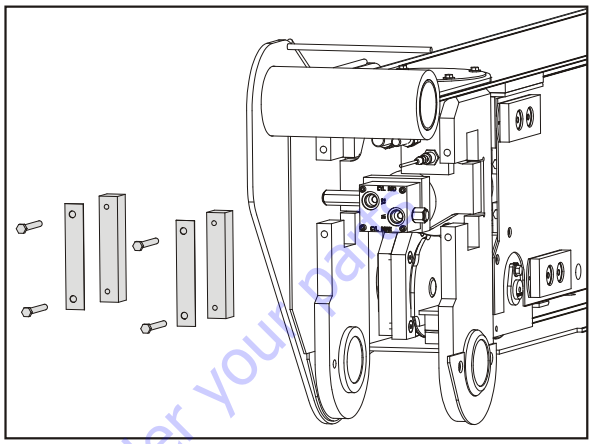
1. Make sure the machine is on a firm, level surface.
2. Raise the boom to a horizontal position.
3. Extend the boom approximately 2 ft. (0.6 m). This will enable access to the bolts that secure the cable mount block to the boom fly section.
4. Tag and disconnect all hydraulic hoses running to the telescope 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.

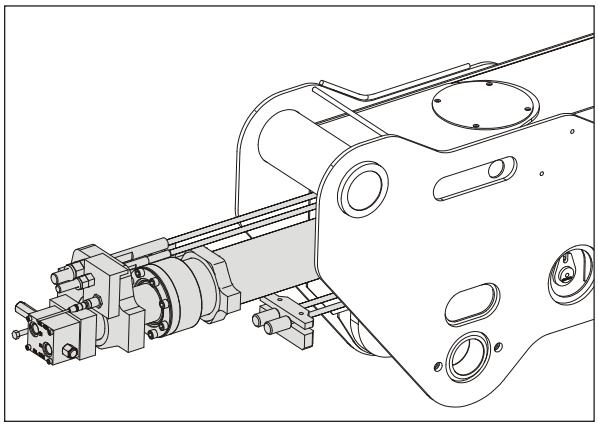


NOTICE

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.

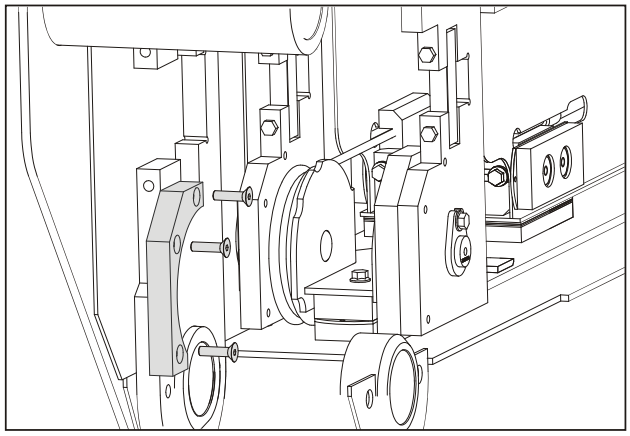
NOTE: *The telescope cylinder weighs approximately 600 lb (272 kg).*

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.

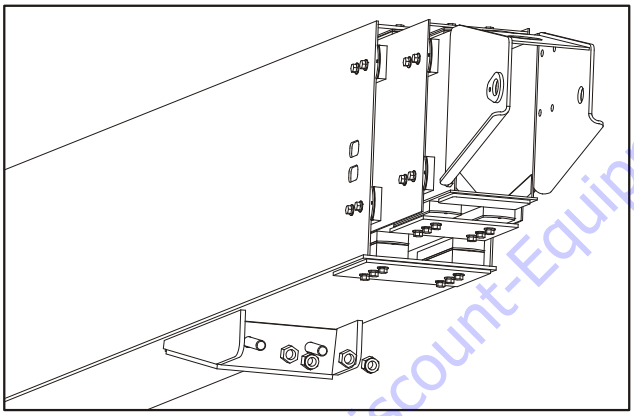


9. Push the boom fly sections back in to gain access to the boom retraction cable.

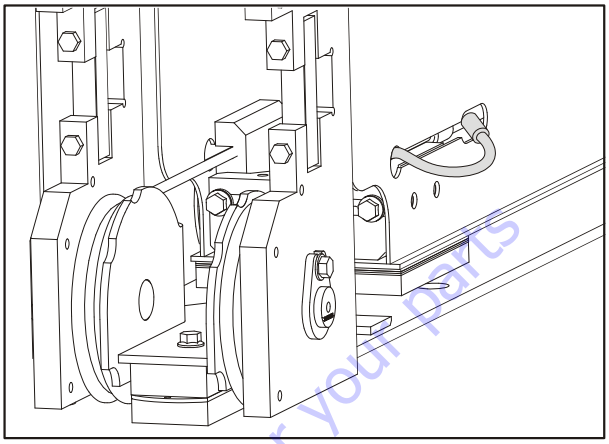
10. Remove the screws securing the sheave guards to the boom mid section and remove the sheave guards.



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.



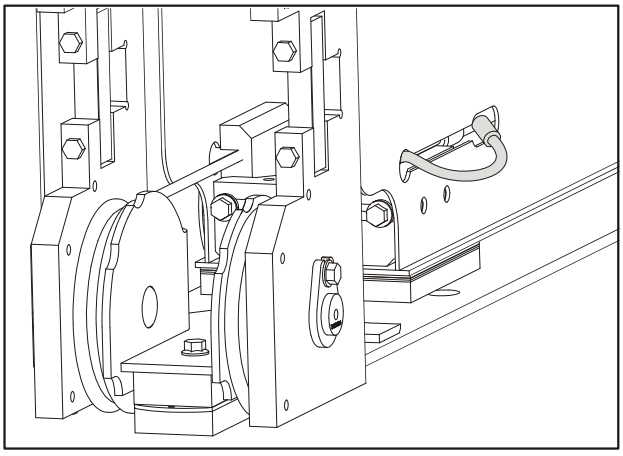
13. From the rear of the boom, pull out the boom retraction cables.

Telescope Cylinder/Boom Cable Installation

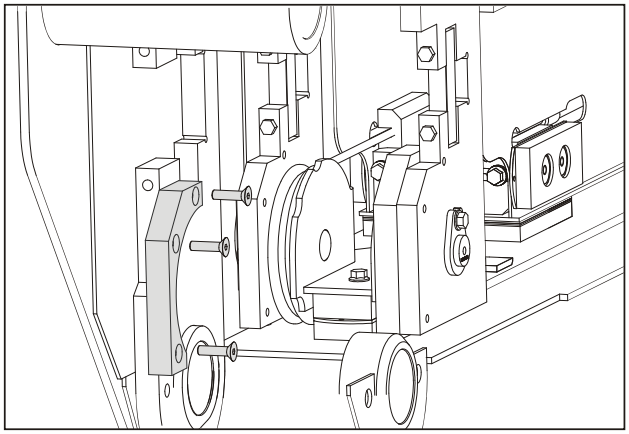
1. Attach the threaded end of the new retraction cables to the tie wires used in the removal procedure.

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.



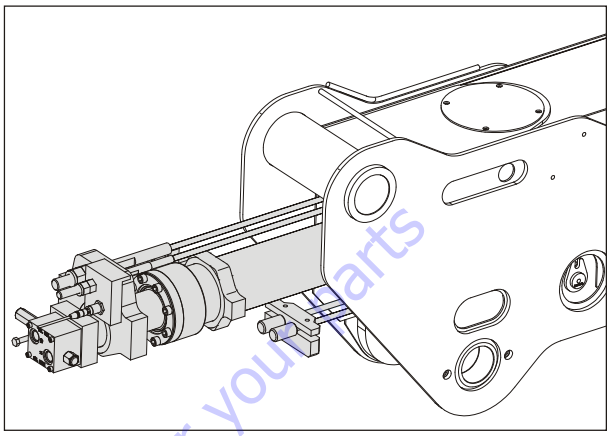
5. Pull the boom sections out to approximately where they were extended to for telescope cylinder removal.
6. Install a new extend sheave on the end of the telescope cylinder.
7. Route new extend cables around the telescope cylinder. Loosely fasten the threaded end of the cables to the rod end of the 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

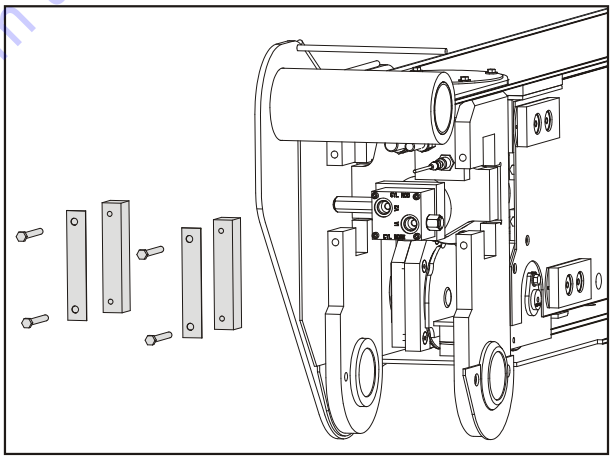
WHEN PUSHING THE TELESCOPE CYLINDER INTO THE BOOM, IT MAY BE NECESSARY AT SOME POINT TO TURN THE CYLINDER SLIGHTLY IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY INTO THE BOOM. DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.

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

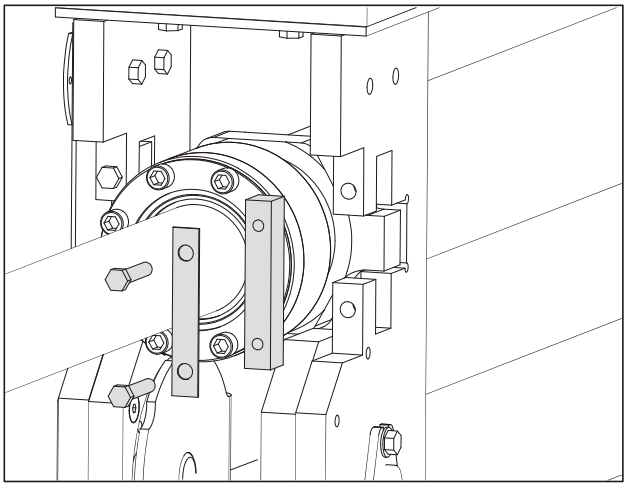
9. Using adequate lifting equipment, carefully push the telescope cylinder assembly and cables back into the boom.



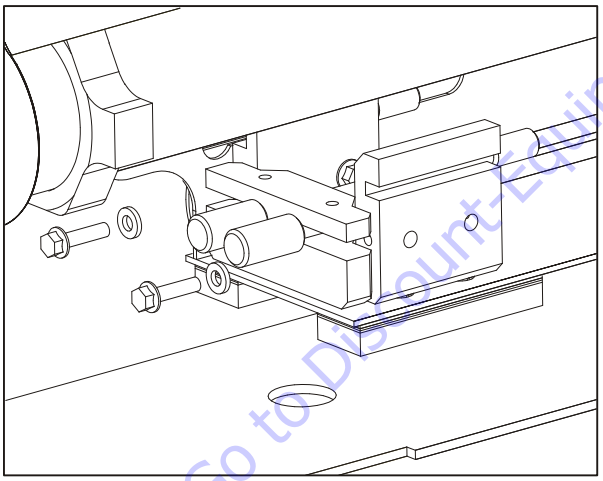
10. Apply Medium Strength Threadlocking Compound to the bolts and fasten the telescope cylinder rod to the boom base section with the bolts, shims, mounting blocks.



11. Apply Medium Strength Threadlocking Compound 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.

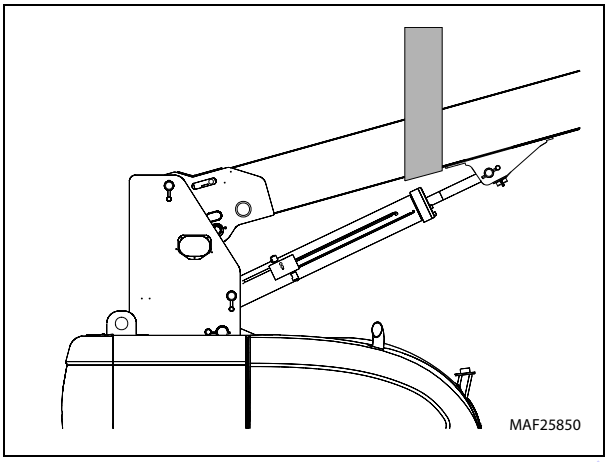
14. Adjust the boom cables as outlined under Section 4.9, Boom Rope Torquing Procedures.

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 lifting device to support the weight of the boom and associated components as shown below.

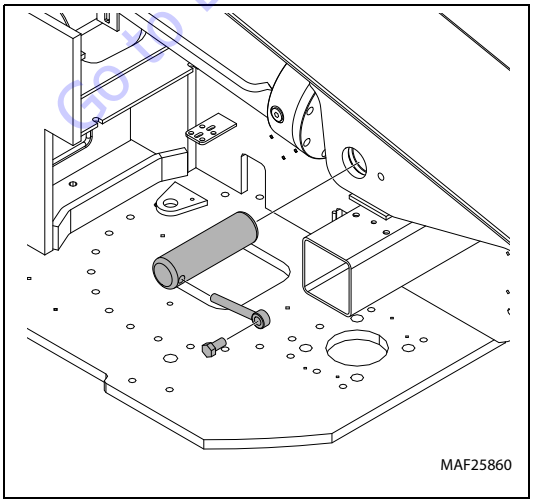
NOTE: *The* lifting *device must be able to support approximately 5350 lb (2430 kg).*



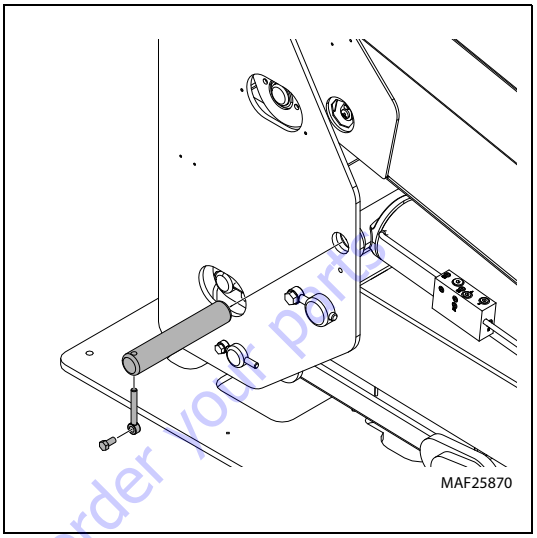
3. Tag and disconnect the hydraulic hoses from the lift cylinder.
4. Use an adequate lifting device to support the lift cylinder.

NOTE: *The lift cylinder weighs approximately 600 lb to 692 lb (271 kg to 314 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.



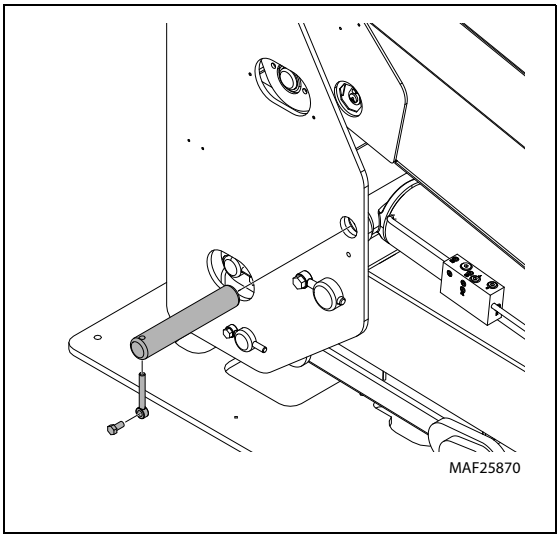
7. Using the lifting device, slide the lift cylinder back enough to allow the cylinder end to clear the attachment point on the boom.
8. Slide the lift cylinder sideways enough to remove it from the machine.

Lift Cylinder Installation

1. Using an adequate lifting device, position the lift cylinder in the machine in the same manner that it was removed.

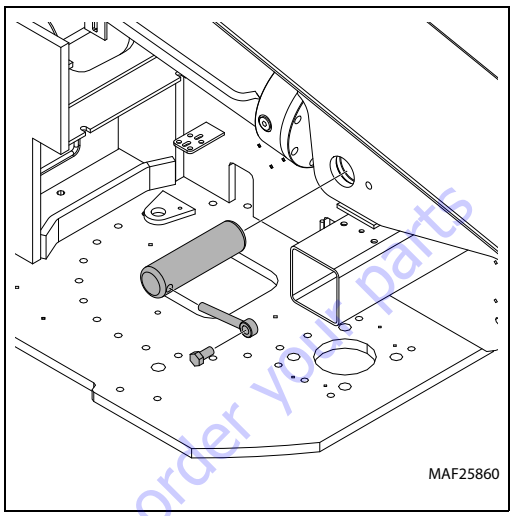
NOTE: *The lift cylinder weighs approximately 620 lb (281 kg).*

2. Using a suitable brass drift and hammer, install the barrel end pivot pin. Secure pivot pin with mounting hardware.



3. Extend the cylinder rod until it aligns with the attachment point on the boom. Take care not to extend the cylinder rod too far.

4. Using a suitable brass drift and hammer, install the rod end pivot pin. Secure pivot pin with mounting hardware.



4.7 JIB (860SJ ONLY)

Removal

1. For platform and support removal see Section 4.2, Platform.

NOTE: *The jib assembly weighs approximately 307 lb (139 kg).*

2. Using a suitable lifting device to support the jib assembly and position the assembly level with ground.

NOTICE

HYDRAULIC LINES AND PORTS SHOULD BE CAPPED IMMEDIATELY AFTER DISCONNECTING LINES TO AVOID ENTRY OF CONTAMINANTS INTO SYSTEM.

3. Tag and disconnect hydraulic lines from platform level cylinder and jib lift cylinder. Use suitable container to retain any residual hydraulic fluid. Cap or plug all openings of hydraulic lines and ports.
4. Remove mounting hardware from platform level cylinder pin #1. Using a suitable brass drift and hammer, remove the cylinder pin from jib assembly.
5. Remove mounting hardware from jib assembly boom pivot pin #2. Using a suitable brass drift and hammer, remove the pivot pin from boom assembly. Remove the jib assembly from the machine.

Disassembly

1. Remove mounting hardware from jib pivot pins #3 and #4. Using a suitable brass drift and hammer, remove the pins from jib pivot weldment.
2. Remove mounting hardware from rotator support pins #5 and #6. Using a suitable brass drift and hammer, remove the pins from rotator support.
3. Remove mounting hardware from lift cylinder pin #7. Using a suitable brass drift and hammer, remove the cylinder pin from jib boom.

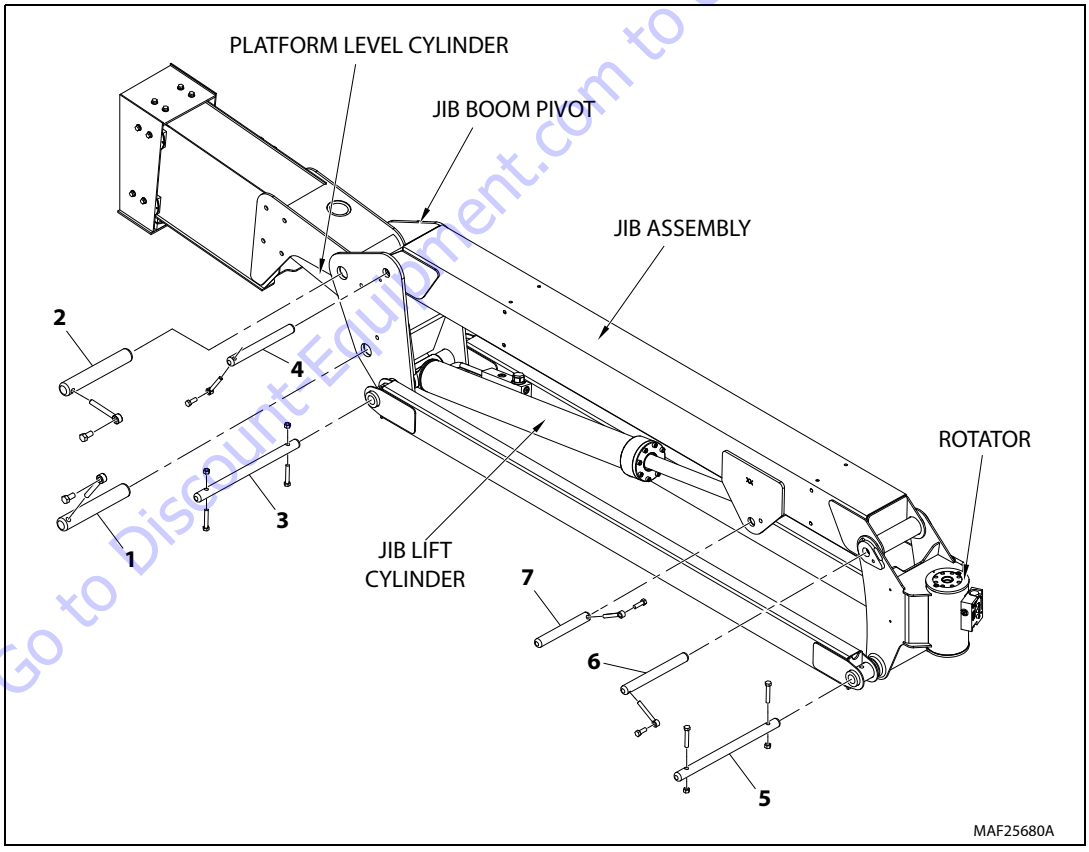


Figure 4-14. Jib Assembly - Removal/Installation

Inspection

NOTE: *When inspecting pins and bearings Refer to Section 2.5, Pins and Composite Bearing Repair Guidelines.*

1. Inspect fly boom pivot pin for wear, scoring, tapering and ovality, or other damage. Replace pins as necessary.
2. Inspect fly boom pivot attach points for scoring, tapering and ovality, or other damage. Replace pins as necessary.
3. Inspect inner diameter of fly boom pivot bearings for scoring, distortion, wear, or other damage. Replace bearings as necessary.
4. Inspect lift cylinder attach pin for wear, scoring, tapering and ovality, or other damage. Ensure pin surfaces are protected prior to installation. Replace pins as necessary.
5. Inspect inner diameter of rotator attach point bearings for scoring, distortion, wear, or other damage.
6. Inspect all threaded components for damage such as stretching, thread deformation, or twisting. Replace as necessary.
7. Inspect structural units of jib boom assembly for bending, cracking, separation of welds, or other damage. Replace boom sections as necessary.

Assembly

1. Align rod end of jib lift cylinder with attach holes in jib assembly. Using a soft head mallet, install cylinder pin #7 into jib and secure with mounting hardware.
2. Align rotator support with attach hole in jib assembly. Using a soft head mallet, install rotator support pin #6 into jib and secure with mounting hardware.
3. Align bottom tubes with attach holes in rotator support. Using a soft head mallet, install rotator support pin #5 into jib assembly and secure with mounting hardware.
4. Align jib assembly with attach hole in jib boom pivot weldment. Using a soft head mallet, install jib assembly pin #4 into jib boom pivot and secure with mounting hardware.
5. Align bottom tubes with attach holes in jib boom pivot weldment. Using a soft head mallet, install jib assembly pin #3 into jib boom pivot weldment and secure with mounting hardware.

Installation

NOTE: *The jib assembly weighs approximately 307 lb (139 kg).*

1. Using a suitable lifting device to support the jib assembly and position the assembly level with ground.
2. Align jib boom pivot weldment with attach holes in fly boom assembly. Using a soft head mallet, install pivot pin #2 into fly boom assembly and secure with mounting hardware.
3. Align the platform level cylinder with attach holes in jib boom pivot weldment. Using a soft head mallet, install platform level cylinder pin #1 into jib pivot weldment and secure with mounting hardware.
4. Remove cap or plugs from openings of hydraulic lines and ports and connect hydraulic lines to platform level cylinder and jib lift cylinder as tagged during removal.

4.8 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.*

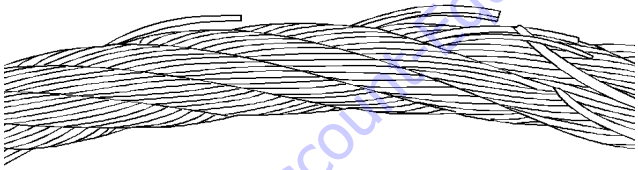


Figure 4-14. Wire Rope Wire Breaks

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.*

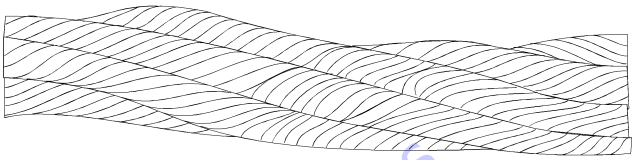


Figure 4-15. Wire Rope Kink

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.*

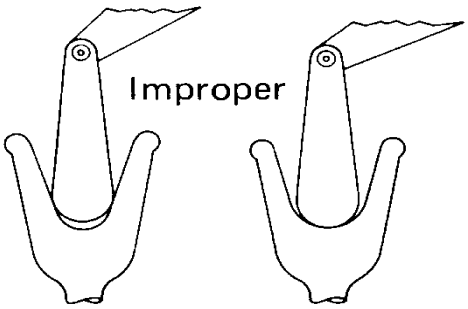


Figure 4-16. Sheave Groove Wear

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.

NOTE: *Delayed movement of the fly boom indicates loose wire ropes.*

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

NOTE: *Sheaves and wire rope must be replaced as sets.*

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.

4.9 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.*

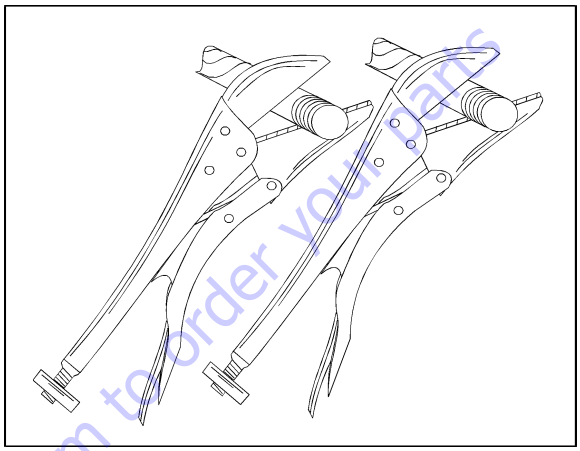


Figure 4-17. Clamping Wire Ropes

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.

4.10 ELEVATION, DUAL CAPACITY & TRANSPORT SWITCHES - 800S

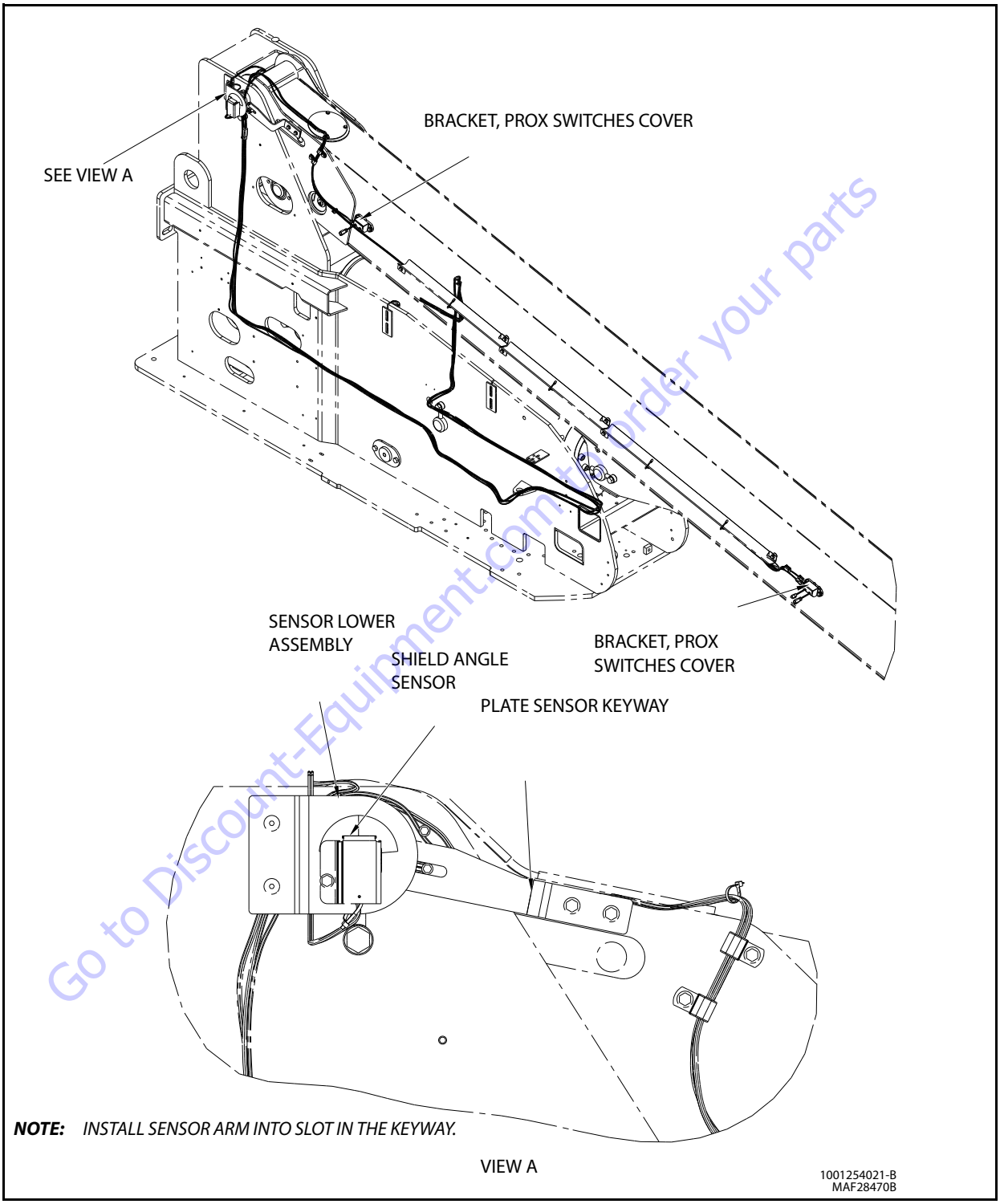
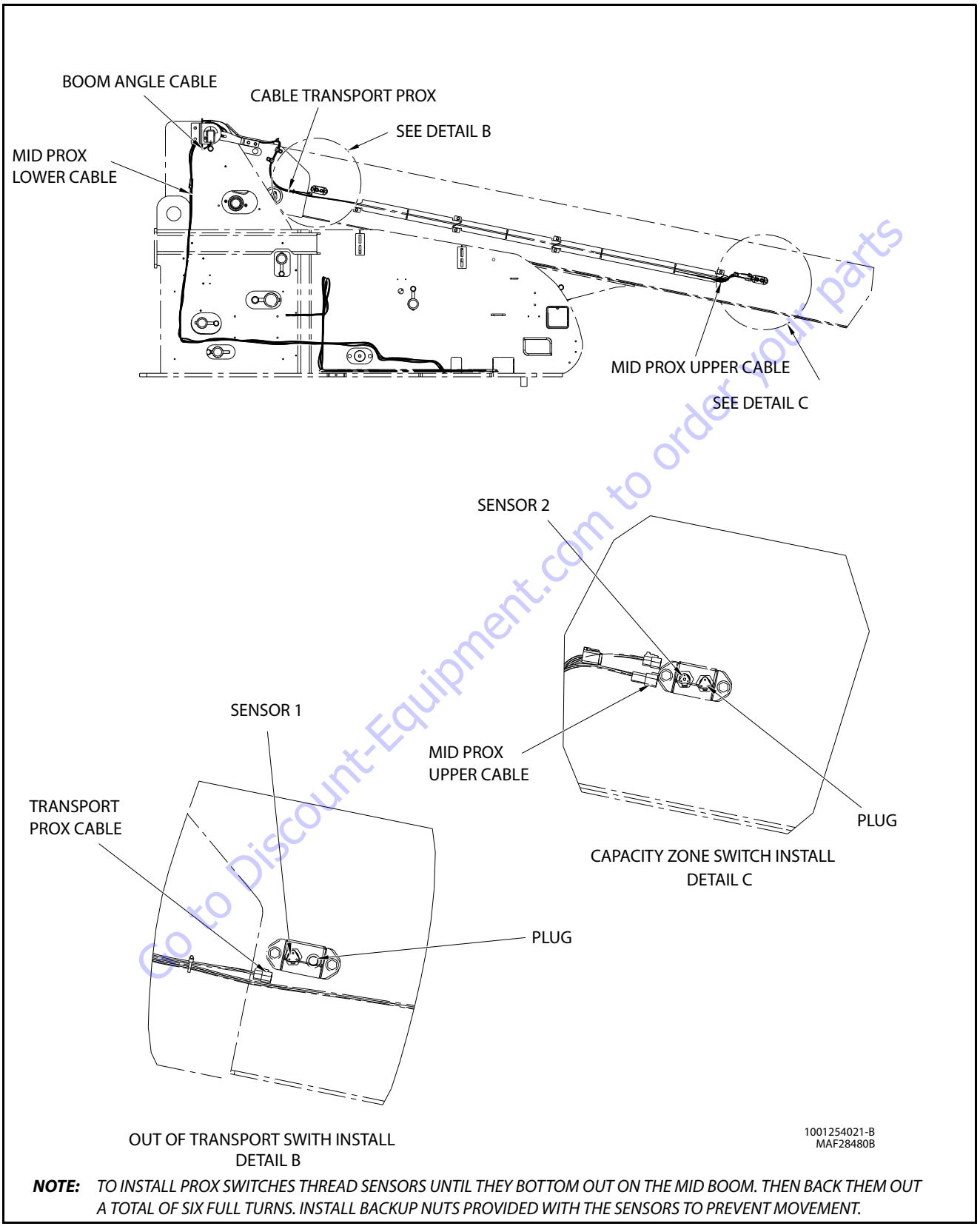


Figure 4-18. Elevation and Transportation Switches - 800S (Sheet 1 of 2)



NOTE: *TO INSTALL PROX SWITCHES THREAD SENSORS UNTIL THEY BOTTOM OUT ON THE MID BOOM. THEN BACK THEM OUT A TOTAL OF SIX FULL TURNS. INSTALL BACKUP NUTS PROVIDED WITH THE SENSORS TO PREVENT MOVEMENT.*

Figure 4-19. Elevation and Transportation Switches - 800S (Sheet 2 of 2)

4.11 ELEVATION, DUAL CAPACITY & TRANSPORT SWITCH - 860SJ

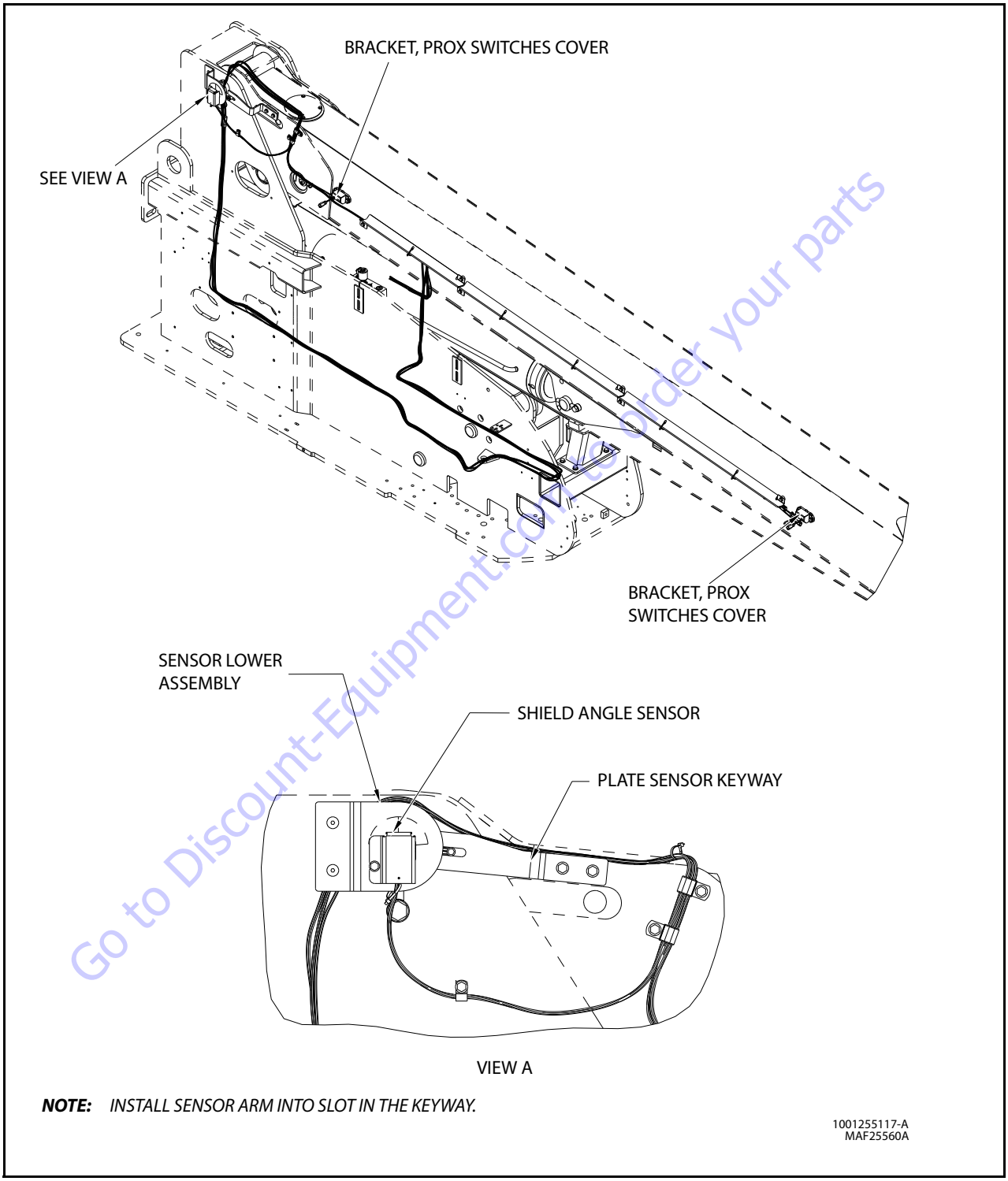
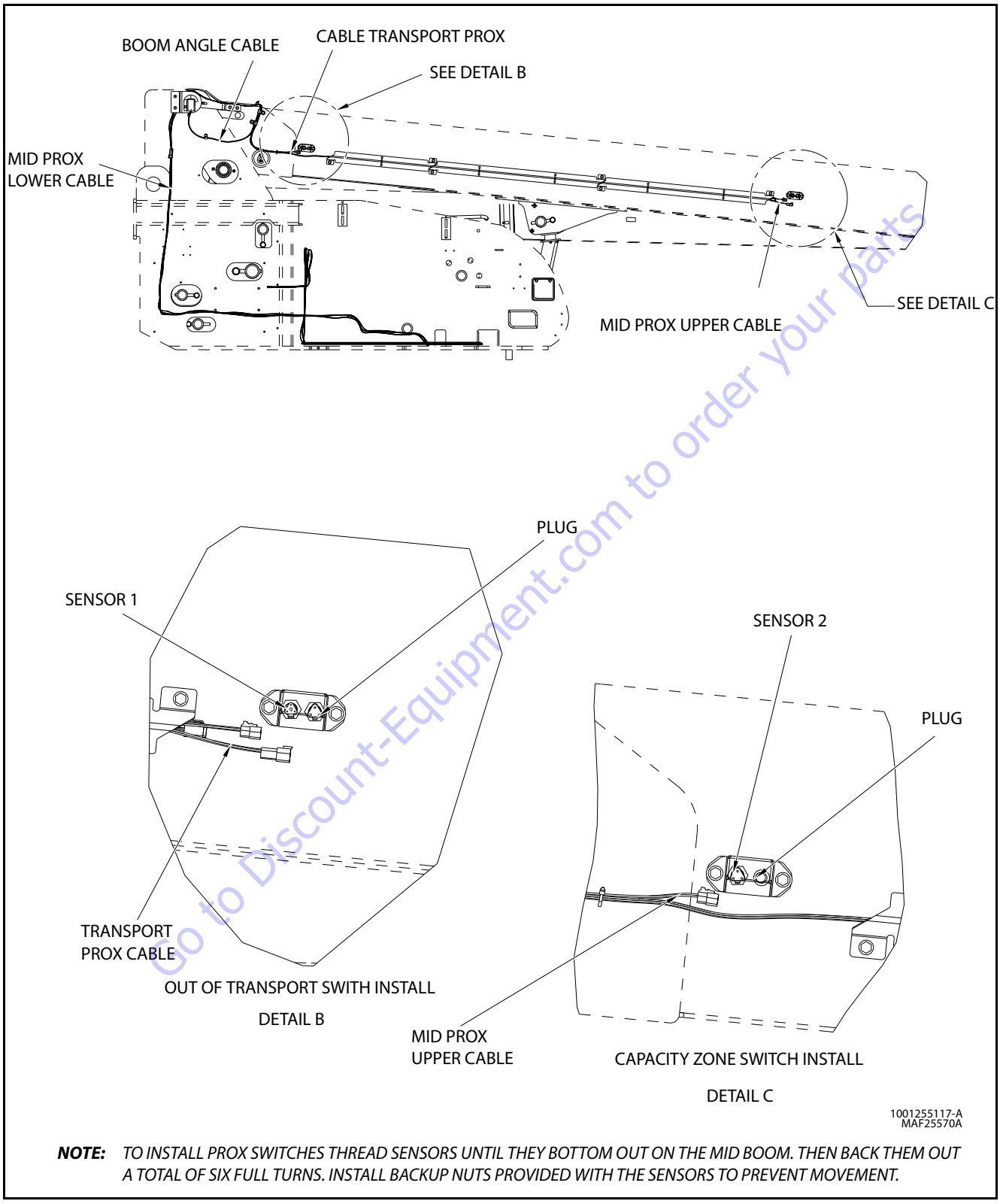


Figure 4-20. Elevation and Transportation Switches - 860SJ (Sheet 1 of 2)



NOTE: *TO INSTALL PROX SWITCHES THREAD SENSORS UNTIL THEY BOTTOM OUT ON THE MID BOOM. THEN BACK THEM OUT A TOTAL OF SIX FULL TURNS. INSTALL BACKUP NUTS PROVIDED WITH THE SENSORS TO PREVENT MOVEMENT.*

Figure 4-21. Elevation and Transportation Switches - 860SJ (Sheet 2 of 2)

4.12 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.

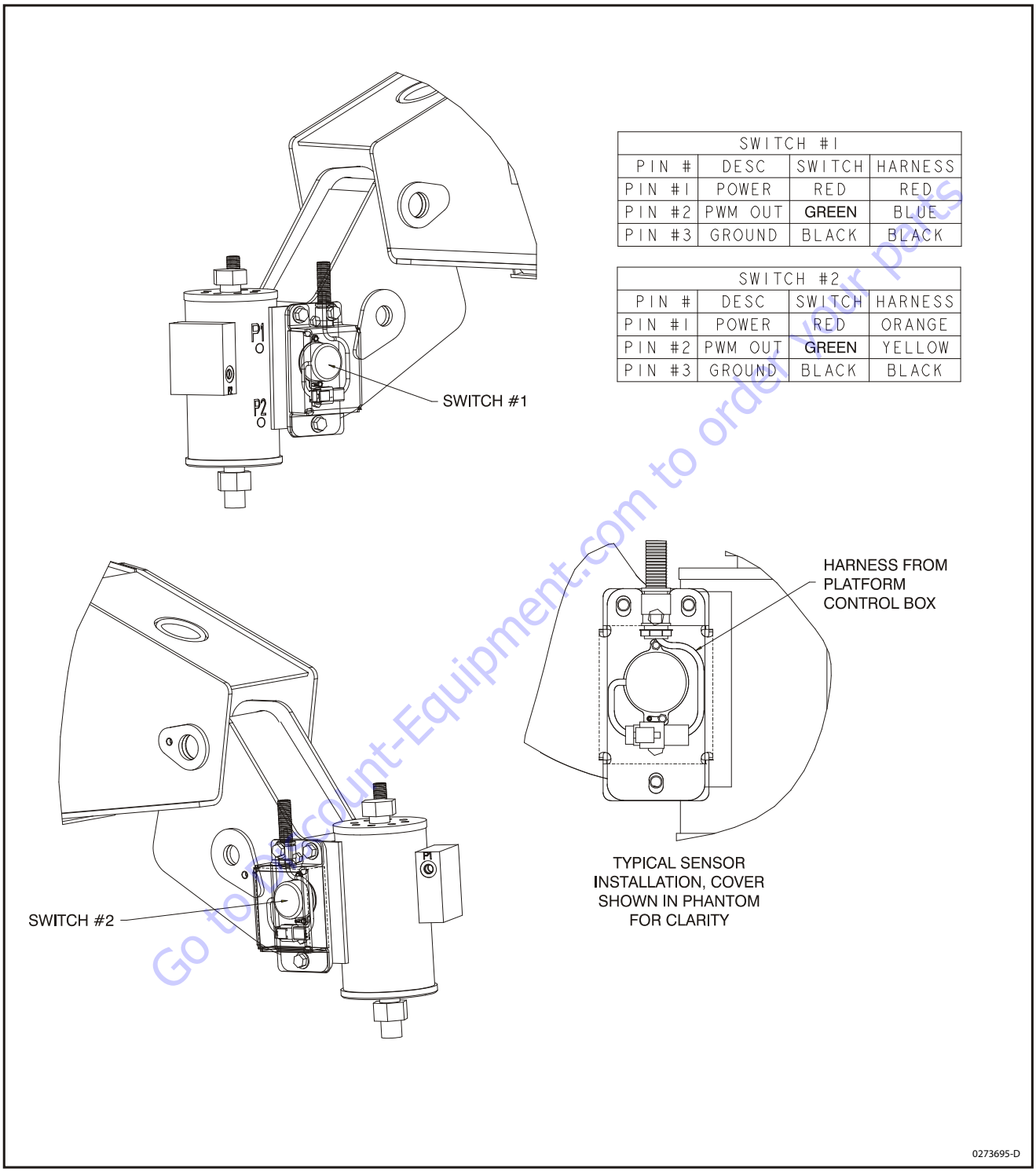
To control electronic platform leveling the platform is equipped with a pair of tilt sensors, one primary and one secondary, mounted to the non-rotating portion of the platform rotator, level up and level down valves that are used to provide proportional hydraulic flow for each directional function,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

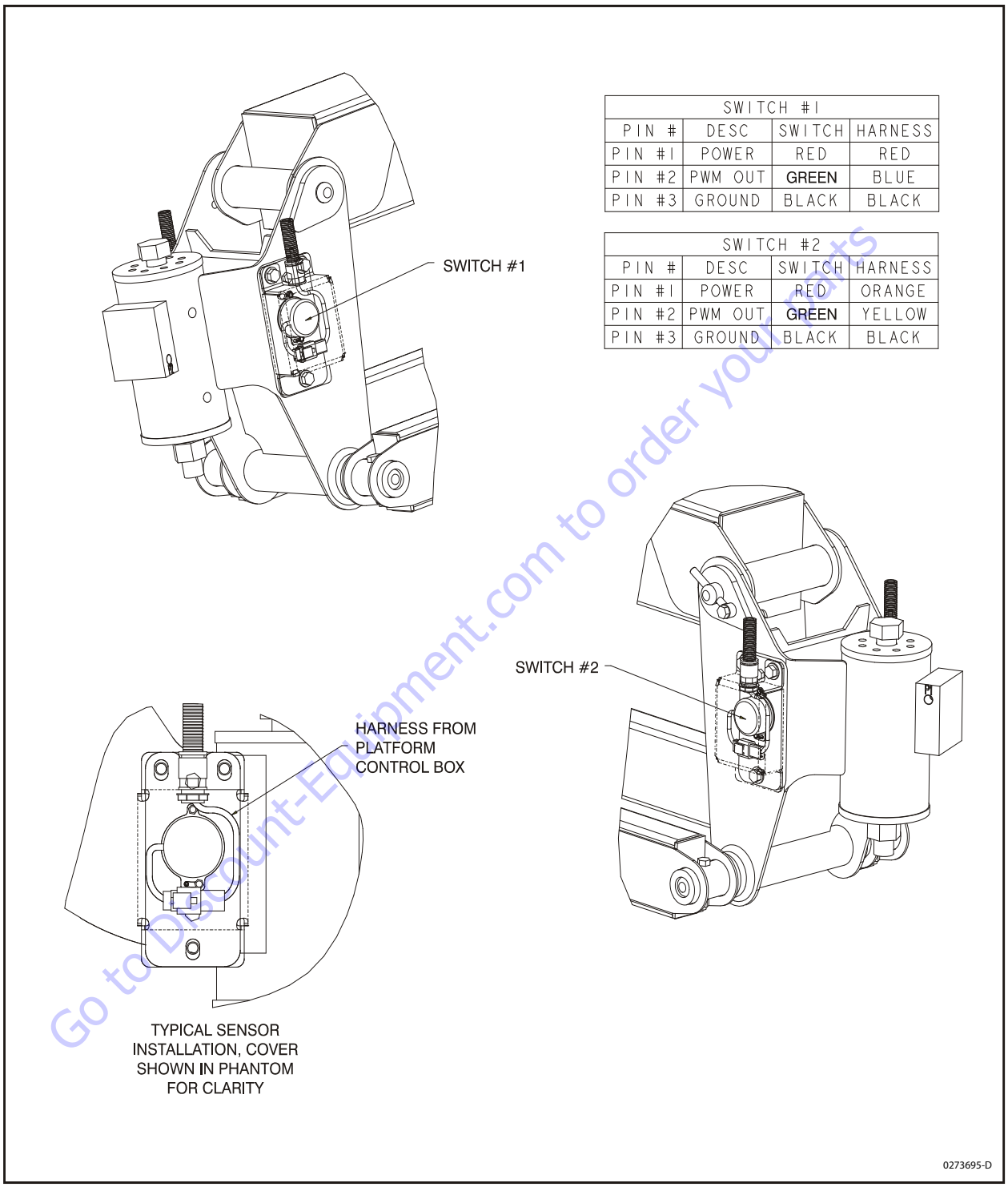
Because of the mounting orientation of the tilt sensors, the primary tilt sensor will output ascending voltage values with increases in positive platform tilt angle. The backup or secondary tilt sensor will output descending voltage values with increases in positive platform angle.



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 4-22. 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 4-23. 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 PN 4360503, PN 4360528, and PN 4360544. PN 4360528 and 4360544 supersede PN 4360503. If one of the 4360503 sensors fail, BOTH sensors must be replaced with two PN 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, Pressure Setting Procedure 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.

4.13 HELAC ROTARY ACTUATOR

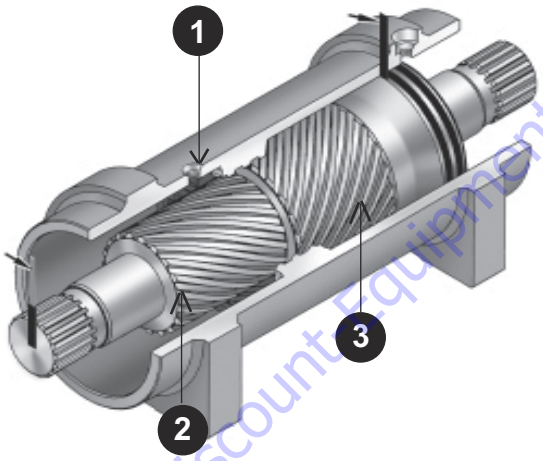
Theory of Operation

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.

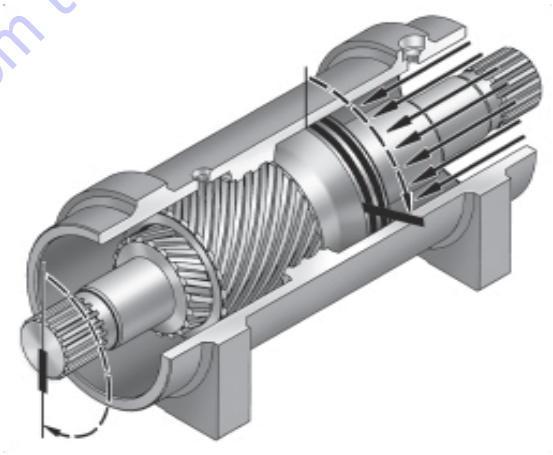
The shaft is supported radially by the large upper radial bearing and the lower radial bearing. Axially, the shaft is separated from the housing by the upper and lower thrust washers. The end cap is adjusted for axial clearance and locked in position by set screws or pins.

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

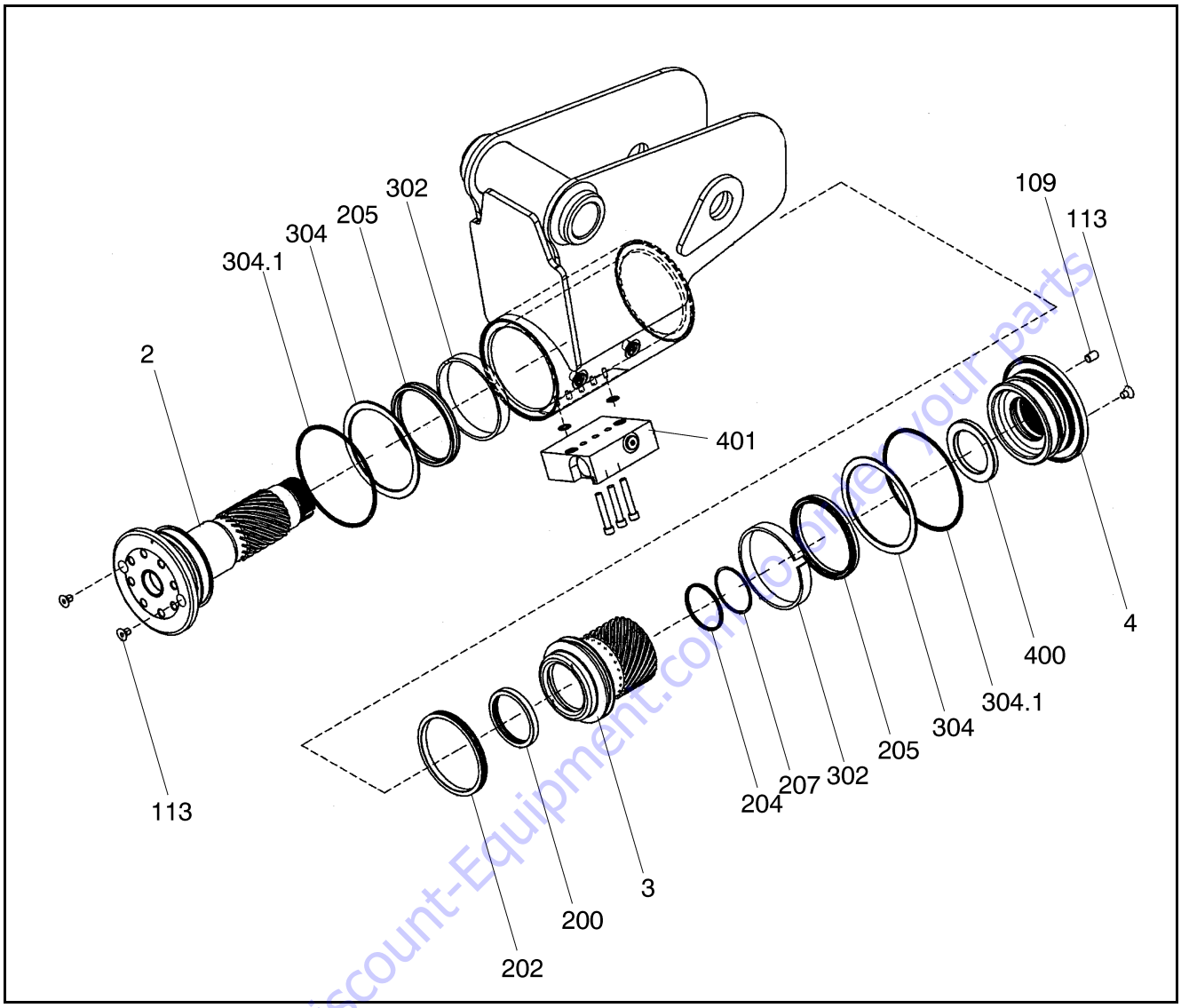


Bars indicate starting positions of piston and shaft. Arrows indicate direction they will rotate. The housing with integral ring gear remains stationary.



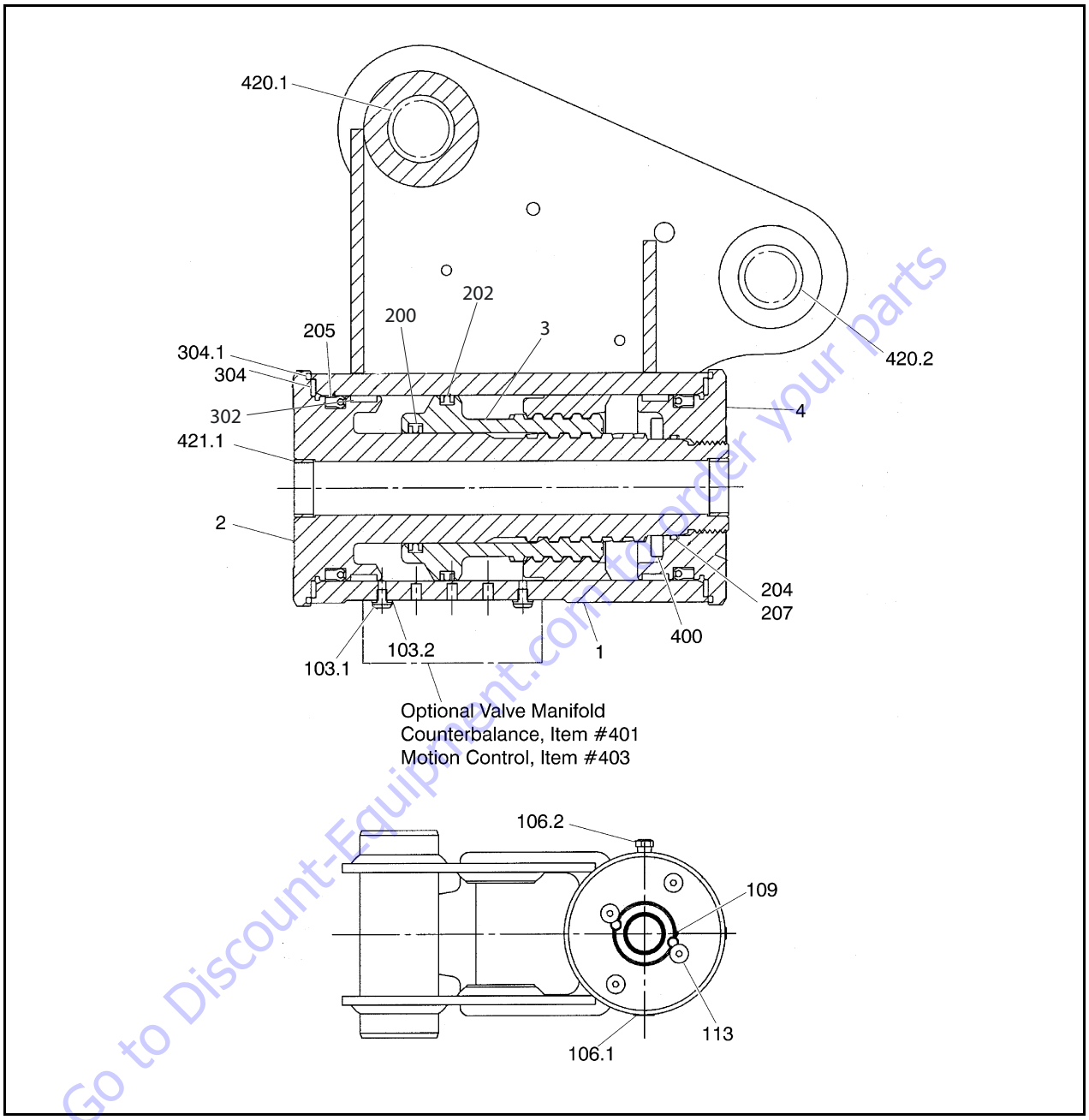
Applying fluid pressure will displace the piston axially while the helical gearing causes the piston and shaft to rotate simultaneously.

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 4-24. 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 4-25. 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.
15. Punch
16. Dowel Pins - Removal and installation of end cap.

⚠ 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).

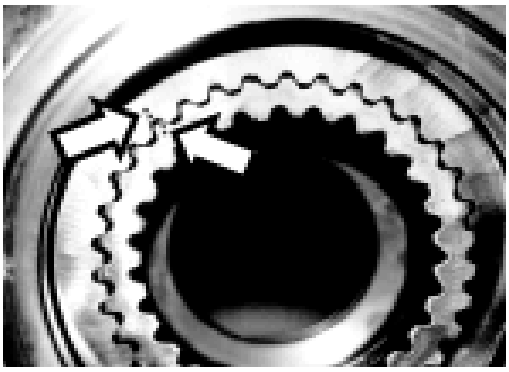
4. Remove the lock pins using an "Easy Out" (a size #2 is shown). If the pin will not come out with the "Easy Out", use 5/16" drill bit to a depth of 1/2" (12.7mm) to drill out the entire pin.

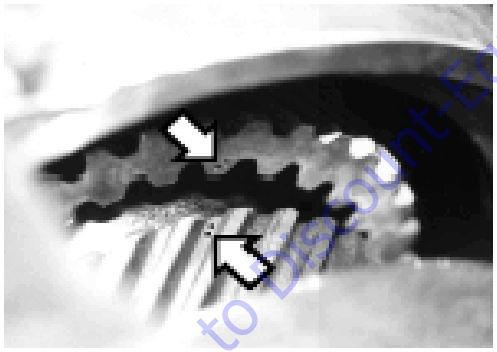
5. Install the end cap removal tools provided with the Helac seal kit.

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.

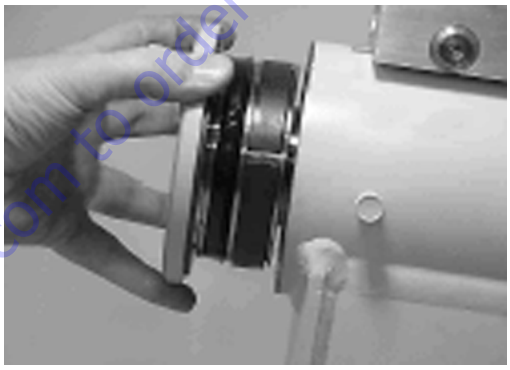
8. Remove the stop tube (400) if included. The stop tube is an available option to limit the rotation of the actuator.



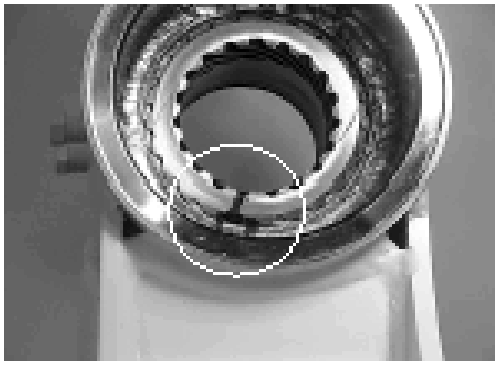


9. Every actuator has timing marks for proper engagement.

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).

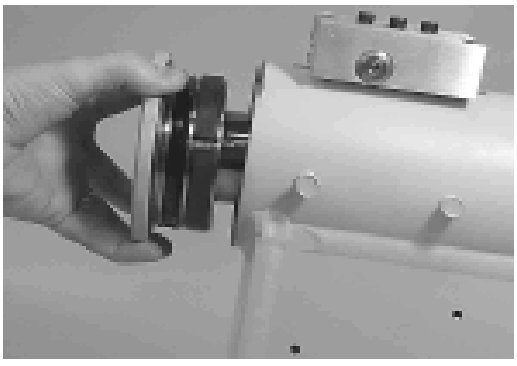
7. Install the inner T-seal (200) into the piston (3) using a circular motion. Install the outer T-seal (202) by stretching it around the groove in a circular motion. Each T-seal has 2 backup rings (see drawing for orientation).

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.

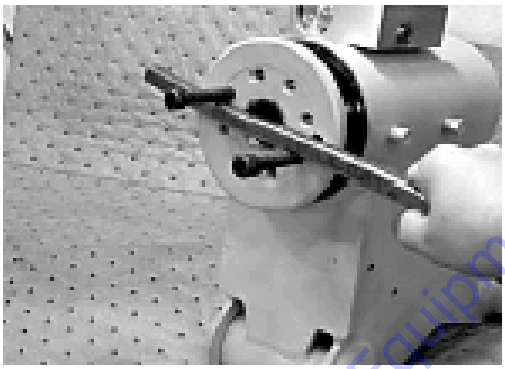
9. Looking into the housing bore from the shaft flange end, rotate the piston (3) until the marks you put on the piston and the housing (1) during disassembly align as shown. Using a rubber mallet, tap the piston into the housing until the gear teeth contact.

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 4-26., Rotator Counterbalance Valve.

1. Make sure the surface of the actuator is clean, free of any contamination and foreign debris including old Threadlocking compound.
2. Make sure the new valve has the O-rings in the counterbores 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. Medium Strength Threadlocking Compound 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).

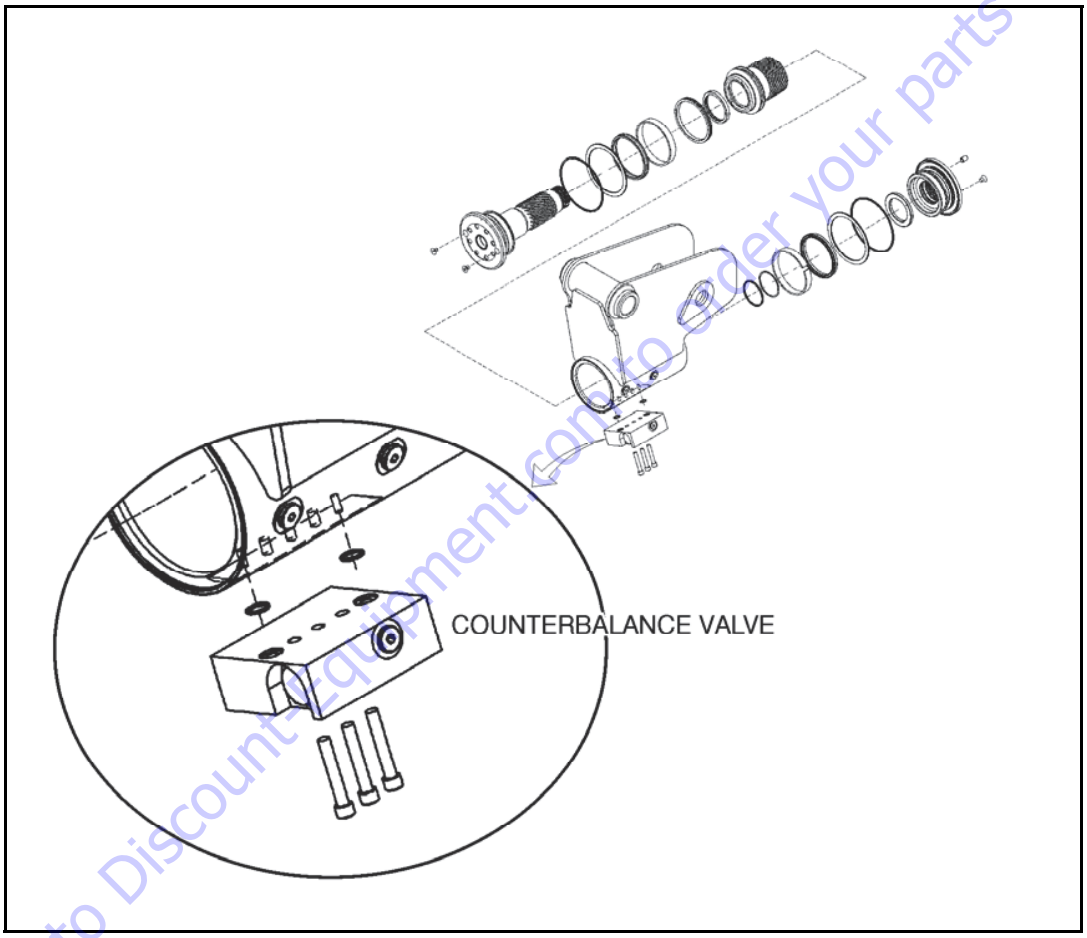


Figure 4-26. Rotator Counterbalance Valve

Greasing Thrust Washers

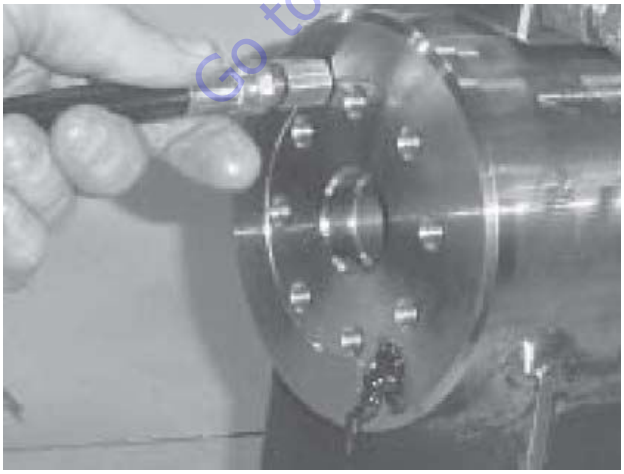
5. After the actuator is assembled but before it is put into service, the thrust washer area must be packed with Lithium grease.

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.

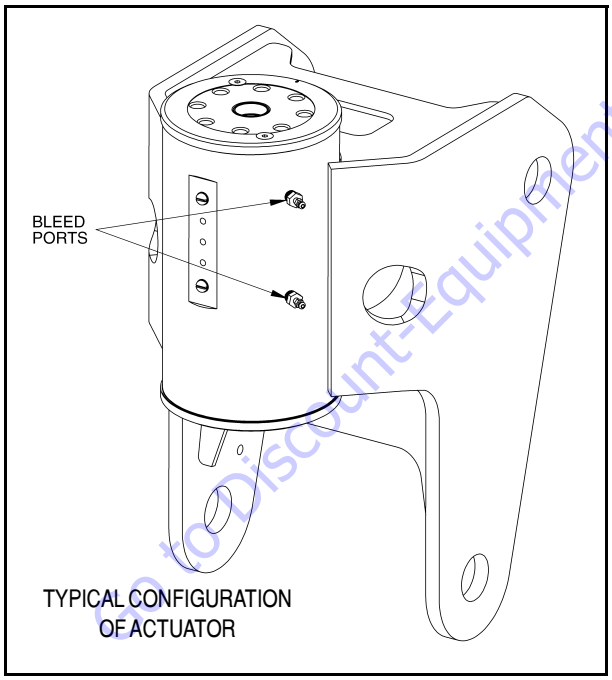
Installation and Bleeding

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

4.14 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 lb (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 lb (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.

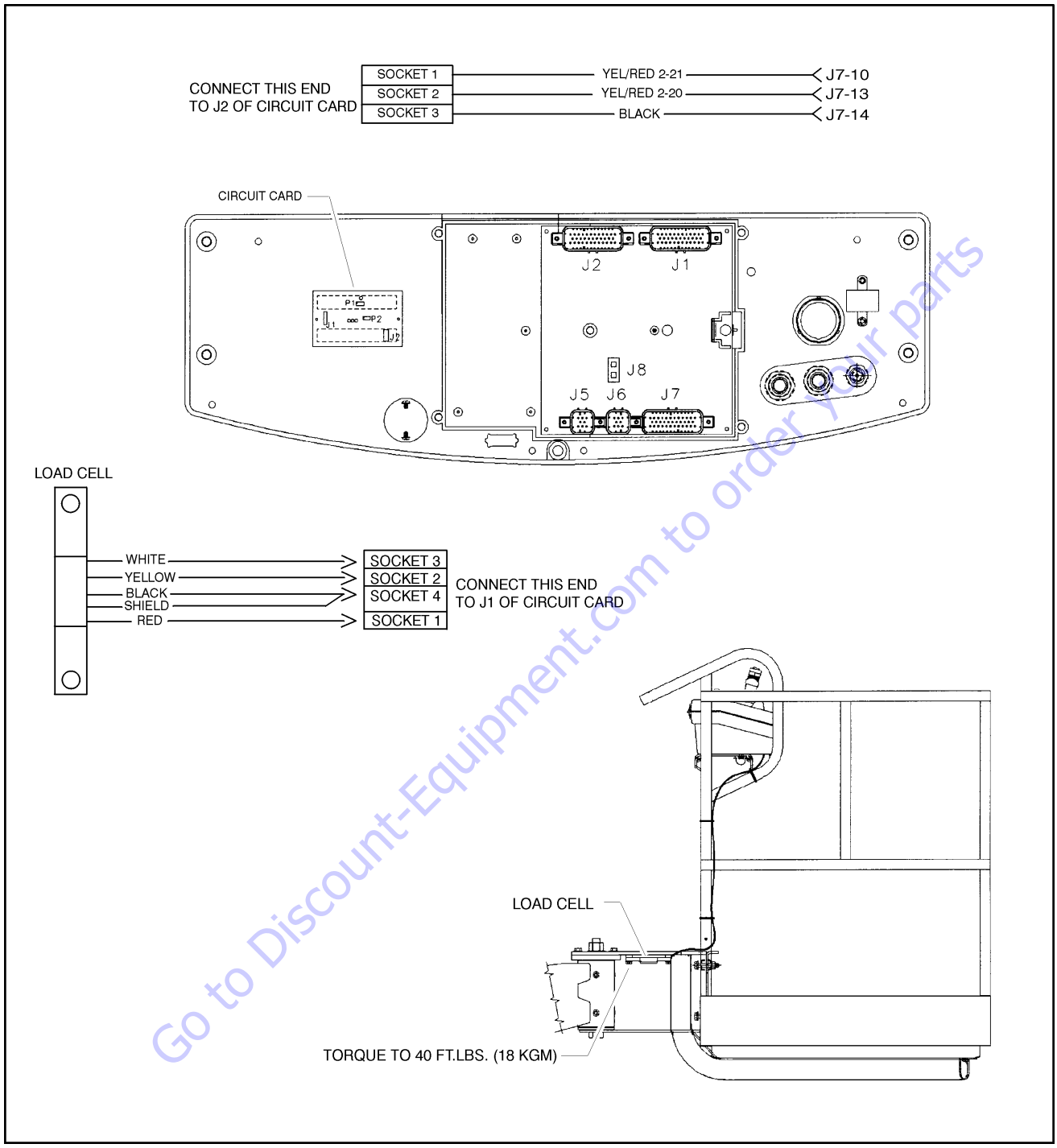


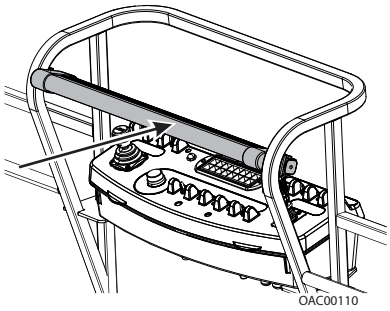
Figure 4-27. Load Sensing Device

4.15 SKYGUARD®

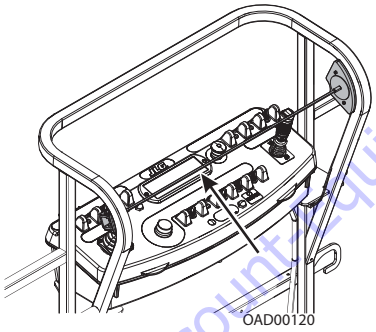
Operation

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.

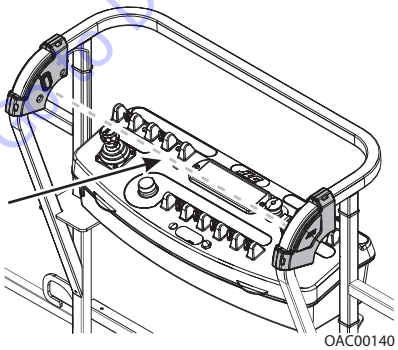
Consult the following illustrations to determine which type of SkyGuard the machine is equipped with. Regardless of the type, SkyGuard function according to the SkyGuard Function Table does not change.



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.										

4.16 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 lb (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 mobile elevating 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.

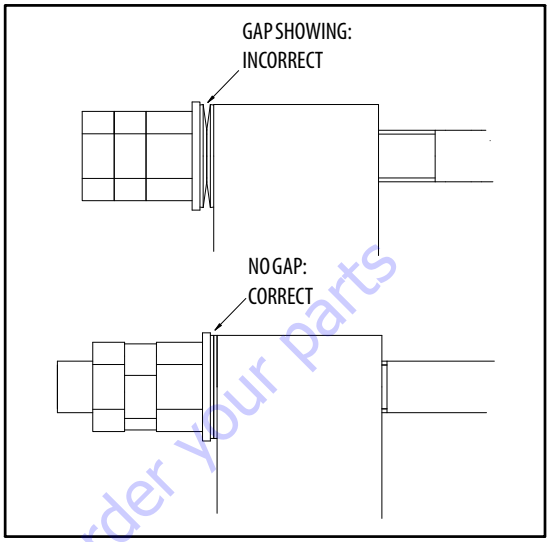
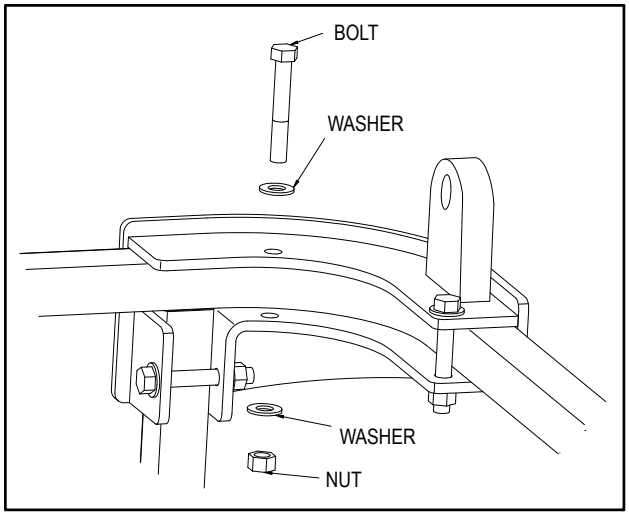


Figure 4-28. Bolt-On External Fall Arrest Cable Tension

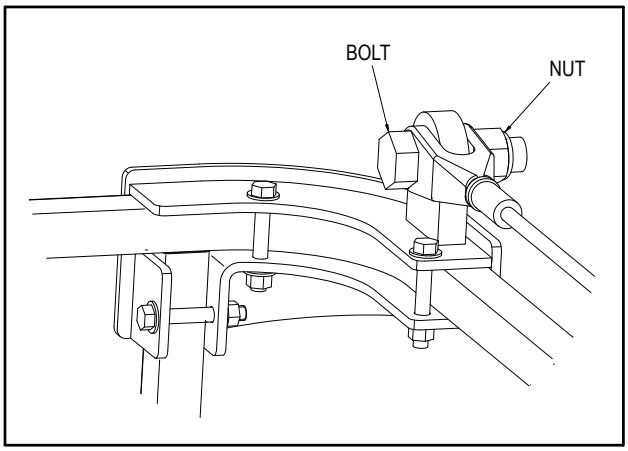
- Fittings & Brackets: Ensure all fittings are tight and there are no signs of fractures. Inspect brackets for any damage.
- Attachment Ring: No cracks or signs of wear are acceptable. Any signs of corrosion requires replacement.
- Attaching Hardware: Inspect all attaching hardware to ensure there are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

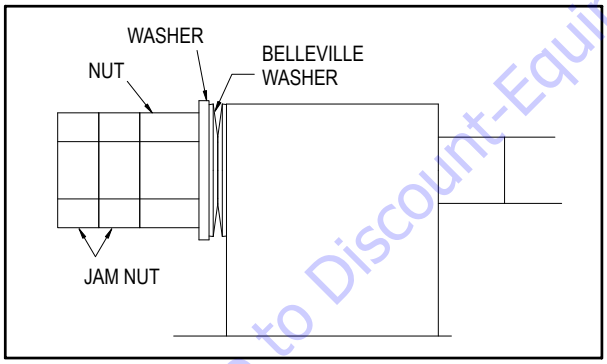


2. Attach the fall arrest cable to the right hand bracket Using the attaching bolt and nut. Orient the bolt as shown below. Do not tighten the nut so cable can still rotate.

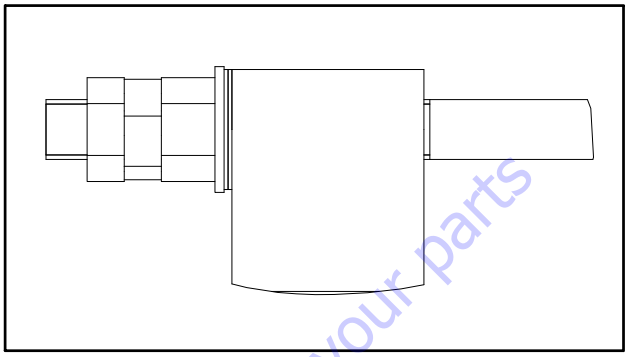


3. Install the Attachment Ring onto the cable.

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.

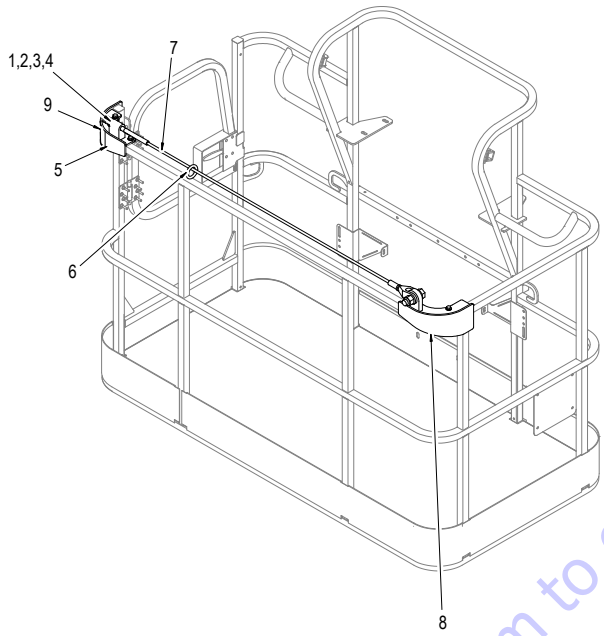


5. Use the two jam nuts to prevent the cable from rotating while the nut is tightened. Tighten the nut until the belleville washers are fully compressed and no gap is present at the outside diameter of the washers. Ensure the cable has not rotated during tightening.



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 4-29. Bolt-On External Fall Arrest System

PARTS FINDER

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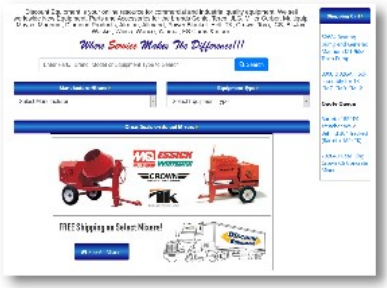

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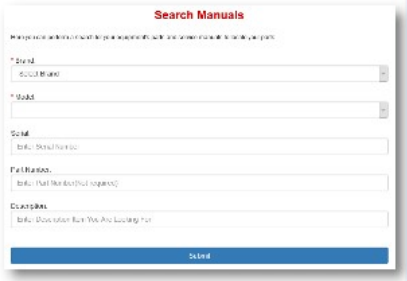

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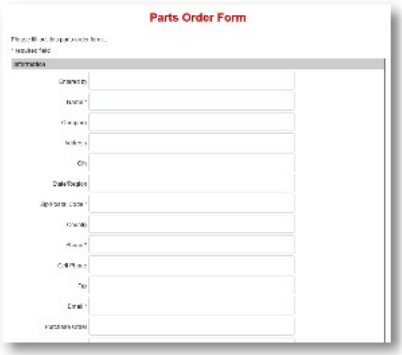

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SECTION 5. BASIC HYDRAULICS INFORMATION & SCHEMATICS

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

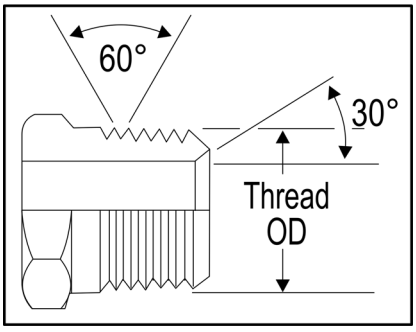


Figure 5-1. NPTF thread

BSPT = British standard pipe tapered per ISO7-1

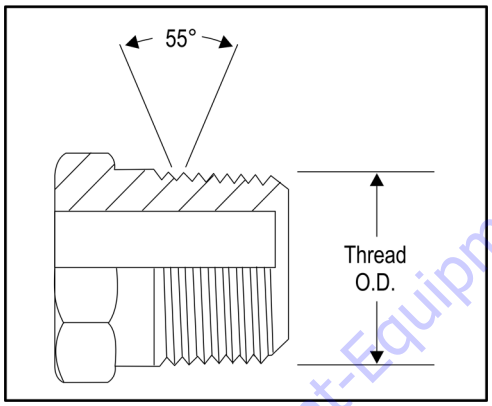


Figure 5-2. BSPT thread

Straight Thread Types, Tube and Hose Connections

JIC = 37° flare per SAE J514

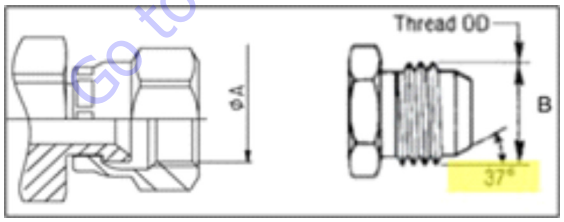


Figure 5-3. JIC Thread

SAE = 45° flare per SAE J512

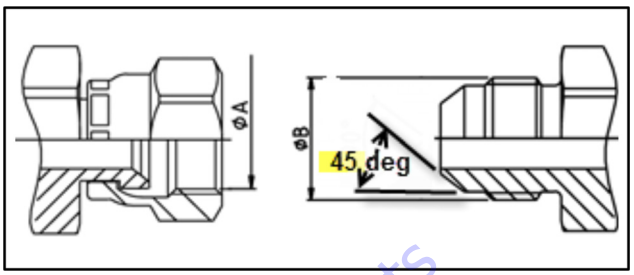


Figure 5-4. SAE Thread

ORFS = o-ring face seal per SAE J1453

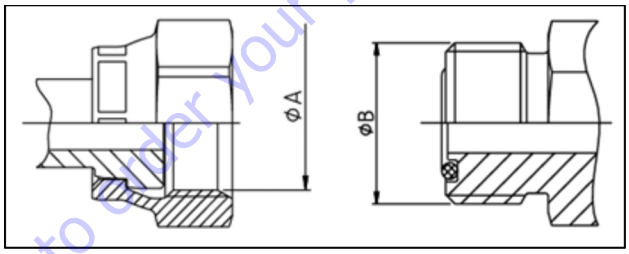


Figure 5-5. ORFS Thread

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

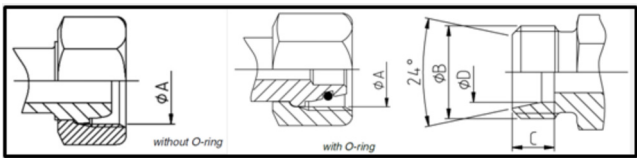


Figure 5-6. MTBL-MBTS Thread

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

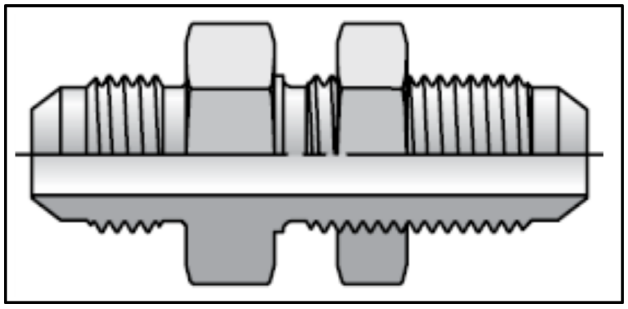
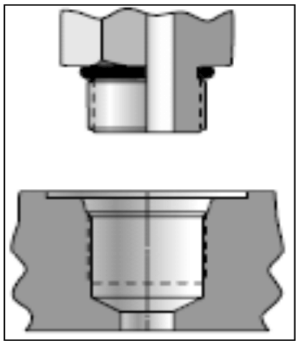


Figure 5-7. Bulkhead Thread

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

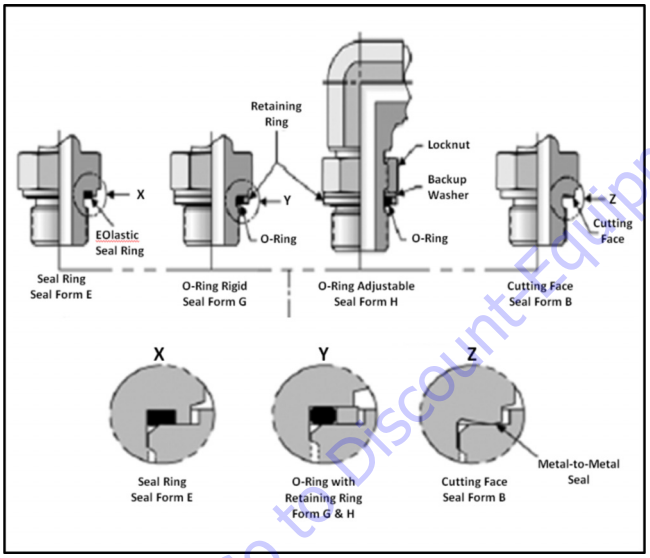


Figure 5-8. MFF-BSPP Thread

Flange Connection Types

FL61 = code 61 flange per SAE J518, ISO 6162

FL62 = code 62 flange per SAE J518, ISO 6162

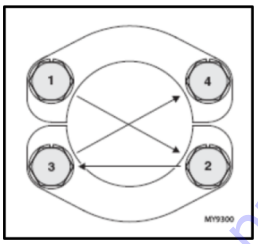


Figure 5-9. ORB-MPP Thread

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.

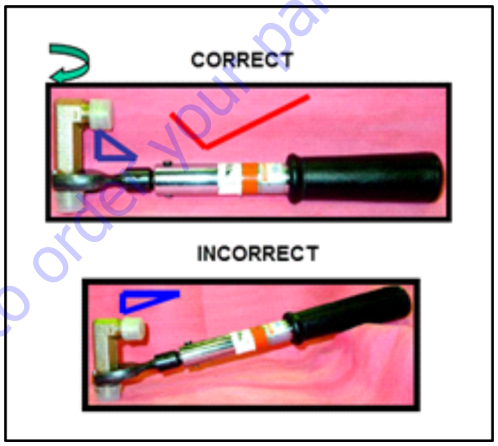


Figure 5-10. Torque Wrench Angle

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 Low Strength Threadlocking Compound, to the male pipe threads if not already applied. Ensure the first 1 to 2 threads are uncovered to prevent system contamination.
3. Assemble connection hand tight.
4. Mark fittings, male and female.

⚠ CAUTION

OVER TIGHTENING MAY CAUSE DEFORMATION OF THE PIPE FITTING AND DAMAGE TO THE JOINING FITTING, FLANGE OR COMPONENT MAY OCCUR.

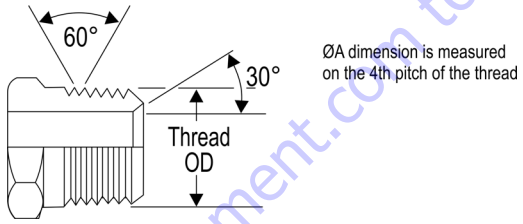
NEVER BACK OFF (LOOSEN) PIPE THREADED CONNECTORS TO ACHIEVE ALIGNMENT. MEET THE MINIMUM REQUIRED TURNS AND USE THE LAST TURN FOR ALIGNMENT.

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 (UNF)	ØA* (in)	ØA* (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 Low Strength Threadlocking Compound, to the male pipe threads if not already applied. Ensure the first 1 to 2 threads are uncovered to prevent system contamination.
3. Assemble connection hand tight.
4. Mark fittings, male and female.

⚠ CAUTION

OVER TIGHTENING MAY CAUSE DEFORMATION OF THE PIPE FITTING AND DAMAGE TO THE JOINING FITTING, FLANGE OR COMPONENT MAY OCCUR.

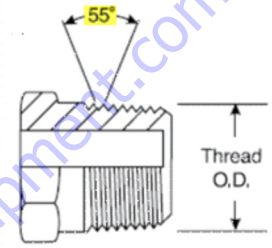
NEVER BACK OFF (LOOSEN) PIPE THREADED CONNECTORS TO ACHIEVE ALIGNMENT. MEET THE MINIMUM REQUIRED TURNS AND USE THE LAST TURN FOR ALIGNMENT.

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 (BSPT)	ØA* (in)	ØA* (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.

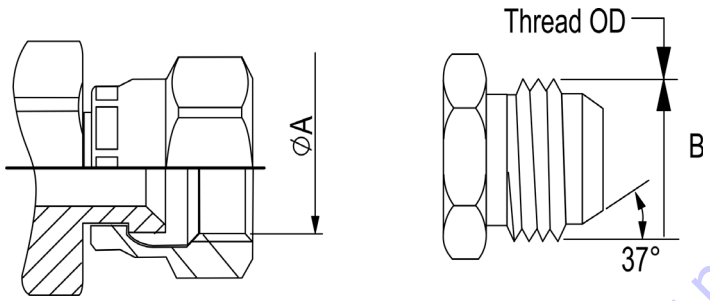
3. Torque assembly to value listed in Table 5-3, 37° Flare (JIC) Thread - Steel or Table 5-4, 37° Flare (JIC) Thread - Aluminum/Brass while using the Double Wrench Method per Double Wrench Method. Refer to FFWR and TFFT Methods for procedure requirements if using the FFWR method.

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

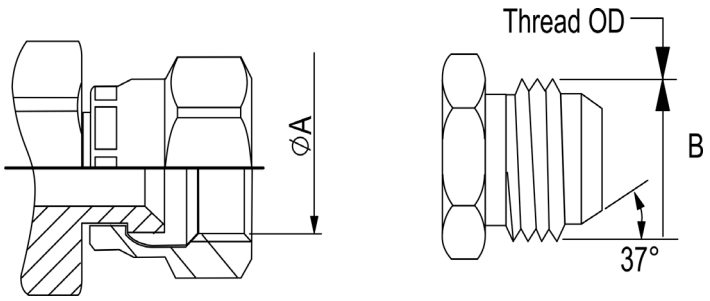


Type/Fitting Identification							Torque						Flats from Wrench Resistance (F.F.W.R)**
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]			
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max	
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.28	7.00	0.31	7.75	6	7	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.

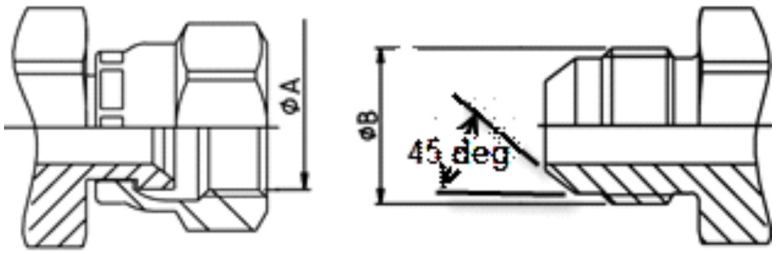
NOTE: *Torque values provided in Table 5-5, 45° Flare (SAE) - Steel and Table 5-6, 45° Flare (SAE) - Aluminum/Brass are segregated based on the material configuration of the connection.*

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

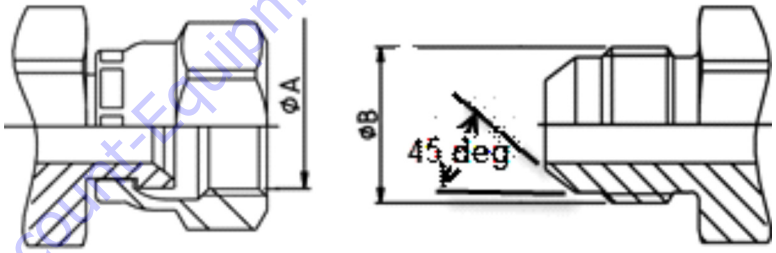
mating components.

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 Methodsfor FFWR procedure requirements.												

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



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

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

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

⚠ CAUTION

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

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

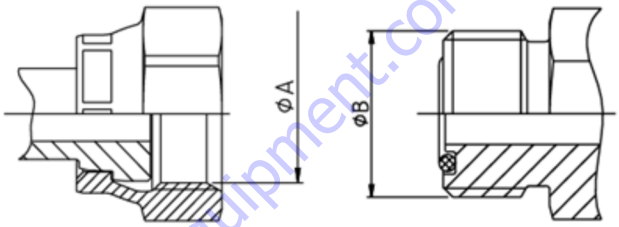
NOTE: *Torque values provided in Table 5-7, O-ring Face Seal (ORFS) - Steel and Table 5-8, O-ring Face Seal (ORFS) - Aluminum/Brass are segregated based on the material configuration of the connection.*

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

- 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

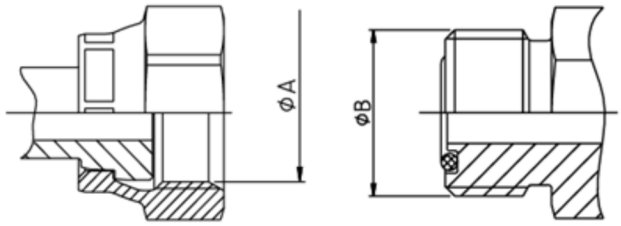


TYPE/FITTING IDENTIFICATION							Torque						Flats from Wrench Resistance (F.F.W.R)**	
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]			Tube Nuts	Swivel & Hose Ends
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max		
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	4	9/16-18	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	2 1/2-12	2.43	61.67	2.50	63.50	20	21	22	27	28	30	1/4 to 1/2	1/2 to 3/4

* ØA and ØB thread dimensions for reference only.

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

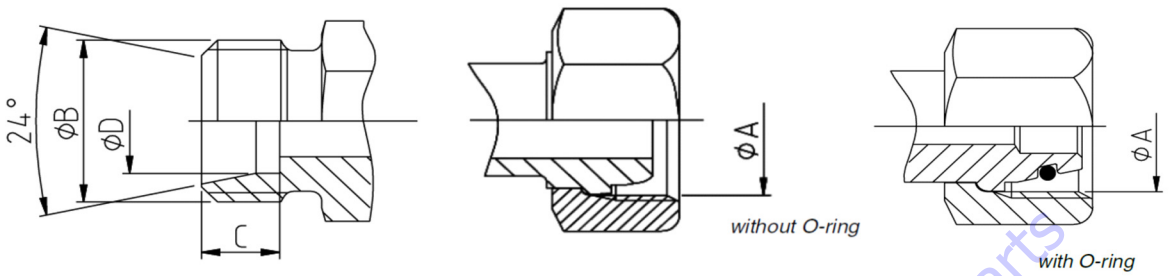
Assembly Instructions for DIN 24° Flare Bite Type Fittings (MBTL and MBTS)

⚠ CAUTION

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

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

Table 5-9. DIN 24°Cone (MBTL & MBTS)



TYPE/FITTING IDENTIFICATION								DIN 24° CONE FLARELESS BITE FITTING (With or Without O-Ring)						
MATERIAL	TYPE	Tube O.D.	Thread M Size	ØA*	ØB*	C*	ØD*	Torque						Flats from Wrench Resistance (F.F.W.R)**
								[Ft-Lb]			[N-m]			
		(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						Flats from Wrench Resistance (F.F.W.R)**
								[Ft-Lb]			[N-m]			
		(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

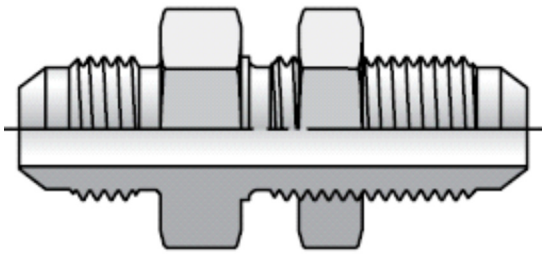
* ØA, ØB, C, & ØD thread dimensions for reference only.

** See Appendix B for FFWR procedure requirements.

Assembly Instructions for Bulkhead (BH) Fittings

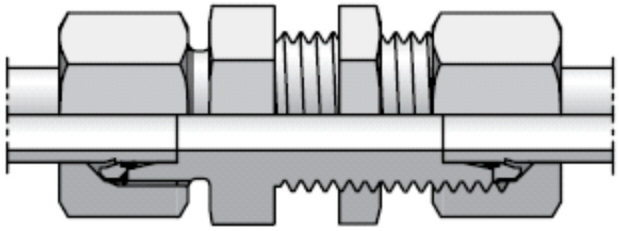
1. Ensure threads and surface are free of rust, weld and brazing splatter, splits, burrs or other foreign material. If necessary replace fitting or adapter.
2. Remove the locknut from the bulkhead assembly.
3. Insert the bulkhead side of the fitting into the panel or bulkhead bracket opening.
4. Hand 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

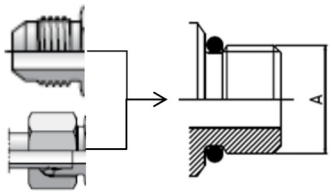
CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

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



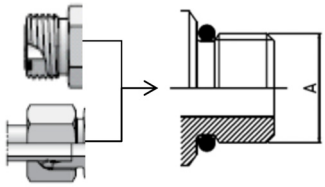
TYPE/FITTING IDENTIFICATION					HEX TYPE PLUGS & STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(85)	(90)	(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

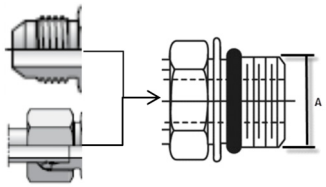


TYPE/FITTING IDENTIFICATION					STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	--	--	--	--	--	--
	3	3/8-24	0.37	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



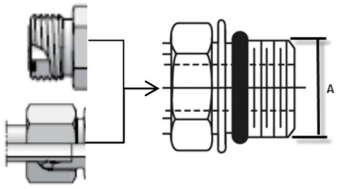
TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(60)	(63)	(66)	7	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.

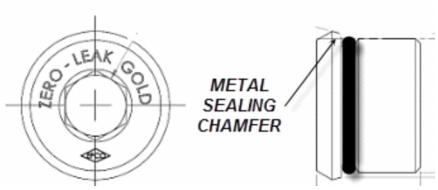
Table 5-16. O-ring Boss (ORB) - Table 5 of 6

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

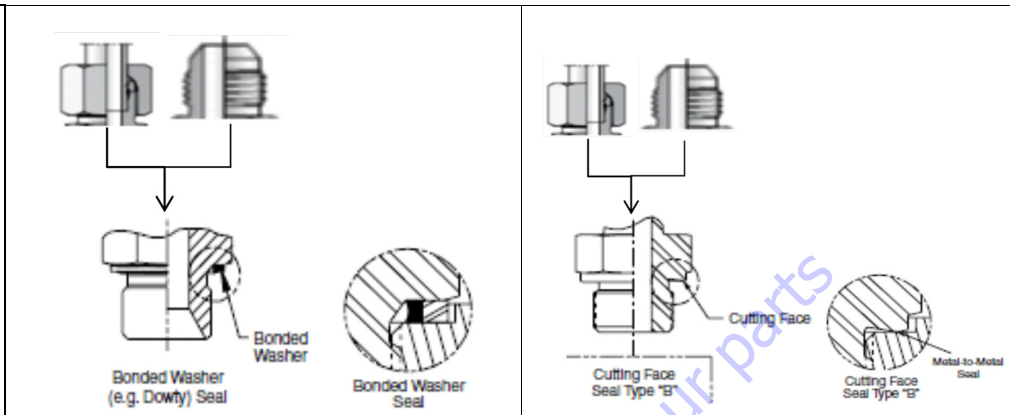
CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

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.

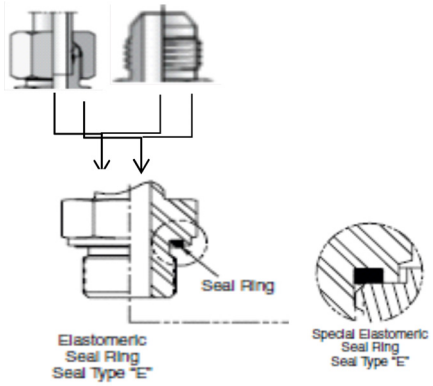
7. Inspect to ensure the O-ring is not pinched and the washer is seated flat on the counterbore of the port.

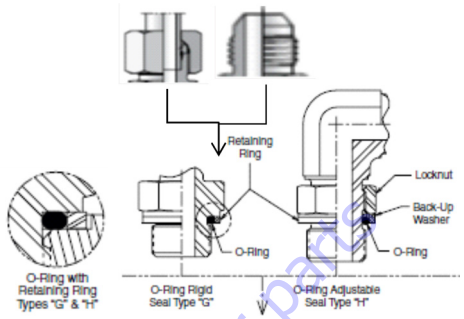
Table 5-18. Metric Flat Face Port (MFF) - L Series - Table 1 of 3



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

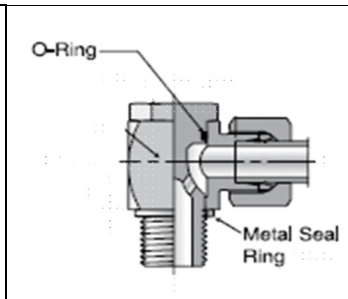
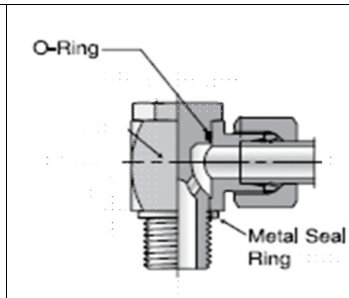
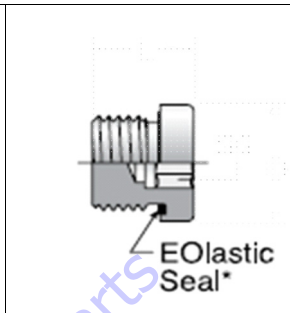
																				
TYPE/FITTING IDENTIFICATION			BANJO FITTINGS with L series DIN (MBTL) opposite end						HIGH PRESSURE BANJO FITTINGS with L series DIN (MBTL) opposite end						FORM E (EOLASTIC SEALING RING) HOLLOW HEX PLUGS								
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque						Torque							
		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

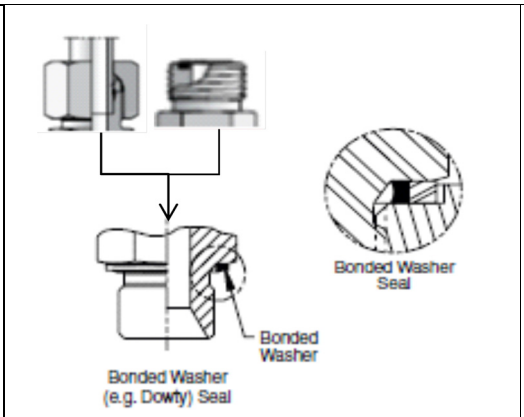
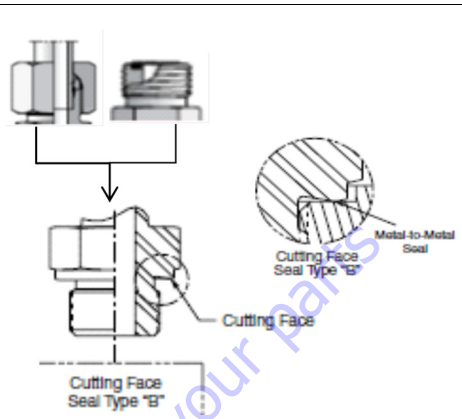
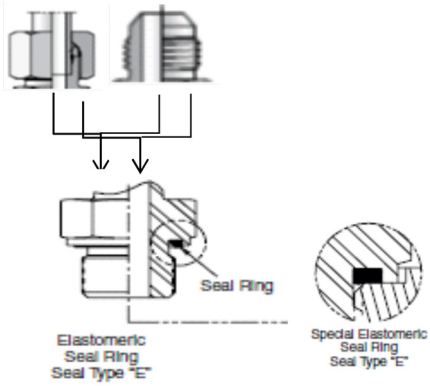
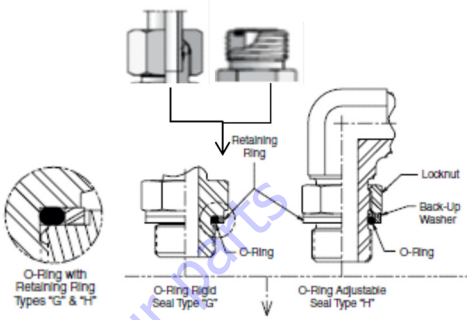
														
TYPE/FITTING IDENTIFICATION			FORM A (SEALING WASHER) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end						FORM B (CUTTING FACE) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[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

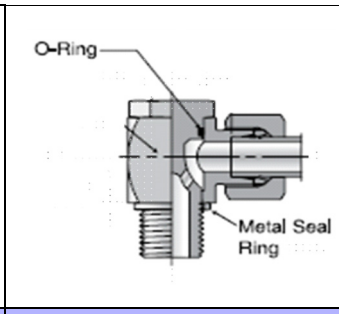
Table 5-22. Metric Flat Face Port (MFF) - S Series - Table 2 of 3

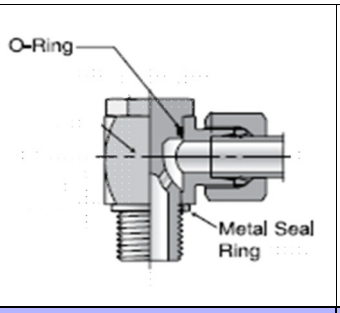


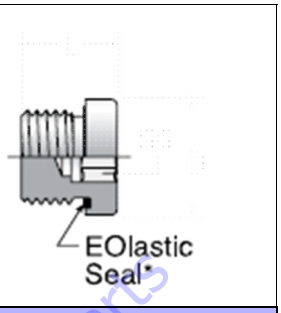


TYPE/FITTING IDENTIFICATION			FORM E (EOLASTIC SEALING RING) STUD ENDS AND HEX TYPE PLUGS with (ORFS) or S series DIN (MBTS) opposite end						FORM G/H (O-RING W/ RETAINING RING) STUD ENDS & ADJUSTABLE STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Thread M Size	Connecting Tube 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) - S Series - Table 3 of 3







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

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

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

⚠ CAUTION

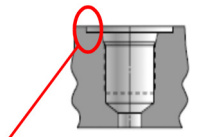
CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

3. Pre-lubricate the O-ring with Hydraulic Oil.
4. For Non-Adjustable Fittings and Plugs, thread the fitting by hand until contact.
5. For Adjustable fittings, refer to Adjustable Stud End Assembly for proper assembly.
6. Torque the fitting or nut to value listed in Table 5-24 while using the Double Wrench Method.
   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:

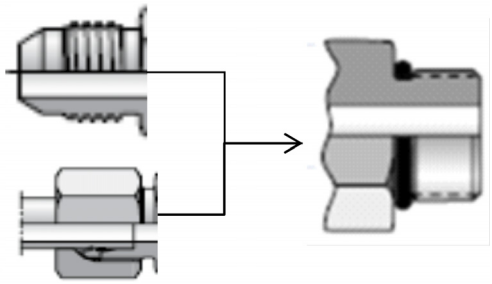
- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

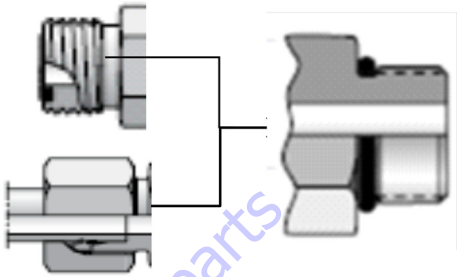
7. Inspect to ensure the O-ring is not pinched and the washer is seated flat on the counterbore of the port.

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



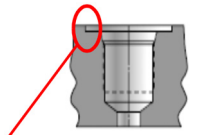
Note: Metric O-ring only style (ISO 6149) requires o-ring chamfer in the port, similar to ISO 11926 (SAE ORB),**but is not interchangeable.**



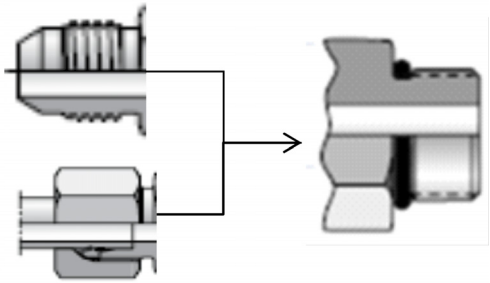


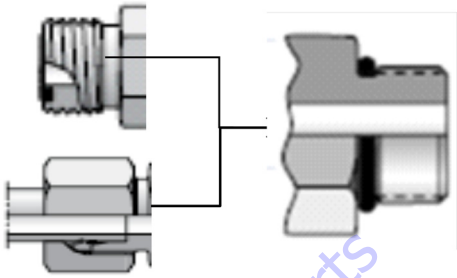
TYPE/FITTING IDENTIFICATION			STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	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

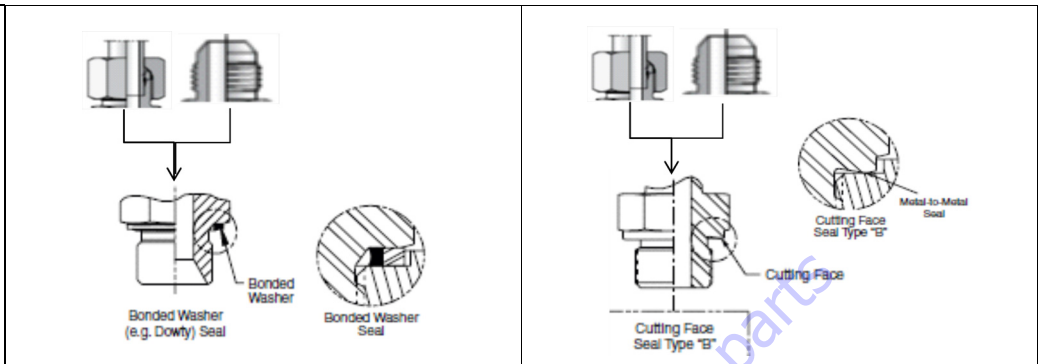
CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

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



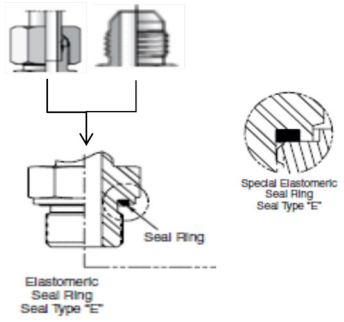
TYPE/FITTING IDENTIFICATION			FORM A**(SEALING WASHER) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM B** (CUTTING FACE) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]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

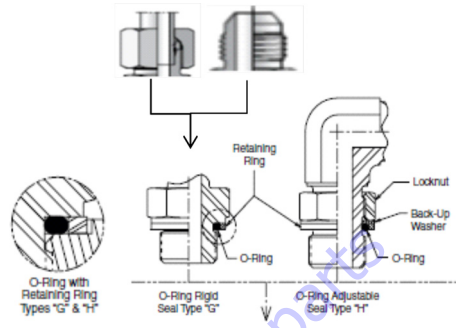
* Typical for JLG Straight Male Stud Fittings

** 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





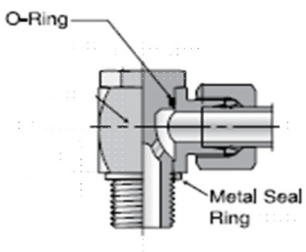
TYPE/FITTING IDENTIFICATION			FORM E* (EOLASTIC SEALING RING) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM G/H*** (O-RING W/ RETAINING RING) STUD ENDS & ADJUSTABLE STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.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

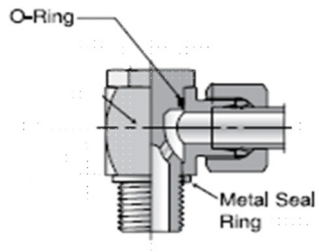
* Typical for JLG Straight Male Stud Fittings

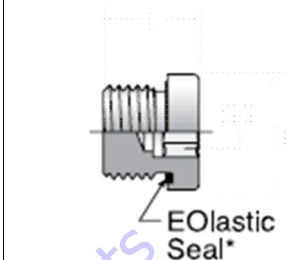
** Non typical for JLG Straight Male Stud Fittings, reference only.

*** Typical for JLG Adjustable Fittings

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







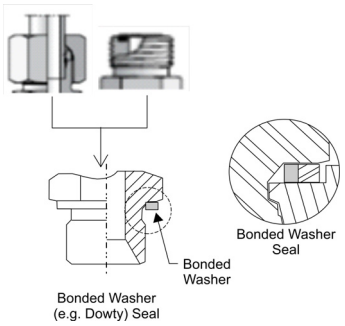
TYPE/FITTING IDENTIFICATION			BANJO FITTINGS with L series DIN (MBTL) opposite end						HIGH PRESSURE BANJO FITTINGS with L series DIN (MBTL) opposite end						FORM E (EOLASTIC SEALING RING) HOLLOW HEX PLUGS					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque						Torque					
		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

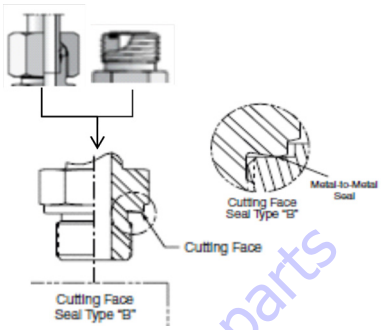
* Typical for JLG Straight Male Stud Fittings

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

*** Typical for JLG Adjustable Fittings

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





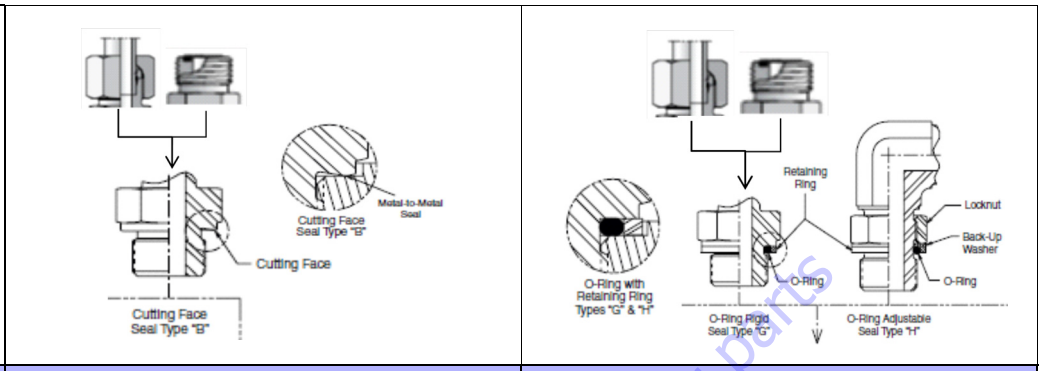
TYPE/FITTING IDENTIFICATION			FORM A** (SEALING WASHER) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end						FORM B** (CUTTING FACE) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]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



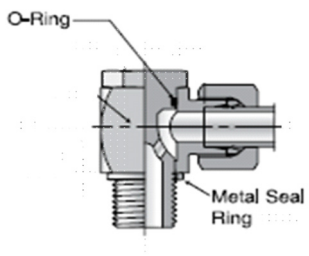
TYPE/FITTING IDENTIFICATION			FORM E* (EOLASTIC SEALING RING) STUD ENDS AND HEX TYPE PLUGS with (ORFS) or S series DIN (MBTS) opposite end						FORM G/H*** (O-RING W/ RETAINING RING) STUD ENDS & ADJUSTABLE STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	BSPP Thread G Size	Connecting 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

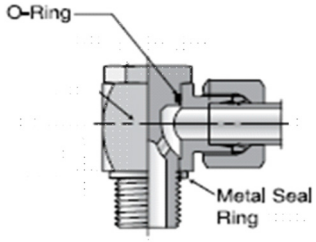
* Typical for JLG Straight Male Stud Fittings

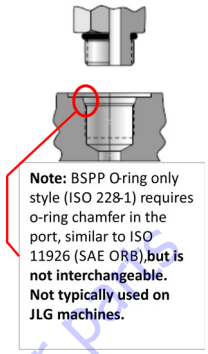
** Non typical for JLG Straight Male Stud Fittings, reference only.

*** 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

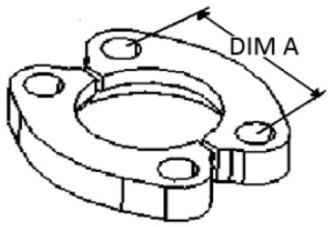
**Non typical for JLG Straight Male Stud Fittings, reference only.

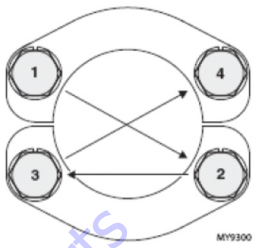
***Typical for JLG Adjustable Fittings

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

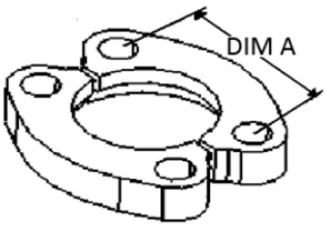


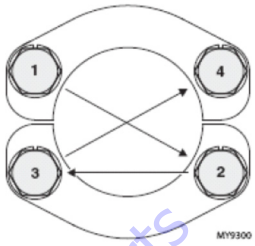


TYPE/FITTING IDENTIFICATION						STEEL 4-BOLT FLANGE SAE J518 (INCH FASTENERS)													
TYPE	Inch Flange SAE Dash Size	Flange Size		A*		Bolt Thread Size	Fastener Torque for Flanges Equipped with GRADE 5 Screws						Fastener Torque for Flanges Equipped with GRADE 8 Screws						
							[Ft-Lb]			[N-m]			[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 backup wrench. If two wrenches are not used, inadvertent component rotation may occur which absorbs torque and causes improper joint load and leads to leaks. For hose connections, the 'layline' printed on the hose is a good indicator of proper hose installation. A twisted lay-line usually indicates the hose is twisted. See Figure 5-11. for double wrench method requirements.

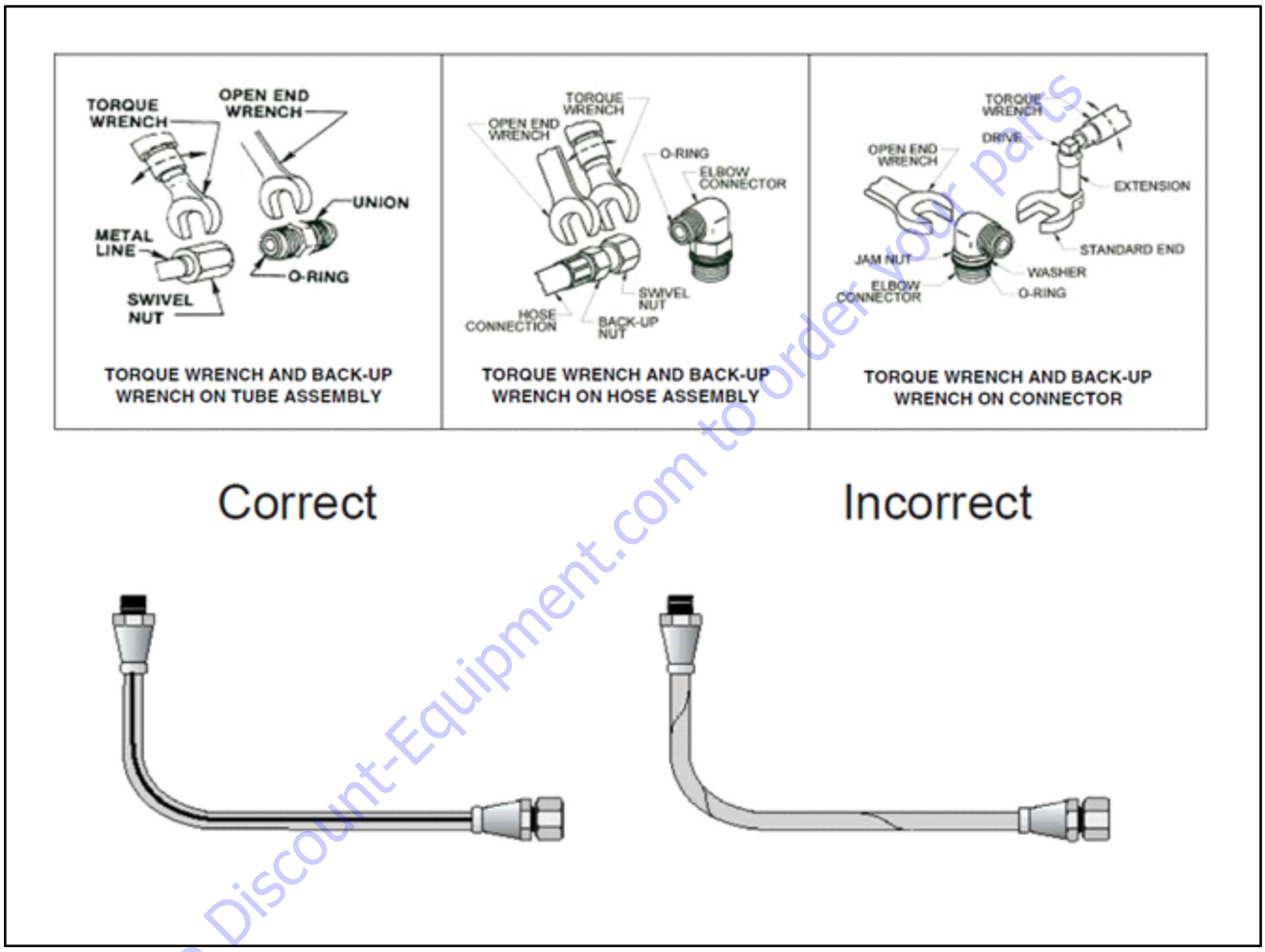


Figure 5-11. Double Wrench Method

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.

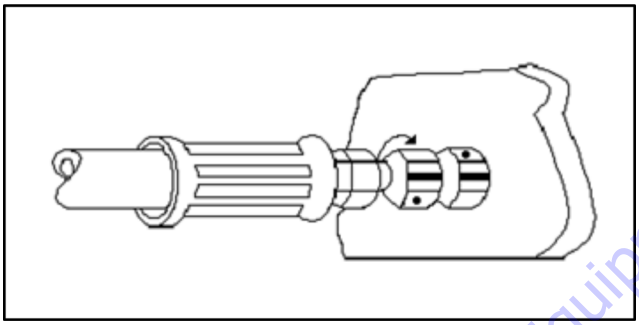


Figure 5-12. FFWR Method

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.

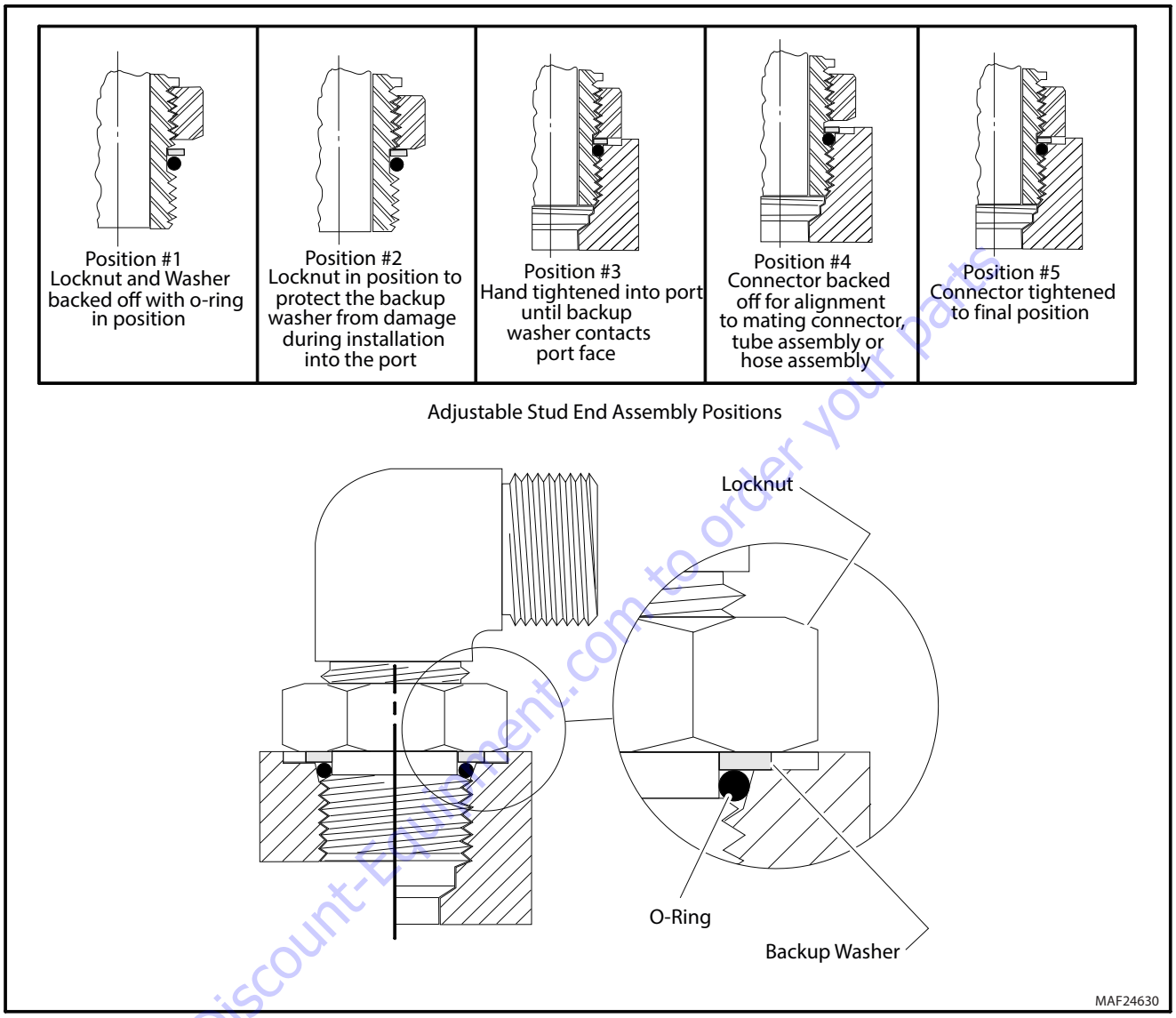


Figure 5-13. Adjustable Stud End Assembly

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 (US Market)

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

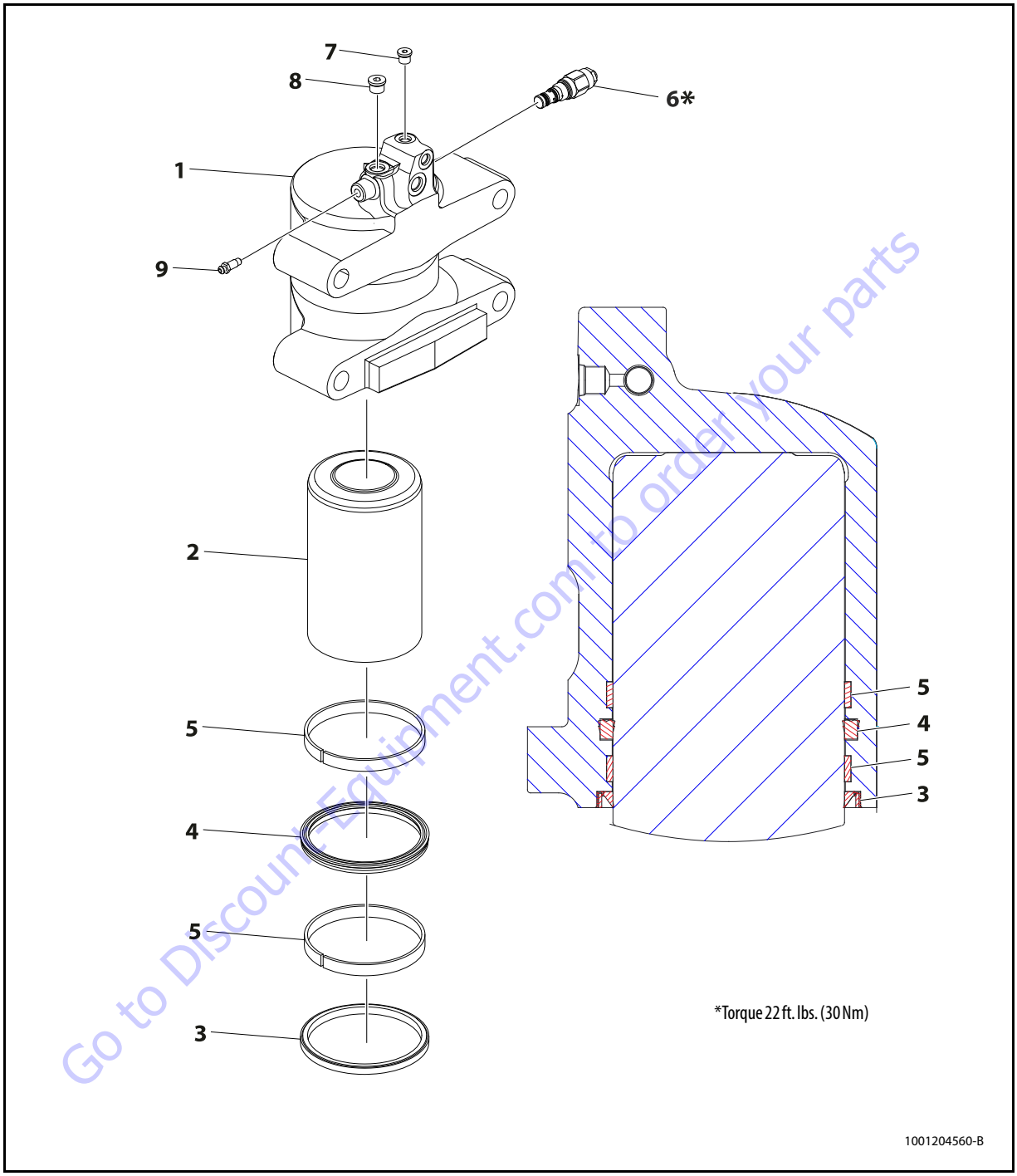
WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

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 (US Market)

Axle Lockout Cylinder (China Market)

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

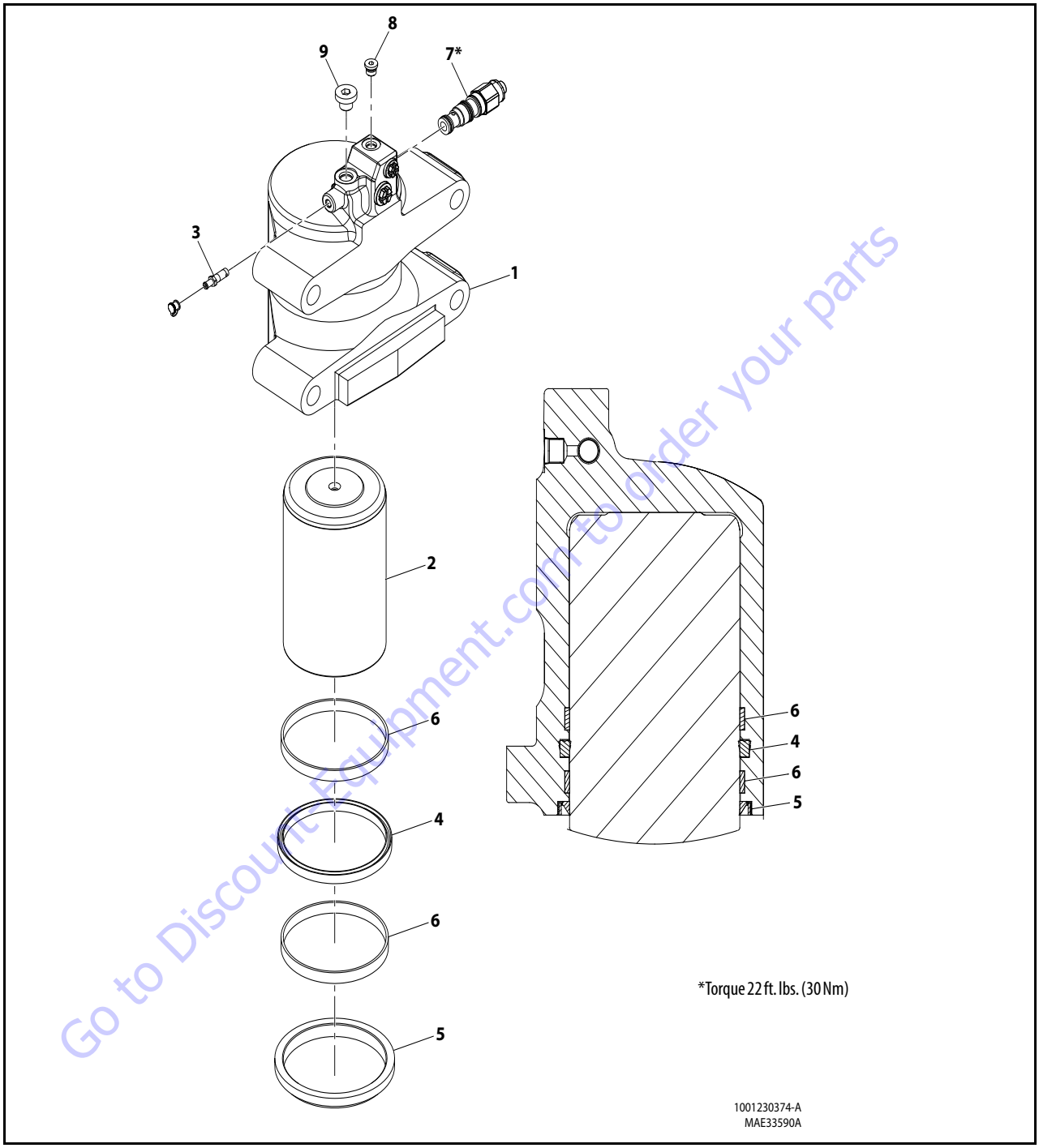
WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

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 (China Market)

Jib Lift Cylinder (860SJ US Market)

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.

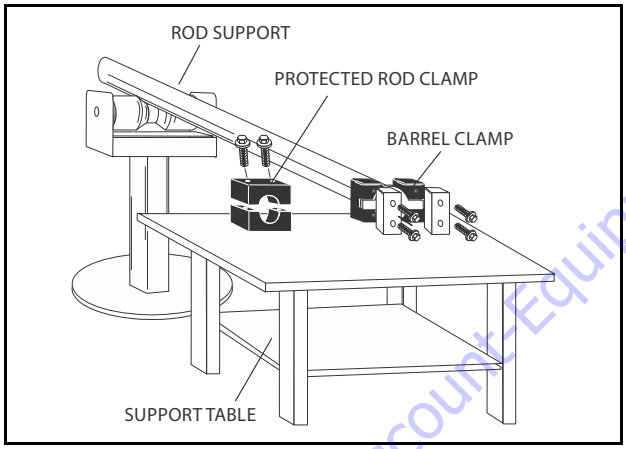


Figure 5-16. Cylinder Barrel Support

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.

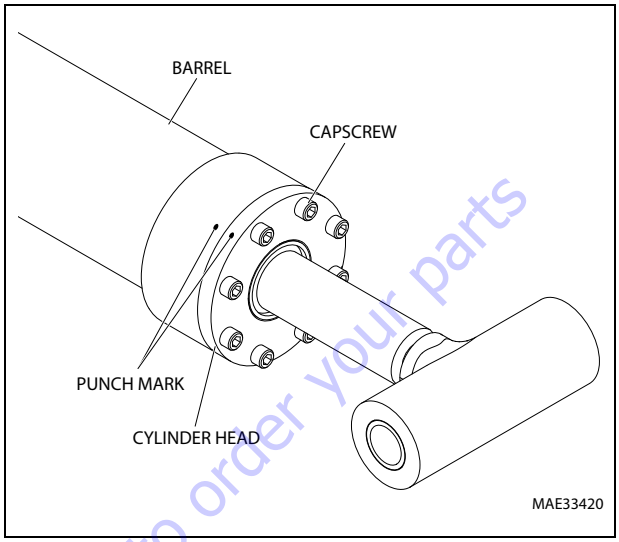


Figure 5-17. Capscrew Removal

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.

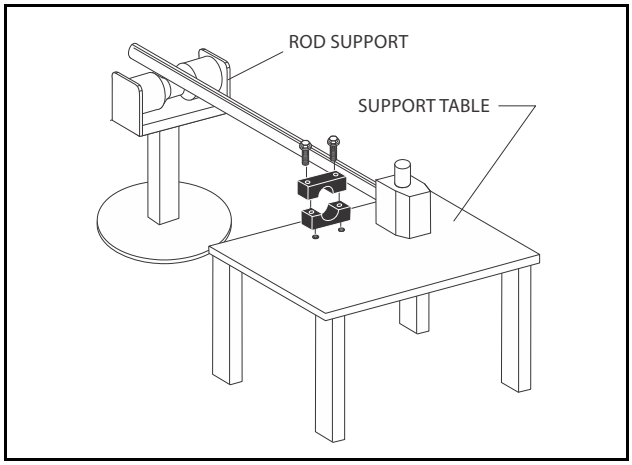
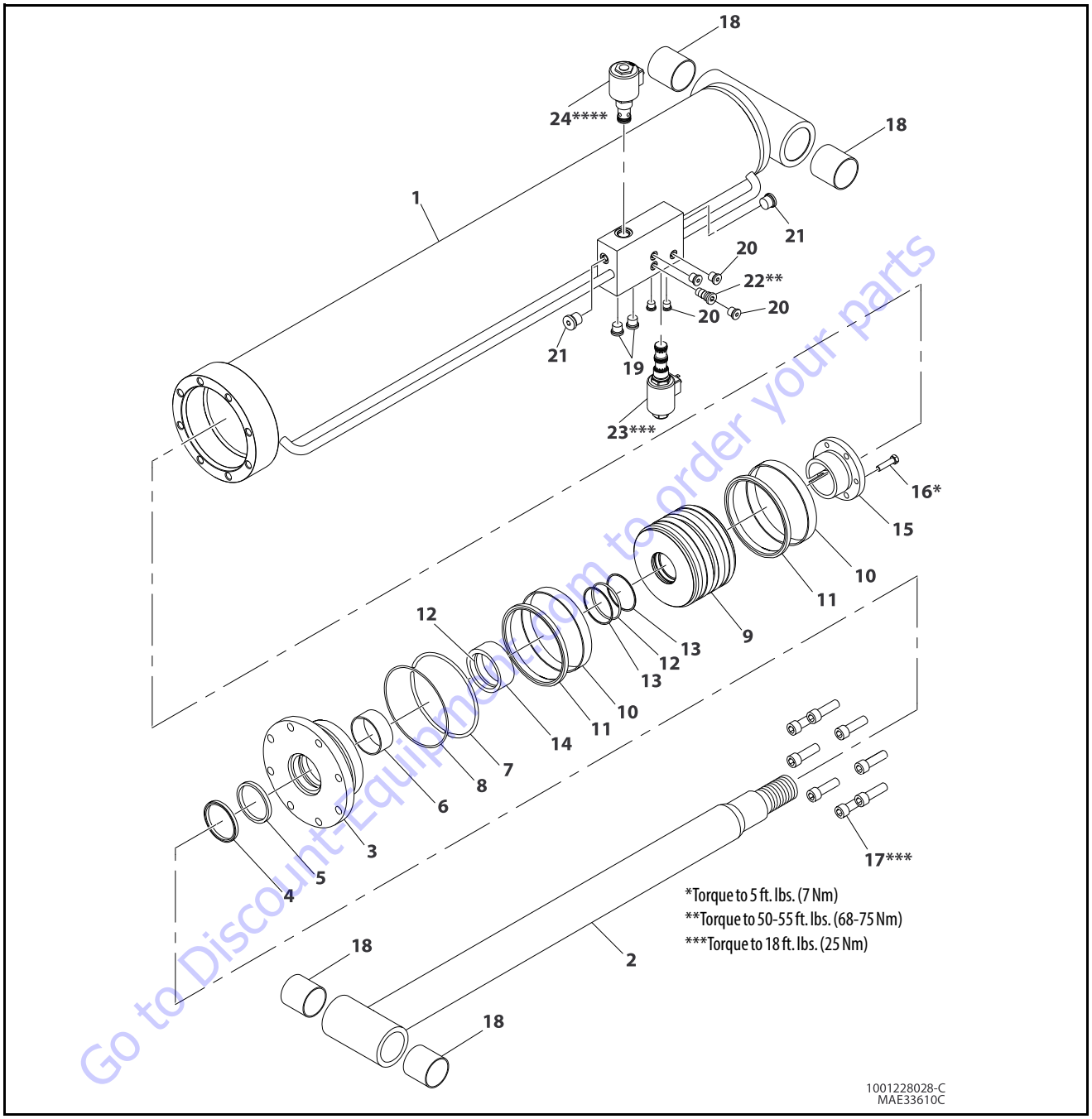


Figure 5-18. Cylinder Rod Support



1. Barrel
2. 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 5-19. Jib Lift Cylinder (860SJ US Market)

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.

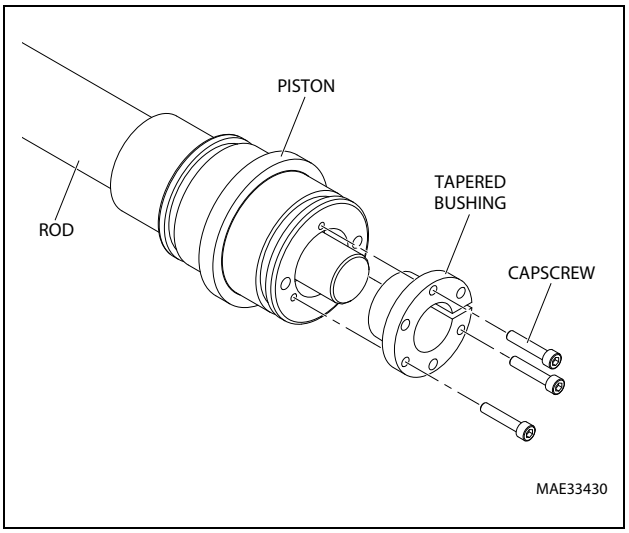


Figure 5-20. Tapered Bushing Removal

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.*

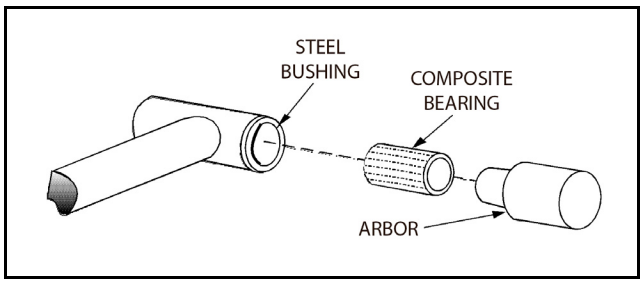


Figure 5-21. Composite Bearing Installation

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.

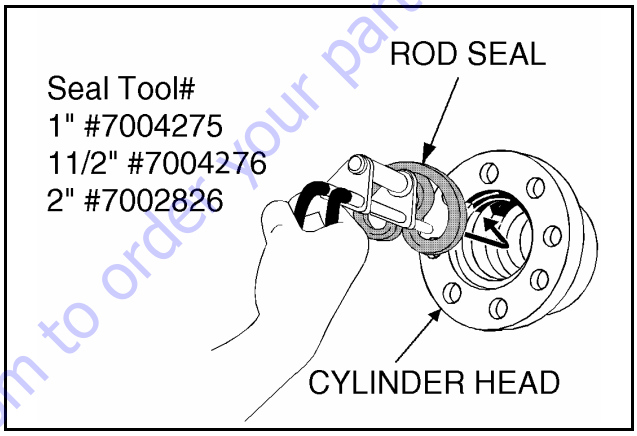


Figure 5-22. Rod Seal Installation

NOTICE

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

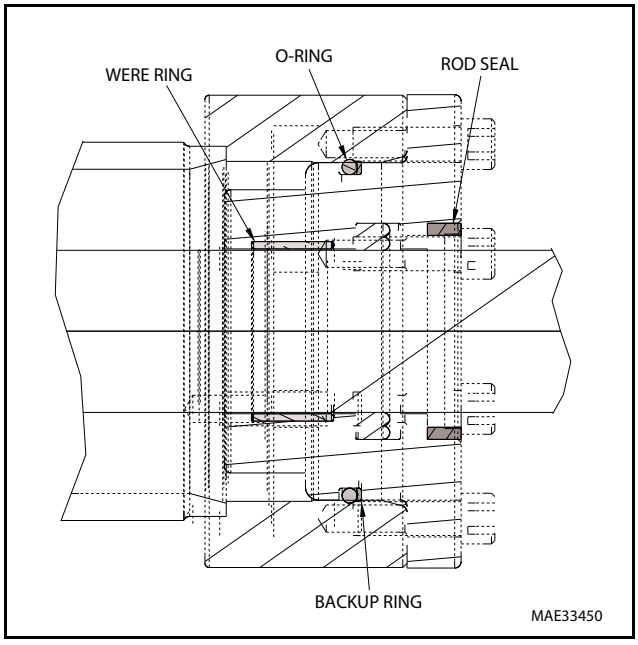


Figure 5-23. Cylinder Head Seal Installation

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.

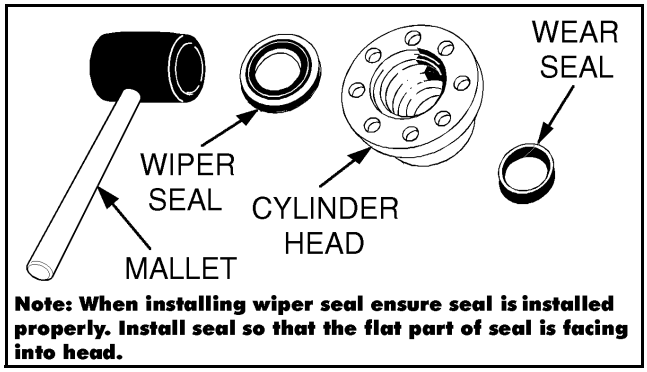


Figure 5-24. Wiper Seal Installation

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

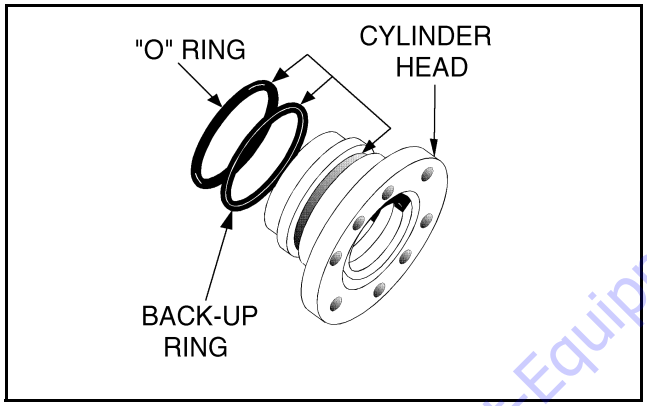


Figure 5-25. Installation of Head Seal Kit

4. 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.

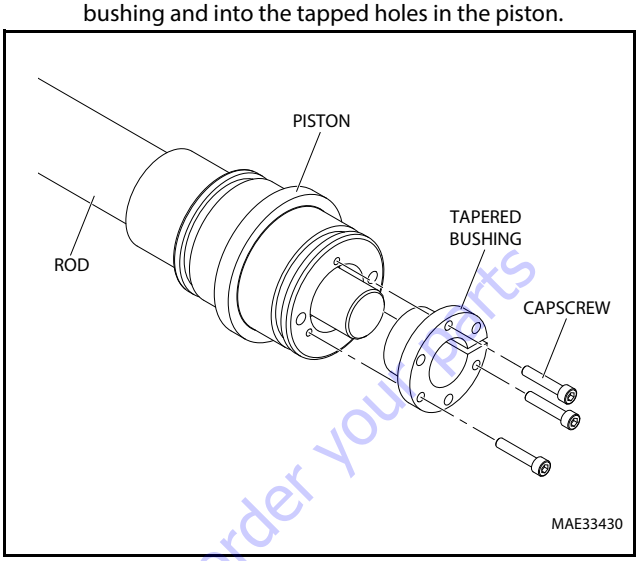


Figure 5-26. Tapered Bushing Installation

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.

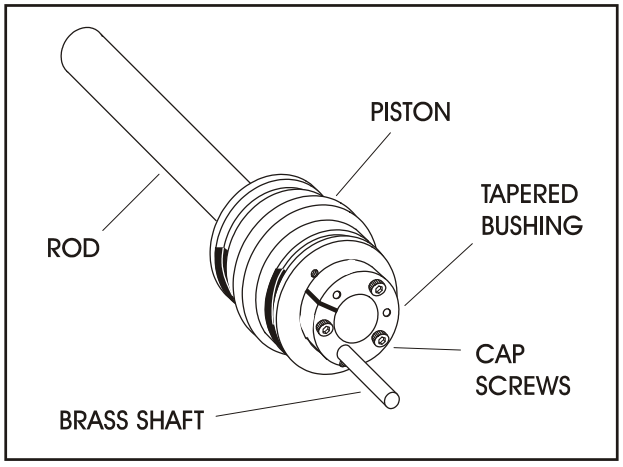


Figure 5-27. Seating the Tapered Bearing

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.

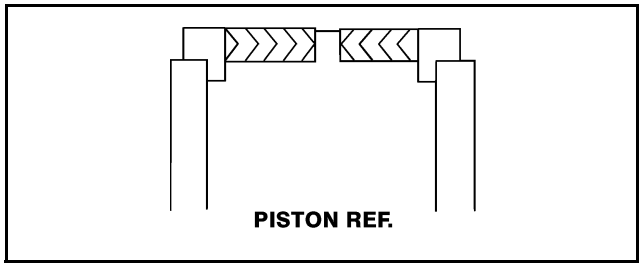


Figure 5-28. Hydrolock Piston Seal Installation

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).

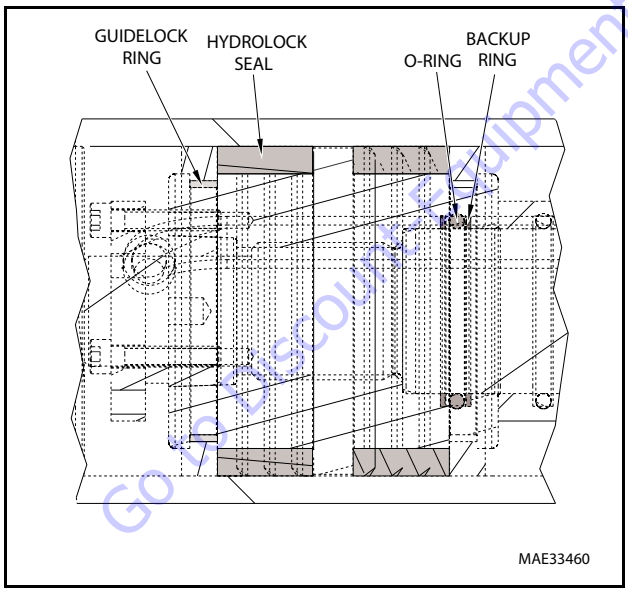


Figure 5-29. Piston Seal Kit Installation

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.

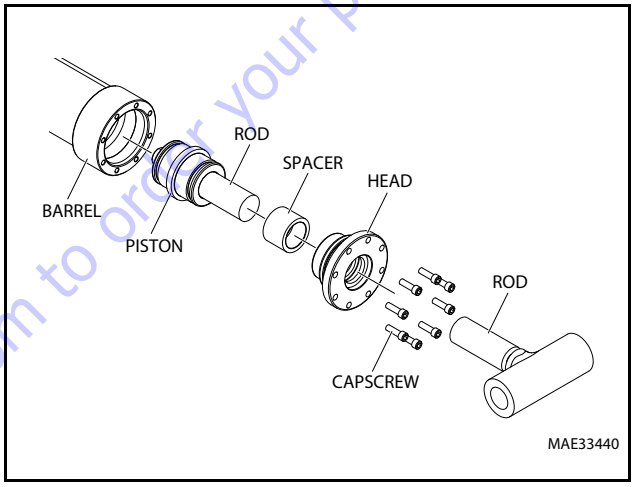


Figure 5-30. Rod Assembly Installation

19. 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).

Jib Lift Cylinder (860SJ China Market)

DISASSEMBLY

NOTICE

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

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

⚠ WARNING

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

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

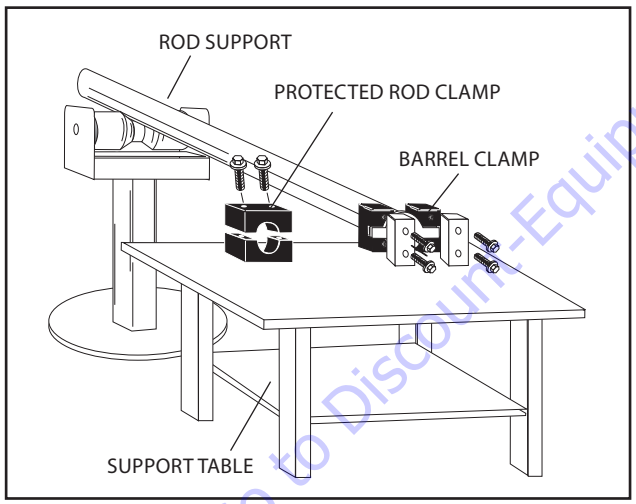


Figure 5-31. Cylinder Barrel Support

5. Unscrew cylinder head (4) with pin-face spanner wrench.

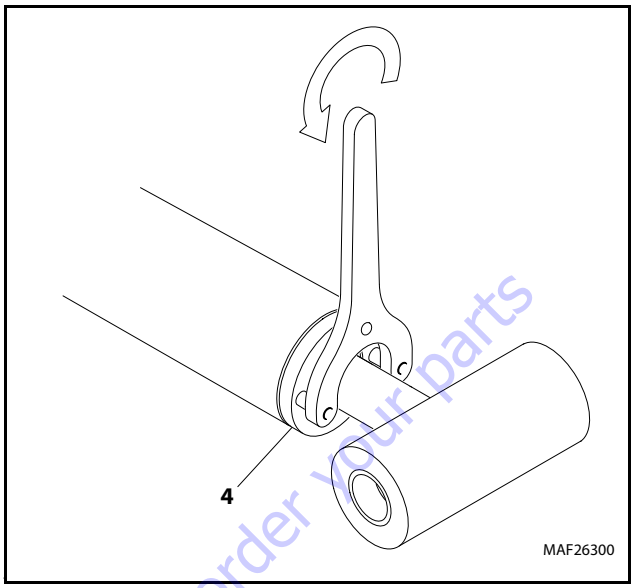


Figure 5-32. Cylinder Head Removal

NOTICE

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

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

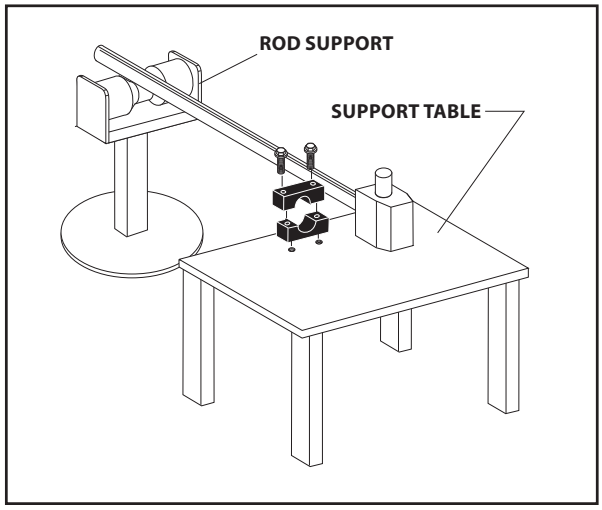
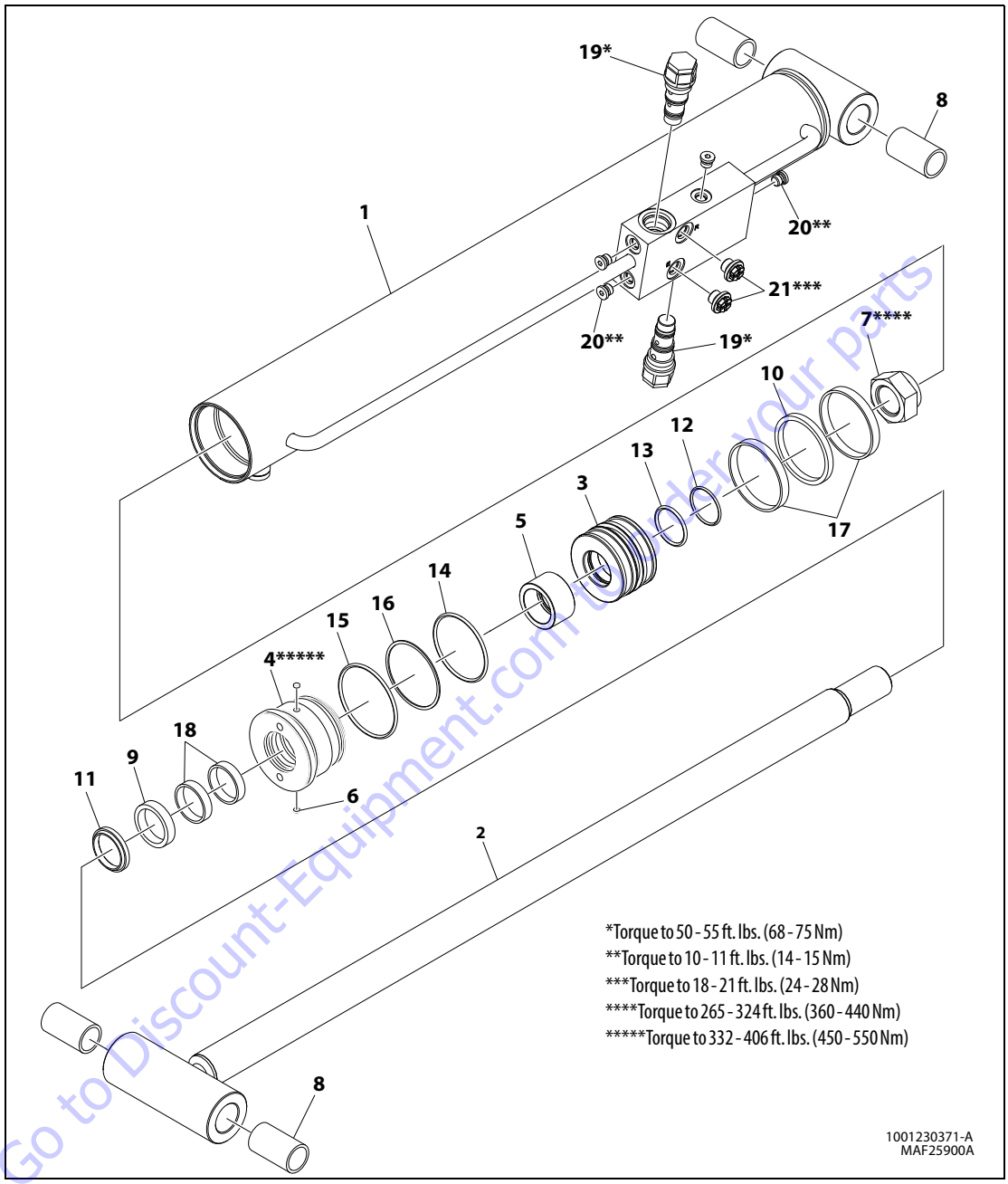


Figure 5-33. Cylinder Rod Support



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

Figure 5-34. Jib Lift Cylinder (860SJ China Market)

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 rod.

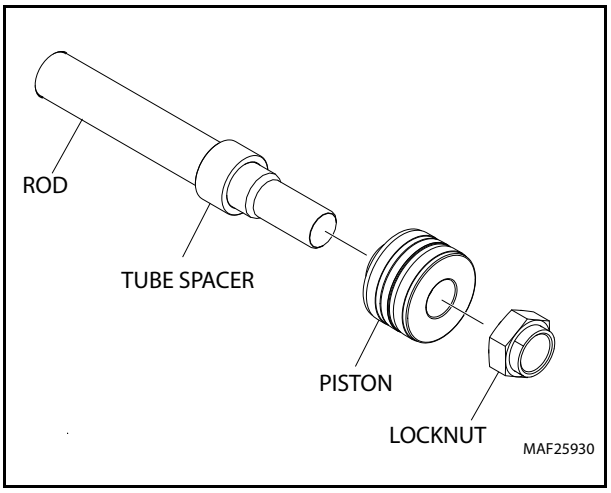


Figure 5-35. Piston Removal

10. Screw the piston counterclockwise by hand and remove the piston from cylinder rod.

11. Remove and discard the piston o-rings, piston seal and wear rings from piston.

NOTICE

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

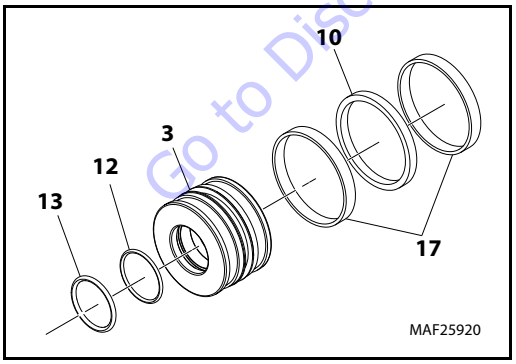


Figure 5-36. Piston Disassembly

12. Remove rod from holding fixture.

13. Remove insert locks from cylinder head.

14. Remove cylinder head from rod.

15. Remove and discard o-ring, backup ring, and o-ring from cylinder head.

16. Remove and discard wiper, rod seal and wear rings from cylinder head.

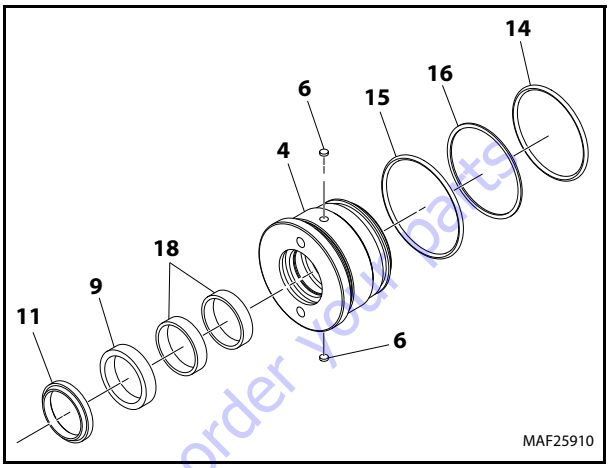


Figure 5-37. Cylinder Head Disassembly

CLEANING AND INSPECTION

1. Clean parts thoroughly with approved cleaning solvent.

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

3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.

4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.

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

6. Inspect piston surface for damage, scoring, or distortion. Dress piston surface or replace piston as necessary.

7. Inspect threaded portion of piston for damage. Dress threads as necessary.

8. Inspect seal and O-ring grooves in piston for burrs and sharp edges. Dress surfaces as necessary.

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

10. Inspect threaded portion of head for damage. Dress threads as necessary.

11. Inspect seal and O-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.

12. Inspect cylinder head outside diameter for scoring, damage, ovality, and tapering. Replace as necessary.

13. f applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of the steel bushing with WD40 prior to bearing installation.

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

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

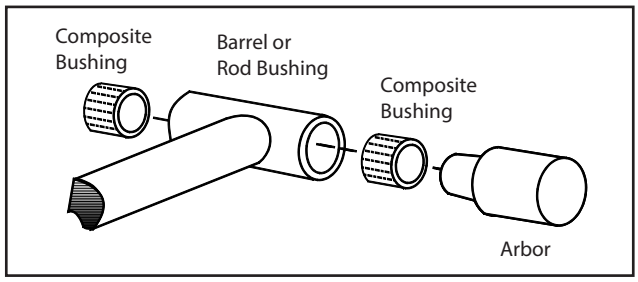


Figure 5-38. Composite Bushing Installation

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

ASSEMBLY

NOTICE

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

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

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

1. Support rod in holding fixture.
2. Install wiper, rod seal and wear rings in inner diameter grooves of cylinder head.
3. Install o-ring, backup ring and o-ring on outer diameter of cylinder head.
4. Slide cylinder head assembly on rod to rod end. Do not dislodge or damage seals.
5. Install insert locks on cylinder head.

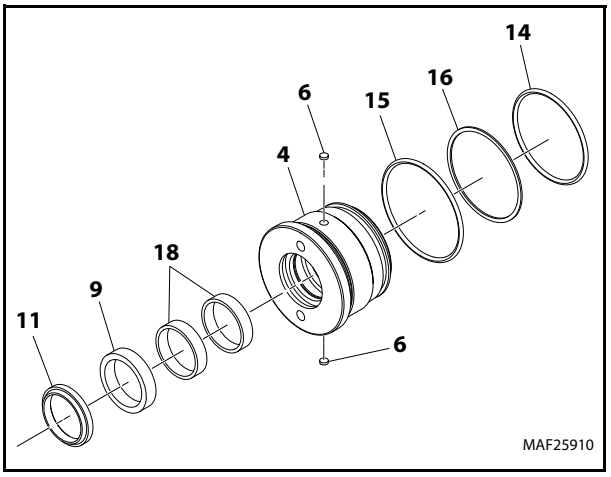


Figure 5-39. Cylinder Head Assembly

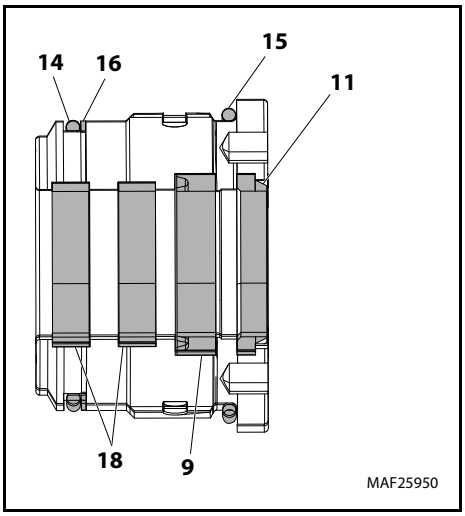


Figure 5-40. Head Seal Kit Installation

6. Install piston o-rings in inner diameter grooves of piston. Install piston seal and wear rings on outer diameter of piston.

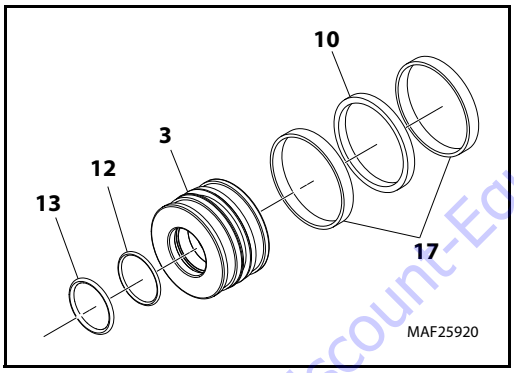


Figure 5-41. Piston Assembly

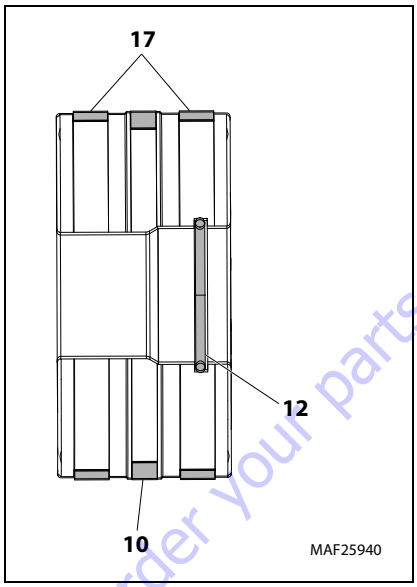


Figure 5-42. Piston Seal Kit Installation

7. Carefully slide the piston spacer on the rod.
8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
9. Carefully thread the piston on the cylinder rod and hand tight.
10. Install locknut onto the piston rod. Torque locknut to 265-324 ft. lbs. (360-440 Nm).

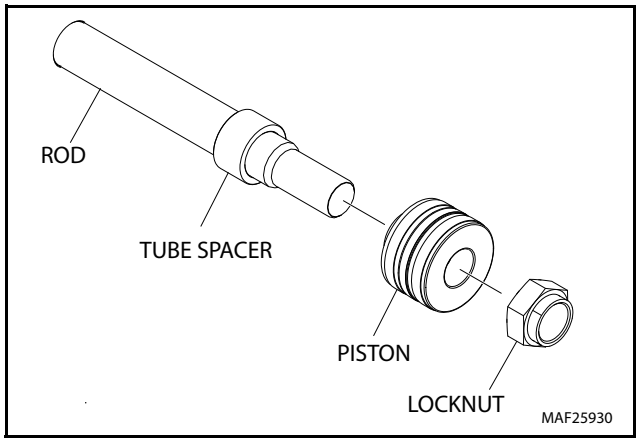


Figure 5-43. Piston Installation

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.

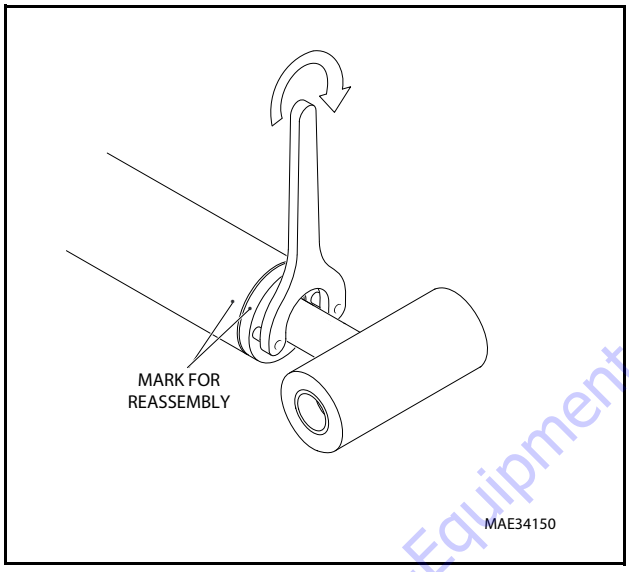


Figure 5-44. Cylinder Head Installation

13. Screw the cylinder head into the barrel using a pin-face spanner wrench and torque cylinder head to 332-406 ft. lbs. (450-550 Nm).

14. 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.

15. Install the new o-rings and plugs into the cylinder port block. Install the counterbalance valves in the rod port block and torque to 50-55 ft. lbs. (68-75 Nm) as shown in Figure 5-34.

Main Boom Lift Cylinder (800S)

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.

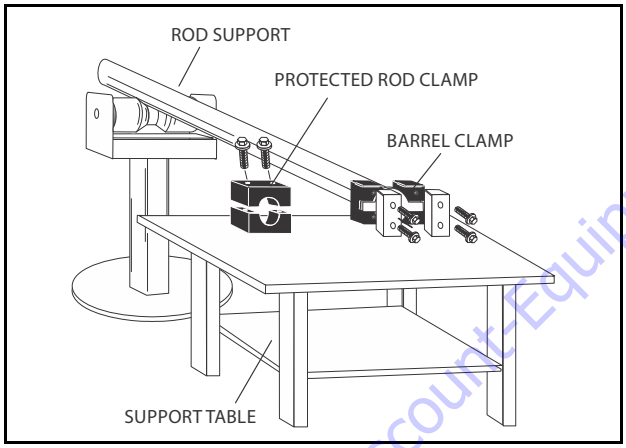


Figure 5-45. Cylinder Barrel Support

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.

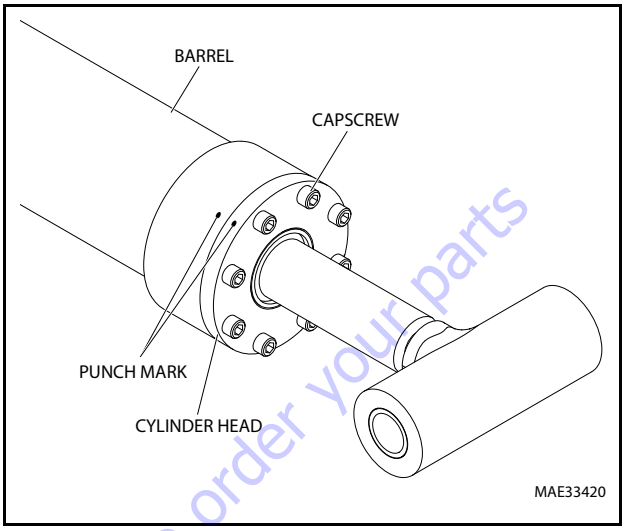


Figure 5-46. Capscrew Removal

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.

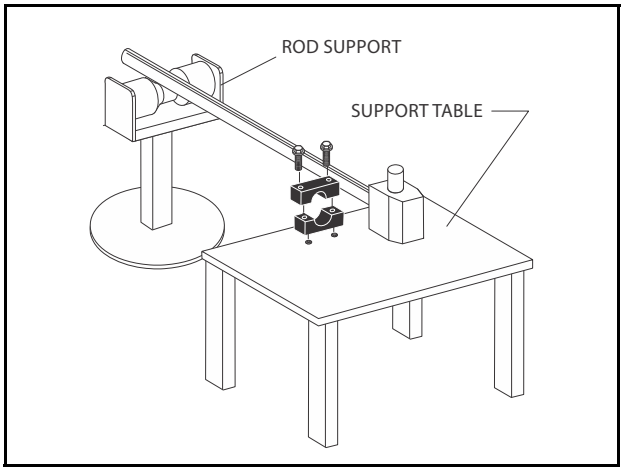
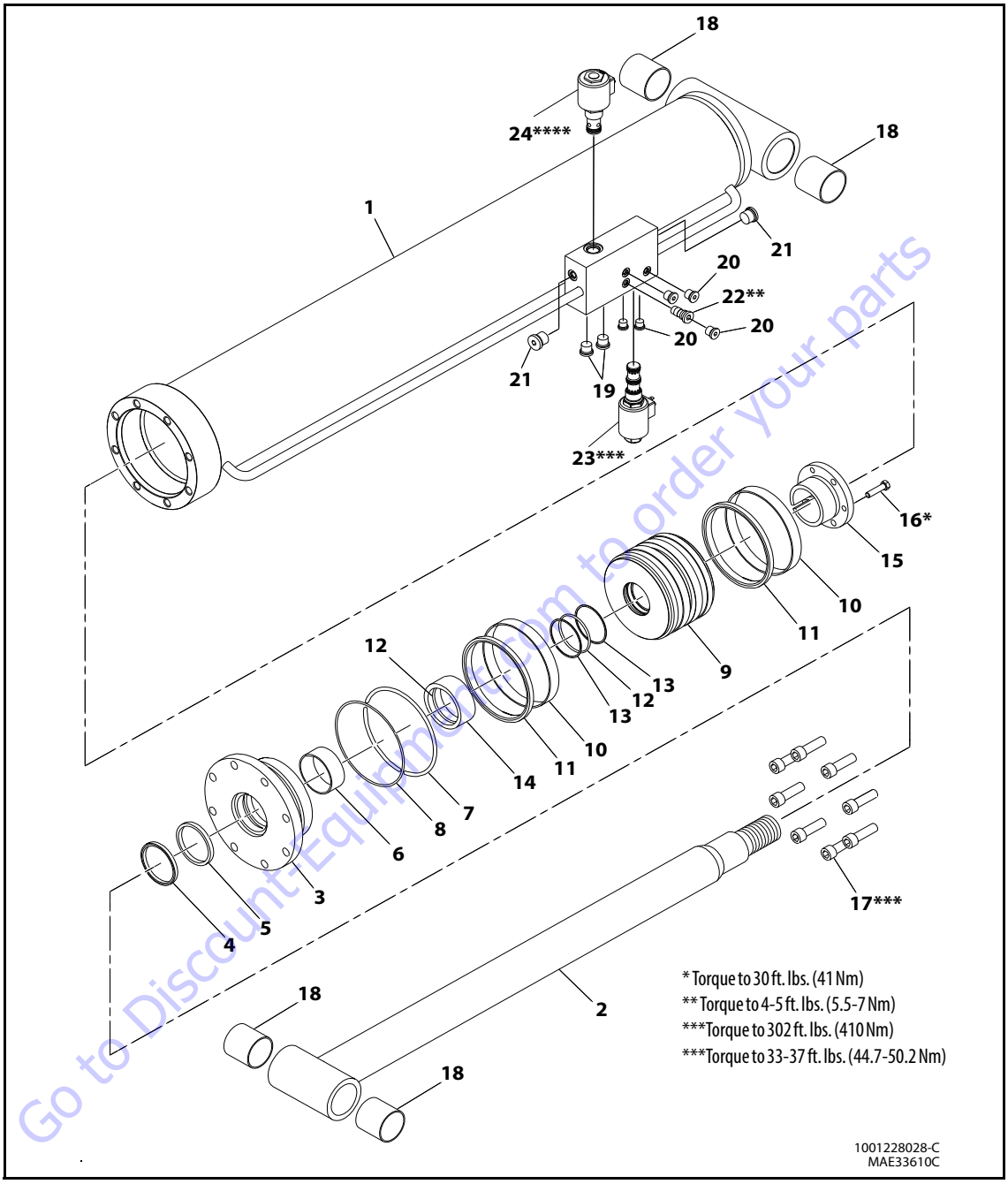


Figure 5-47. Cylinder Rod Support



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. Cartridge, Relief Valve
23. Cartridge, Lift Holding Solenoid
24. Cartridge, Lift Relief Proportional Solenoid

Figure 5-48. Main Boom Lift Cylinder (800S)

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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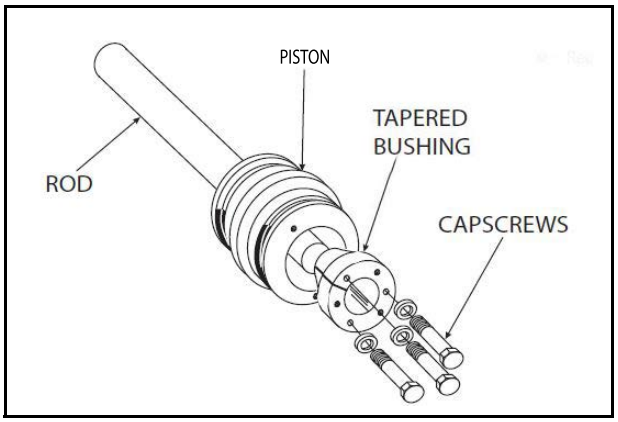


Figure 5-49. Tapered Bushing Removal

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.*

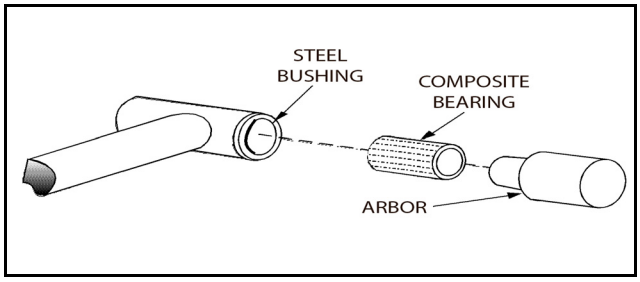


Figure 5-50. Composite Bearing Installation

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.

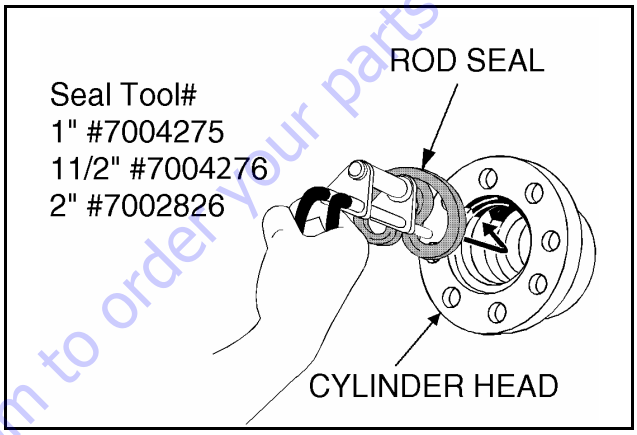


Figure 5-51. Rod Seal Installation

NOTICE

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

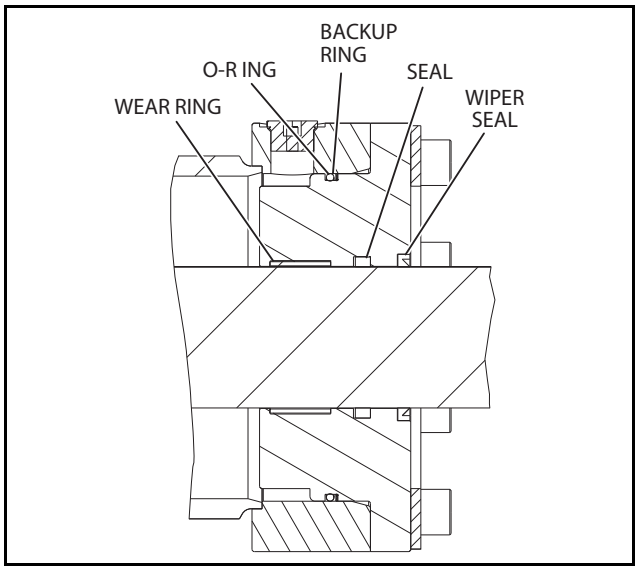


Figure 5-52. Cylinder Head Seal Installation

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.

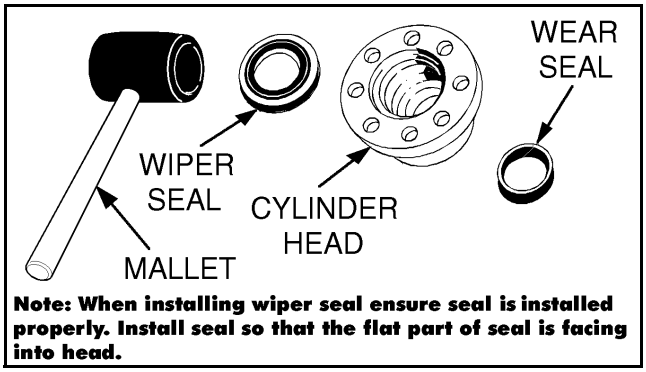


Figure 5-53. Wiper Seal Installation

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

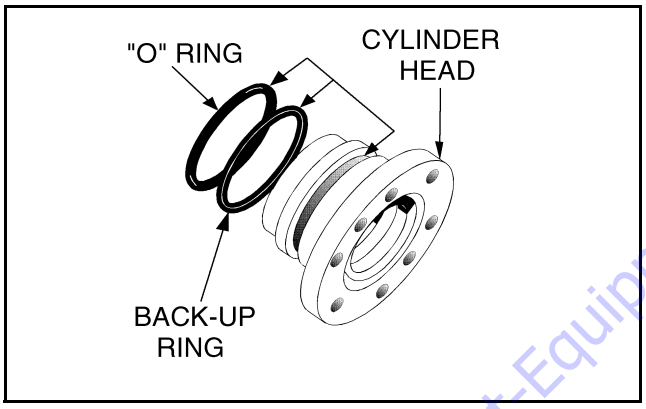


Figure 5-54. Installation of Head Seal Kit

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.

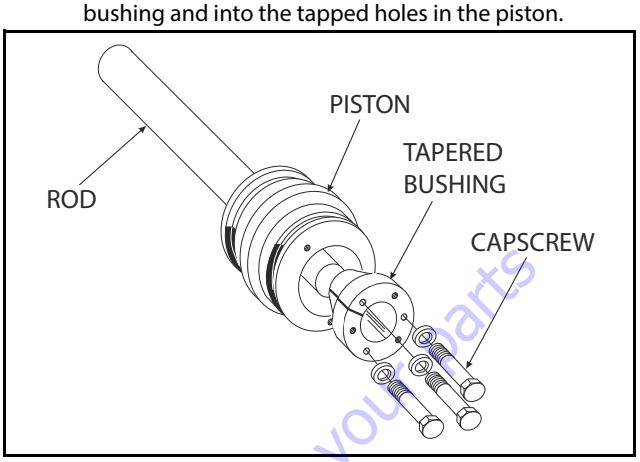


Figure 5-55. Tapered Bushing Installation

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.

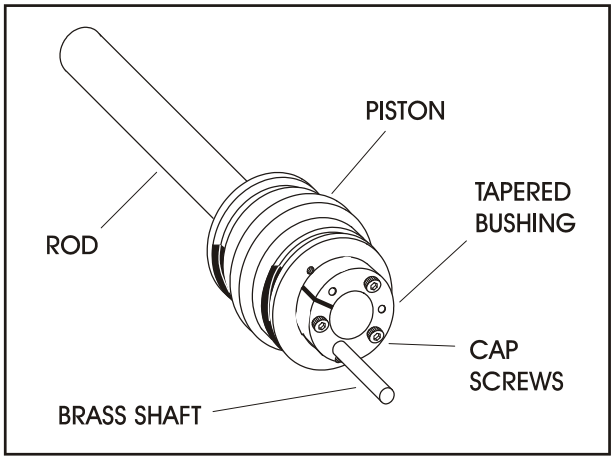


Figure 5-56. Seating the Tapered Bearing

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).

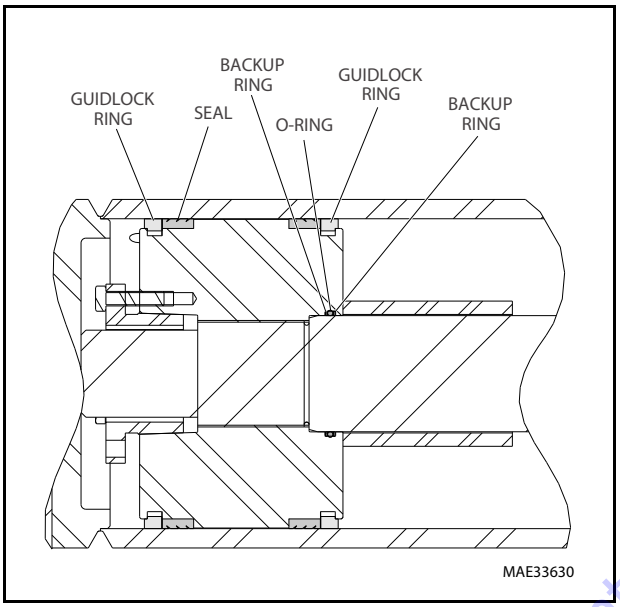


Figure 5-57. Piston Seal Kit Installation

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.

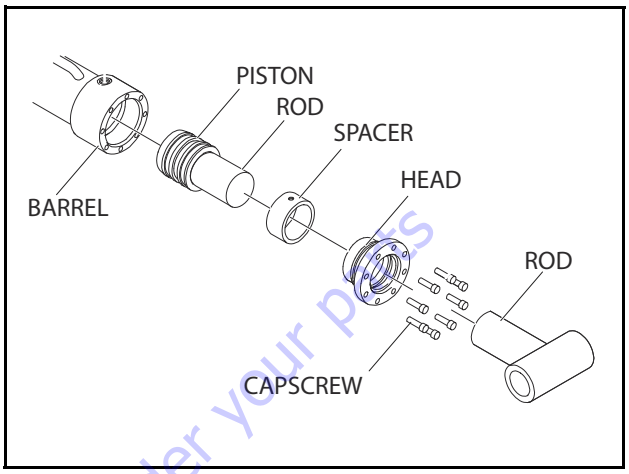


Figure 5-58. Rod Assembly Installation

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 5-48., Main Boom Lift Cylinder (800S). 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 US Market)

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.

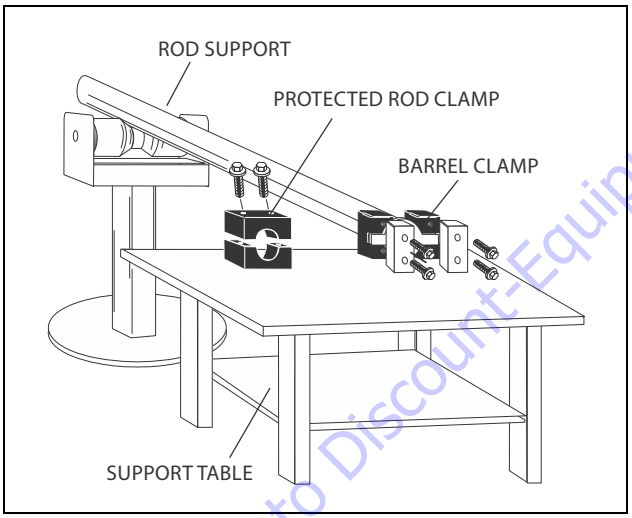


Figure 5-59. Cylinder Barrel Support

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

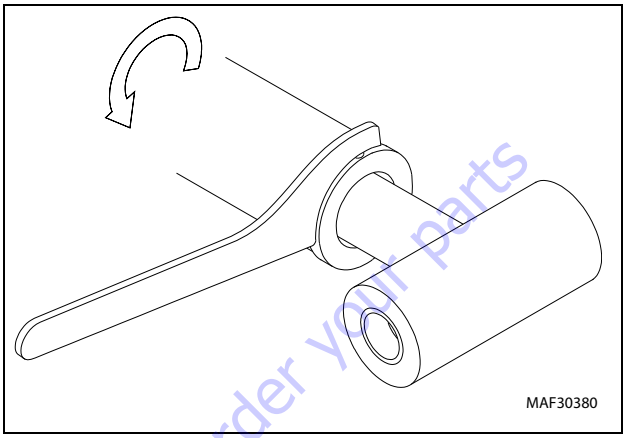


Figure 5-60. Cylinder Head Removal

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.

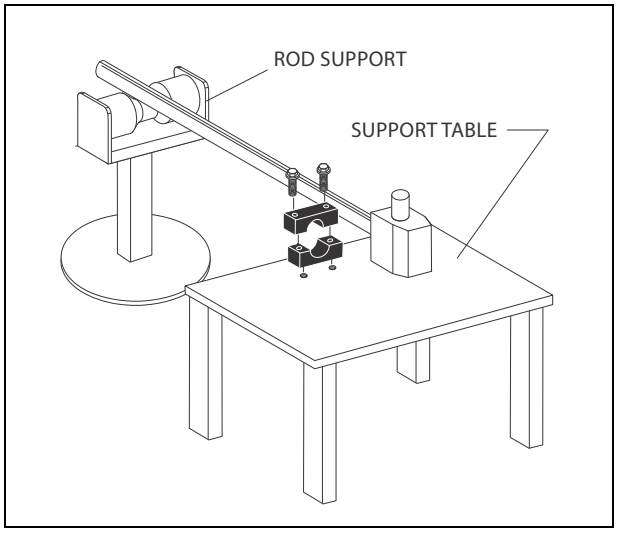
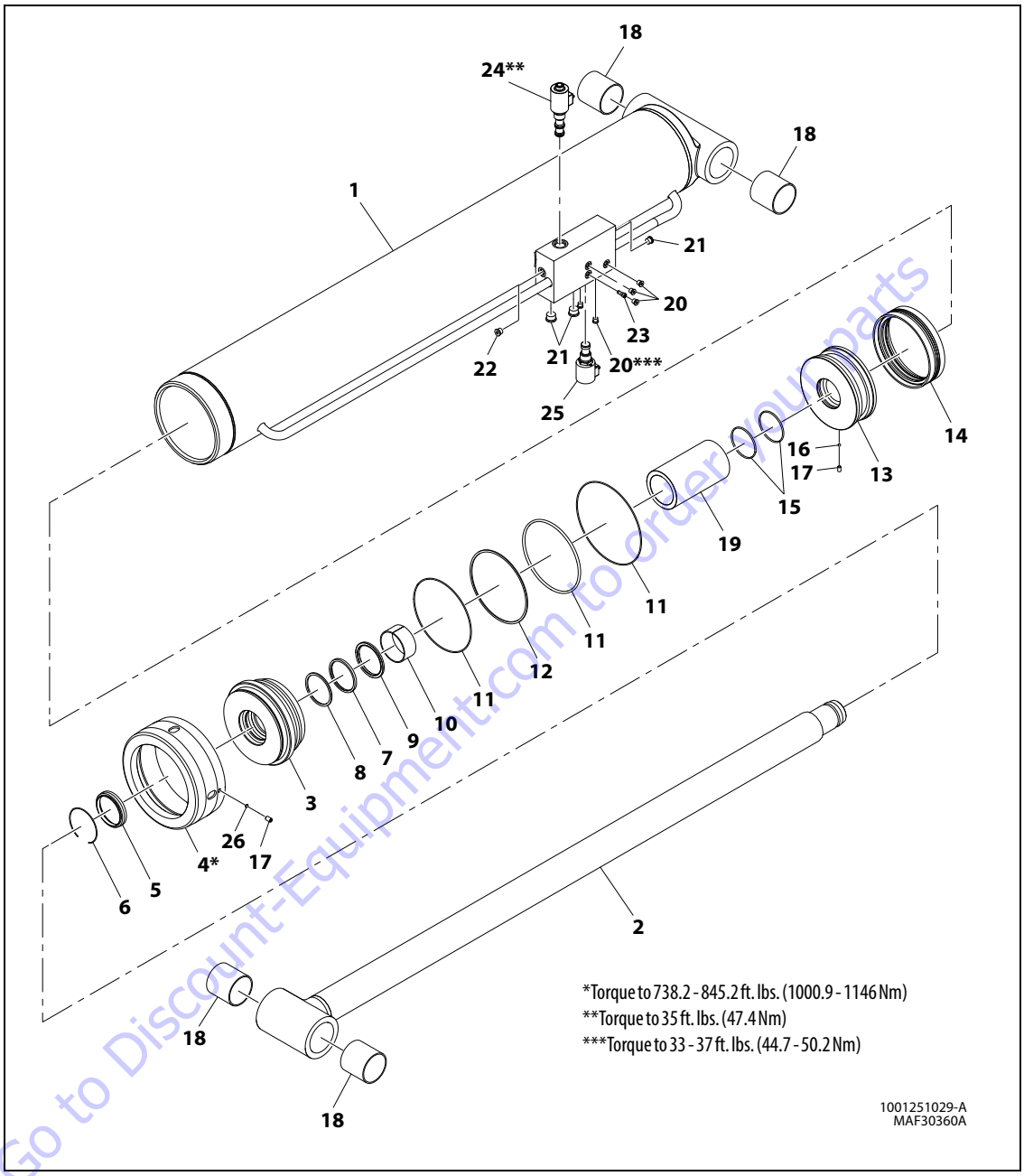


Figure 5-61. Cylinder Rod Support



1. Barrel
2. Rod
3. Head
4. Tube Spacer
5. Wiper
6. Retaining Ring
7. Rod Seal
8. Backup ring
9. Buffer ring
10. Bearing Ring
11. O-ring
12. Backup Ring
13. Piston
14. Piston Seal
15. O-ring
16. Steel Ball
17. Set Screw
18. Bushing
19. Spacer
20. Plug
21. Plug
22. Plug
23. Relief Valve
24. Proportional Valve
25. Poppet valve
26. Locking Insert

Figure 5-62. Main Boom Lift Cylinder (860SJ US Market)

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

9. Loosen and remove the setscrew and steel ball which attaches the piston to the rod.

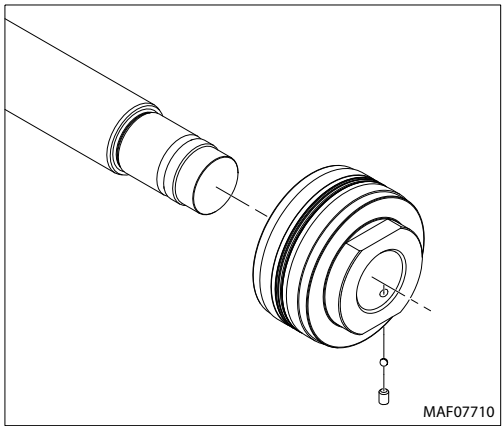


Figure 5-63. Piston Removal

10. Screw the piston counterclockwise and remove the piston from cylinder rod.

NOTICE

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

11. Remove and discard the piston seal from outside grooves of piston.

12. Remove and discard the o-rings from inside groove of the piston.

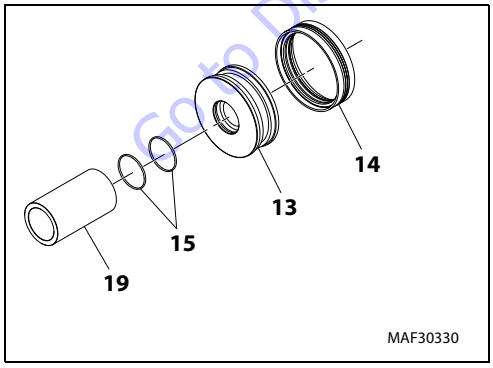


Figure 5-64. Piston Seal Disassembly

13. Remove piston spacer from the rod.

14. Remove the rod from the holding fixture. Remove the cylinder head gland.

15. Remove and discard Retaining ring, rod seal, wiper, backup ring, buffer ring and Bearing ring from inside groove of the head.

16. Remove and discard o-ring and backup ring from outside groove of the head.

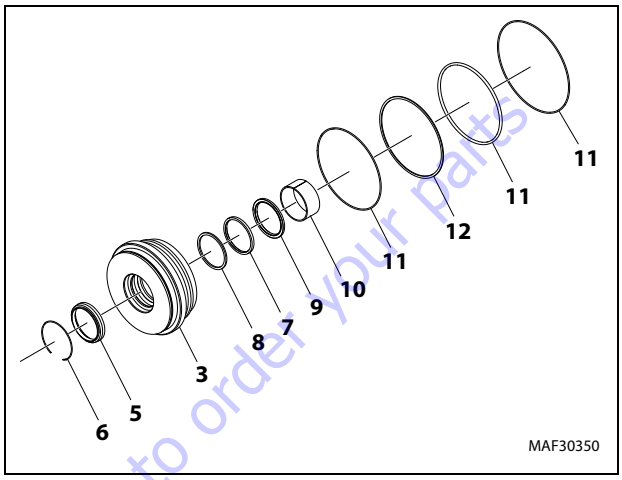


Figure 5-65. Cylinder Head Disassembly

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.*

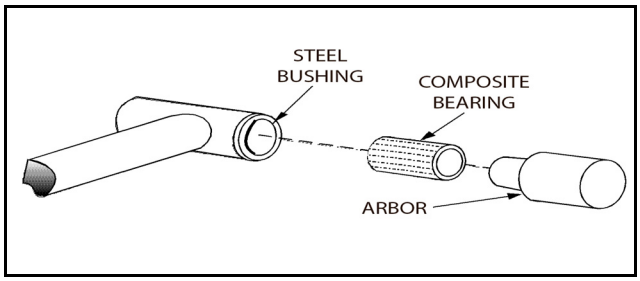


Figure 5-66. Composite Bearing Installation

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.*

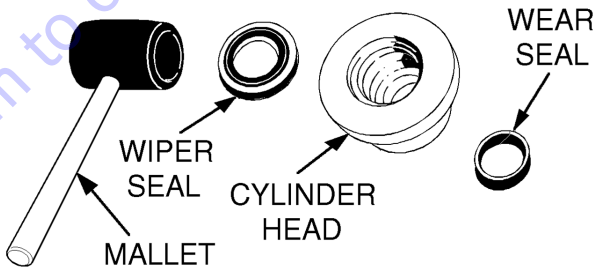
NOTE: *Apply a light film of hydraulic oil to all components prior to assembly.*

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

NOTICE

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

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.



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

Figure 5-67. Wiper Seal Installation

3. Install backup ring and o-ring in outside groove of the cylinder head.
4. Install Retaining ring, Rod seal, Wiper, Backup ring, Buffer ring and Bearing ring in inside groove of the head.

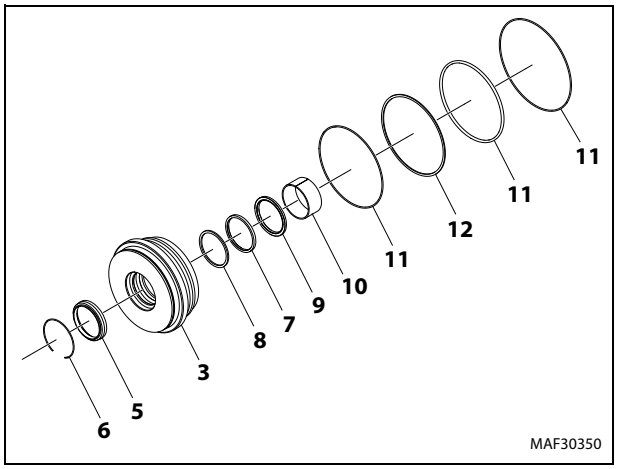


Figure 5-68. Cylinder Head Assembly

5. 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.
6. Carefully slide the piston spacer on the rod.
7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
8. Install new o-ring in inside groove of the piston.
9. Install setscrew and steel ball on the piston and attach the piston on the rod.

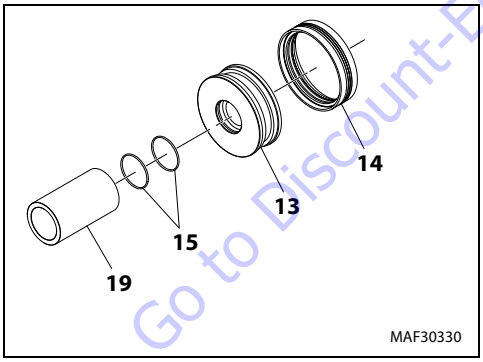


Figure 5-69. Piston Seal Installation

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

NOTICE

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

13. With barrel clamped 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.
14. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

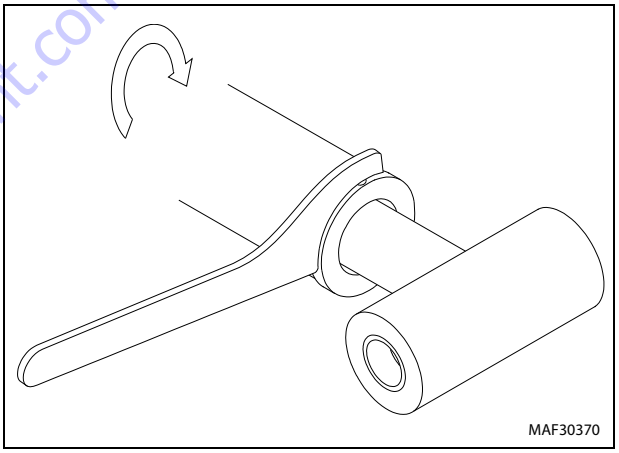


Figure 5-70. Cylinder Head Tightening

15. Screw the cylinder head into the barrel using a hook-spanner wrench and torque cylinder head to 738.2 - 845.2 ft. lbs. (1000.9 - 1146 Nm).
16. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.
17. Install the new o-rings and plugs into the cylinder portblock and torque plug as shown in Figure 5-62., Main Boom Lift Cylinder (860SJ US Market).
18. Install the Proportional valve, Poppet valve, Relief valve and plugs, using new o-rings as applicable.

Main Boom Lift Cylinder (860SJ China Market)

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.

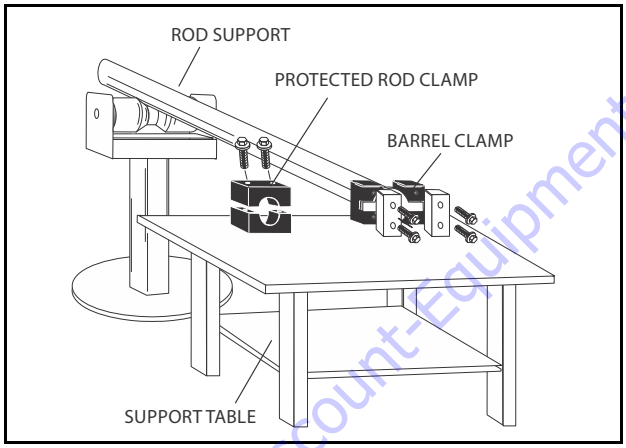


Figure 5-71. Cylinder Barrel Support

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.

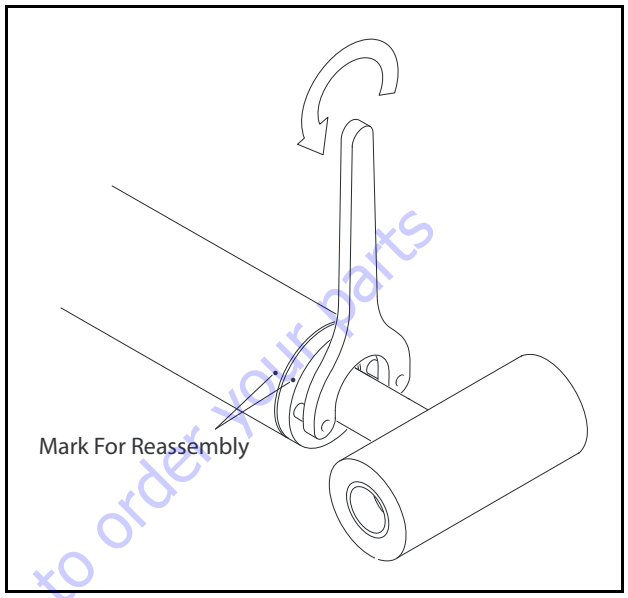


Figure 5-72. Cylinder Head Removal

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.

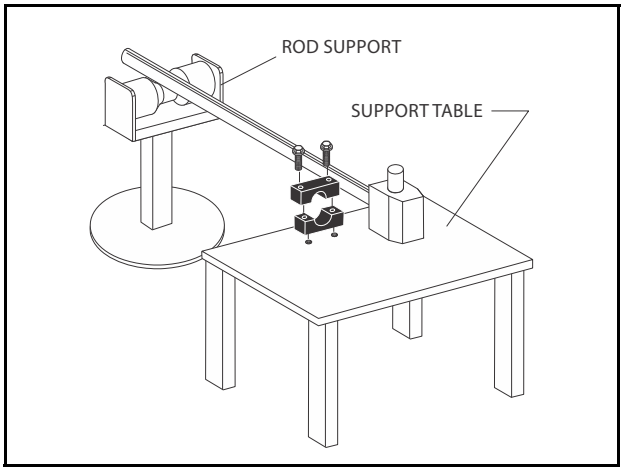
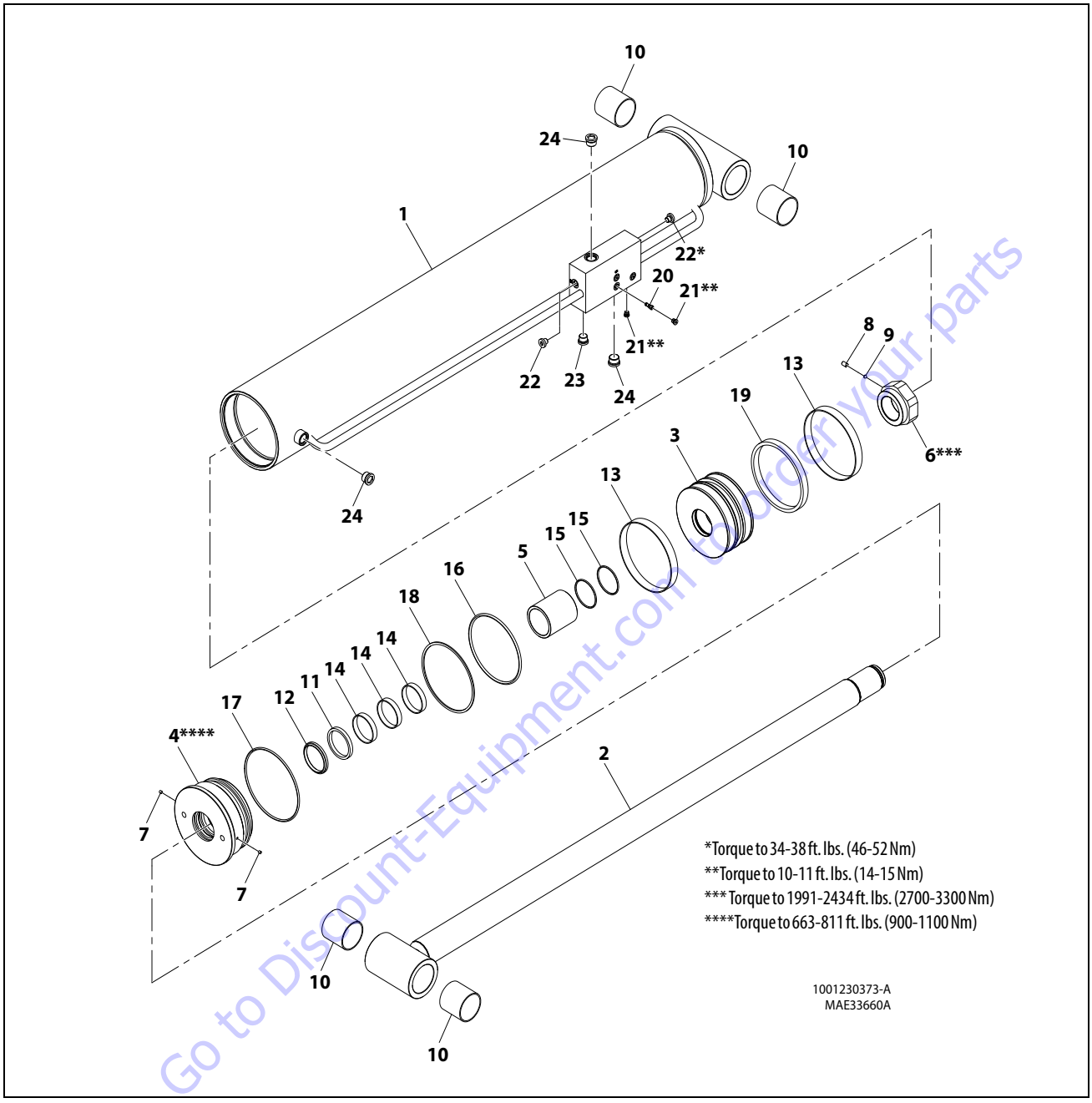


Figure 5-73. Cylinder Rod Support



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 5-74. Main Boom Lift Cylinder (860SJ China Market)

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.

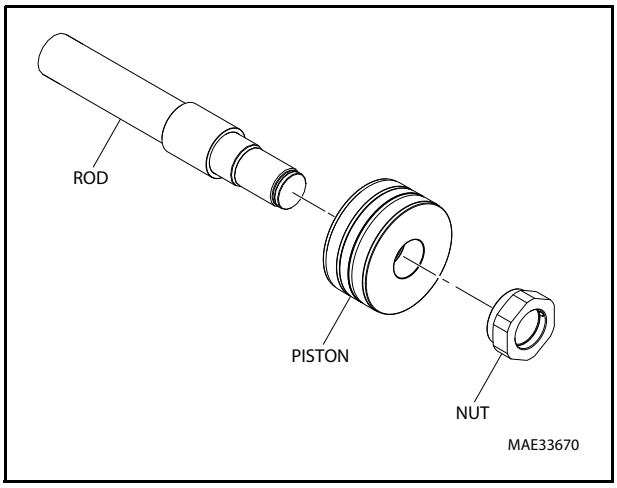


Figure 5-75. Piston Removal

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.*

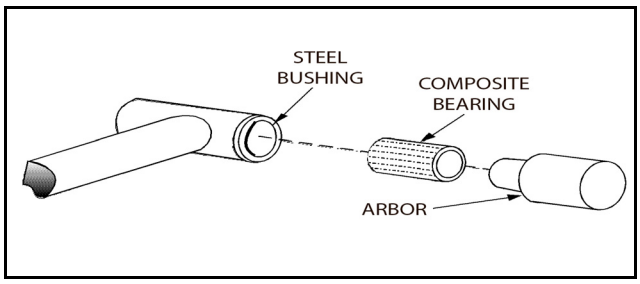


Figure 5-76. Composite Bearing Installation

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.

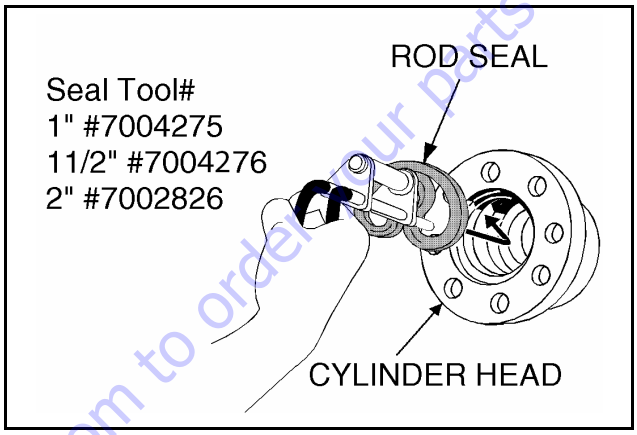


Figure 5-77. Rod Seal Installation

NOTICE

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

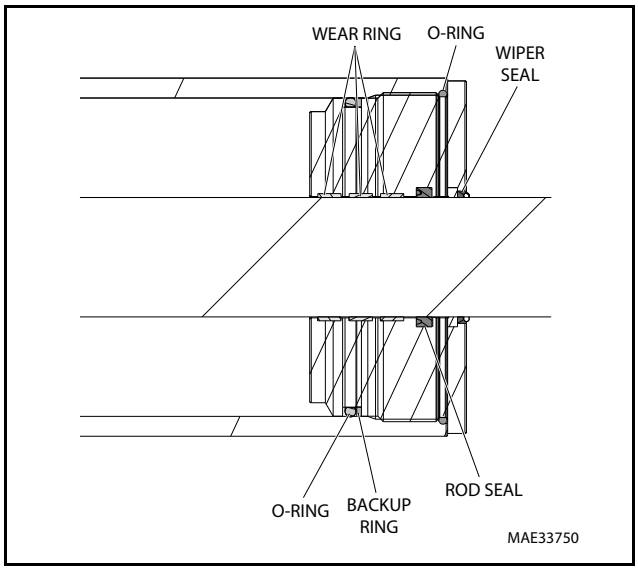


Figure 5-78. Cylinder Head Seal Installation

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.

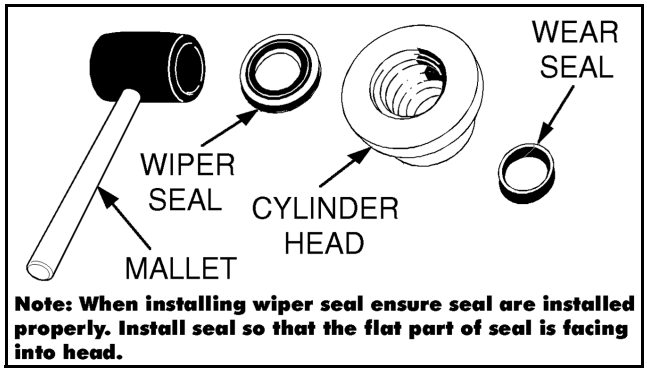


Figure 5-79. Wiper Seal Installation

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

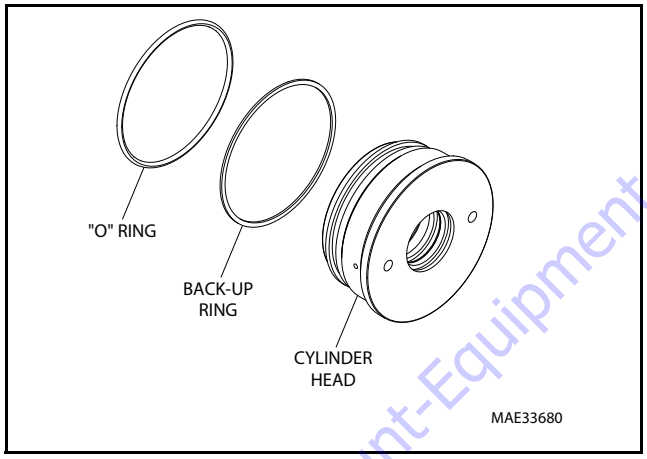


Figure 5-80. Installation of Head Seal Kit

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).

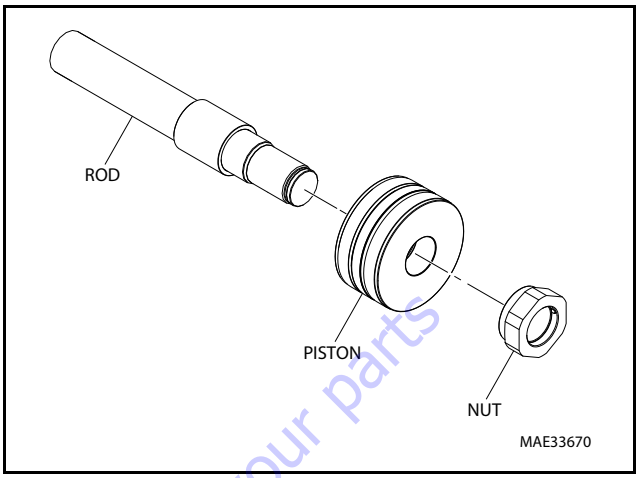


Figure 5-81. Piston Installation

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).

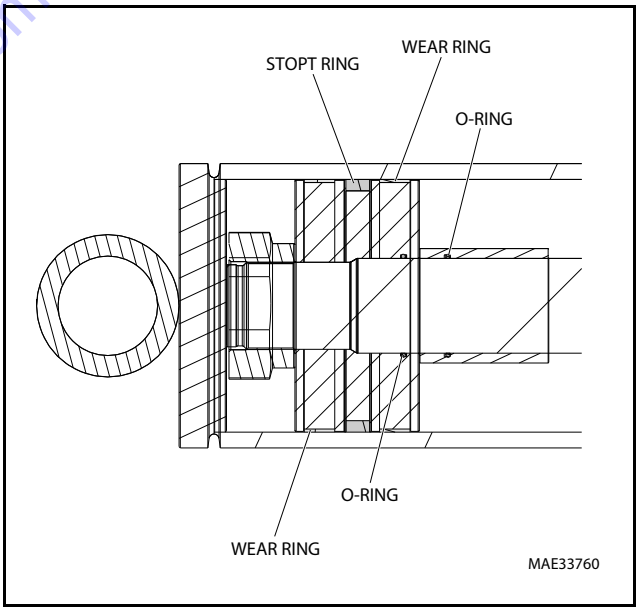


Figure 5-82. Piston Seal Kit Installation

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.

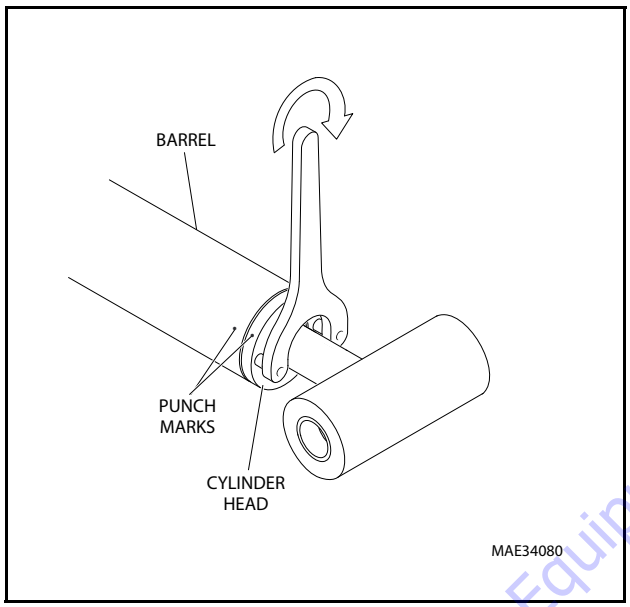


Figure 5-83. Cylinder Head Installation

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 5-74., Main Boom Lift Cylinder (860SJ China Market).
17. Install the proportional valve, lift holding valve, relief valve, check valve and plugs, using new O-rings as applicable.

Platform Level Cylinder (800S and 860SJ US Market)

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.

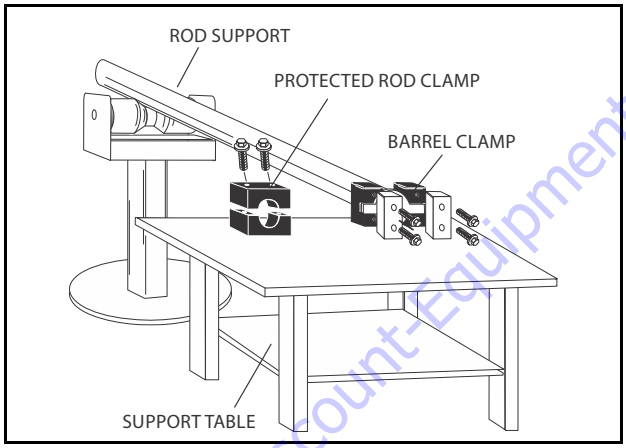


Figure 5-84. Cylinder Barrel Support

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.

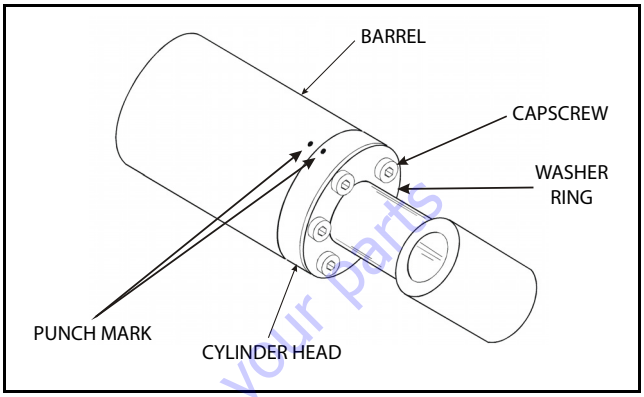


Figure 5-85. Capscrew Removal

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.

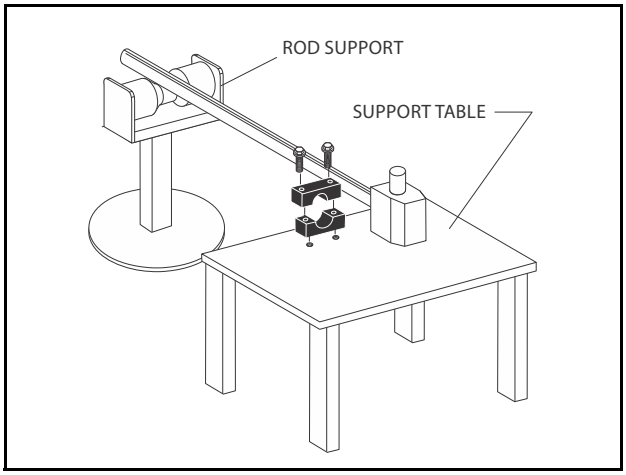
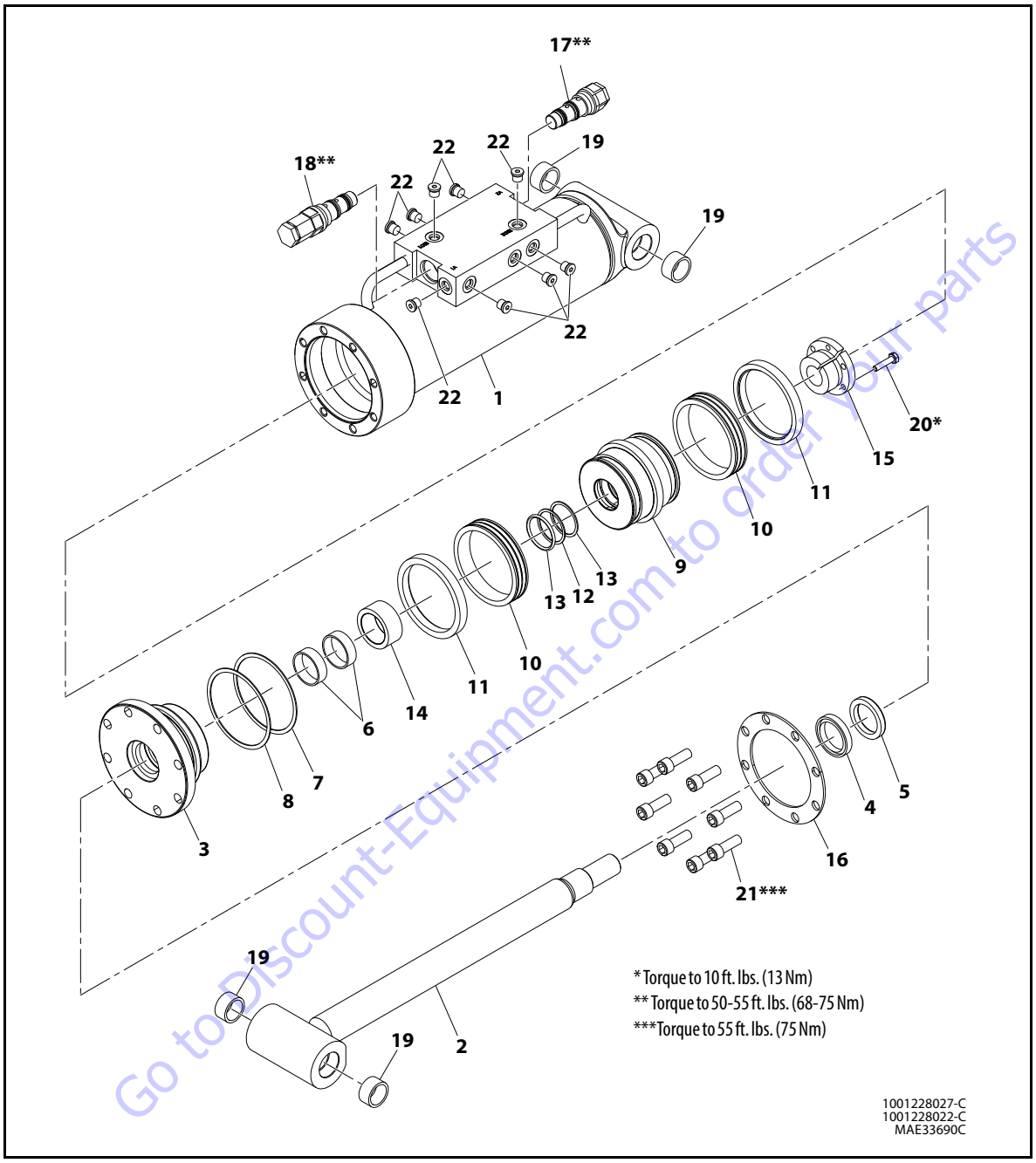


Figure 5-86. Cylinder Rod Support



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. Counterbalance Valve (Barrel End)
18. Counterbalance Valve (Rod End)
19. Bushing
20. Capscrew
21. Capscrew
22. Plug

Figure 5-87. Platform Level Cylinder (800S and 860SJ US Market)

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.

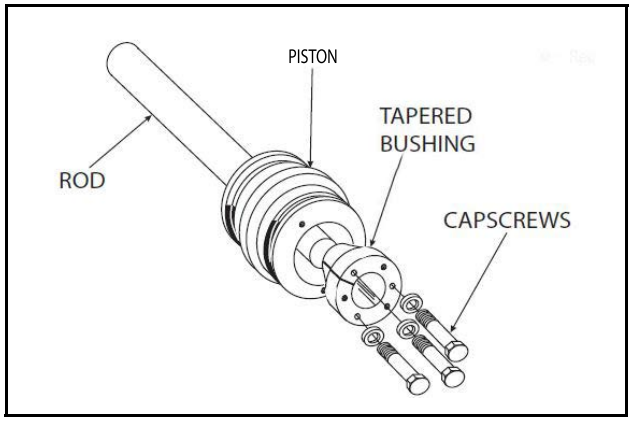


Figure 5-88. Tapered Bushing Removal

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.*

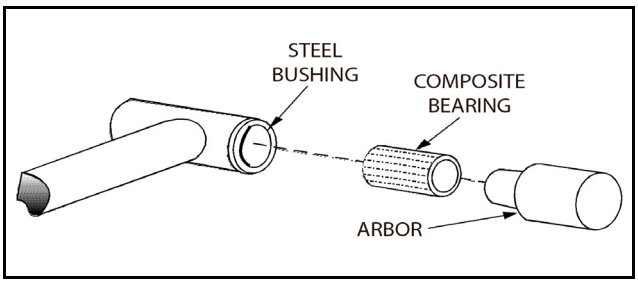


Figure 5-89. Composite Bearing Installation

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.

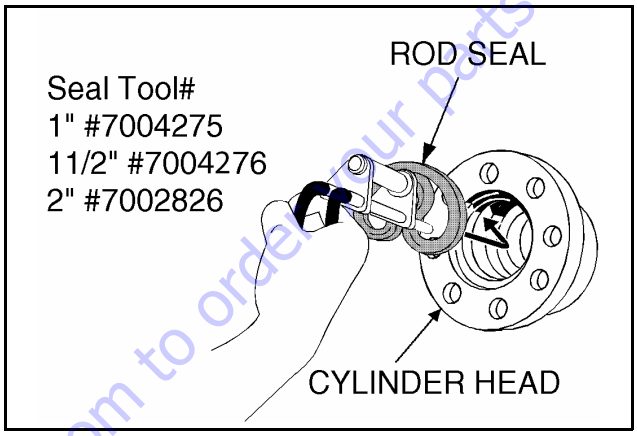


Figure 5-90. Rod Seal Installation

NOTICE

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

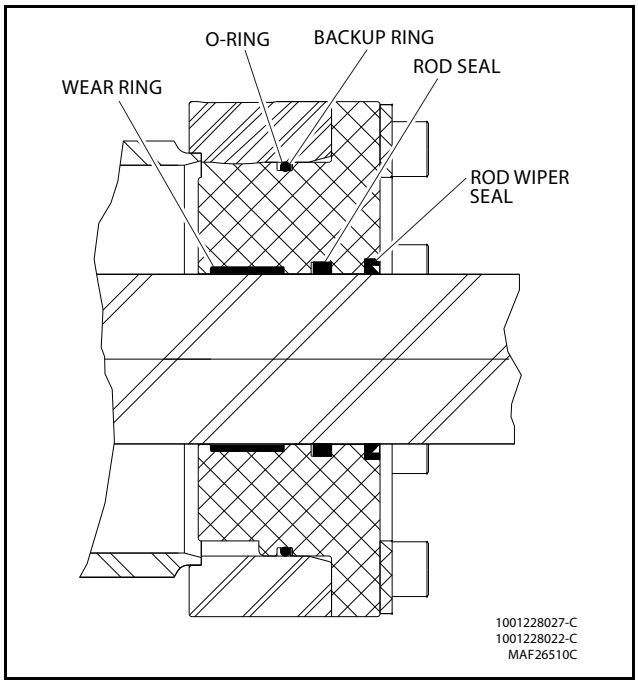


Figure 5-91. Cylinder Head Seal Installation

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.

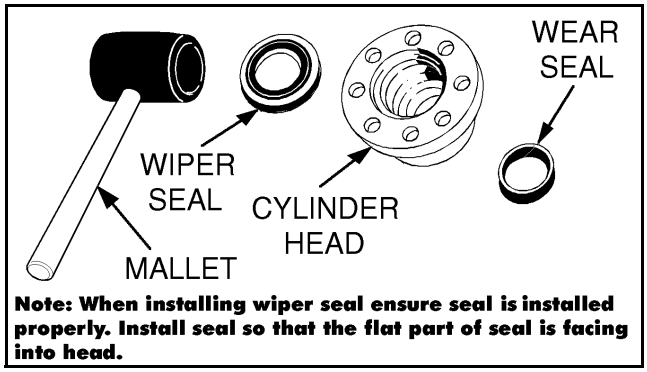


Figure 5-92. Wiper Seal Installation

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

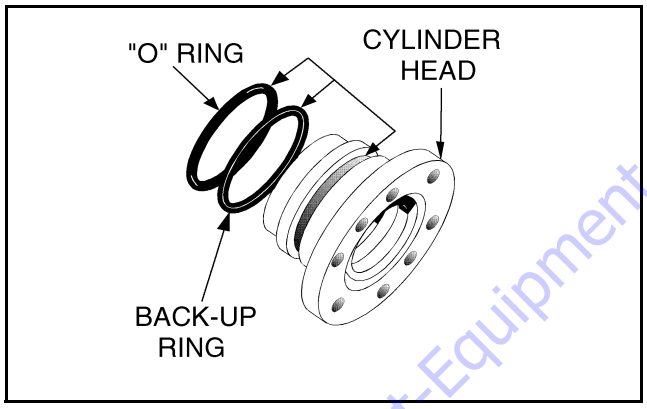


Figure 5-93. Installation of Head Seal Kit

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.

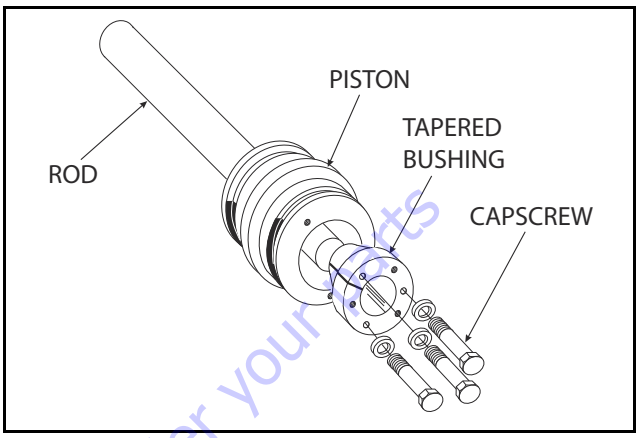


Figure 5-94. Tapered Bushing Installation

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.

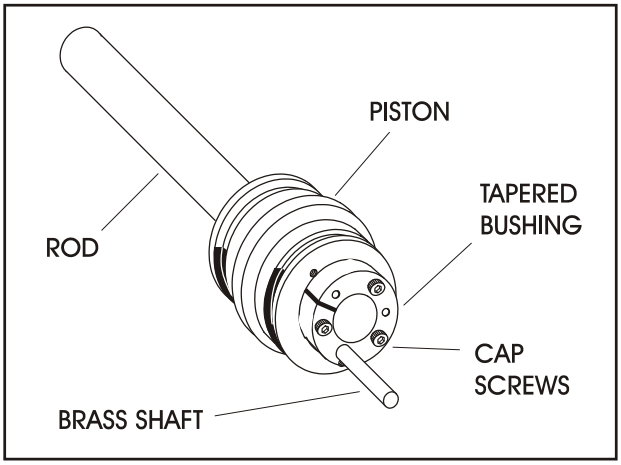


Figure 5-95. Seating the Tapered Bearing

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.

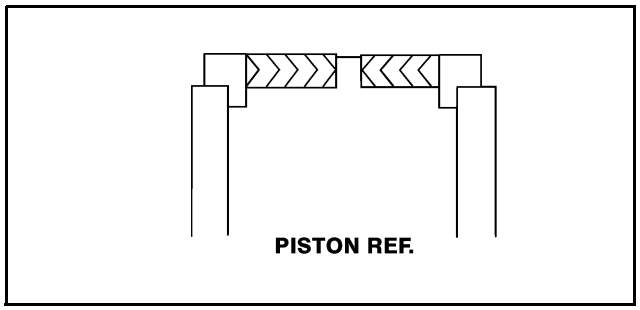


Figure 5-96. Hydrolock Piston Seal Installation

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).

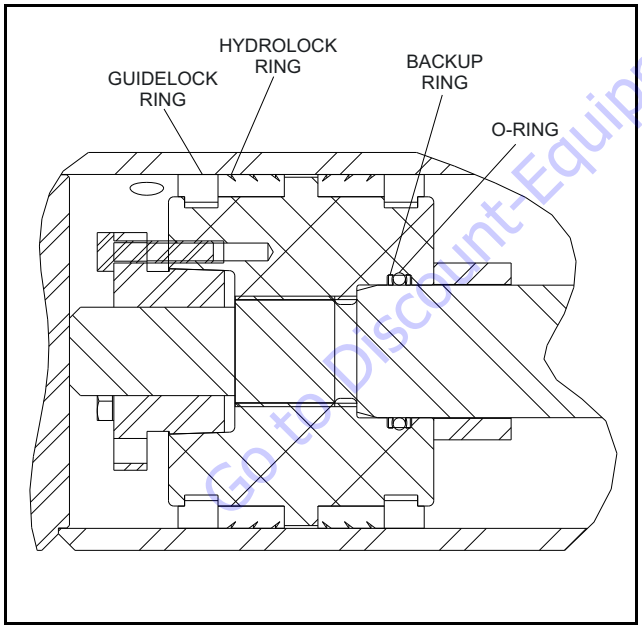


Figure 5-97. Piston Seal Kit Installation

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.

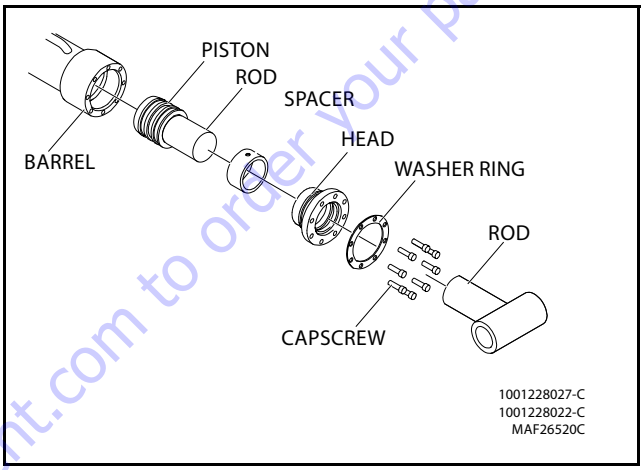


Figure 5-98. Rod Assembly Installation

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 China Market)

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.

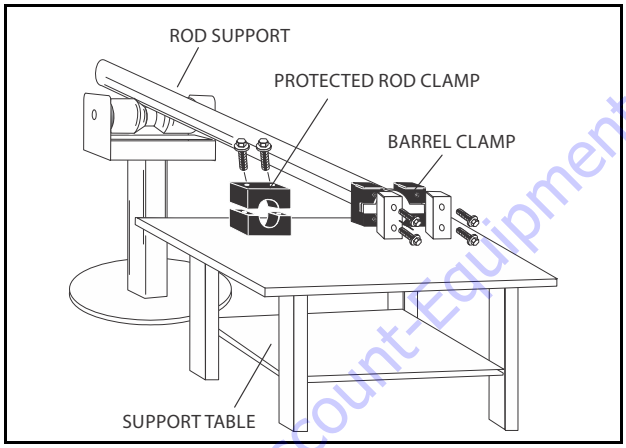


Figure 5-99. Cylinder Barrel Support

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.

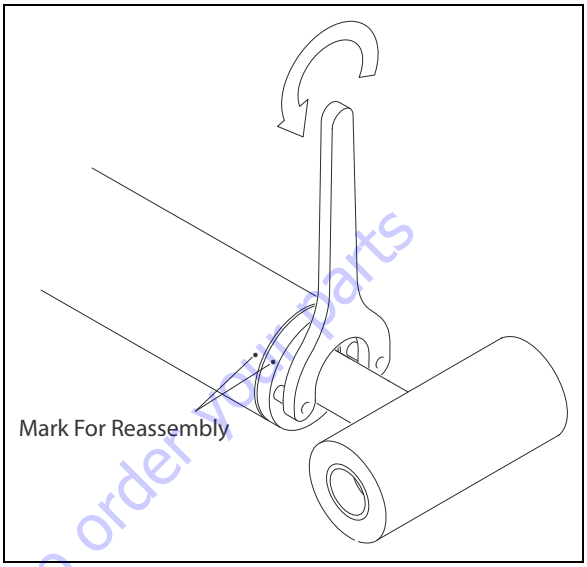


Figure 5-100. Cylinder Head Removal

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.

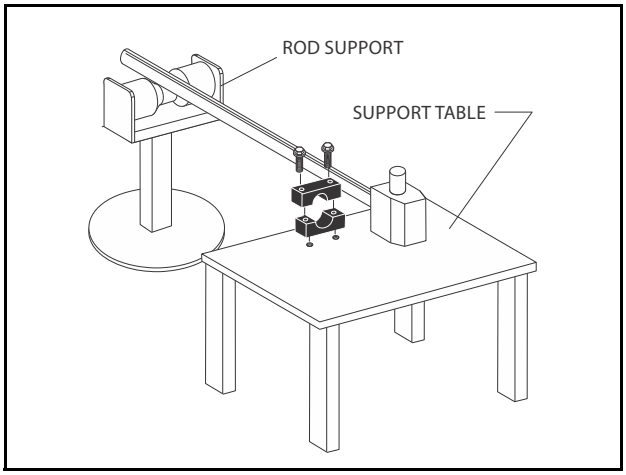
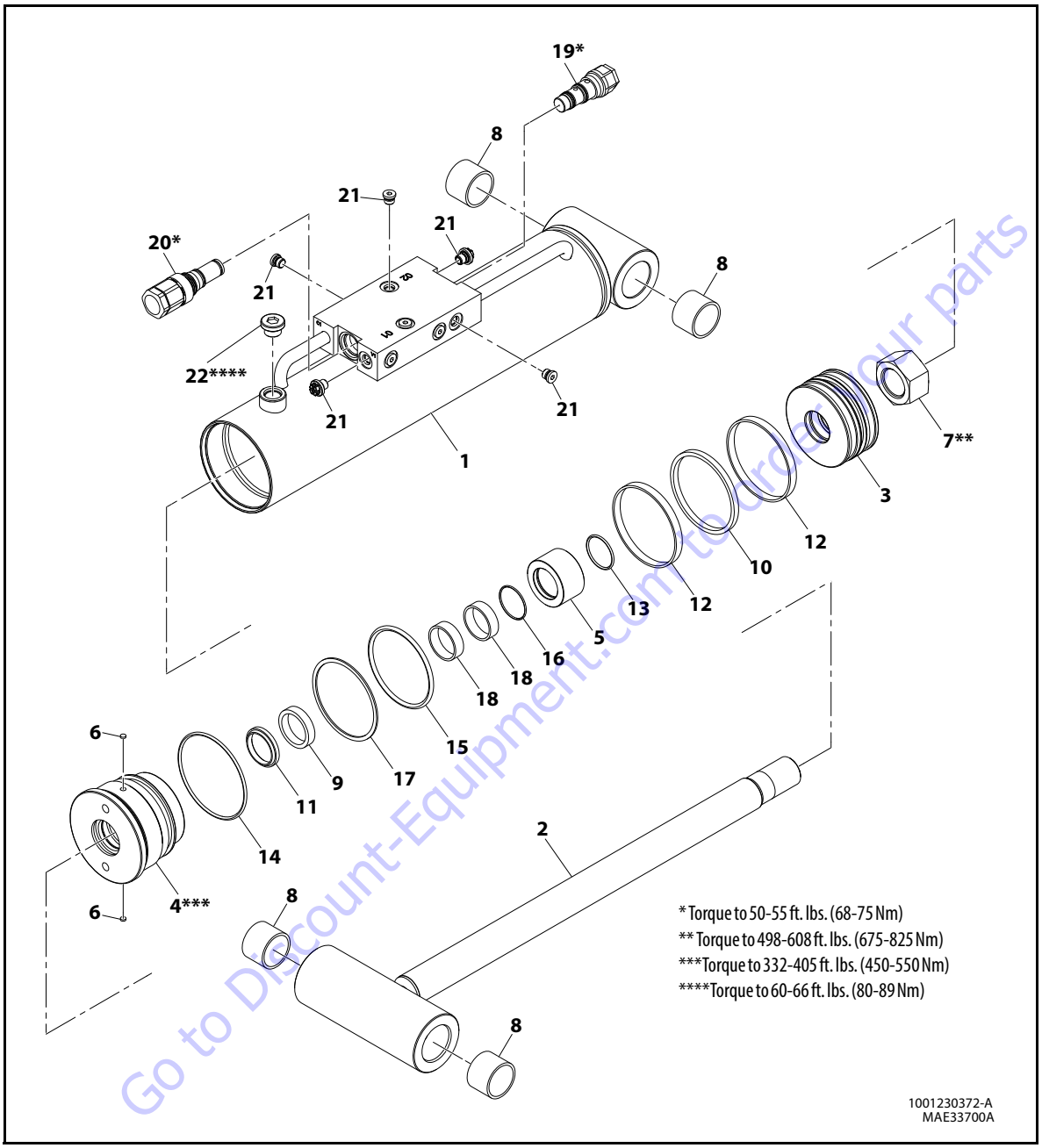


Figure 5-101. Cylinder Rod Support



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 5-102. Platform Level Cylinder (860SJ China Market)

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.

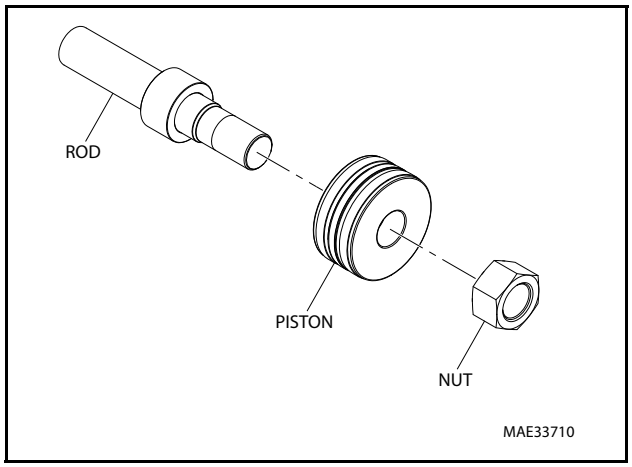


Figure 5-103. Piston Removal

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.*

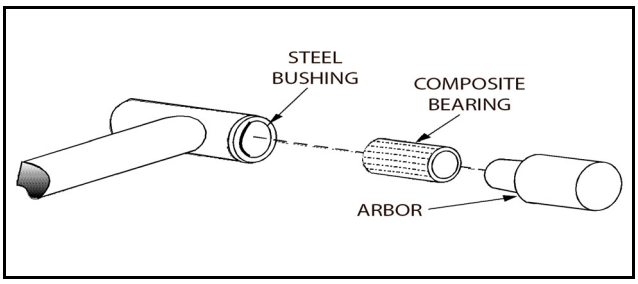


Figure 5-104. Composite Bearing Installation

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.

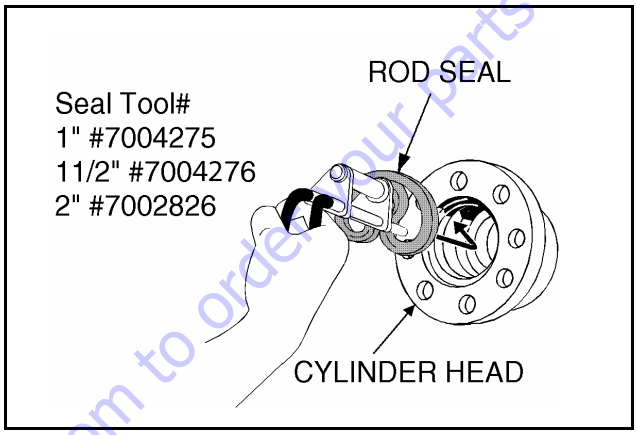


Figure 5-105. Rod Seal Installation

NOTICE

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

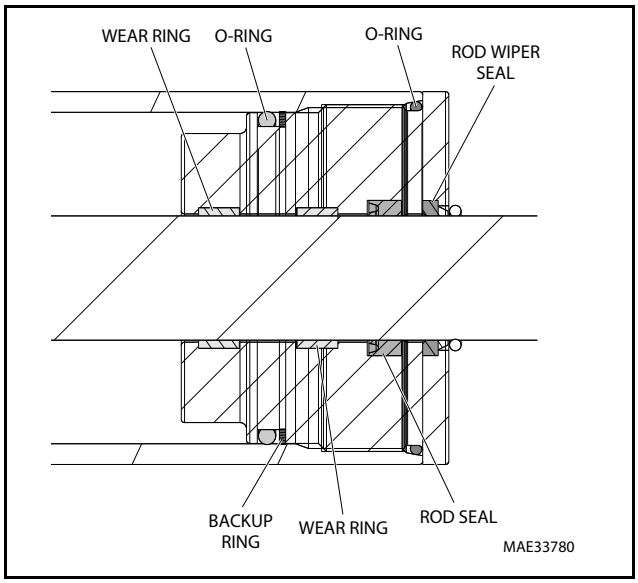


Figure 5-106. Cylinder Head Seal Installation

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.

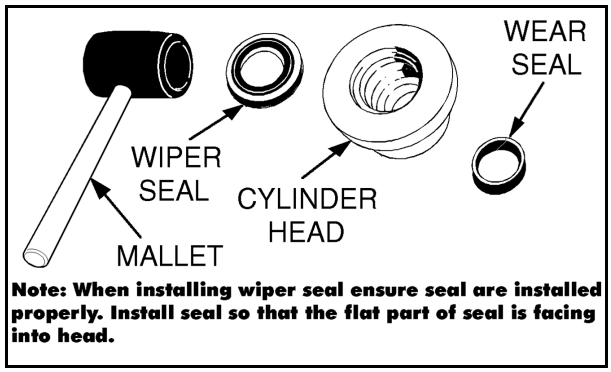


Figure 5-107. Wiper Seal Installation

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

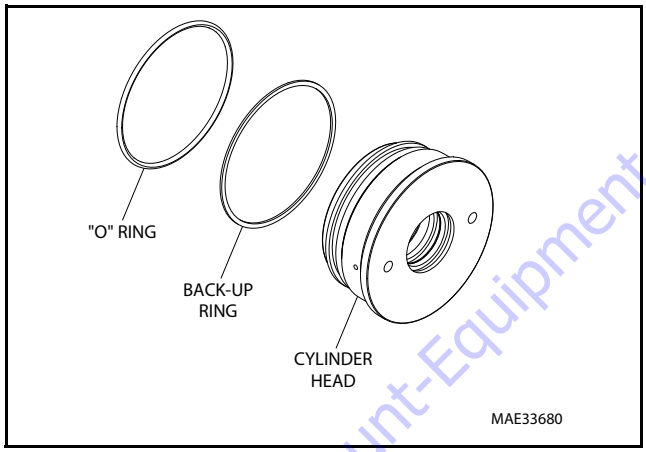


Figure 5-108. Installation of Head Seal Kit

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).

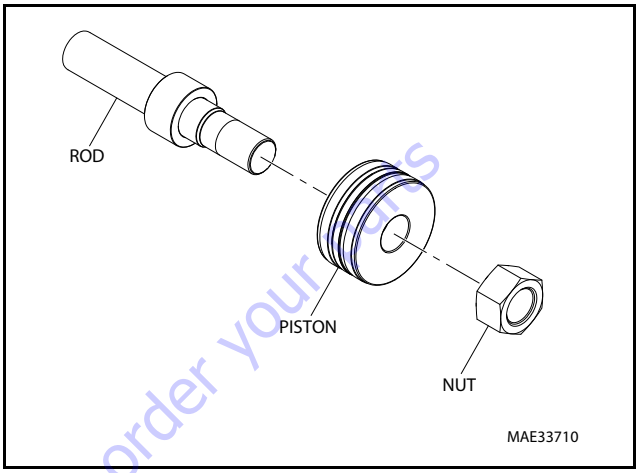


Figure 5-109. Piston Installation

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.

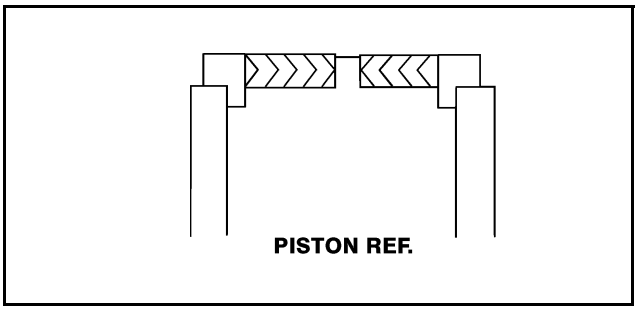


Figure 5-110. Hydrolock Piston Seal Installation

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).

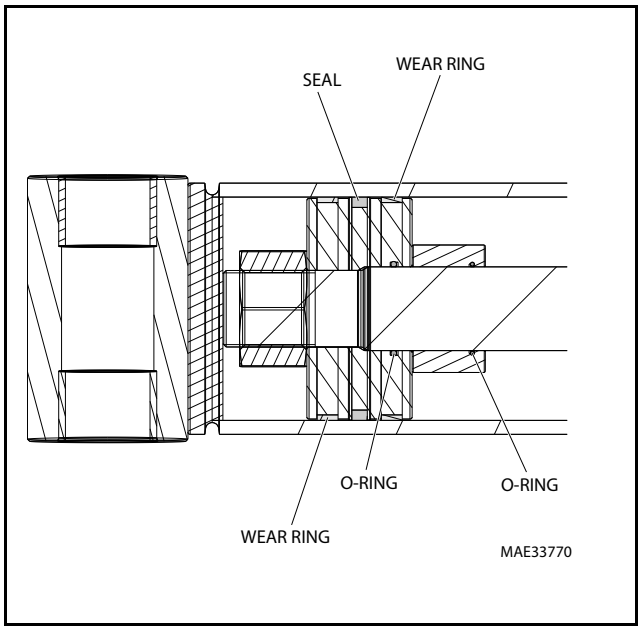


Figure 5-111. Piston Seal Kit Installation

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.

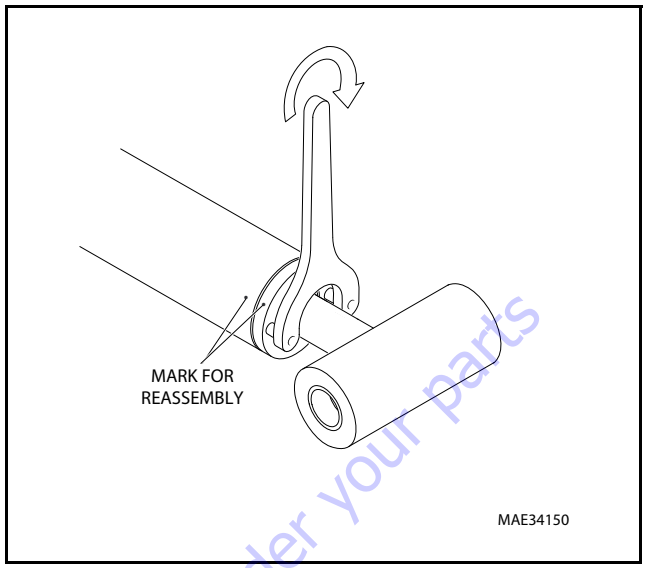


Figure 5-112. Cylinder Head Installation

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).

Steer Cylinder (800S and 860SJ US Market)

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.

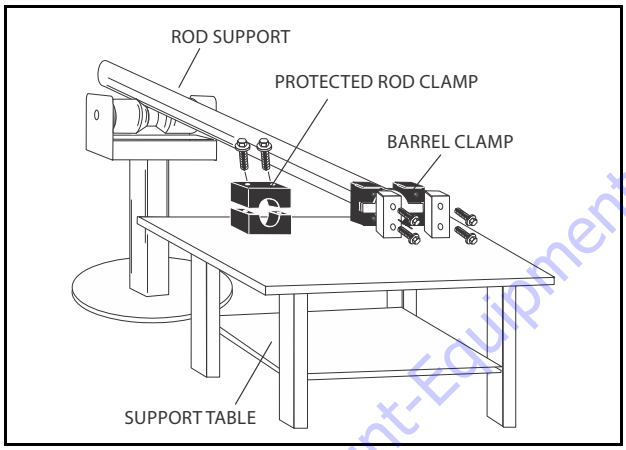


Figure 5-113. Cylinder Barrel Support

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

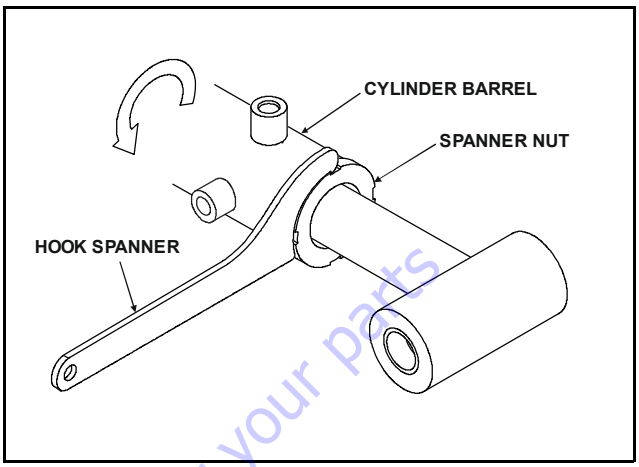


Figure 5-114. Spanner Nut Removal

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.

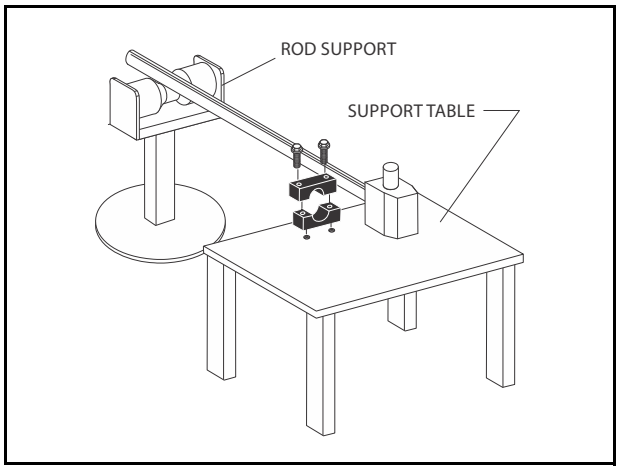
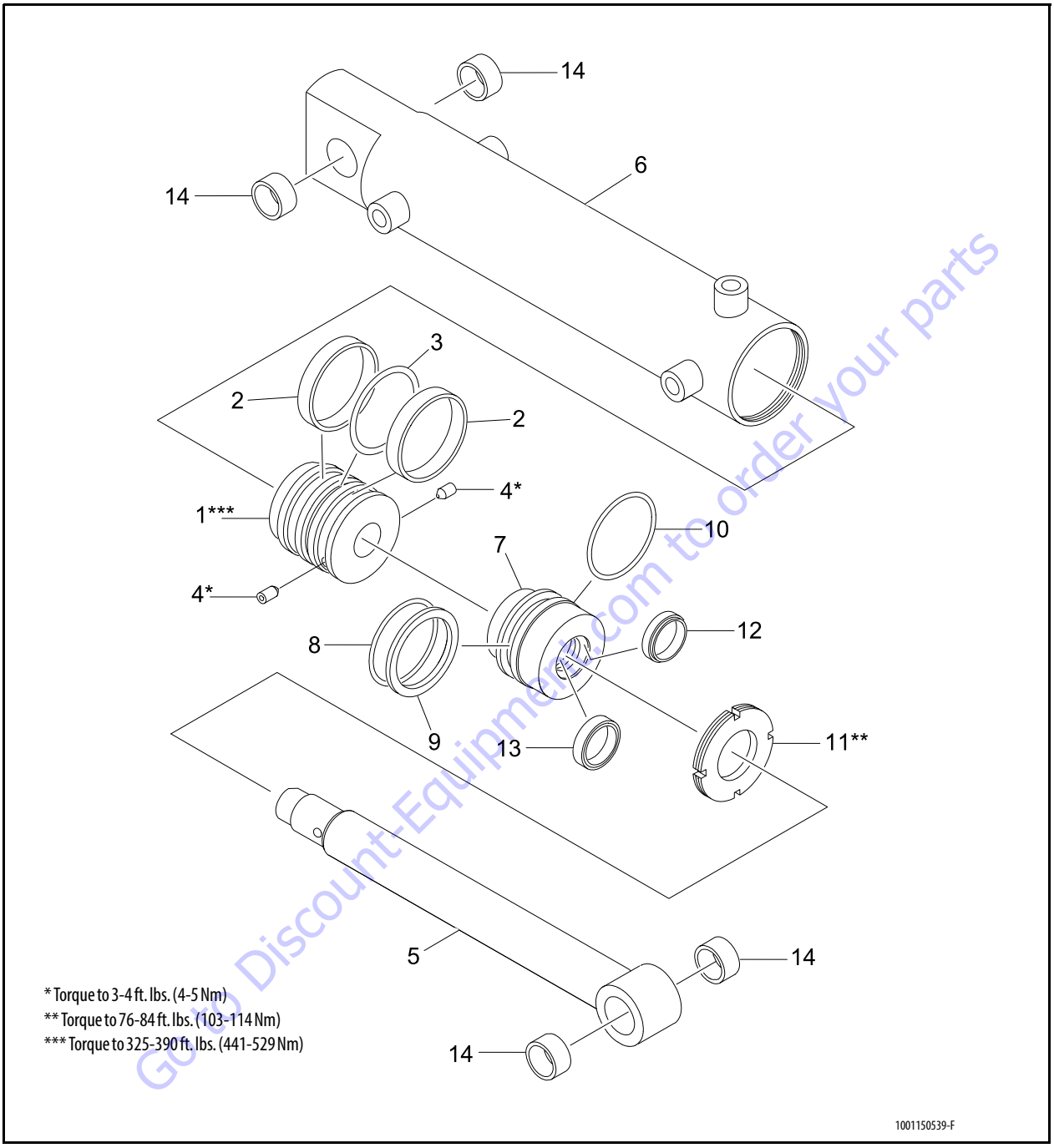


Figure 5-115. Cylinder Rod Support



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 5-116. Steer Cylinder (US Market)

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.*

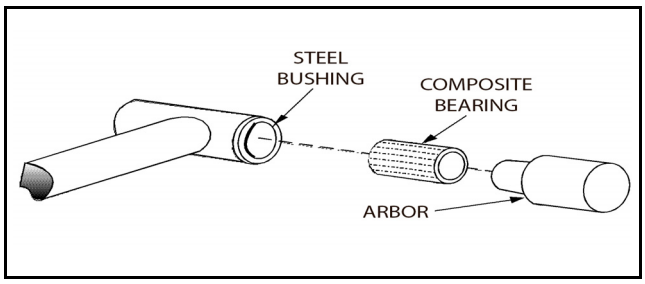


Figure 5-117. Composite Bearing Installation

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.

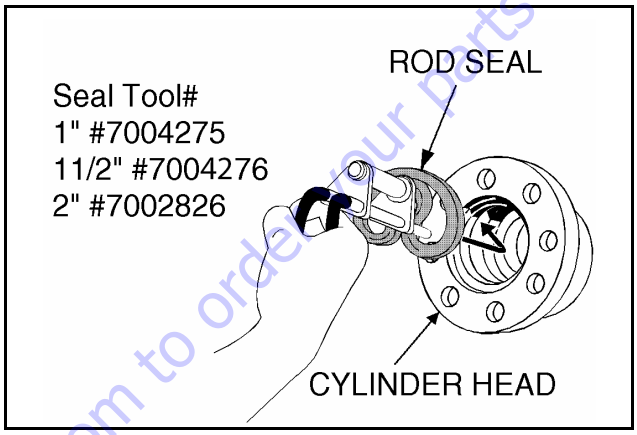


Figure 5-118. Rod Seal Installation

NOTICE

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

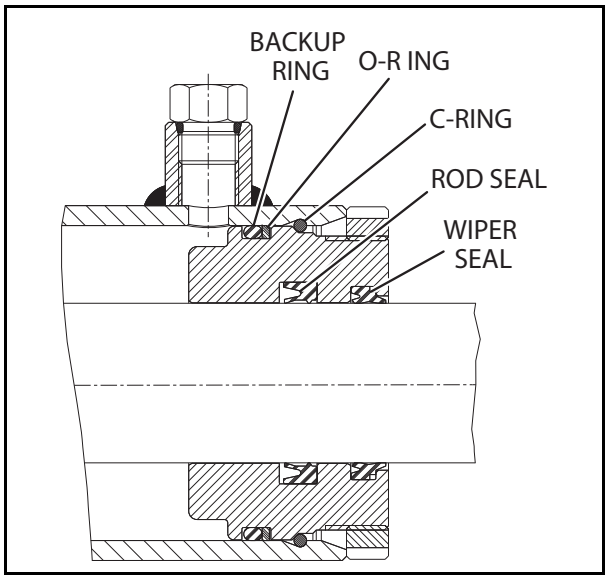
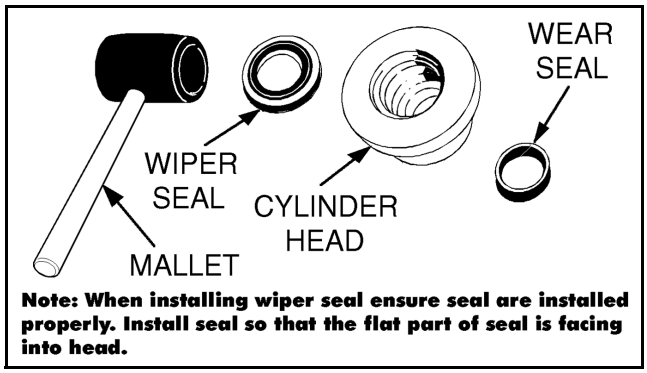


Figure 5-119. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal 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 5-120. Wiper Seal Installation

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

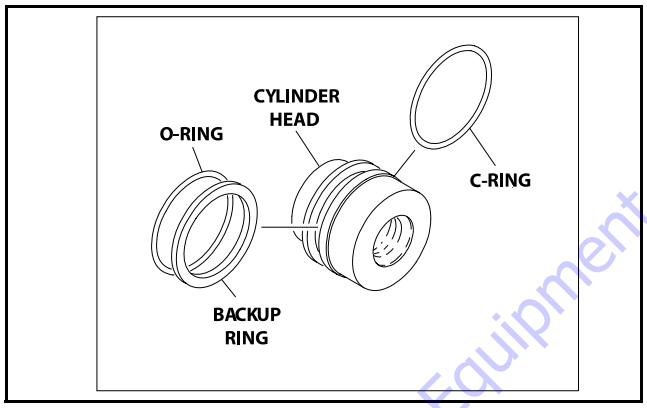


Figure 5-121. Installation of Head Seal Kit

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 Medium Strength Threadlocking Compound 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).

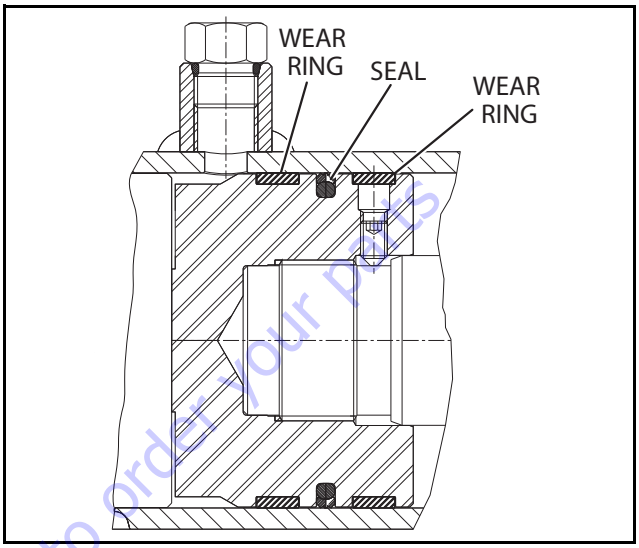


Figure 5-122. Installation of Piston Seal Kit

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 Medium Strength Threadlocking Compound to spanner nut thread.*

14. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted).

Steer Cylinder (860SJ China Market)

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.

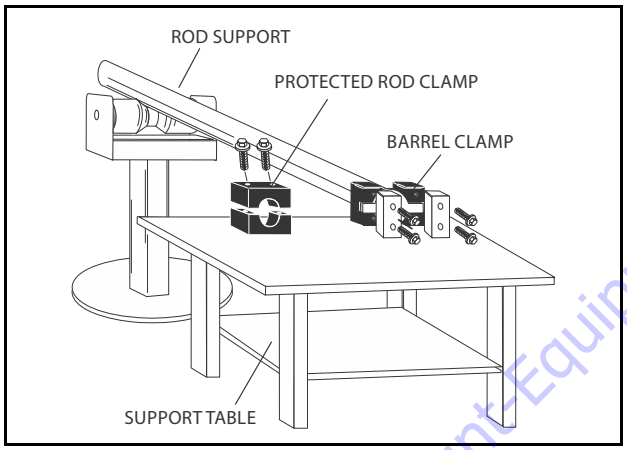


Figure 5-123. Cylinder Barrel Support

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

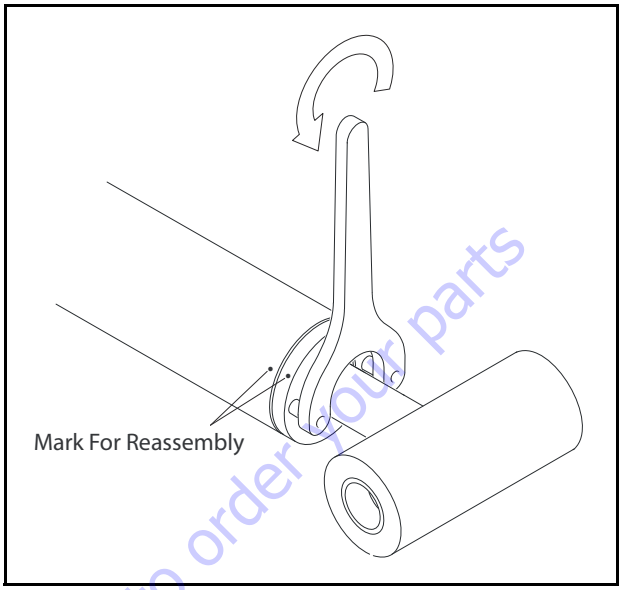


Figure 5-124. Cylinder Head Removal

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.

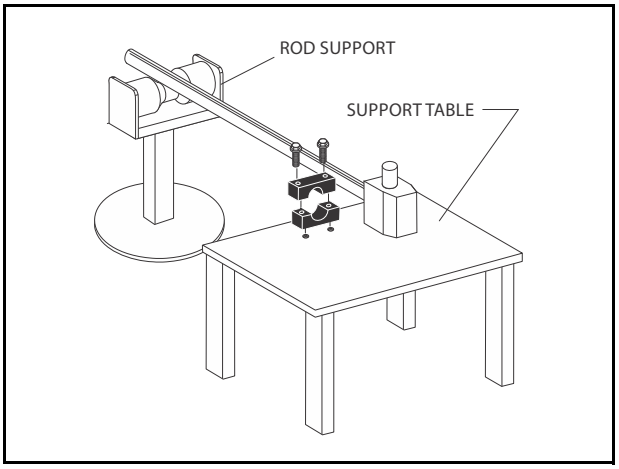
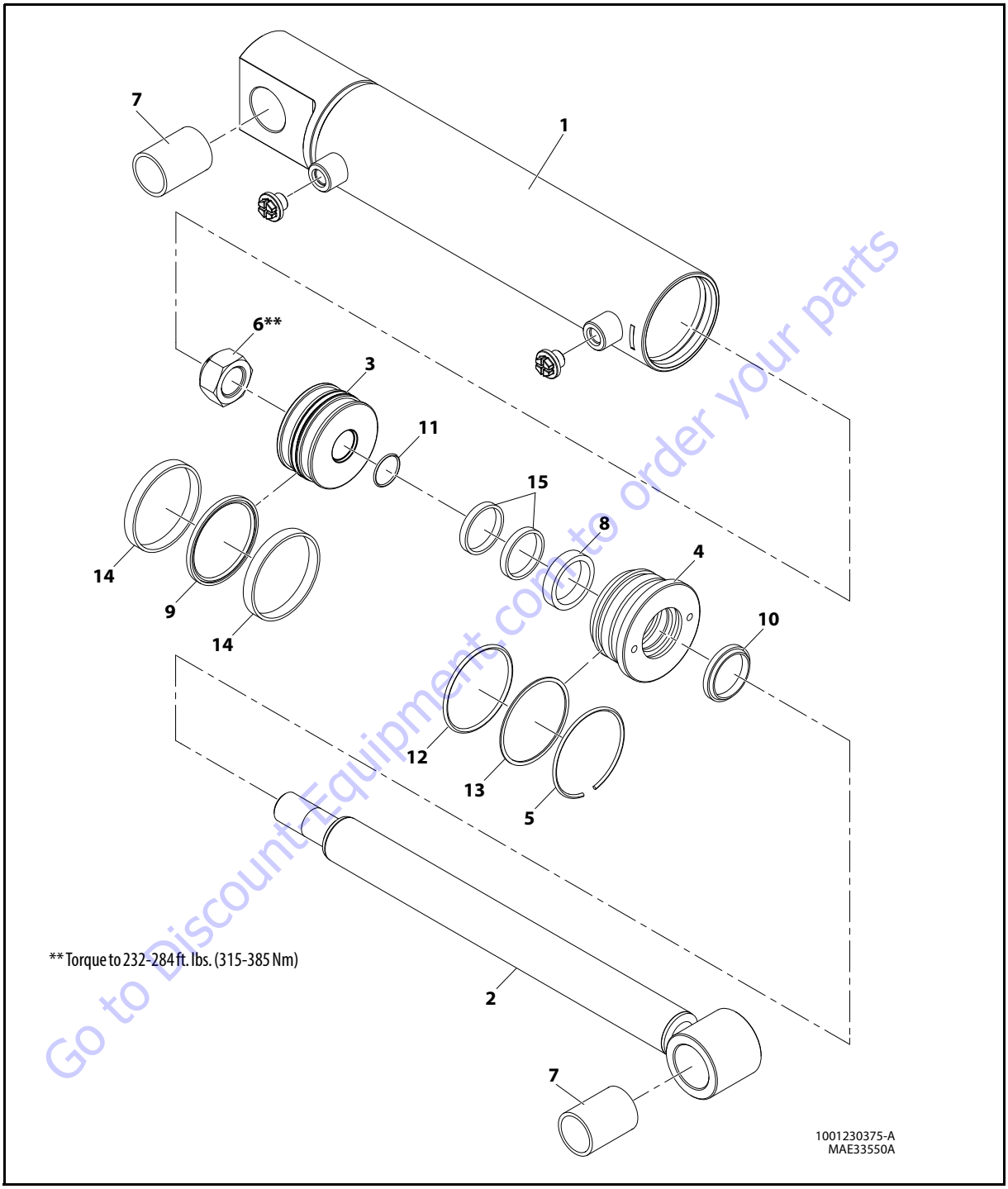


Figure 5-125. Cylinder Rod Support



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

Figure 5-126. Steer Cylinder (860SJ China Market)

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.*

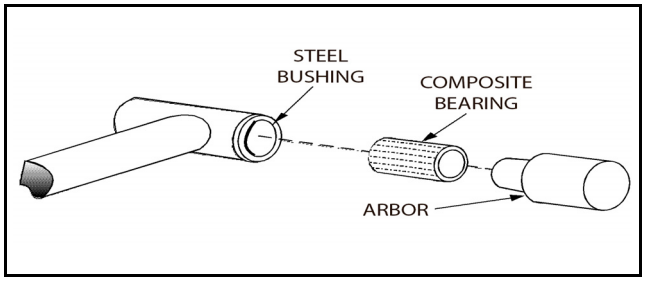


Figure 5-127. Composite Bearing Installation

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.

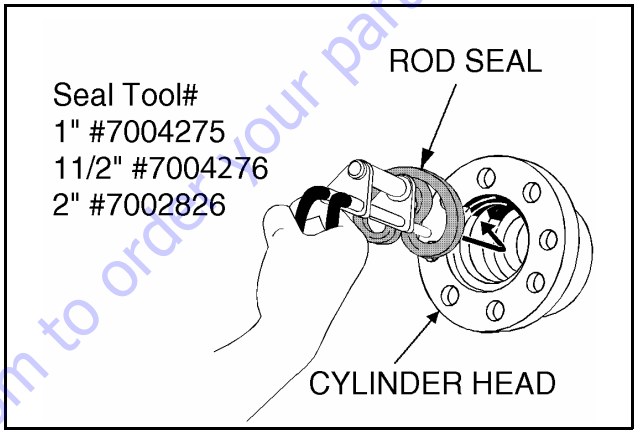


Figure 5-128. Rod Seal Installation

NOTICE

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

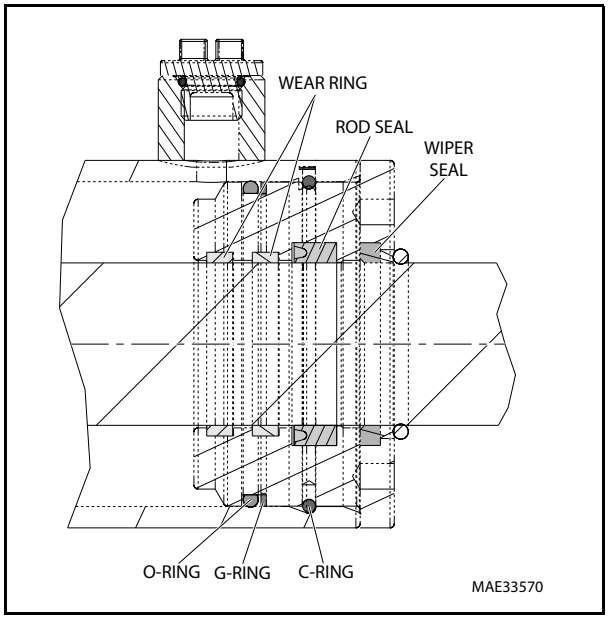
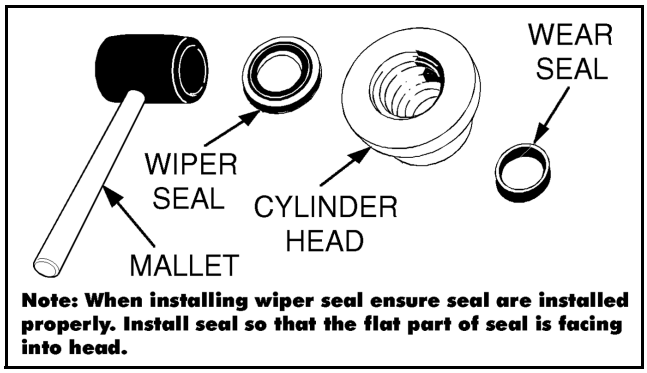


Figure 5-129. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal 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 5-130. Wiper Seal Installation

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

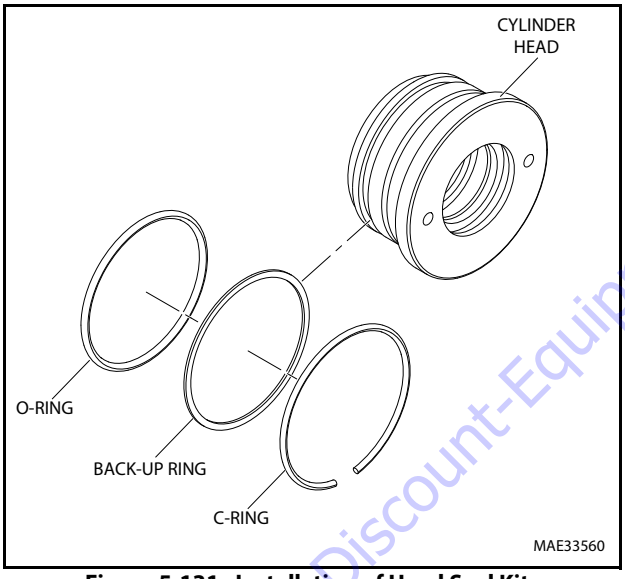


Figure 5-131. Installation of Head Seal Kit

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).

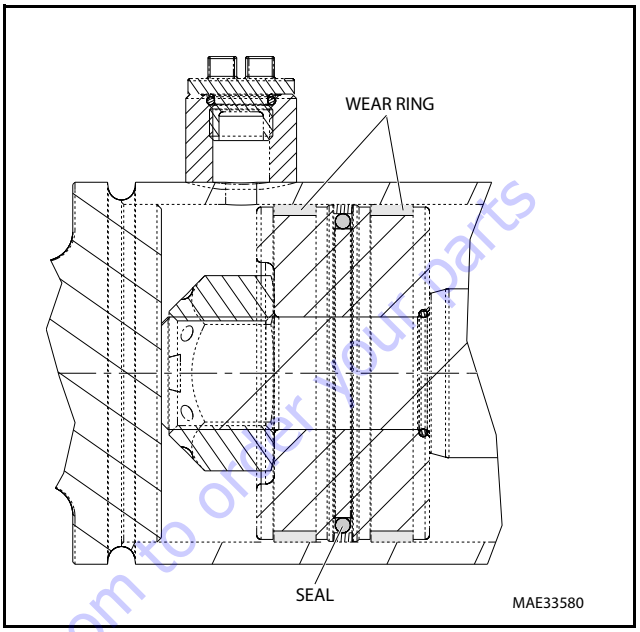


Figure 5-132. Installation of Piston Seal Kit

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.

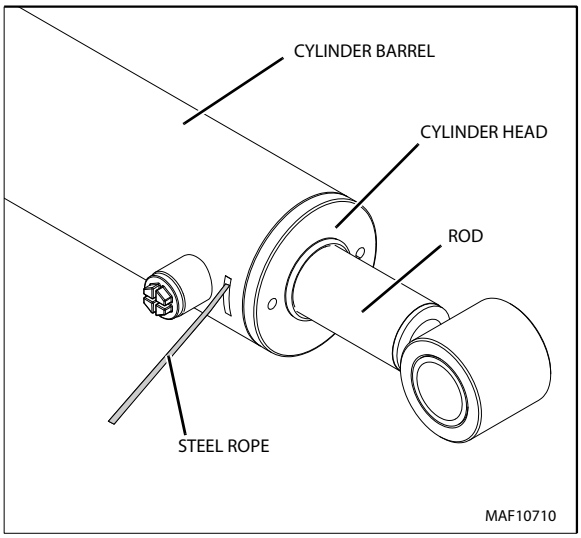


Figure 5-133. Installation of Steel Rope

14. Rotate the cylinder head using a pin face spanner until the steel rope is completely inserted.

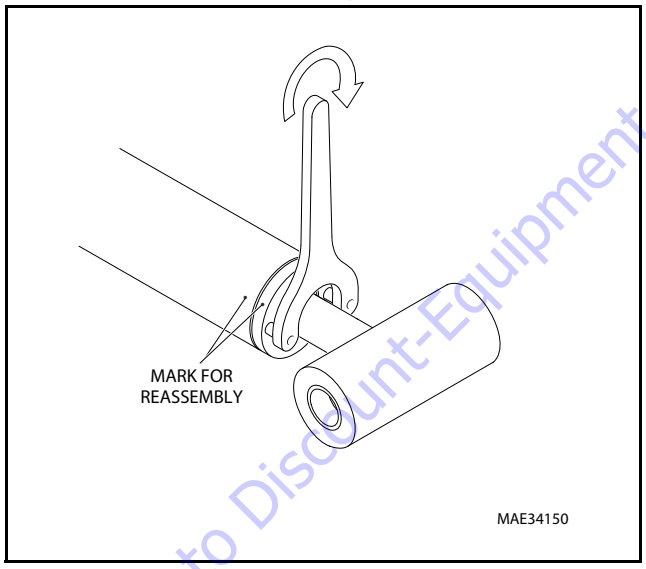


Figure 5-134. Cylinder Head Installation

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

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

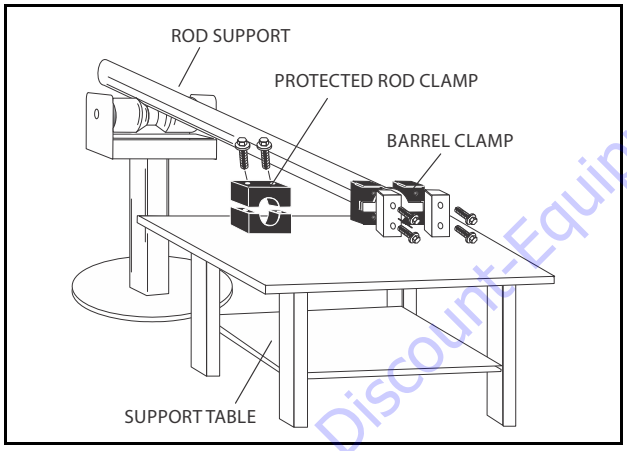


Figure 5-135. Cylinder Barrel Support

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.

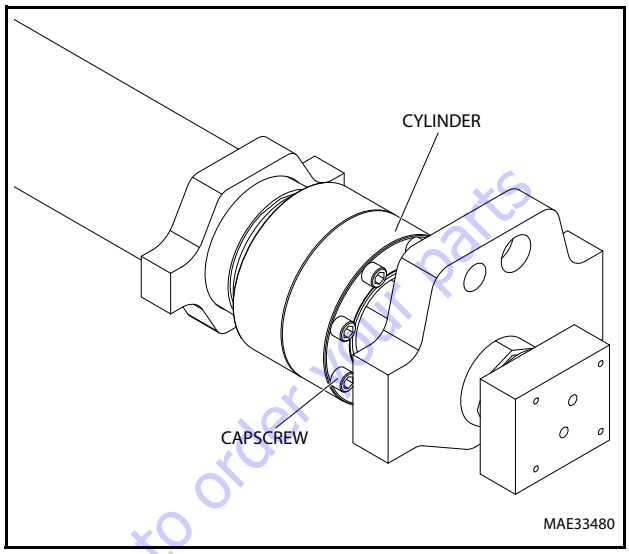


Figure 5-136. Capscrew Removal

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.

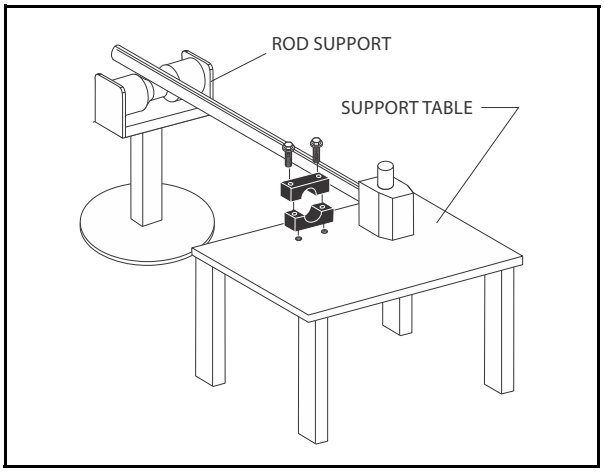
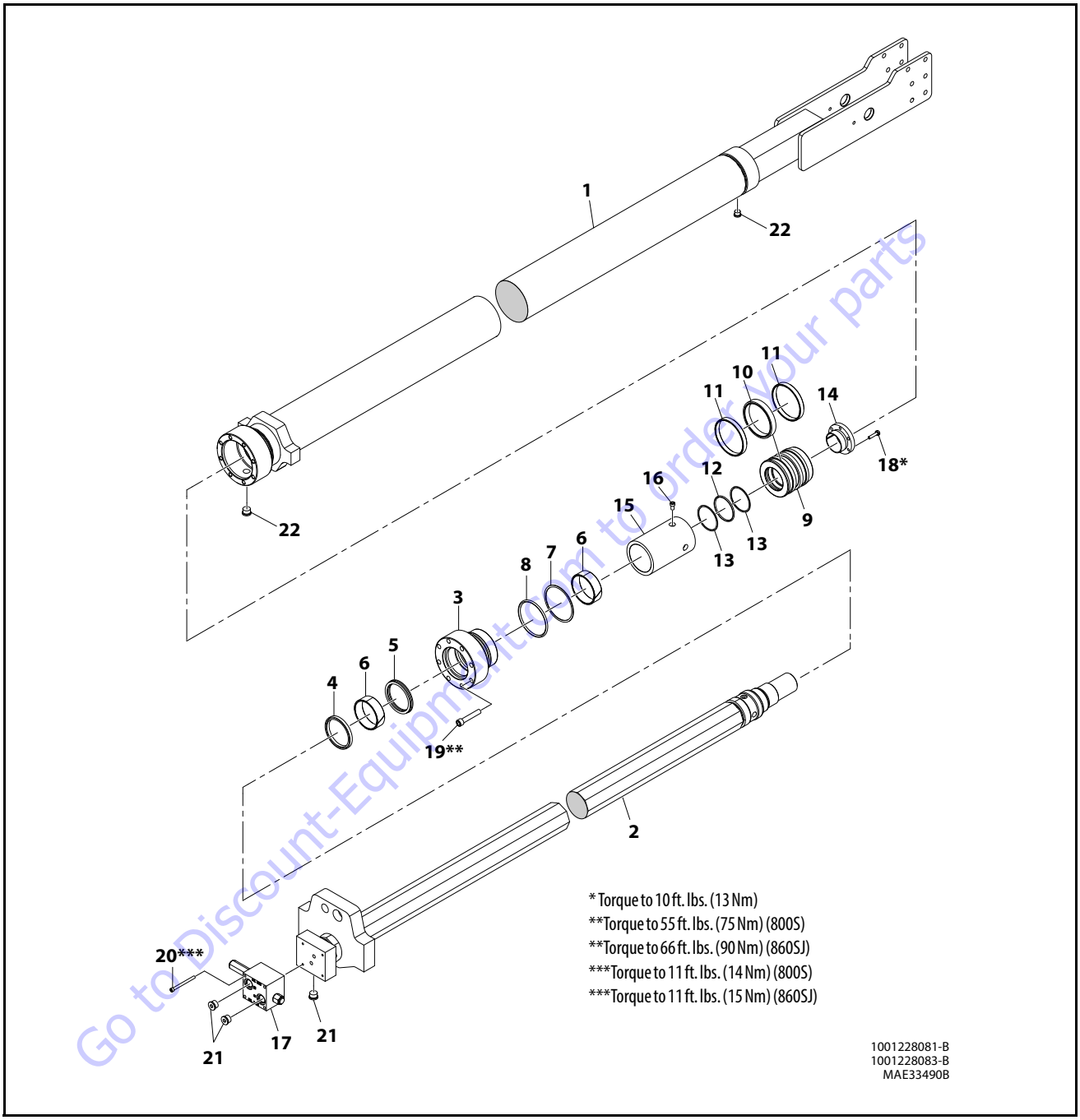


Figure 5-137. Cylinder Rod Support



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 5-138. 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.

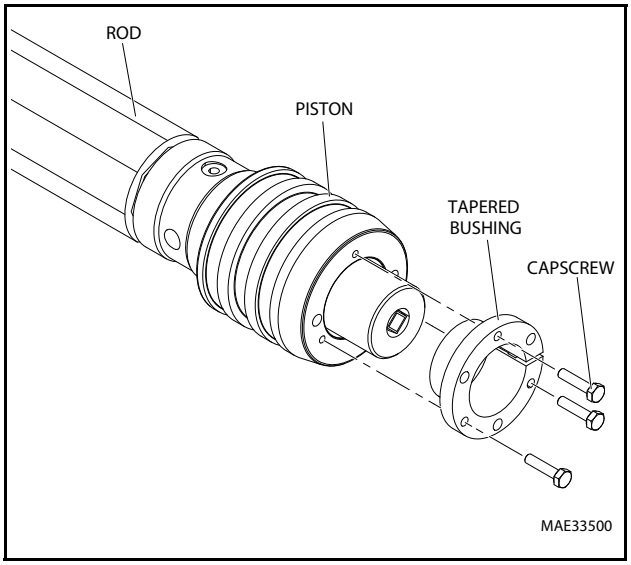


Figure 5-139. Tapered Bushing Removal

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.*

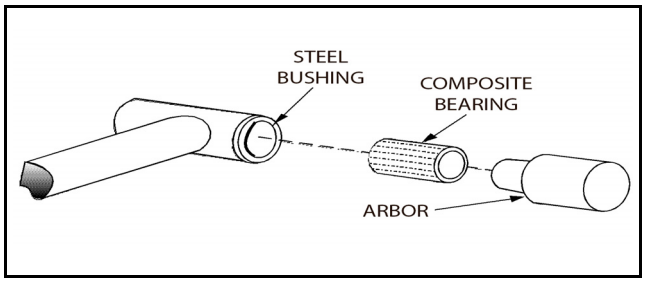


Figure 5-140. Composite Bearing Installation

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.

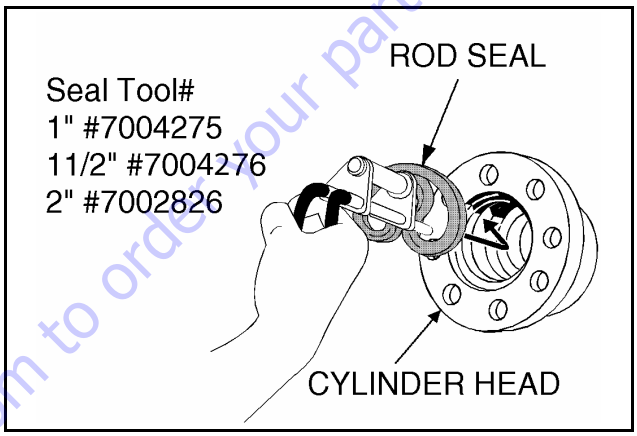


Figure 5-141. Rod Seal Installation

NOTICE

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

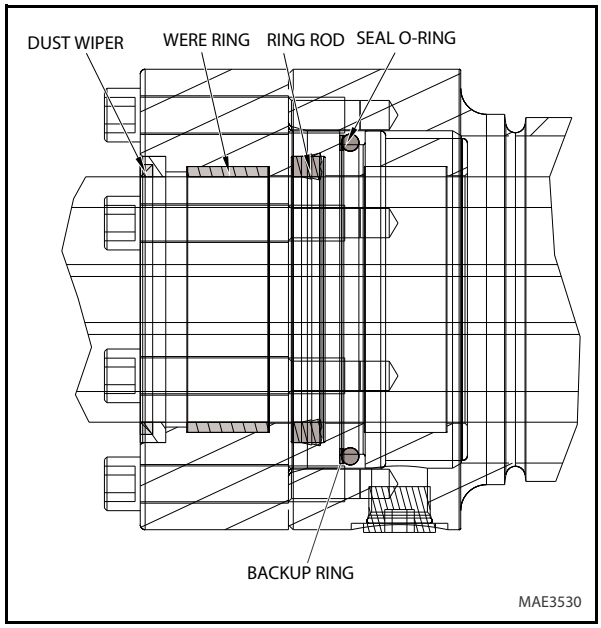


Figure 5-142. Cylinder Head Seal Installation

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.

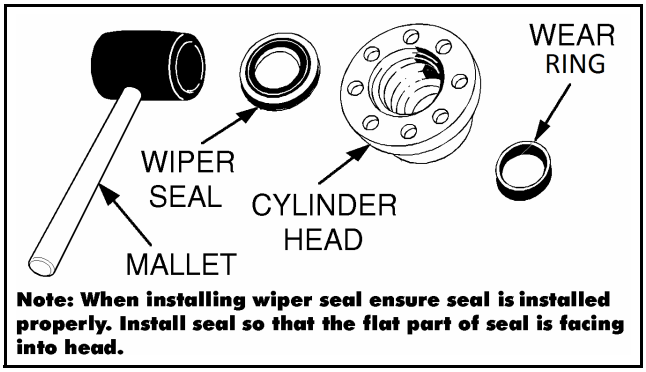


Figure 5-143. Wiper Seal Installation

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

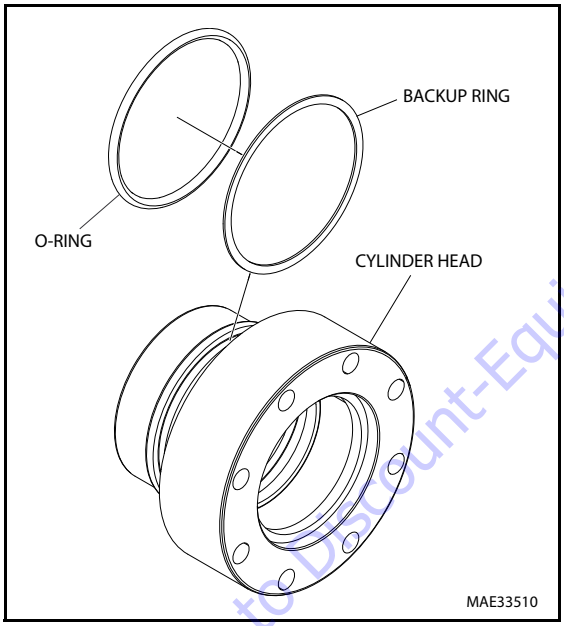


Figure 5-144. Installation of Head Seal Kit

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.

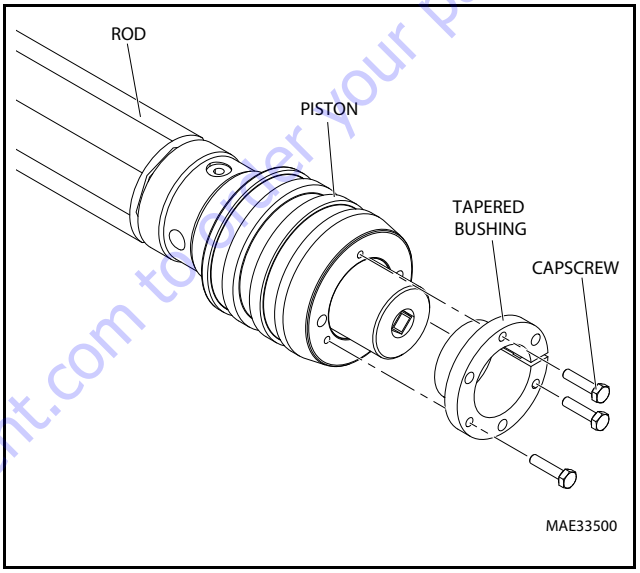


Figure 5-145. Tapered Bushing Installation

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.

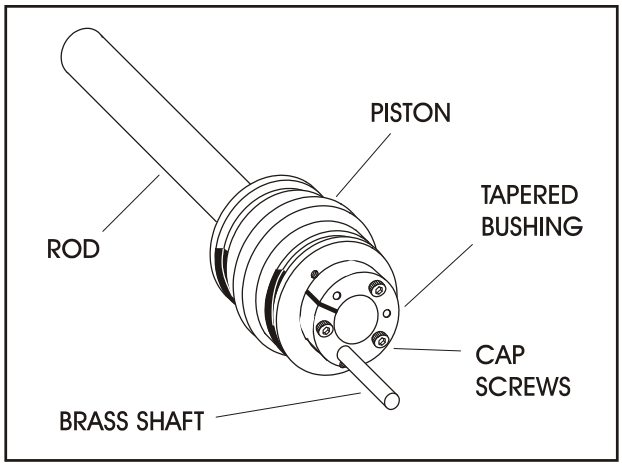


Figure 5-146. Seating the Tapered Bearing

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).

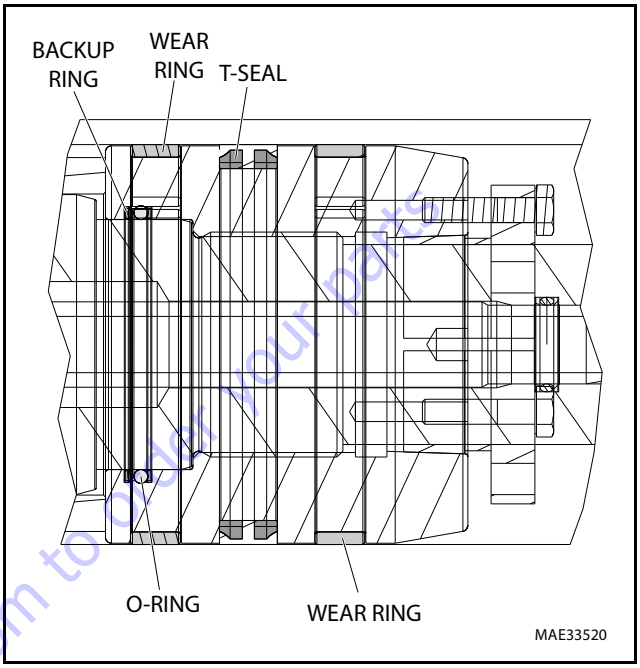


Figure 5-147. Piston Seal Kit Installation

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.

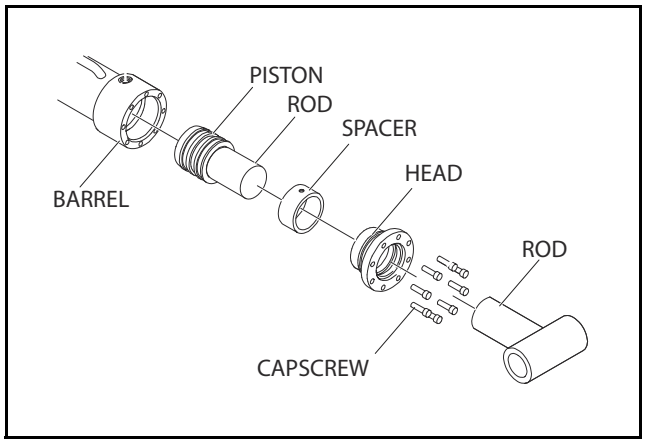
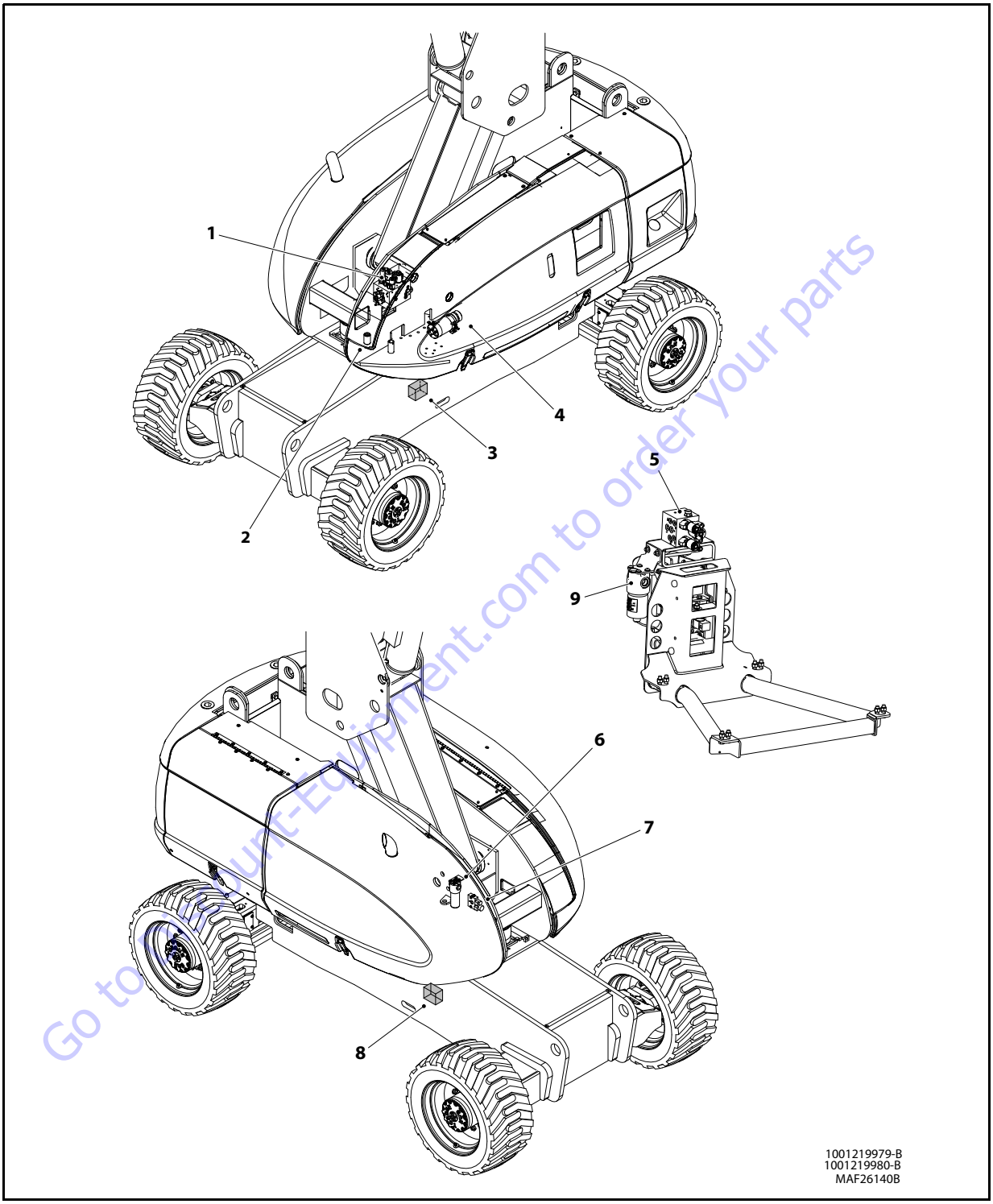


Figure 5-148. Rod Assembly Installation

19. Secure the cylinder head gland using the capscrews. For Torque capscrews Refer Figure 5-138., 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 5-138., 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)
9. High Pressure Filter

Figure 5-149. 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.

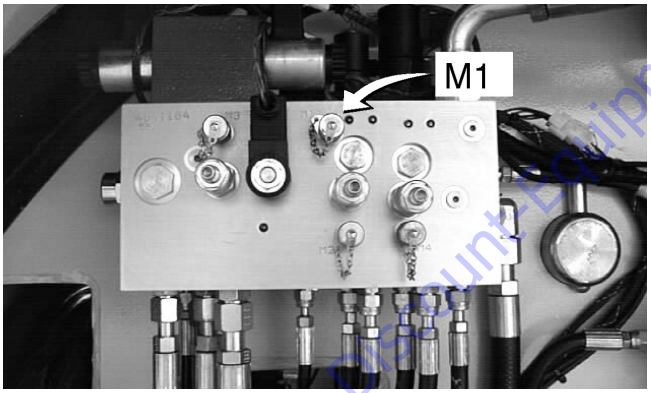
To ensure all pressures are set correctly, the following procedures must be followed in order.

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.

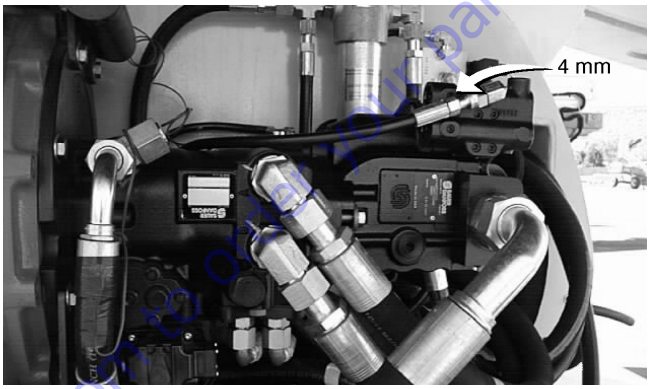
Set Up of the Function Pump

STAND BY PRESSURE OR LOAD SENSE PRESSURE

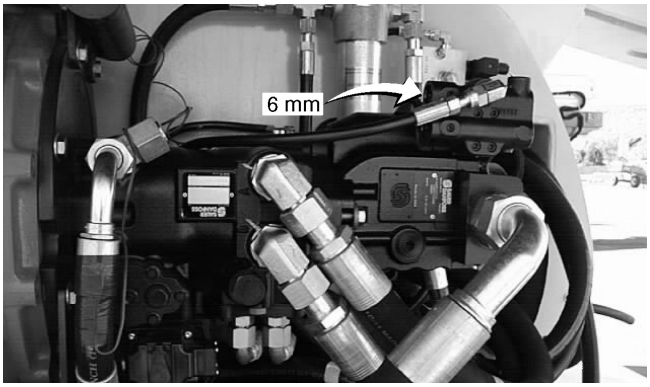
1. Install a low pressure gauge at port "M1" of the main valve block. A low pressure gauge capable of reading 500 psi.



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.

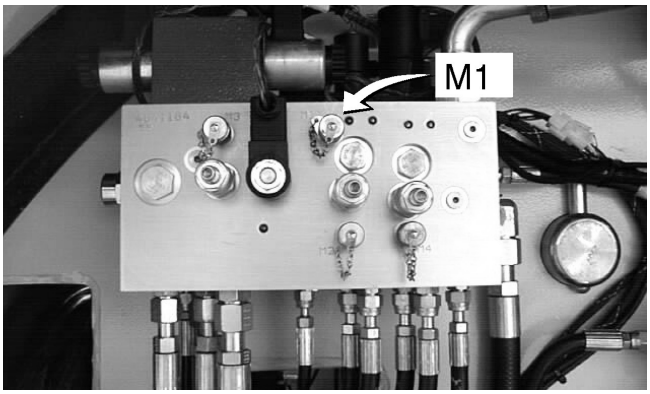


   b. Next, using the 6 mm wrench adjust the main adjustment clockwise to increase or counterclockwise to decrease. The pressure should read between 400-440 psi (27.5 to 30 Bar).



HIGH PRESSURE RELIEF

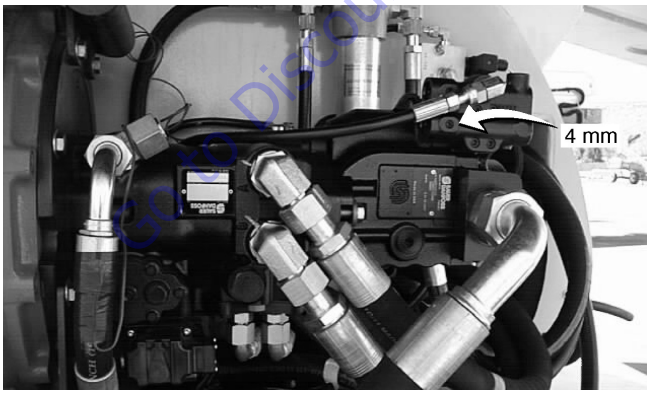
1. Install a high pressure gauge at the "M1" port of the main valve block.



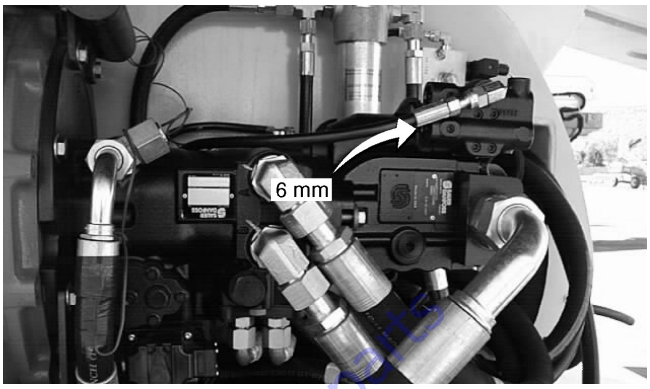
2. Activate telescope in and hold. The gauge should read 2600 psi.

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, counter-clockwise 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, counter-clockwise to decrease.

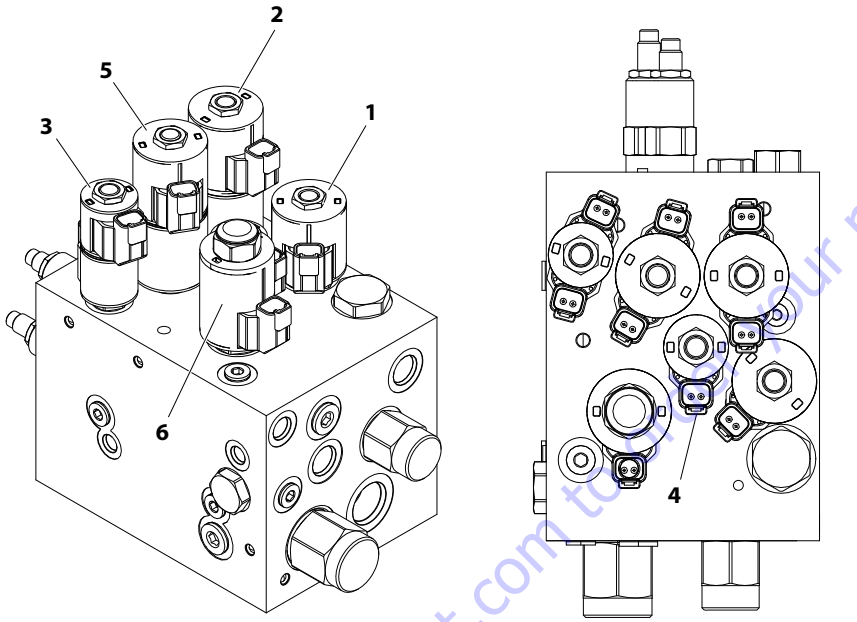


Table 5-33. Main Valve Coil Resistance

#	Coil Resistance @ 20°C (Ohms)
1	7.1
2	7.1
3	8.8
4	8.8
5	7.1
6	4.5

1. Main Dump Valve (Coil Resistance 7.1 Ohms @ 20oC) (50-55 ft. lb. (68-75 Nm))
2. Steer Valve (Coil Resistance 7.1 Ohms @ 20oC) (24-26 ft. lb. (33-36 Nm))
3. Tele Solenoid Valve (Coil resistance 8.8 Ohms @ 20oC) (19-21 ft. lb. (26-29 Nm))
4. Lift Valve (Coil resistance 8.8 Ohms @ 20oC) (19-21 ft. lb. (26-29 Nm))
5. Swing Valve (Coil Resistance 7.1 Ohms @ 20oC) (24-26 ft. lb. (33-36 Nm))
6. Telescope Flow Valve (Coil resistance 4.5 Ohms @ 20oC) (50-55 ft. lb. (68-75 Nm))

Figure 5-150. Main Valve Identification

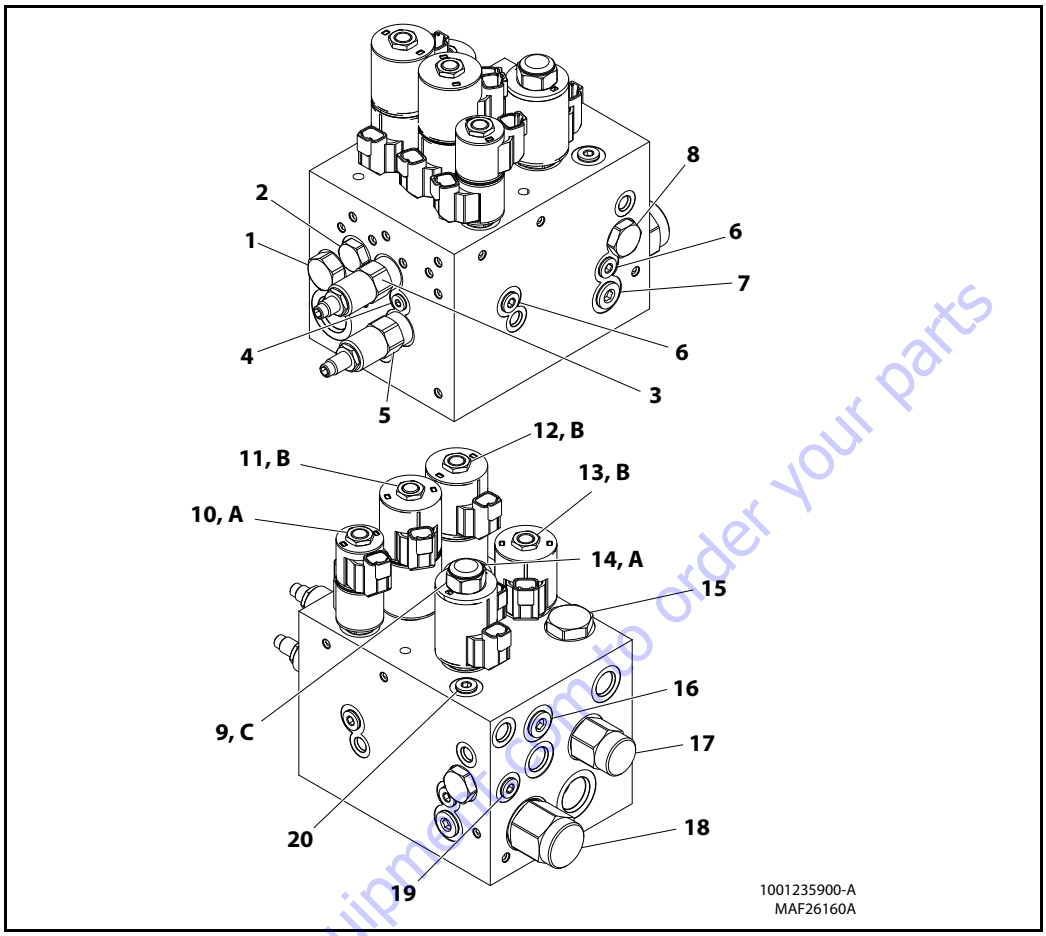


Table 5-34. Cartridge Torque Values

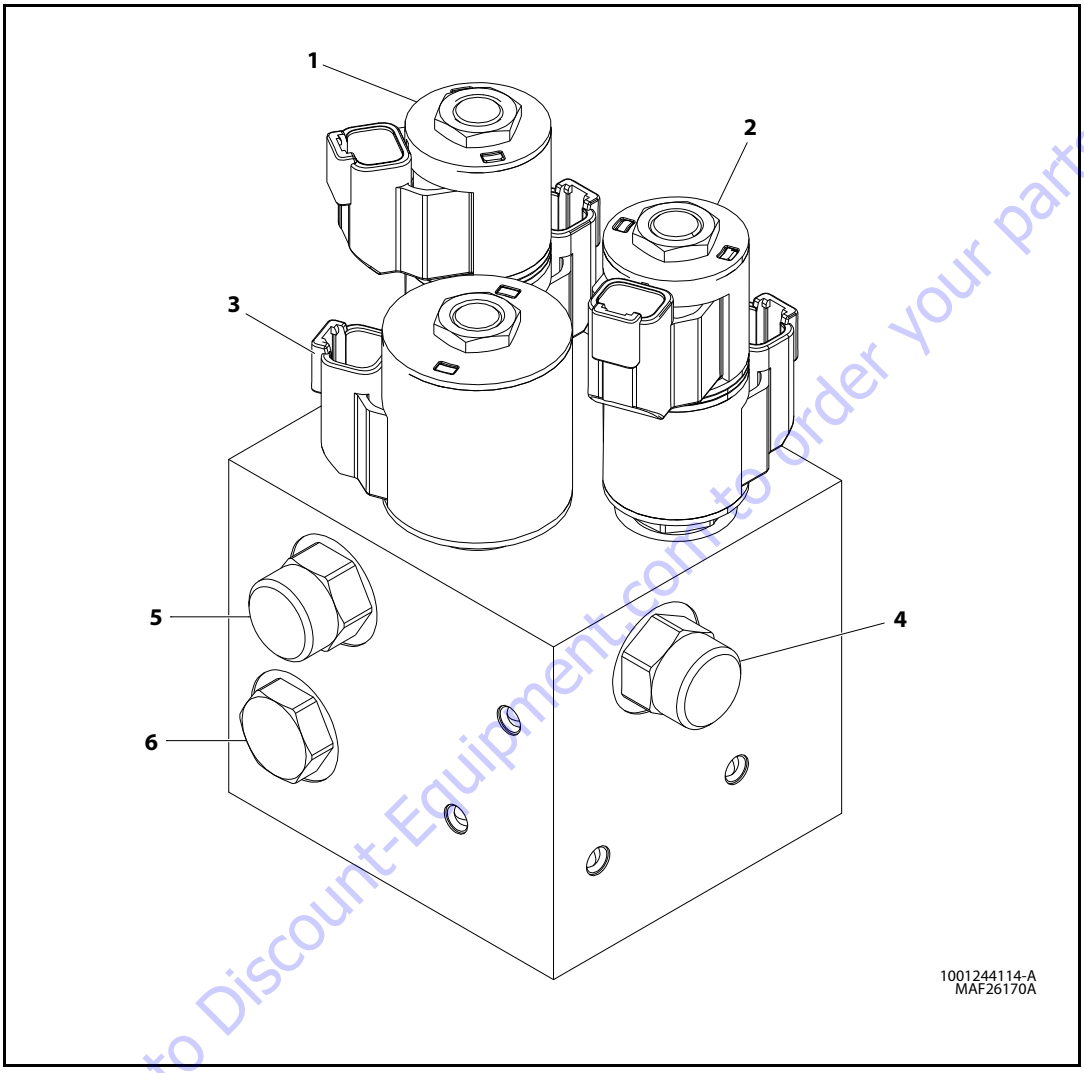
	Ft-Lbs.	Nm
1	33-37	45-50
2	19-21	26-29
3	19-21	26-29
4	14-16	19-22
5	19-21	26-29
6	23-27	31-37
7	33-37	45-50
8	24-26	33-36
9	50-55	68-75
10	19-21	26-29

	Ft-Lbs.	Nm
11	24-26	33-36
12	24-26	33-36
13	50-55	68-75
14	19-21	26-29
15	70-80	95-108
16	33-37	45-50
17	50-55	68-75
18	95-100	129-136
19	23-27	31-37
20	23-27	31-37

Table 5-35. Coil Torque Values

	Ft-Lbs.	Nm
A	5-7	7-10
B	5-7	7-10
C	5-7	7-10

Figure 5-151. 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 5-152. Platform Valve Identification (800S)

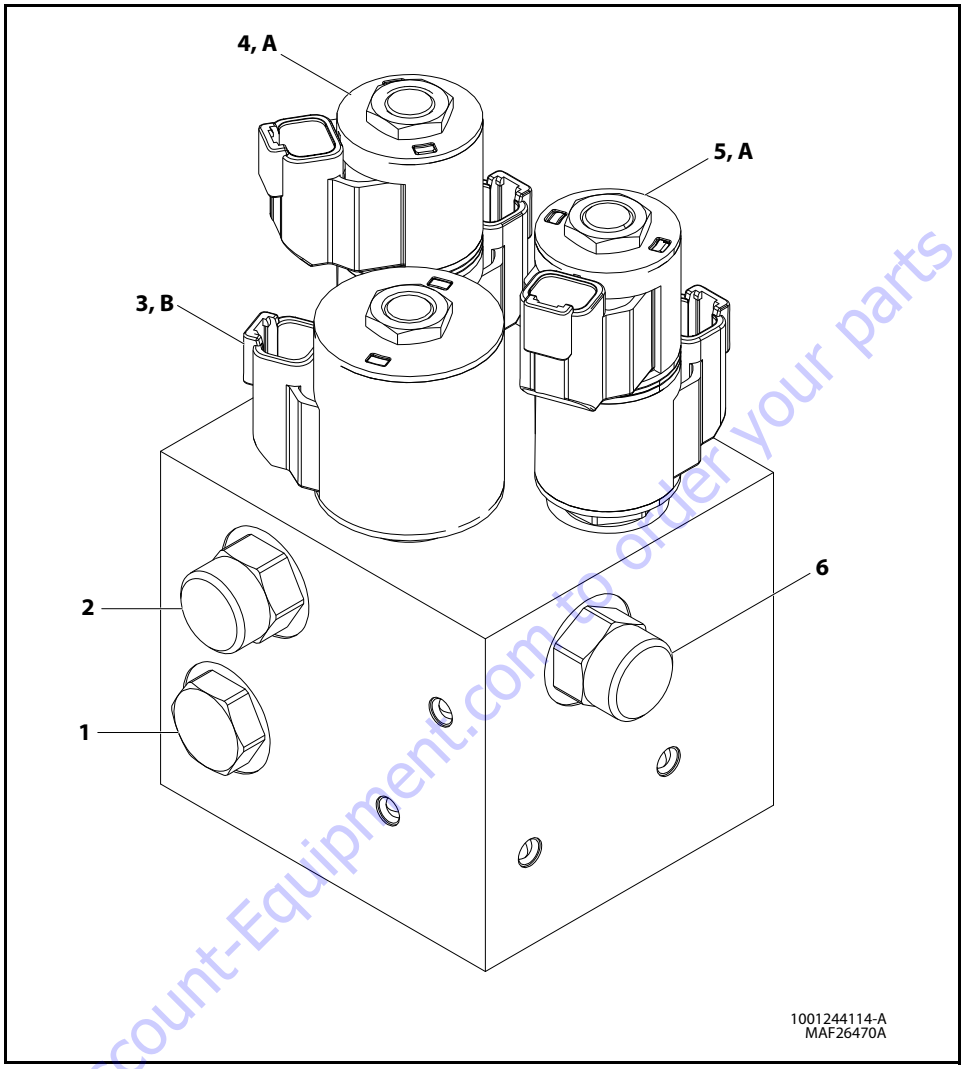


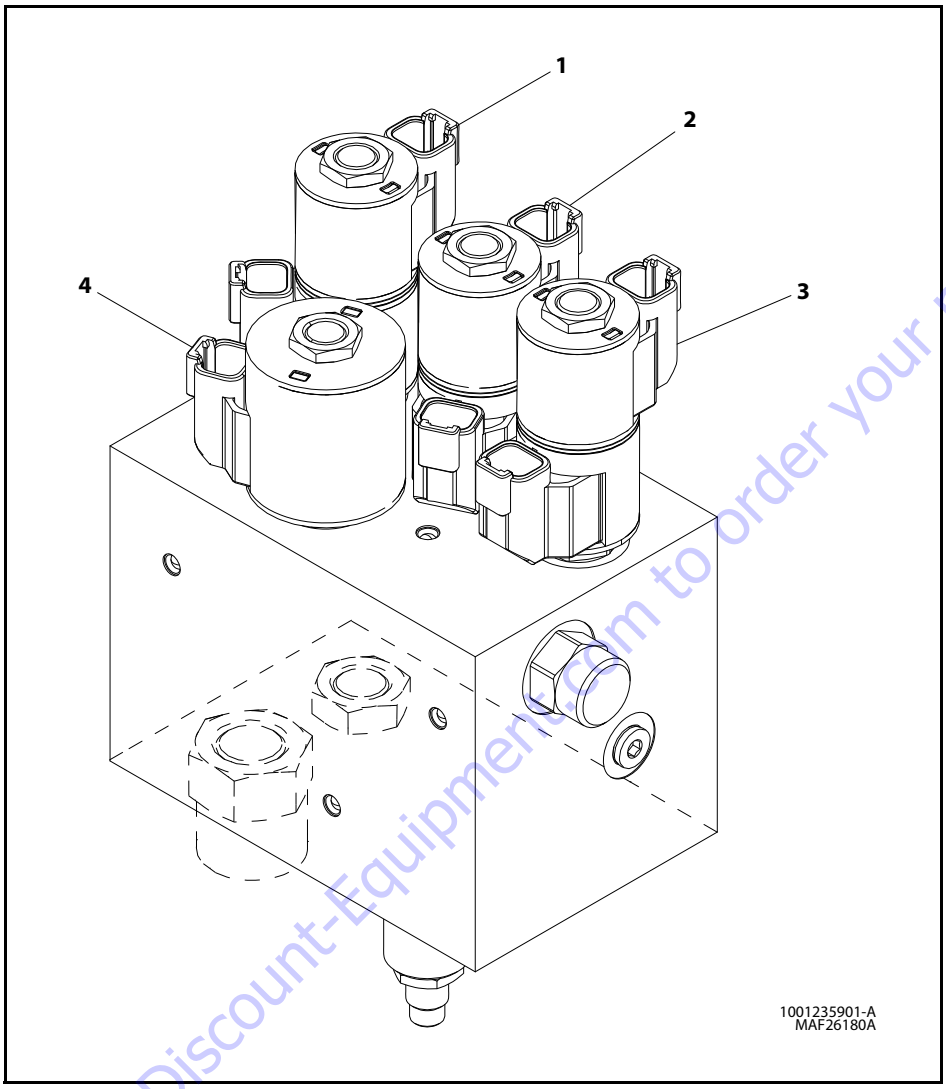
Table 5-36. Cartridge Torque Values

	Ft-Lbs.	Nm
1	NA	NA
2	20	27.1
3	25	33.9
4	20	27.1
5	20	27.1
6	20	27.1

Table 5-37. Coil Torque Values

	Ft-Lbs.	Nm
A	5	6.7
B	6	8

Figure 5-153. 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 5-154. Platform Valve Identification (860SJ)

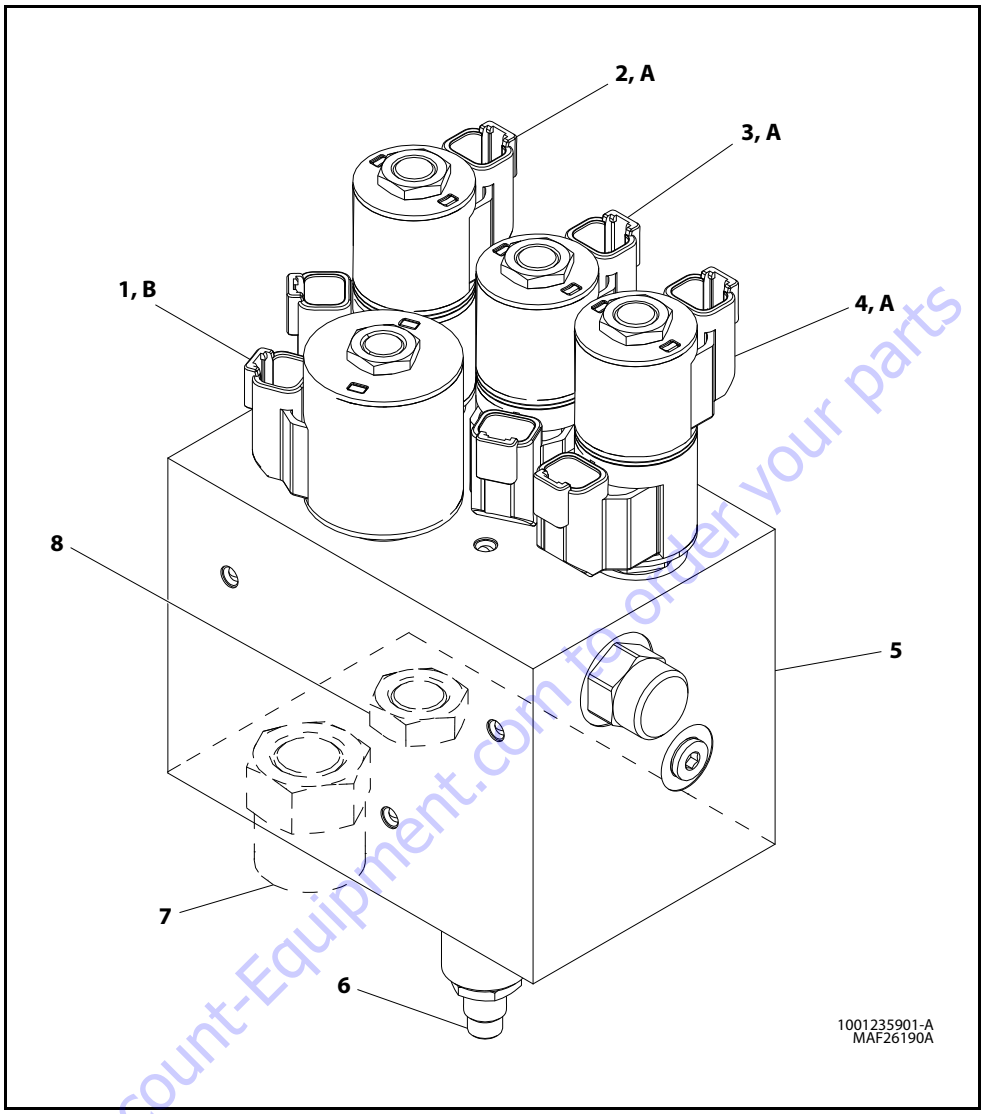


Table 5-38. Cartridge Torque Values

	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 5-155. 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.*

5.6 HYDRAULIC SCHEMATICS

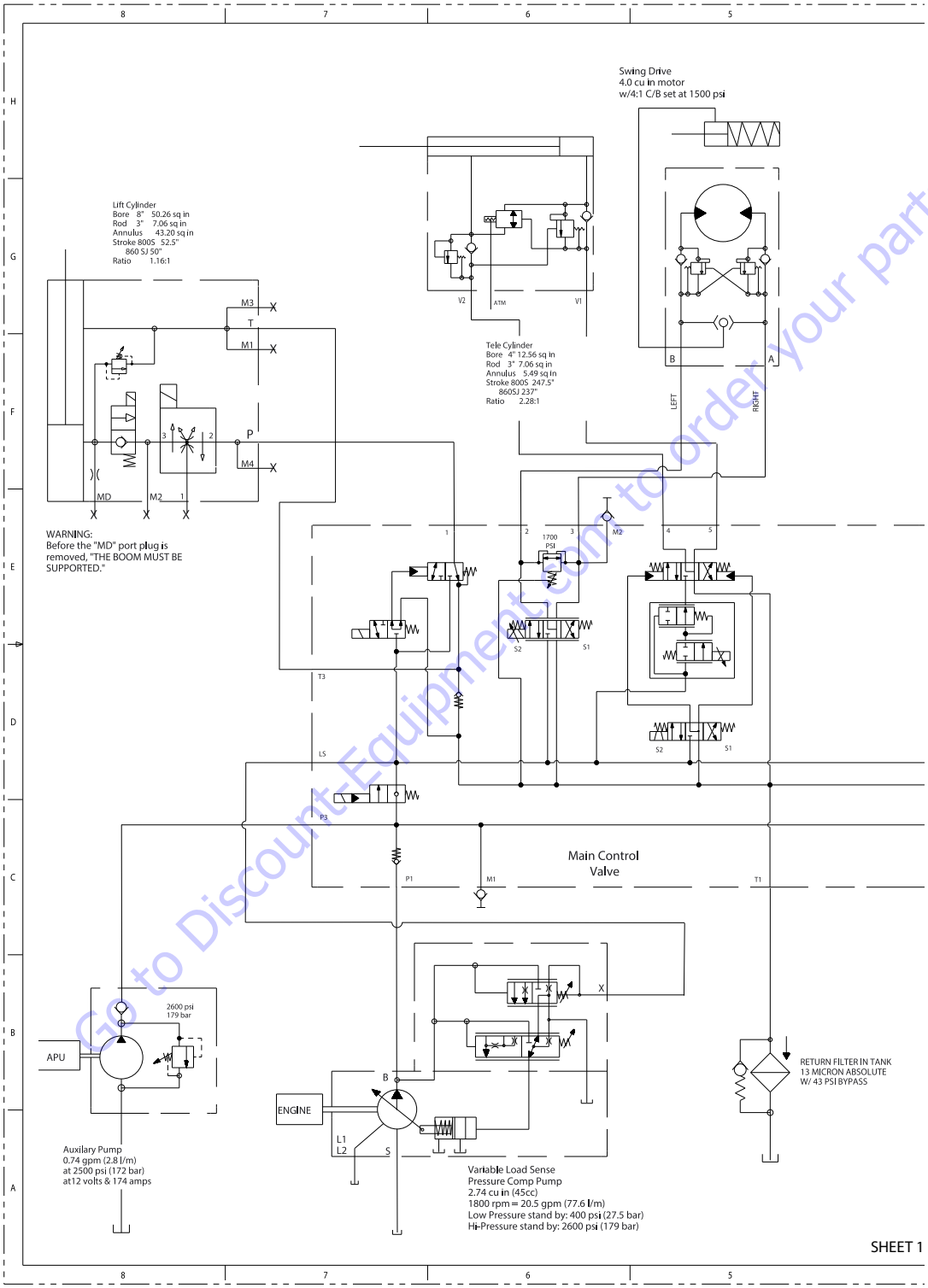


Figure 5-156. Hydraulic Schematic - Sheet 1of 6

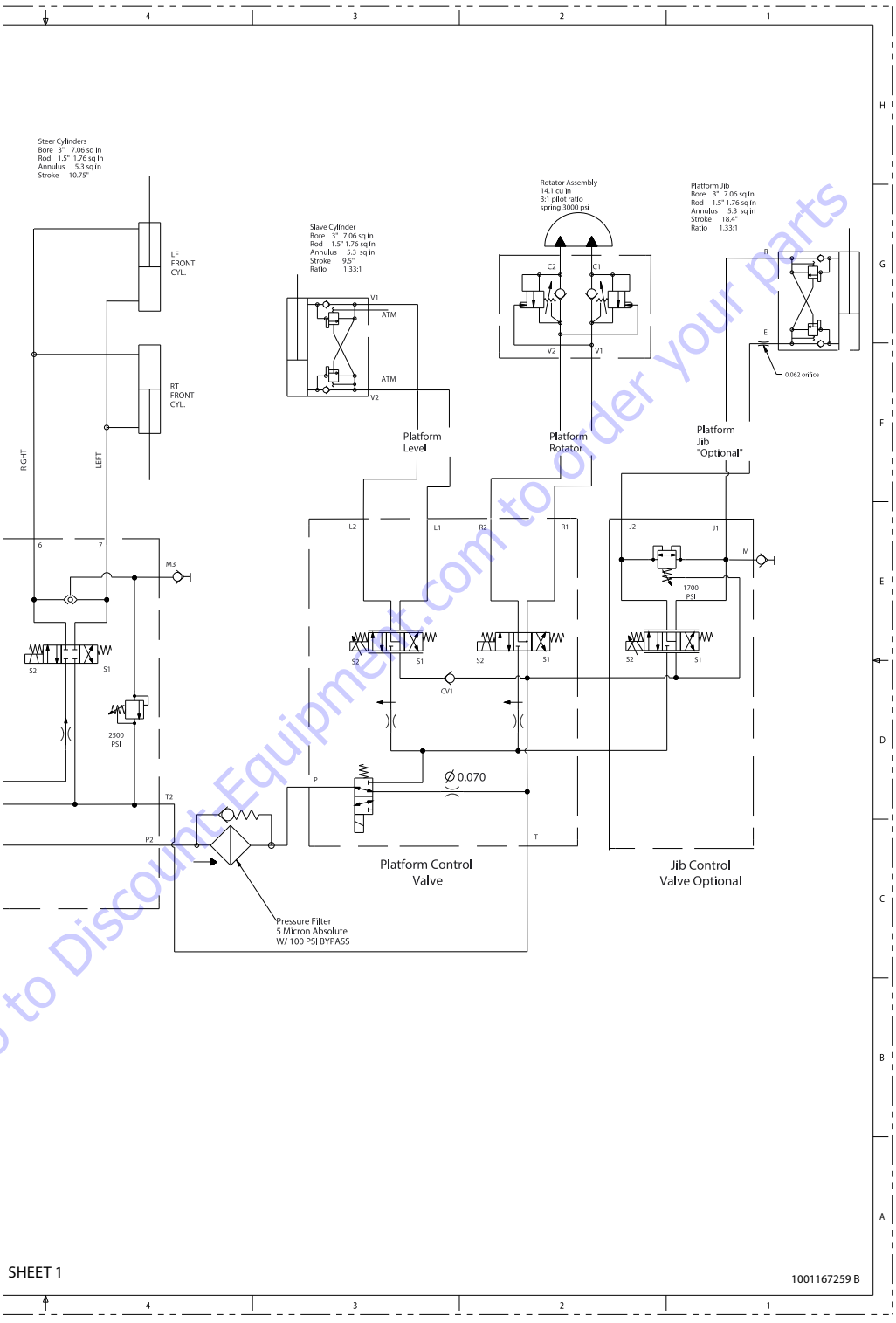


Figure 5-157. Hydraulic Schematic - Sheet 2 of 6

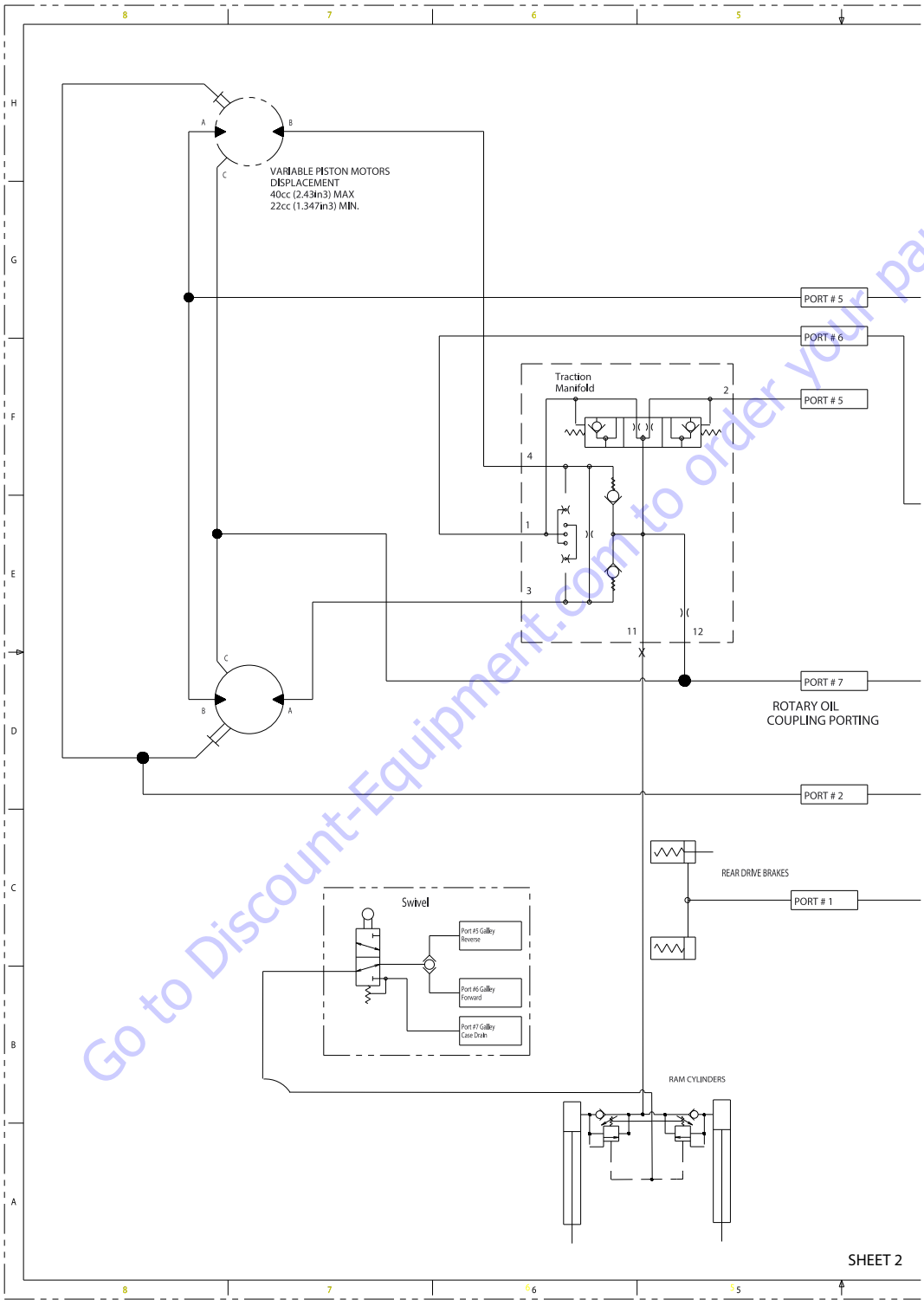


Figure 5-158. Hydraulic Schematic - Sheet 3 of 6

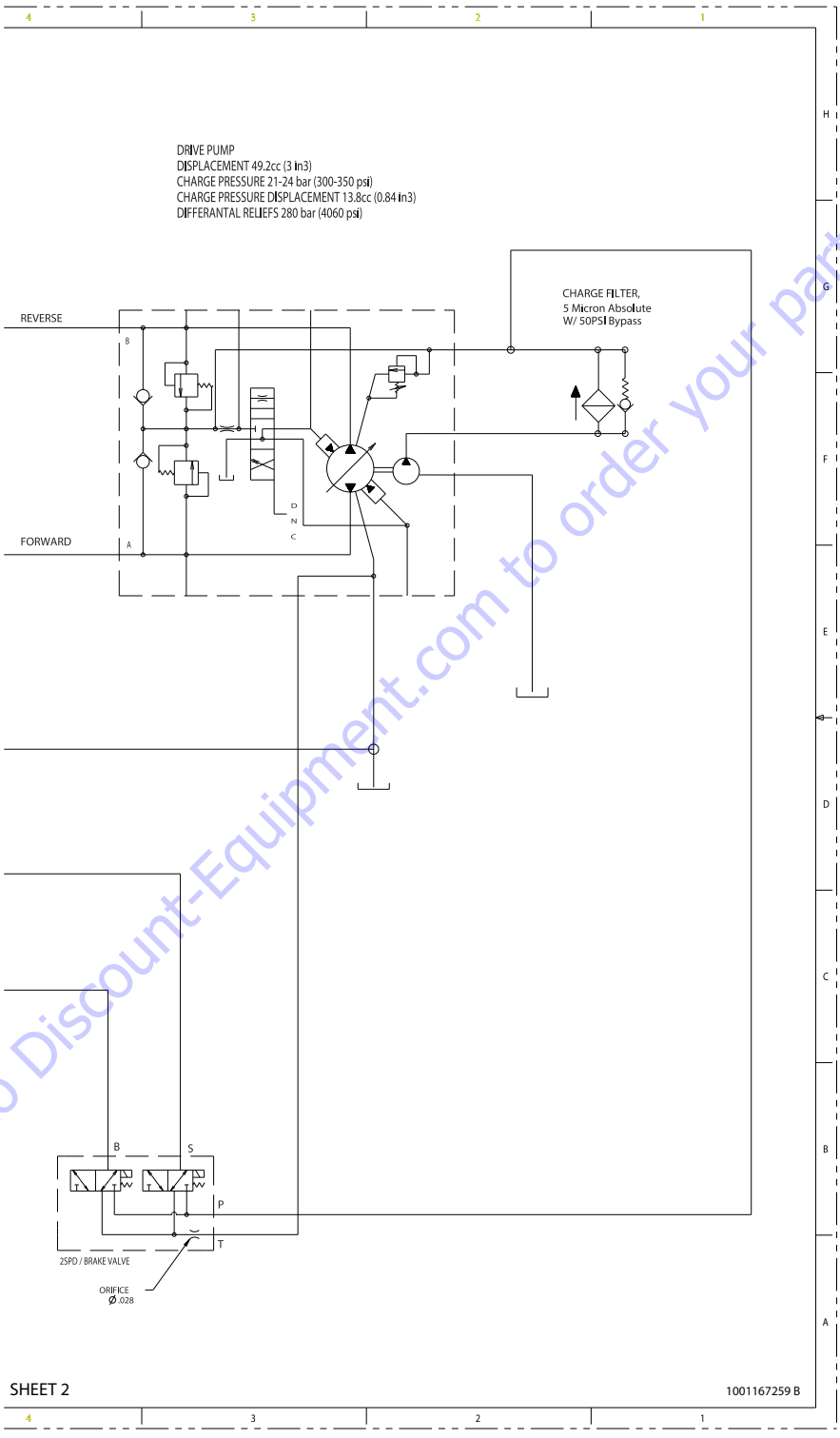


Figure 5-159. Hydraulic Schematic - Sheet 4 of 6

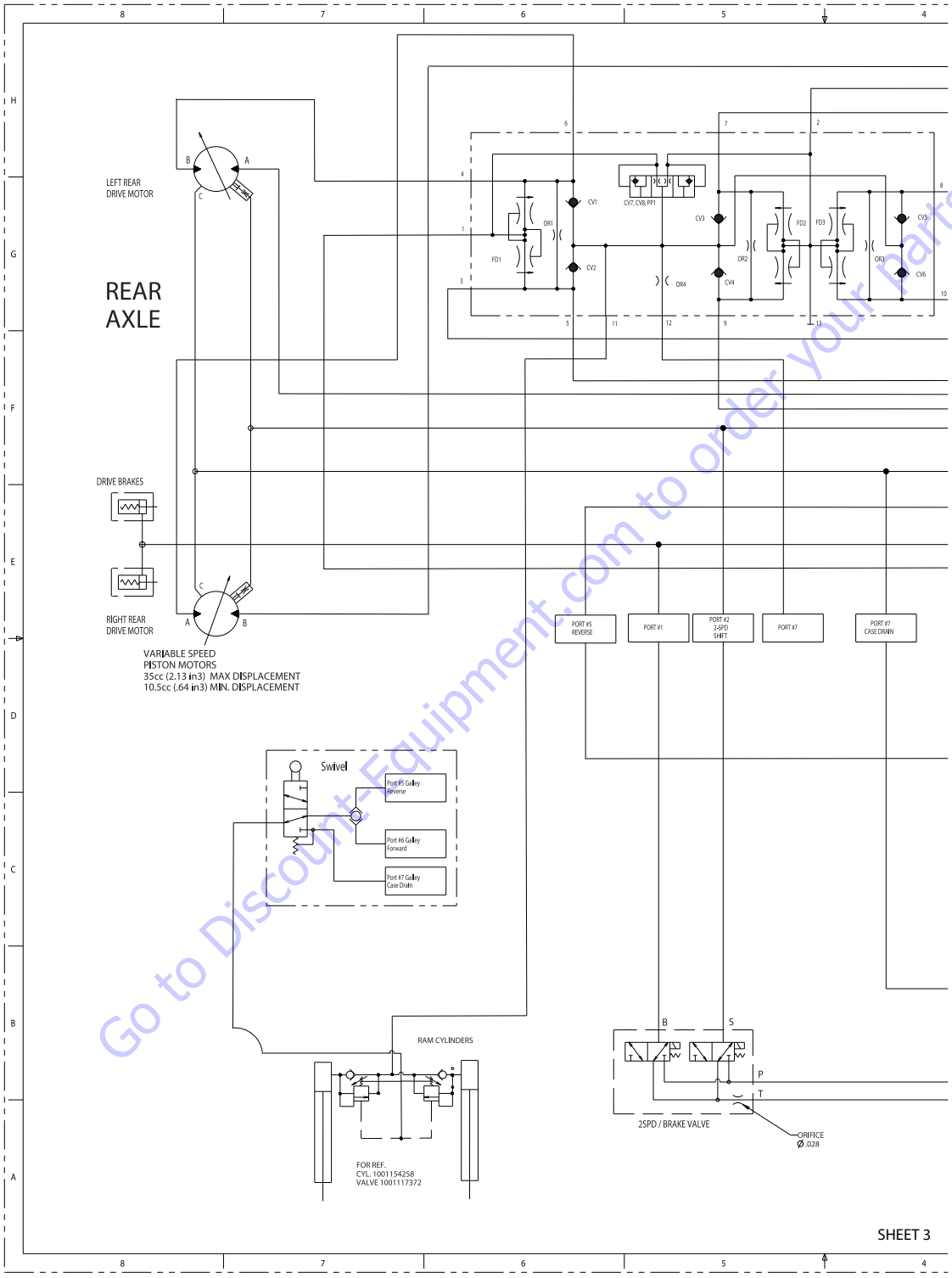


Figure 5-160. Hydraulic Schematic - Sheet 5 of 6

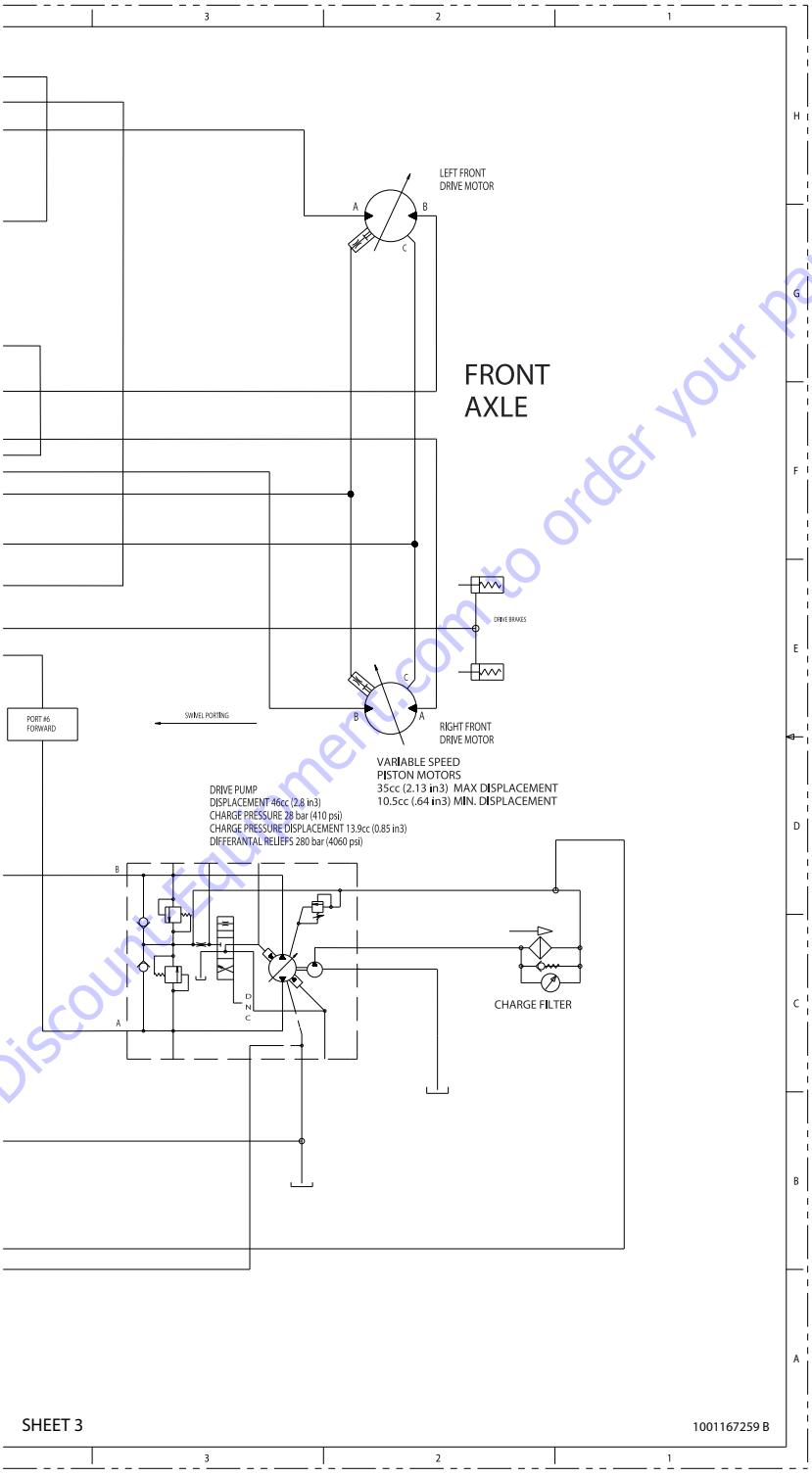


Figure 5-161. Hydraulic Schematic - Sheet 6 of 6

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.

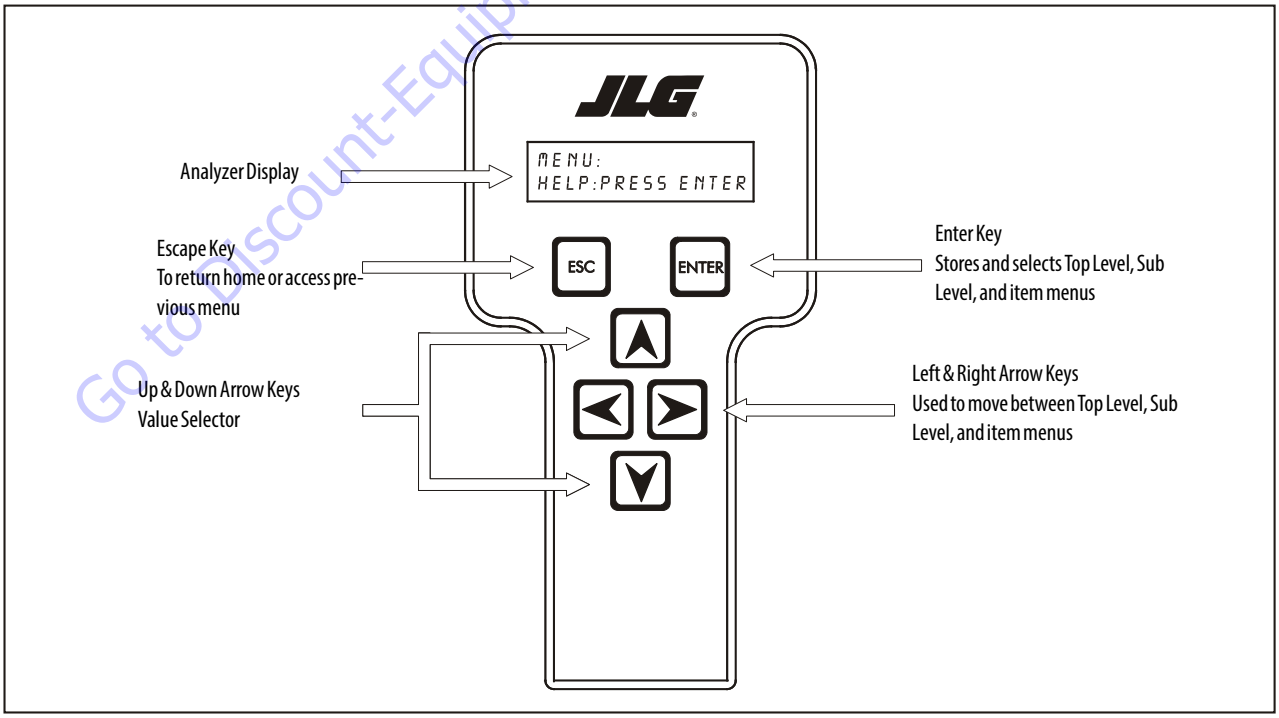


Figure 6-1. Hand Held Analyzer

To Connect the JLG Control System Analyzer

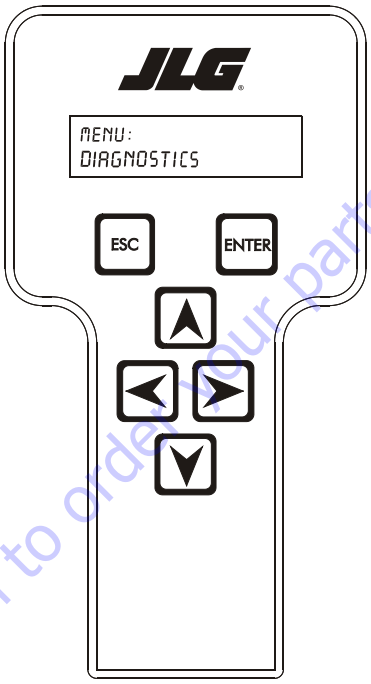
1. Connect one end of the cable, supplied with the analyzer, to the correct four pin connector on the motor control unit; there will be only one connector which correctly fits the cable.
2. Connect the other end of the cable to the analyzer.

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.

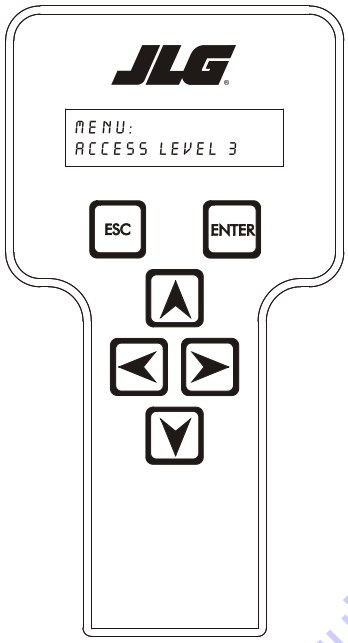
The available menu items will vary depending on the vehicle; check the vehicle manual for more information.

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.

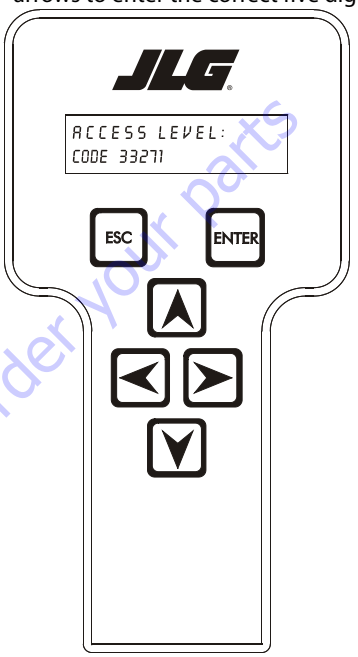
To change the access level, a PASSWORD must be entered; the password must be known.

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:



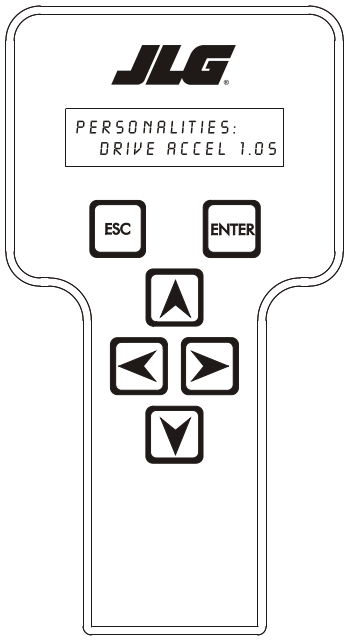
ACCESS LEVEL:
CODE 33271

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:



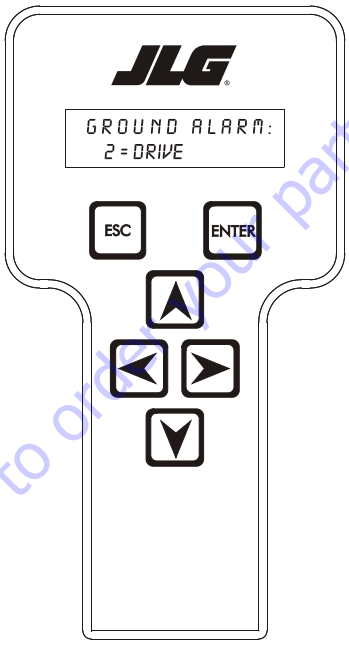
PERSONALITIES:
DRIVE ACCEL 1.0s

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.

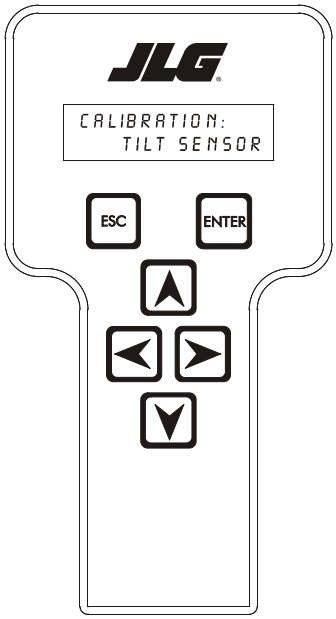
The available personality and machine digit items will vary depending on the vehicle; check the vehicle manual for more information.

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

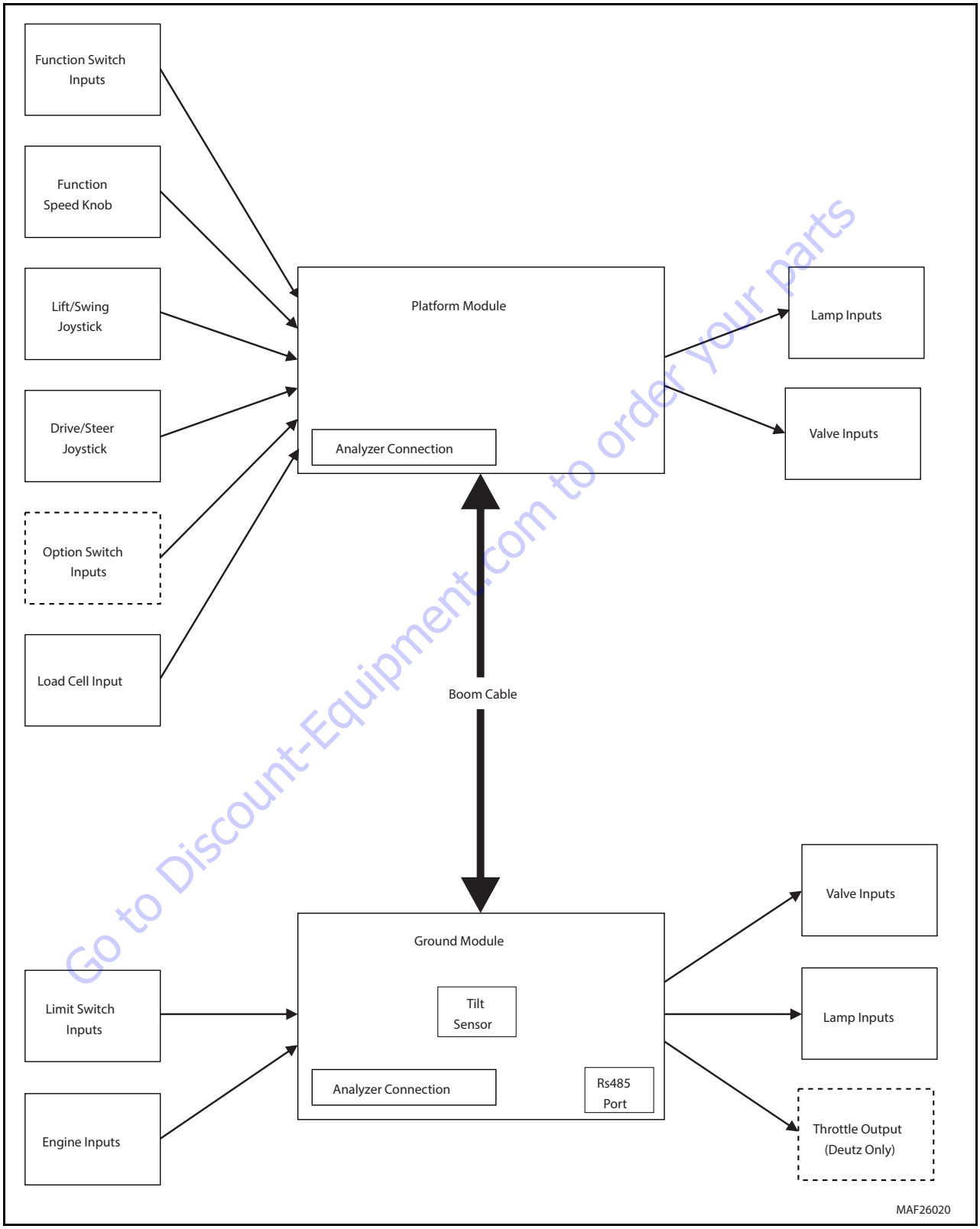


Figure 6-2. ADE Block Diagram

Table 6-2. Machine Configuration Programming Information (Software Version P6.31)

Configuration Label/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: 1	**1**	**600A**	**1**
	2	740A	
	3	800S	
	4	H800A	
MARKET: 2*	**1**	**ANSI USA**	**1**
	2	ANSI EXPORT	
	3	CSA	
	4	CE	
	5	AUSTRALIA	
	6	JAPAN	
	7	GB	
* Certain model selections will limit market options.			

Table 6-2. Machine Configuration Programming Information (Software Version P6.31)

Configuration Label/Digit	Number	Description	Default Number
ENGINE: 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	PERKINS 804C	
	9	DEUTZ F4 TIER2: Deutz F4M2011 Diesel (Tier 2)	
	10	DEUTZ F3 TIER2: Deutz F3M2011 Diesel (Tier 2)	
	11	FORD GAS TIER2: Ford LRG425 EFI Gas (Tier 2)	
	12	FORD D/F TIER2: Ford LRG425 EFI Dual Fuel (Tier 2)	
	13	**DEUTZ ECM: Engine Control Module - ECM (Tier 2 and Tier 3)**	**13**
	14	DUAL FUEL ECM: GM/PSI 3.0L Dual Fuel (Tier 2)	
	15	PERKINS ECM	
	16	CAT ECM T4I	
	17	CAT ECM T4F	
	18	DEUTZ EMR4: Deutz Engine Control Module (Tier 4 Final)	
	19	FORD DUAL FUEL	
	20	KUBOTA D1305	
* Certain model selections will limit engine options. * Certain market selections will limit engine options.			
GLOW PLUG: 4*	1	NO GLOW PLUGS: No glow plugs installed.	
	2	AIR INTAKE: Glow plugs installed in the air intake on the manifold.	
	3	**IN-CYLINDER: Glow plugs installed in each cylinder.**	**3**
* Only visible for diesel engine selections.			

Table 6-2. Machine Configuration Programming Information (Software Version P6.31)

Configuration Label/Digit	Number	Description	Default Number
STARTER LOCKOUT: 5*	**1**	**DISABLED: Automatic pre-glow time determined by ambient air temperature; engine start can be attempted at any time during pre-glow.**	**1**
	2	ENABLED: Automatic pre-glow time determined by ambient air temperature; engine start is NOT permitted until pre-glow is finished.	
* Only visible for diesel engine selections.			
ENGINE SHUTDOWN: 6	1	DISABLED: No engine shutdown.	
	2	**ENABLED: Shutdown engine when coolant temperature is greater than 110 deg. C or the oil pressure is less than 8 PSI.**	**2**
FUEL CUTOUT: 7*	**1**	**RESTART: Engine allowed to be restarted multiple times when very low fuel level is reached**	**1**
	2	ONE RESTART: Engine allowed to be restarted once for 2 minutes when very low fuel level is reached	
	3	ENGINE STOP: Engine not able to restart when very low fuel level is reached	
* Only visible for diesel engine selections.			
TILT: 8*	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.	
	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 DEG + DRV CUT Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also reduces drive speed to creep when drive reversal is allowed, drive is disallowed otherwise.	
	8	**4 DEG + DRV CUT Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also reduces drive speed to creep when drive reversal is allowed, drive is disallowed otherwise.**	**8**
	9	3 DEG + DRV CUT Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also reduces drive speed to creep when drive reversal is allowed, drive is disallowed otherwise.	
* Certain market selections will limit tilt options and alter default setting.			

Table 6-2. Machine Configuration Programming Information (Software Version P6.31)

Configuration Label/Digit	Number	Description	Default Number
JIB: 9*	**1**	**NO: No jib installed.**	**1**
	2	YES: Jib installed which has up and down movements only.	
* Only visible under certain model selections.			
4 WHEEL STEER: 10*	**1**	**NO: No four-wheel steer installed.**	**1**
	2	YES: Four-wheel steer installed.	
* Only visible under certain model selections.			
SOFT TOUCH: 11*	**1**	**NO: No soft touch installed.**	**1**
	2	YES: Soft touch installed	
* Only visible under certain model selections.			
SKYGUARD: 12	1	NO: No SkyGuard installed.	
	2	**BAR/SKYLINE: SkyGuard system installed.**	**2**
	3	SKYEYE: SkyGuard system installed.	
GEN SET/WELDER: 13	**1**	**NO: No generator installed.**	**1**
	2	BELT DRIVE: Belt driven setup.	
GEN SET CUTOUT: 14*	**1**	**MOTION ENABLED: Motion enabled when generator is ON.**	**1**
	2	MOTION CUTOUT: Motion cutout in platform mode only.	
* Only visible if gen set / welder selection is not NO.			
H & T LIGHTS: 15	**1**	**NO: No head and tail lights installed.**	**1**
	2	YES: Head and tail lights installed.	
CABLE SWITCH: 16*	**1**	**NO: No broken cable switch installed.**	**1**
	2	YES: Broken cable switch installed.	
* Only visible under certain model selections.			
LOAD SYSTEM: 17*	1	NO: No load sensor installed.	
	2	WARN ONLY: Functions in creep, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF).	
	3	**CUTOUT PLATFORM: All functions cutout, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF).**	**3**
	4	CUTOUT ALL: All functions cutout, flash overload light (500mS on, 500mS off), platform alarm beeps (5 sec ON, 2 sec OFF).	
* Certain market selections will limit load system options or alter default setting.			

Table 6-2. Machine Configuration Programming Information (Software Version P6.31)

Configuration Label/Digit	Number	Description	Default Number
FUNCTION CUTOUT: 18*	**1**	**NO: No drive cutout.**	**1**
	2	BOOM CUTOUT: Boom function cutout while driving above elevation.	
	3	DRIVE CUTOUT: Drive & steer cutout above elevation.	
* Certain market selections will limit function cutout options or alter default setting.			
GROUND ALARM: 19	1	NO: No ground alarm installed.	
	2	DRIVE: Travel alarm sounds when the drive function is active (Option).	
	3	DESCENT: Descent alarm sounds when lift down is active (Option).	
	4	**MOTION: Motion alarm sounds when any function is active (Option).**	**4**
DRIVE: 20	**1**	**4WD: Four wheel drive.**	**1**
	2	2DW: 2 wheel drive	
	3	2WD W/ 2-SPEED: Two wheel drive with 2-speed valve.	
DISPLAY UNITS: 21*	**1**	**IMPERIAL: DEG F, PSI, LB**	**1**
	2	METRIC: DEG C, KPA, KGS	
* Certain market selections will alter default setting.			
LEVELING MODE: 22*	**1**	**ALL FUNCTIONS: Platform level with all functions.**	**1**
	2	LEVEL LIFT/TELESCOPE: Platform level on lift and telescope only.	
* Only visible under certain model selections.			
DRIVE CONTROL: 23*	1	NORMAL: Drive coils are energized from the Ground Module.	
	2	PROPULSION: Drive coils are energized from the Propulsion Module.	
	3	**ENHANCED: Drive coils are energized from the Ground Module and the ground side of the drive coils are brought back to current feedback returns.**	**3**
* Only visible under certain model selections.			
DRIVE PUMP: 24*	**1**	**SAUER DANFOSS: Machine equiped with Sauer Danfoss drive pump.**	**1**
	2	EATON: Machine equipped with Eaton drive pump .	
	3	M46-XXXX: Machine equiped with M46-XXXX drive pump.	
	4	830XXXXX: Machine equiped with 830XXXXX: drive pump.	
* Only visible under certain model selections.			

Table 6-2. Machine Configuration Programming Information (Software Version P6.31)

Configuration Label/Digit	Number	Description	Default Number
BOOM CONTROL: 25*	1	NORMAL: Boom function coils are energized from the Ground Module	
	2	**ENHANCED: Boom function are energized from the Ground Module and the ground side of the drive coils are brought back to current feedback returns**	**2**
* Only visible under certain model selections.			
CLEARSKY: 26	**1**	**NO: ClearSky (telematics) options is disabled.**	**1**
	2	YES: ClearSky (telematics) option is enabled.	
CRIBBING OPTION: 27*	**1**	**NO: Cribbing Option is disabled.**	**1**
	2	YES: Cribbing Option is enabled.	
* Only visible under certain model selections.			
FUEL TANK SIZE: 28*	**1**	**31 Gallon Tank**	**1**
	0	52 Gallon Tank	
* Only visible under certain model selections.			
ALARM / HORN: 29	1	SEPARATE: Separate alarm and horn.	
	2	**COMBINED: Combination alarm / horn.**	**2**
ALERT BEACON: 30	**1**	**OFF FOR CREEP: Alert beacon will not flash while in Creep**	**1**
	2	20FPS FOR CREEP: Alert beacon will flash at 20FPS while in Creep	
TEMP CUTOUT: 31*	**1**	**NO: Temp Cutout is Disabled**	**1**
	2	YES: Temp Cutout is Enabled	
* Certain model selections will limit temp cutout options.			
PLAT LVL OVR CUT 32	**1**	**NO: Platform Level Override will always be functional**	**1**
	2	YES: Platform Level Override will only be functional when In Transport	
WATER IN FUEL SENSOR: 33*	**1**	**NO: Water in Fuel Sensor Disabled**	**1**
	2	YES: Water in Fuel Sensor Enabled	
* Only visible if engine selection is Deutz EMR4.			
CAPACITY 34*	**1**	**SINGLE: Single Capacity system installed**	**1**
	2	DUAL: Dual Capacity system installed	
	3	TRIPLE: Triple Capacity system installed	
* Only visible under certain model selections.			

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Table 6-3. 800S Machine Configuration Programming Settings (Software Version P6.31)

800 S	ANSI USA	ANSI Export	CSA	CE	Australia	Japan	GB
Model Number	**3**	**3**	**3**	**3**	**3**	**3**	**3**
Market	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Engine	**13**	**13**	**13**	**13**	**13**	**13**	**13**
Glow Plug	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
	3	**3**	**3**	**3**	**3**	**3**	**3**
Starter Lockout	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Engine Shut-down	1	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**	**2**
Fuel Cutout	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
	3	3	3	3	3	3	3
Tilt	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
	4	4	4	4	4	4	4
	5	5	5	5	5	5	5
	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
	8	**8**	**8**	**8**	**8**	**8**	**8**
	9	9	9	9	9	9	9
Jib	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
4 Wheel Steer	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Soft Touch	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
SkyGuard	1	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**	**2**
	3	3	3	3	3	3	3
Gen Set / Welder	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Gen Set Cutout	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Head & Tail-lights	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Cable Switch	1	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**	**2**
Load System	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
	3	**3**	**3**	X	**3**	**3**	**3**
	4	4	4	**4**	X	4	4

Table 6-3. 800S Machine Configuration Programming Settings (Software Version P6.31)

800 S	ANSI USA	ANSI Export	CSA	CE	Australia	Japan	GB
Function Cut-out	**1**	**1**	**1**	1	**1**	**1**	**1**
	X	2	2	**2**	2	2	2
	3	3	3	X	3	3	3
Ground Alarm	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
	3	3	3	3	3	3	3
	4	**4**	**4**	**4**	**4**	**4**	**4**
Drive	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
	3	3	3	3	3	3	3
Display Units	**1**	**1**	1	1	1	1	1
	2	2	**2**	**2**	**2**	**2**	**2**
Leveling Mode	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Drive Control	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
	3	**3**	**3**	**3**	**3**	**3**	**3**
Drive Pump	1	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**	**2**
	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
Boom Control	X	X	X	X	X	X	X
	2	**2**	**2**	**2**	**2**	**2**	**2**
ClearSky	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Cribbing Option	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Fuel Tank Size	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Alarm / Horn	1	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**	**2**
Alert Beacon	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Temp Cutout	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	X	2	X	2	X	X	2
Plat Lvl Ovr Cut	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Water In Fuel Sensor	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Capacity	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
	3	3	3	3	3	3	3

BOLD TEXT indicates the default setting. Plain text indicates another available selection. SHADED CELLS indicate hidden menus or selections.

Table 6-4. 860SJ Machine Configuration Programming Settings (Software Version P6.31)

860 SJ	ANSI USA	ANSI Export	CSA	CE	Australia	Japan	GB
Model Number	**3**	**3**	**3**	**3**	**3**	**3**	**3**
Market	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Engine	**13**	**13**	**13**	**13**	**13**	**13**	**13**
Glow Plugs	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
	3	**3**	**3**	**3**	**3**	**3**	**3**
Starter Lockout	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Engine Shut-down	1	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**	**2**
Fuel Cutout	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
	3	3	3	3	3	3	3
Tilt	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
	4	4	4	4	4	4	4
	5	5	5	5	5	5	5
	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
	8	**8**	**8**	**8**	**8**	**8**	**8**
	9	9	9	9	9	9	9
Jib	1	1	1	1	1	1	1
	2	***2***	***2***	***2***	***2***	***2***	***2***
4 Wheel Steer	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Soft Touch	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
SkyGuard	1	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**	**2**
	3	3	3	3	3	3	3
Gen Set / Welder	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Gen Set Cutout	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Head & Tail-lights	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Cable Switch	1	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**	**2**
Load System	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
	3	**3**	**3**	X	**3**	**3**	**3**
	4	4	4	**4**	X	4	4

Table 6-4. 860SJ Machine Configuration Programming Settings (Software Version P6.31)

860 SJ	ANSI USA	ANSI Export	CSA	CE	Australia	Japan	GB
Function Cut-out	**1**	**1**	**1**	1	**1**	**1**	**1**
	X	2	2	**2**	2	2	2
	3	3	3	X	3	3	3
Ground Alarm	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
	3	3	3	3	3	3	3
	4	**4**	**4**	**4**	**4**	**4**	**4**
Drive	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
	3	3	3	3	3	3	3
Display Units	**1**	**1**	1	1	1	1	1
	2	2	**2**	**2**	**2**	**2**	**2**
Leveling Mode	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Drive Control	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
	3	**3**	**3**	**3**	**3**	**3**	**3**
Drive Pump	1	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**	**2**
	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
Boom Control	X	X	X	X	X	X	X
	2	**2**	**2**	**2**	**2**	**2**	**2**
ClearSky	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Cribbing Option	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Fuel Tank Size	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Alarm / Horn	1	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**	**2**
Alert Beacon	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Temp Cutout	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	X	2	X	2	X	X	2
Plat Lvl Ovr Cut	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Water In Fuel Sensor	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
Capacity	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2	2
	3	3	3	3	3	3	3

BOLD TEXT indicates the default setting. Plain text indicates another available selection. ***RED ITALIC*** text indicates the required selection for machine model. SHADED CELLS indicate hidden menus or selections.

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.*

NOTE: *GROUND MODE speeds are automatically limited to being lower than platform speed for a given function.*

NOTE: *Set personalities in the following order: creep speeds, platform speeds, and then ground speeds.*

Table 6-5. Machine Personality Settings and Function Speeds (Software Version P6.31)

FUNCTION	PERSONALITY	RANGE	DANFOSS		EATON	
			DEFAULTS-800S	DEFAULTS-860SJ	DEFAULTS-800S	DEFAULTS-860SJ
DRIVE	Acceleration	0.0-5.0 sec	2.0	2.0	2.0	2.0
	Deceleration	0.0-3.0 sec	2.0	2.0	2.0	2.0
	Forward Minimum speed	1-35%	4	4	15	15
	Forward Maximum speed	1-100%	30	30	53	53
	Reverse Minimum speed	1-35%	4	4	15	15
	Reverse Maximum speed	1-100%	30	30	53	53
	Elevated Maximum speed	1-100%	20	20	28	28
	Creep Maximum speed	1-90%	20	20	30	30
STEER	Maximum speed	1 to 100%	100	100	100	100
MAIN LIFT	Acceleration	0.0-5.0 sec	2.5	2.5	2.5	2.5
	Deceleration	0.0-3.0 sec	1.5	1.5	1.5	1.5
	Minimum Up speed	1-60%	15	15	15	15
	Maximum Up speed	1-100%	80	80	80	80
	Creep maximum Up speed	1-65%	30	30	30	30
	Minimum Down speed	1-60%	15	15	15	15
	Maximum down speed	1-100%	80	80	80	80
	Creep Maximum down speed	1-75%	30	30	30	30
	Soft Up	1-75%	70	70	70	70
	Soft Down	1-75%	75	75	75	75
SWING	Acceleration	0.0-5.0 sec	2.8	2.8	2.8	2.8
	Deceleration	0.0-3.0 sec	1.7	1.7	1.7	1.7
	Minimum Left speed	1-50%	14	14	14	14
	Maximum Left speed	1-100%	65	65	65	65
	Creep Maximum Left speed	1-65%	43	43	43	43
	Minimum Right speed	1-50%	14	14	14	14
	Maximum Right speed	1-100%	68	68	68	68
	Creep Maximum Right speed	1-65%	49	49	49	49
MAIN TELESCOPE	Acceleration	0.0-5.0 sec	3.5	3.5	3.5	3.5
	Deceleration	0.0-3.0 sec	1.0	1.0	1.0	1.0
	Minimum IN speed	1-65%	24	24	24	24
	Maximum IN speed	1-100%	63	63	63	63
	Minimum OUT speed	1-65%	26	26	26	26
	Maximum OUT speed	1-100%	65	65	65	65

Table 6-5. Machine Personality Settings and Function Speeds (Software Version P6.31)

FUNCTION	PERSONALITY	RANGE	DANFOSS		EATON	
			DEFAULTS-800S	DEFAULTS-860SJ	DEFAULTS-800S	DEFAULTS-860SJ
PLATFORM LEVEL	Acceleration	0.0-5.0 sec	0.1	0.1	0.1	0.1
	Deceleration	0.0-3.0 sec	0.1	0.1	0.1	0.1
	Minimum Up speed	1-65%	48	48	48	48
	Maximum Up speed	1-100%	100	100	100	100
	Minimum Down speed	1-65%	48	48	48	48
	Maximum Down speed	1-100%	100	100	100	100
PLATFORM ROTATE	Acceleration	0.0-5.0 sec	0.1	0.1	0.1	0.1
	Deceleration	0.0-3.0 sec	0.1	0.1	0.1	0.1
	Minimum Left speed	1-65%	69	69	69	69
	Maximum Left speed	1-100%	90	90	90	90
	Minimum Right speed	1-65%	69	69	69	69
	Maximum Right speed	1-100%	90	90	90	90
JIB LIFT	Acceleration	0.0-5.0 sec	3.3	3.3	3.3	3.3
	Deceleration	0.0-3.0 sec	0.8	0.8	0.8	0.8
	Minimum Up speed	1-65%	43	43	43	43
	Maximum Up speed	1-100%	80	80	80	80
	Minimum Down	1-65%	40	40	40	40
	Maximum Down	1-100%	75	75	75	75
GROUND MODE	Tower Lift Up speed	1-100%	N/A	N/A	N/A	N/A
	Tower Lift Down speed	1-100%	N/A	N/A	N/A	N/A
	Main Lift Up speed	1-100%	63	63	63	63
	Main Lift down speed	1-100%	63	63	63	63
	Swing Left speed	1-100%	64	64	64	64
	Main Telescope speed	1-100%	62	62	62	62
	Tower Telescope speed	1-100%	N/A	N/A	N/A	N/A
	Platform Rotate speed	1-100%	89	89	89	89
	Platform Level speed	1-100%	99	99	99	99
	Jib Lift speed	1-100%	79	79	79	79

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6.3 MACHINE ORIENTATION WHEN DOING SPEED TESTS

Tower Lift: Upper Boom horizontal, telescope retracted. Tower Lift Up, record time. Tower Lift Down, record time. Turn Platform Speed Control Knob fully counterclockwise to enter Creep mode; Creep light on Panel must be energized. Verify that machine will Tower Up and Down. Return Knob to fully clockwise.

Main Lift: Tower lift fully elevated, tower telescope fully extended, Main Telescope fully retracted. Main Lift Up, record time. Main Lift Down, record time. Turn Platform Speed Control Knob fully counterclockwise to enter Creep mode; Creep light on Panel must be energized. Verify that machine will Lift Up and Down. Return Knob to fully clockwise.

Swing: Boom at full elevation, Telescope retracted. Swing Right until over rear axle or end stop (if equipped). To eliminate effect of controller rampup/down, record time starting, while swinging, as turntable is centered. Swing Left 360° or end stop (if equipped), record time. Swing Right 360° or end stop (if equipped), record time. Turn Platform Speed Control Knob fully counterclockwise to enter Creep mode; Creep light on Panel must be energized. Verify that machine will swing left and right. Return Knob to fully clockwise.

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

Tower Telescope: Tower lift fully elevated, upper boom horizontal, telecsope retracted. Telescope out, record time. Telescope in, record time. Turn Platform Speed Control Knob fully counterclockwise to enter Creep mode; Creep light on Panel must be energized. Verify that machine will Jib Lift Up and Down. Return Knob to fully clockwise.

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

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

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

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

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

Test Notes

1. Stop watch should be started with the function movement, not with actuation of joystick 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) unless noted.
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 platform speed control knob clicked into the creep position.
6. Drive speeds should be set to the values below regardless of the tire size.

Table 6-6. Function Speeds (In Seconds)

Function	800S	860SJ
Lift Up	59-75	56-73
Lift Down	57-75	56-75
Swing Right & Left*	110-135	110-135
NOTE: *No more than 10% difference between swing left and swing right.*		
Telescope Out	59-65	56-65
Telescope In	45-57	44-60
Platform Rotate Right & Left**	18-30	18-30
NOTE: *No more than 15% difference between rotate left and rotate right.*		
Jib Up	N/A	33-47
Jib Down	N/A	29-39
Drive (Forward)	33-45	33-45
Drive (Reverse)	33-45	33-45
Drive (Elevated)	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).

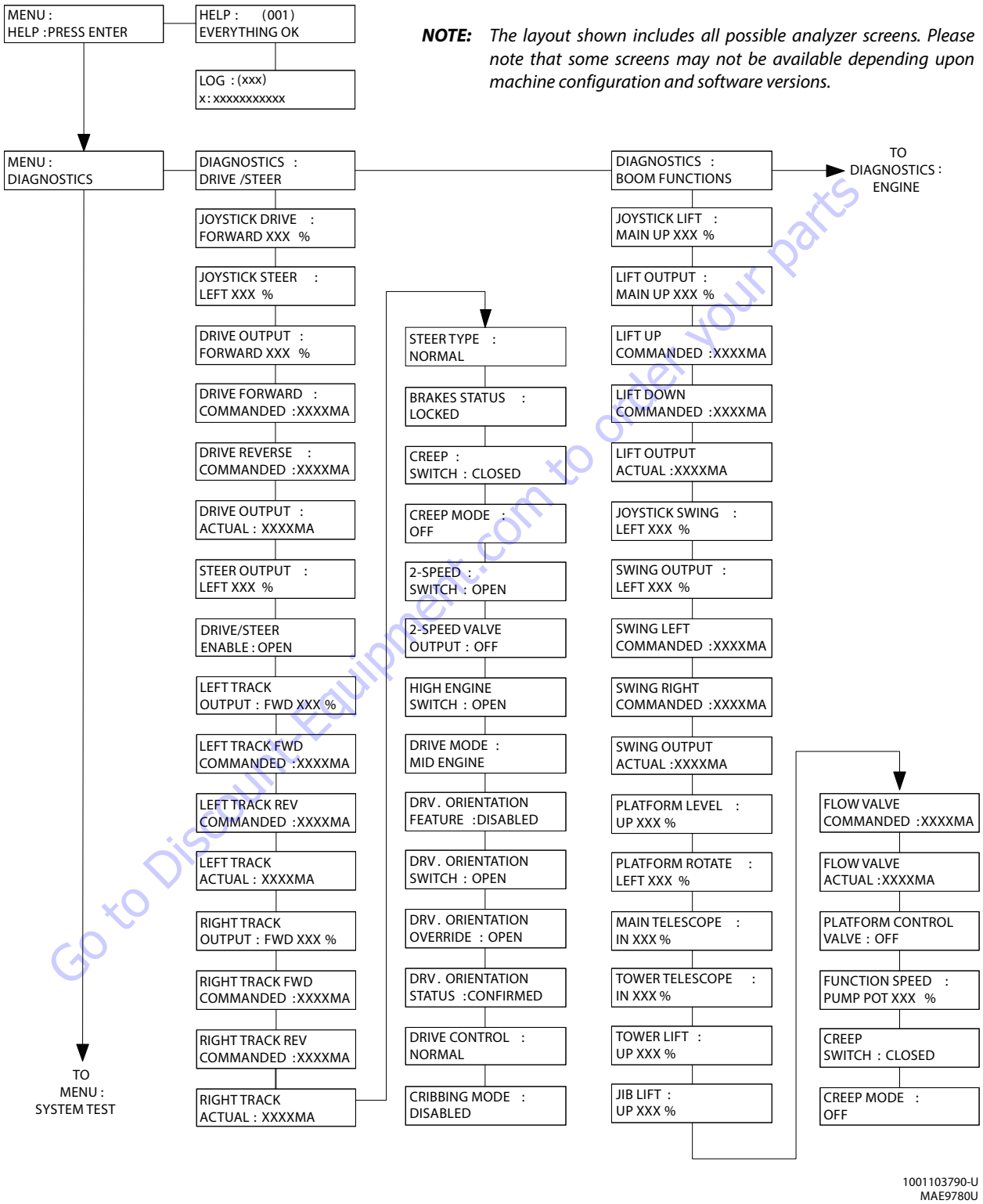
Interlocks: Any device that sends an electrical input. (For an example a limit switch, proximity switch, etc).

Platform Level: 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.

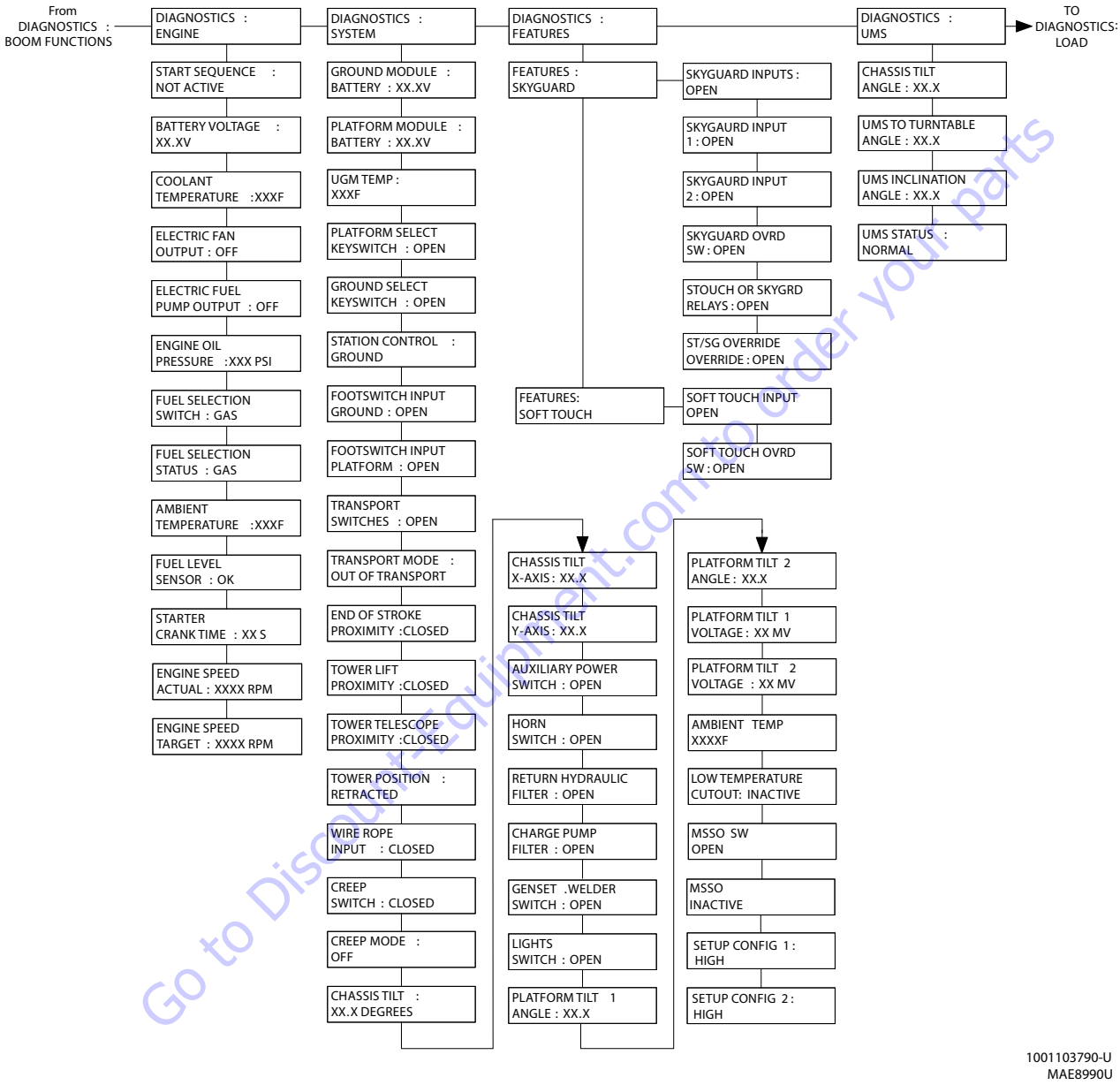
Drive: The GROUND MODULE stores crack points, sends commands for each drive pump. (Command is computed from drive joystick input, interlocks, wheel angle, etc).

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.



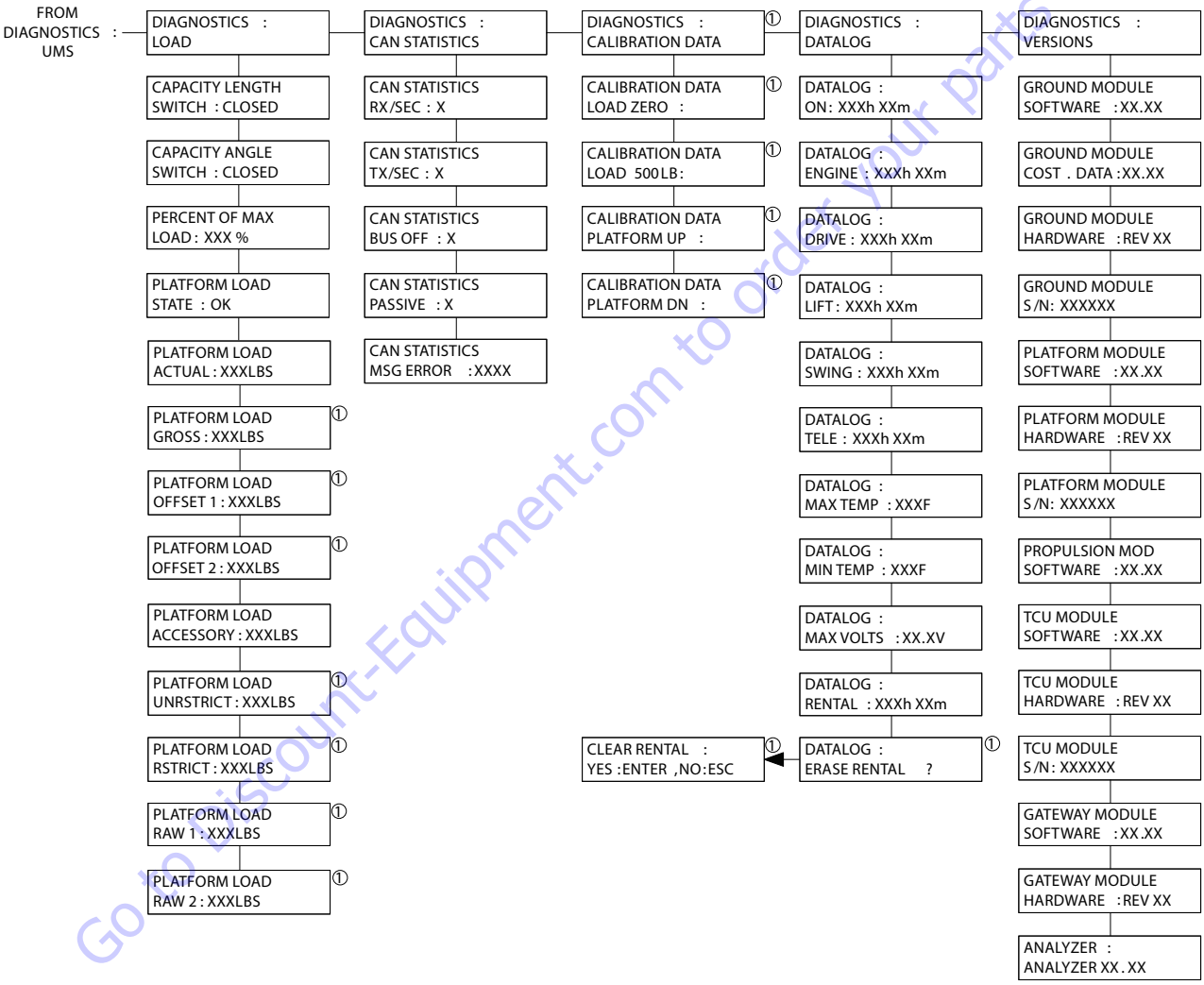
NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration and software versions.*

Figure 6-3. Analyzer Flow Chart - Diagnostics (Software Version P6.30) - Sheet 1 of 7



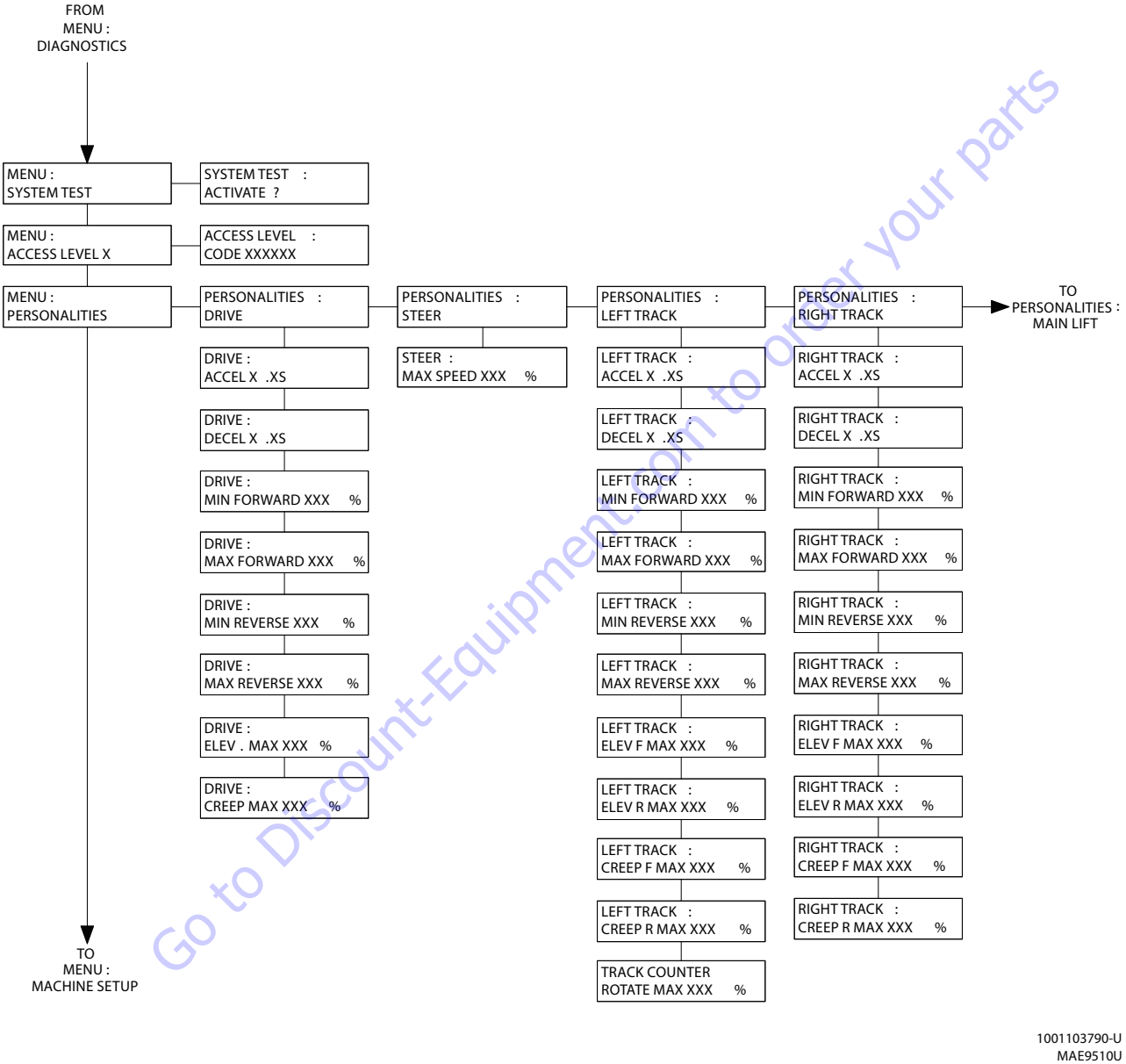
NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration and software versions.*

Figure 6-4. Analyzer Flow Chart - Diagnostics (Software Version P6.30) - Sheet 2 of 7



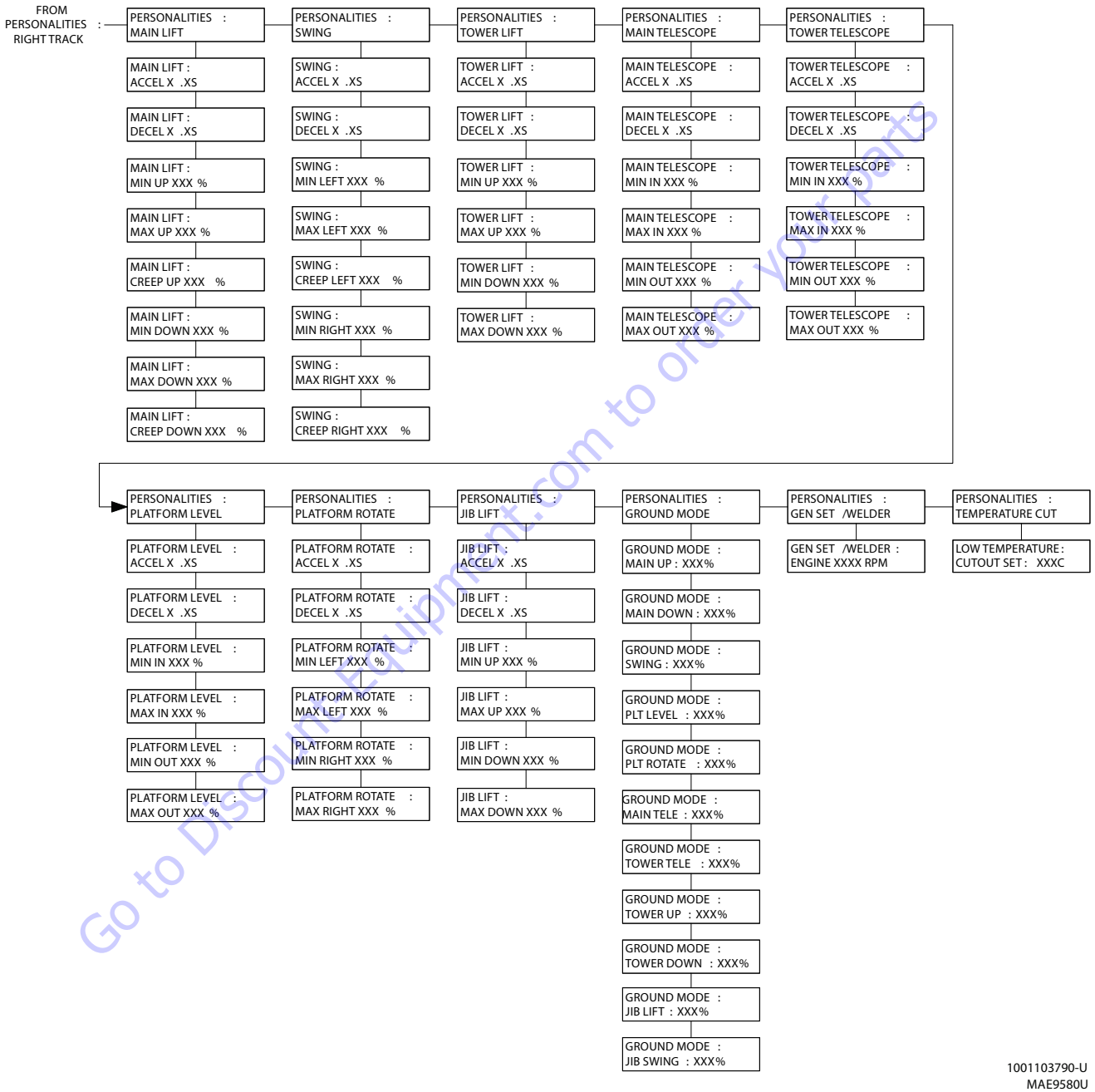
NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration and software versions.*

Figure 6-5. Analyzer Flow Chart - Diagnostics (Software Version P6.30) - Sheet 3 of 7



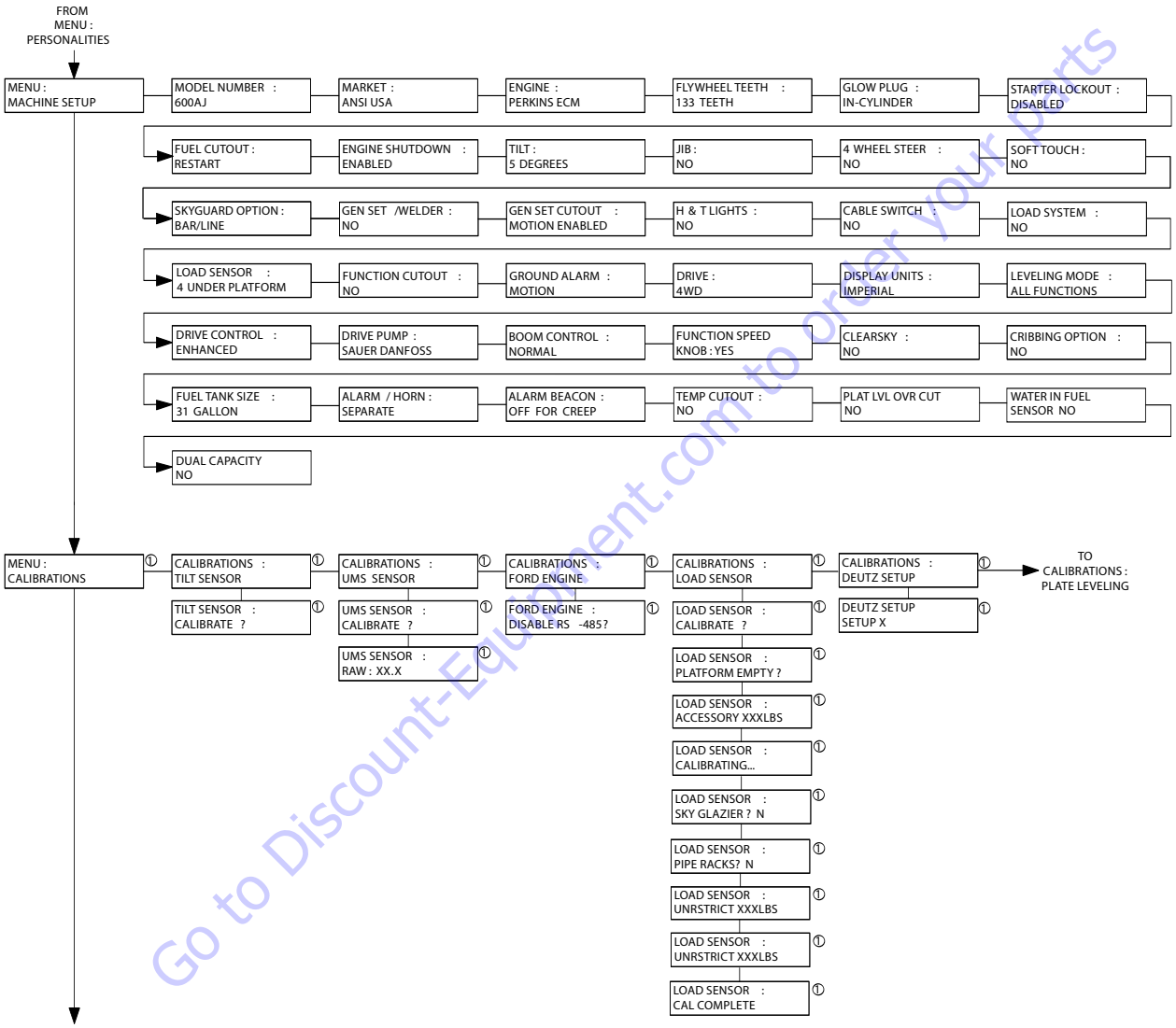
NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration and software versions.*

Figure 6-6. Analyzer Flow Chart - Diagnostics (Software Version P6.30) - Sheet 4 of 7



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 P6.30) - Sheet 5 of 7



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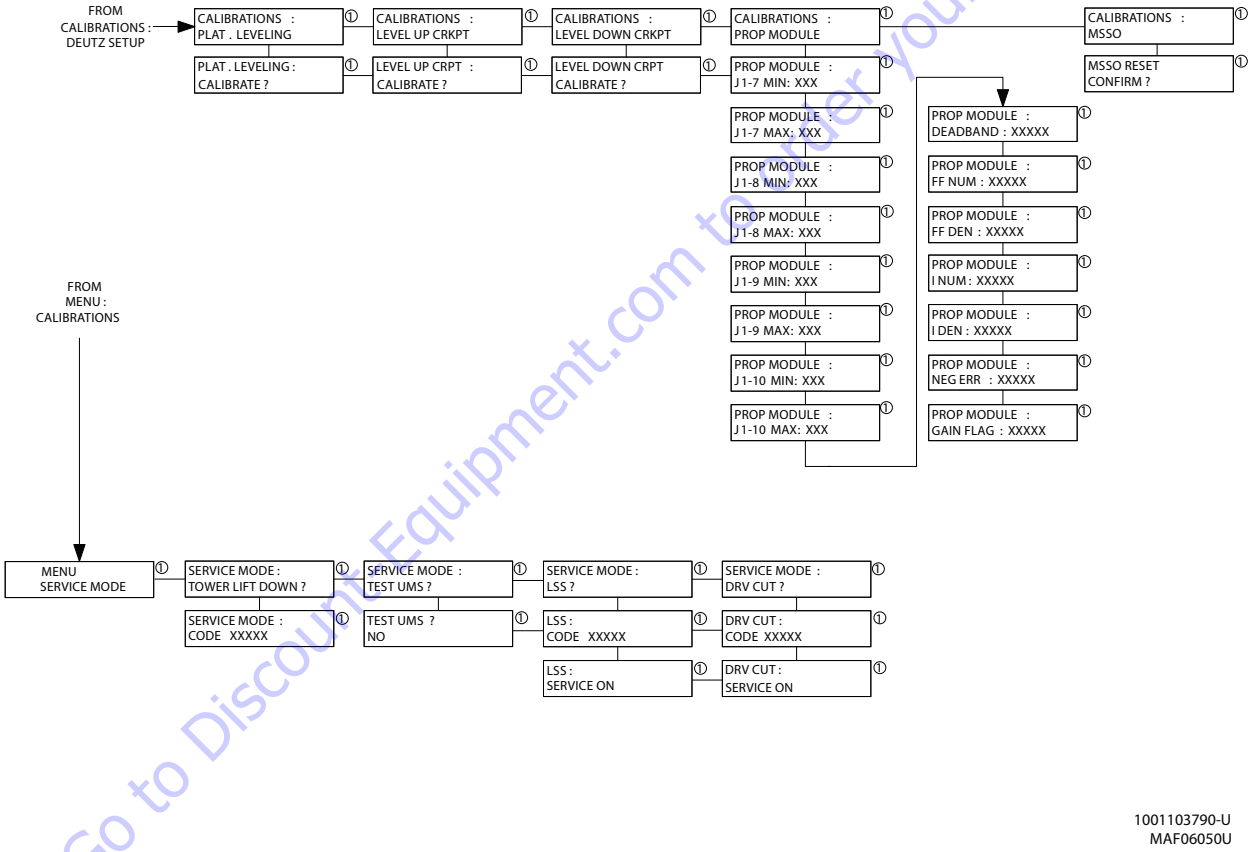
NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration and software versions.*

Figure 6-8. Analyzer Flow Chart - Diagnostics (Software Version P6.30) - Sheet 6 of 7



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 P6.30) - Sheet 7 of 7

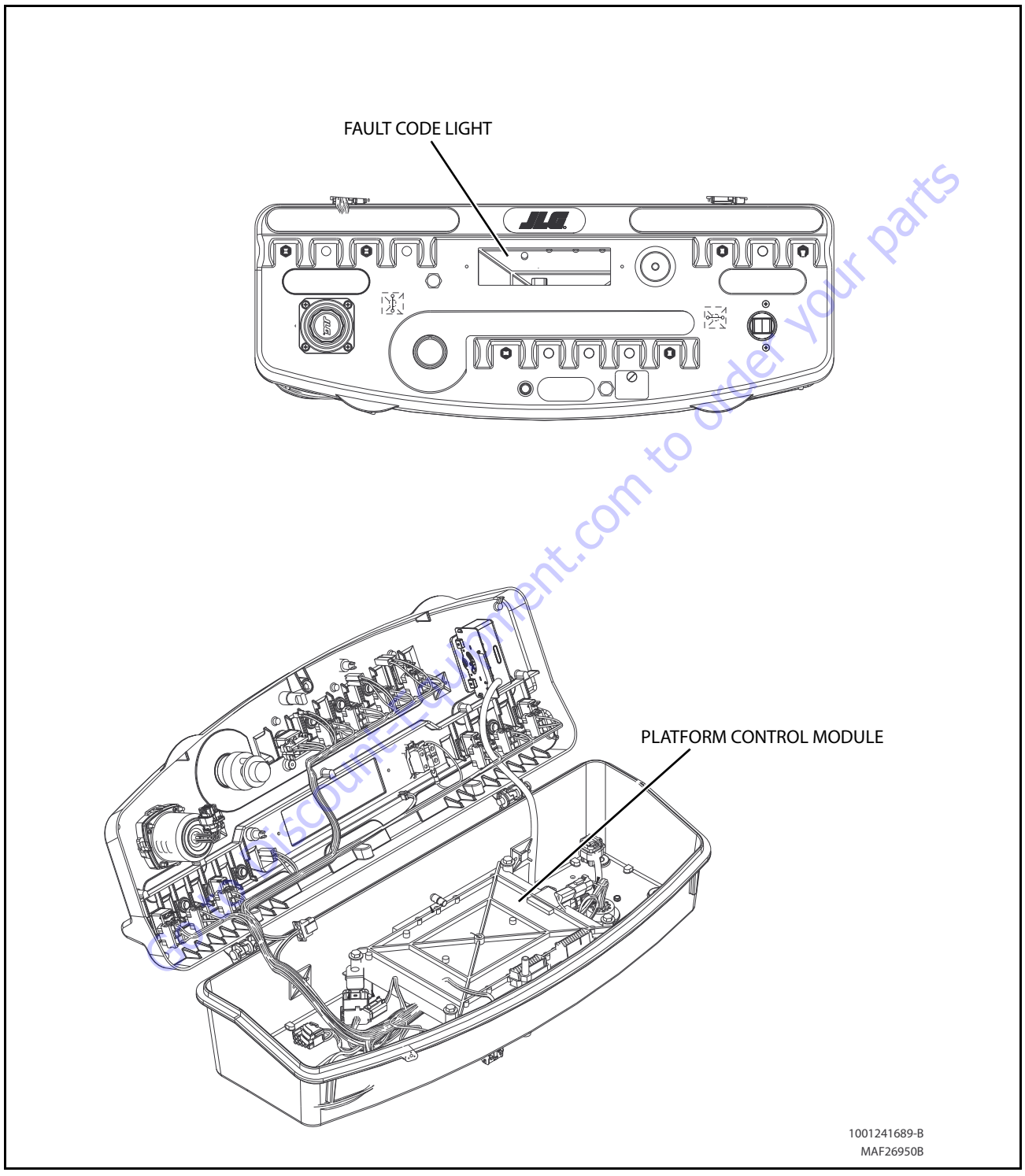
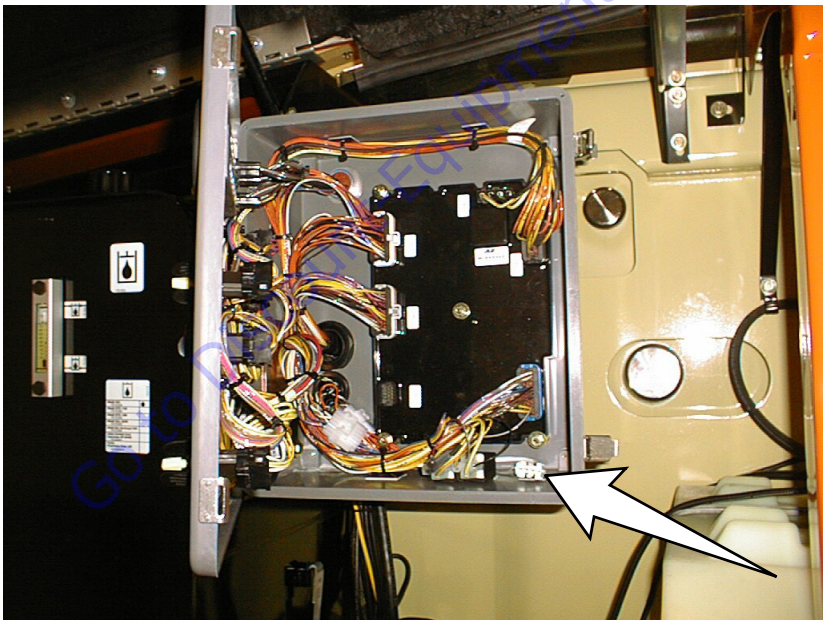


Figure 6-10. Fault Code Light and module Location

PLATFORM CONNECTION



GROUND CONTROL CONNECTION

Figure 6-11. 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

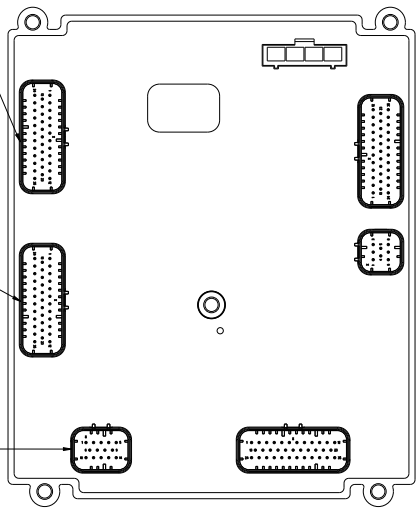


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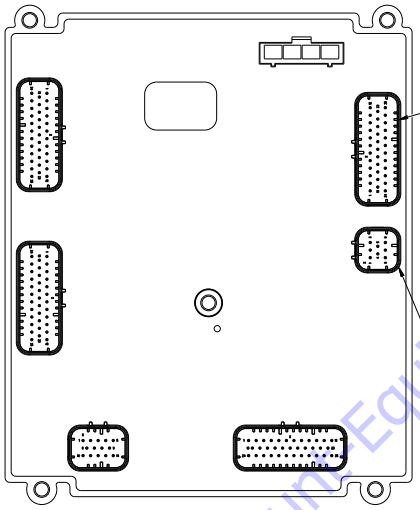
Figure 6-12. Ground Control Module - Sheet 1 of 3



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	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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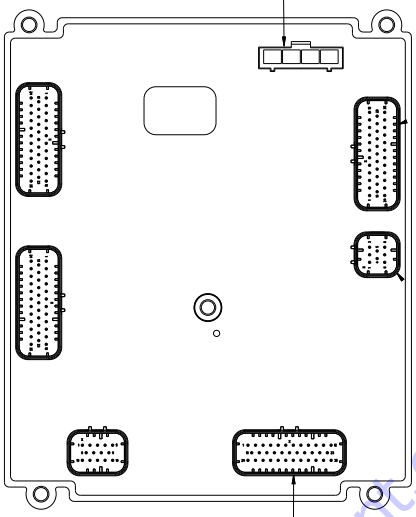
Figure 6-13. Ground Control Module - Sheet 2 of 3

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 6-14. Ground Control Module - Sheet 3 of 3

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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 NOTE: used when elevation cutout switches are limiting maximum speed
CREEP MAX	Displays/adjusts maximum drive speed 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 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 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 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 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 Not displayed if JIB = NO
JIB (L/R)	Displays/adjusts jib swing speed 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 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 NOTE: demand is controlled by the pump pot
ROT. LEFT . . .	Displays basket rotate switch direction & demand NOTE: demand is controlled by the pump pot
U TELE IN . . .	Displays telescope switch direction & demand NOTE: demand is controlled by the pump pot
JIB UP . . .	Displays jib lift switch direction & demand NOTE: demand is controlled by the pump pot Not displayed if JIB = NO
JIB LEFT . . .	Displays jib swing switch direction & demand NOTE: demand is controlled by the pump pot 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 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 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; The UGM shall limit Drive to Creep The Steer Left switch input = Low; The Steer Right switch input = Low; 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. 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. - There is a +/-.1V range. around these values due to resistor tolerances.
2219	22	L/S JOY. OUT OF RANGE HIGH	Resistive joysticks. - 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. - 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. - 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 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; 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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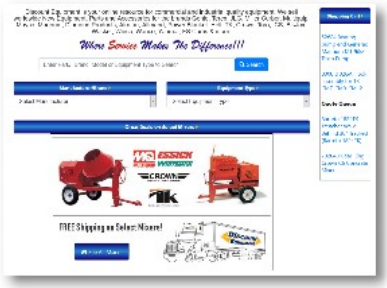

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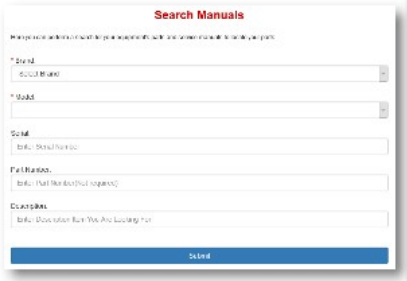

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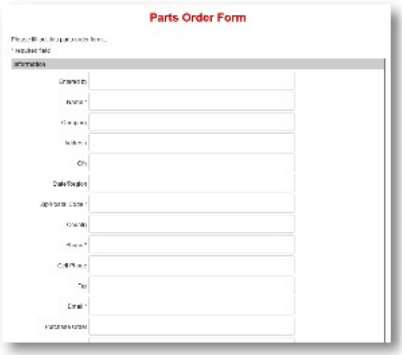

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SECTION 7. BASIC ELECTRICAL INFORMATION & SCHEMATICS

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

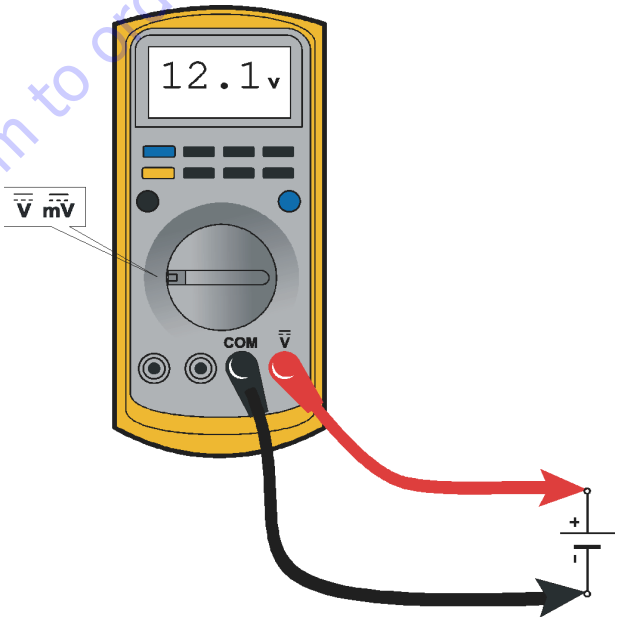


Figure 7-1. Voltage Measurement (DC)

- 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

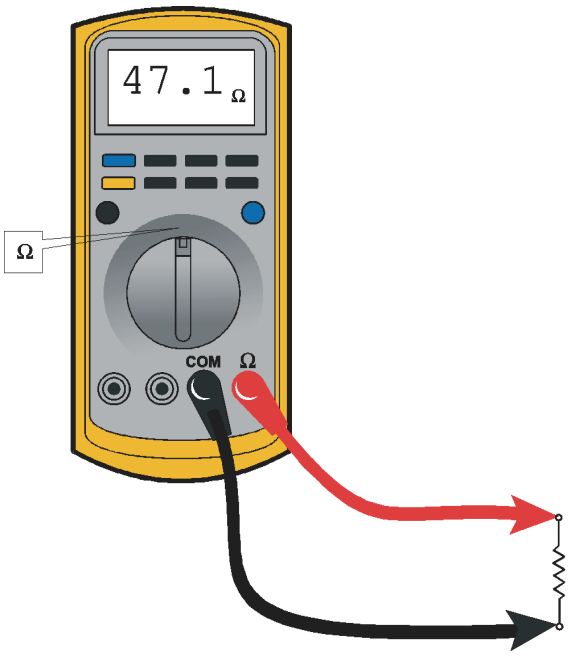


Figure 7-2. Resistance Measurement

- 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

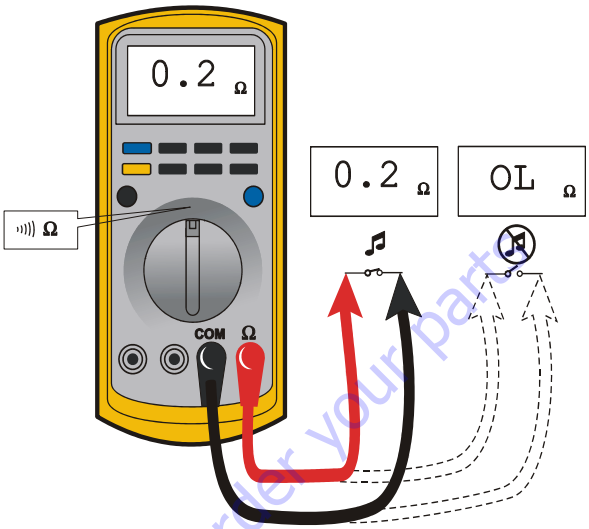


Figure 7-3. Continuity Measurement

- 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

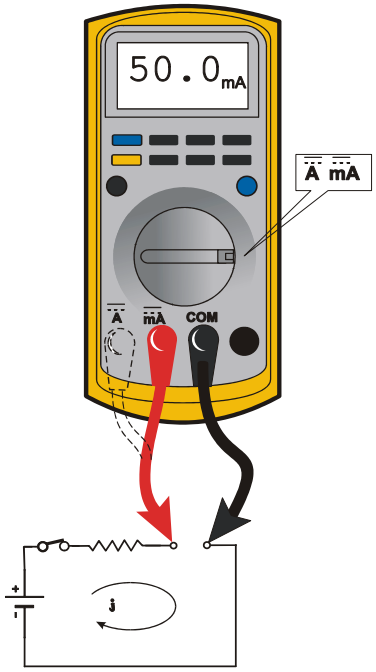


Figure 7-4. Current Measurement (DC)

- 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 PN 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

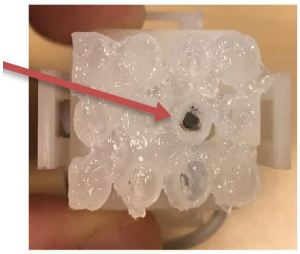
The following is general guidance for the installation of dielectric grease in a connector system.

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

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

AMP Mate-N-Lok

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



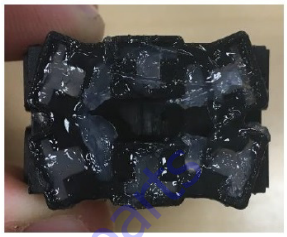
Improper

Proper

AMP Faston

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

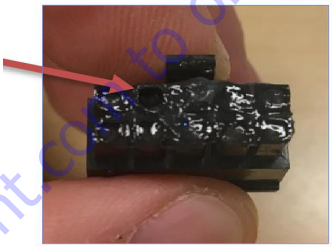
Improper



Proper

AMP Micro-Fit

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

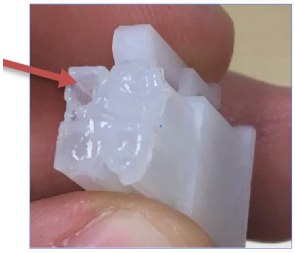


Improper

Proper

AMP Mini Fit Jr

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

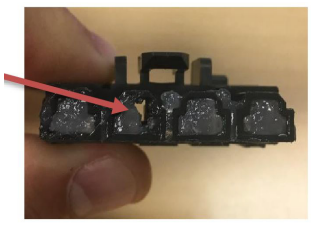


Improper

Proper

Mini Fit Sr

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

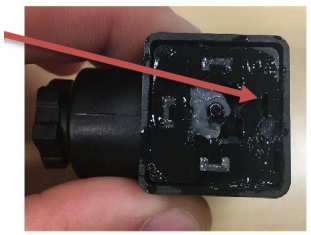


Improper

Proper

DIN Connectors

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



Improper

Proper

Exceptions

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

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

Enclosures

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

Carling Switch Connectors

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

7.4 AMP CONNECTOR

Assembly

Check to be sure the wedge lock is in the open, or as-shipped, position (See Figure 7-5.). Proceed as follows:

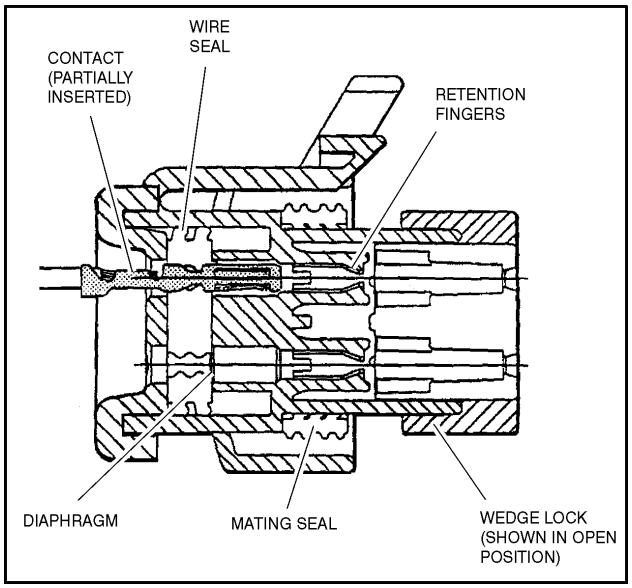


Figure 7-5. Connector Assembly Figure 1

1. To insert a contact, push it straight into the appropriate circuit cavity as far as it will go (See Figure 7-7.).

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 7-7.).

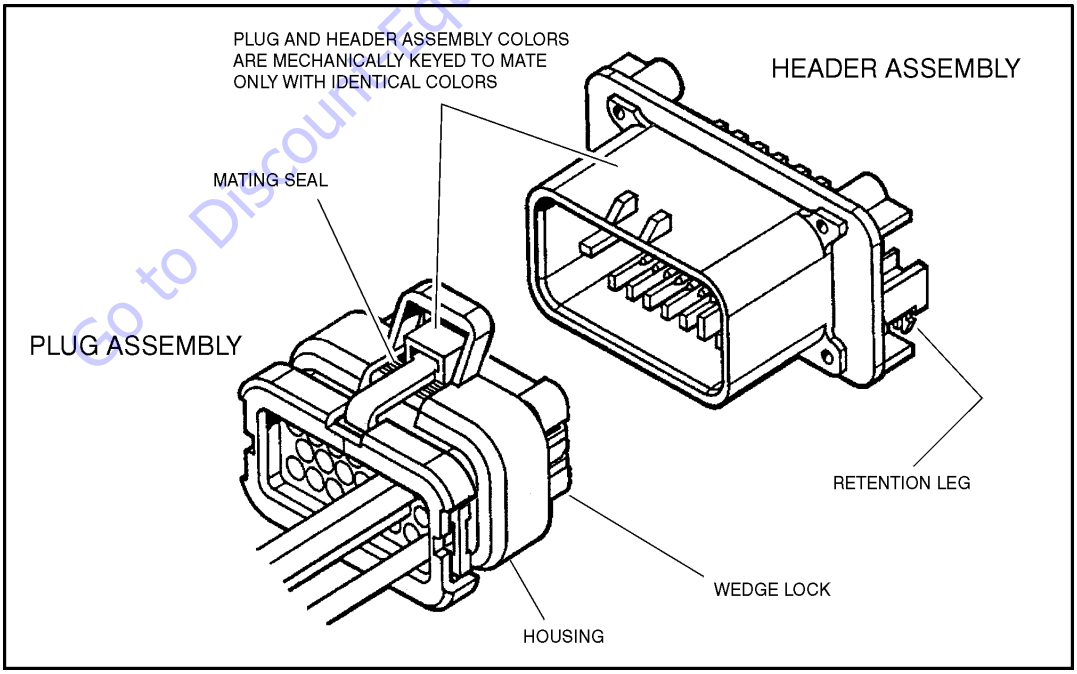


Figure 7-6. AMP Connector

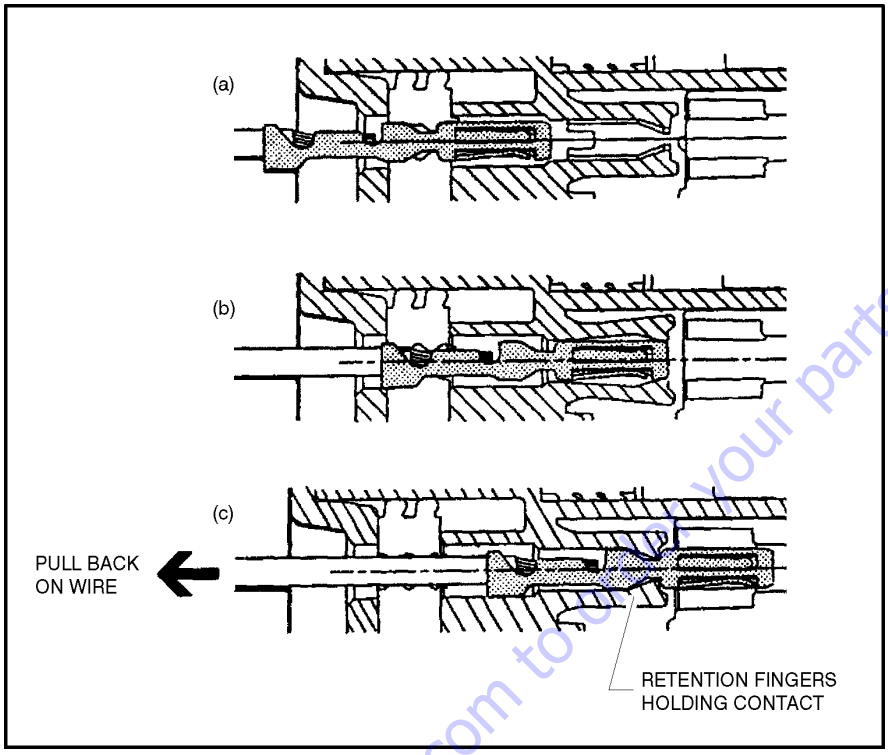


Figure 7-7. Connector Assembly Figure 2

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 7-8.).

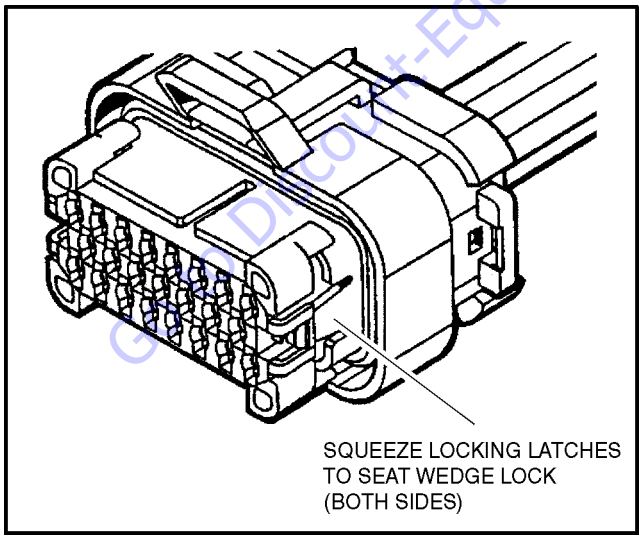


Figure 7-8. Connector Assembly Figure 3

4. Slide the wedge lock into the housing until it is flush with the housing (See Figure 7-9.).

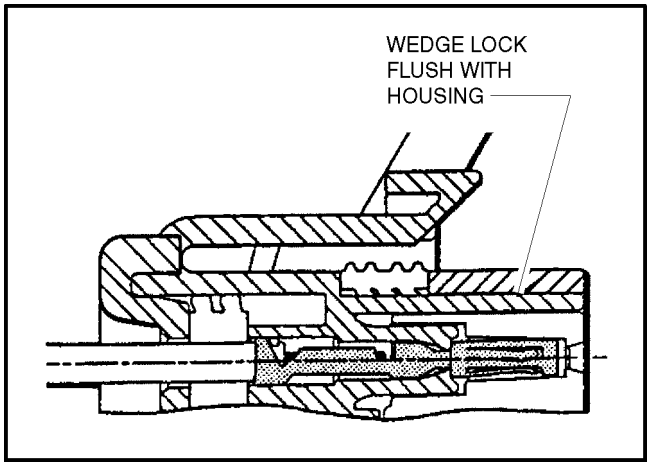


Figure 7-9. Connector Assembly Figure 4

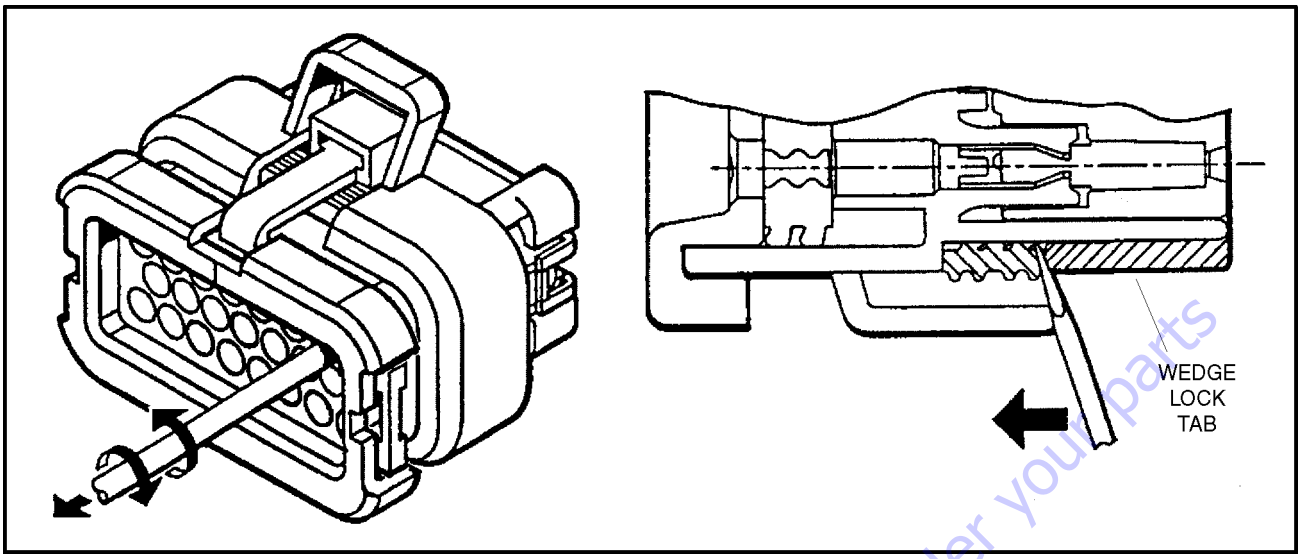


Figure 7-10. Connector Disassembly

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.

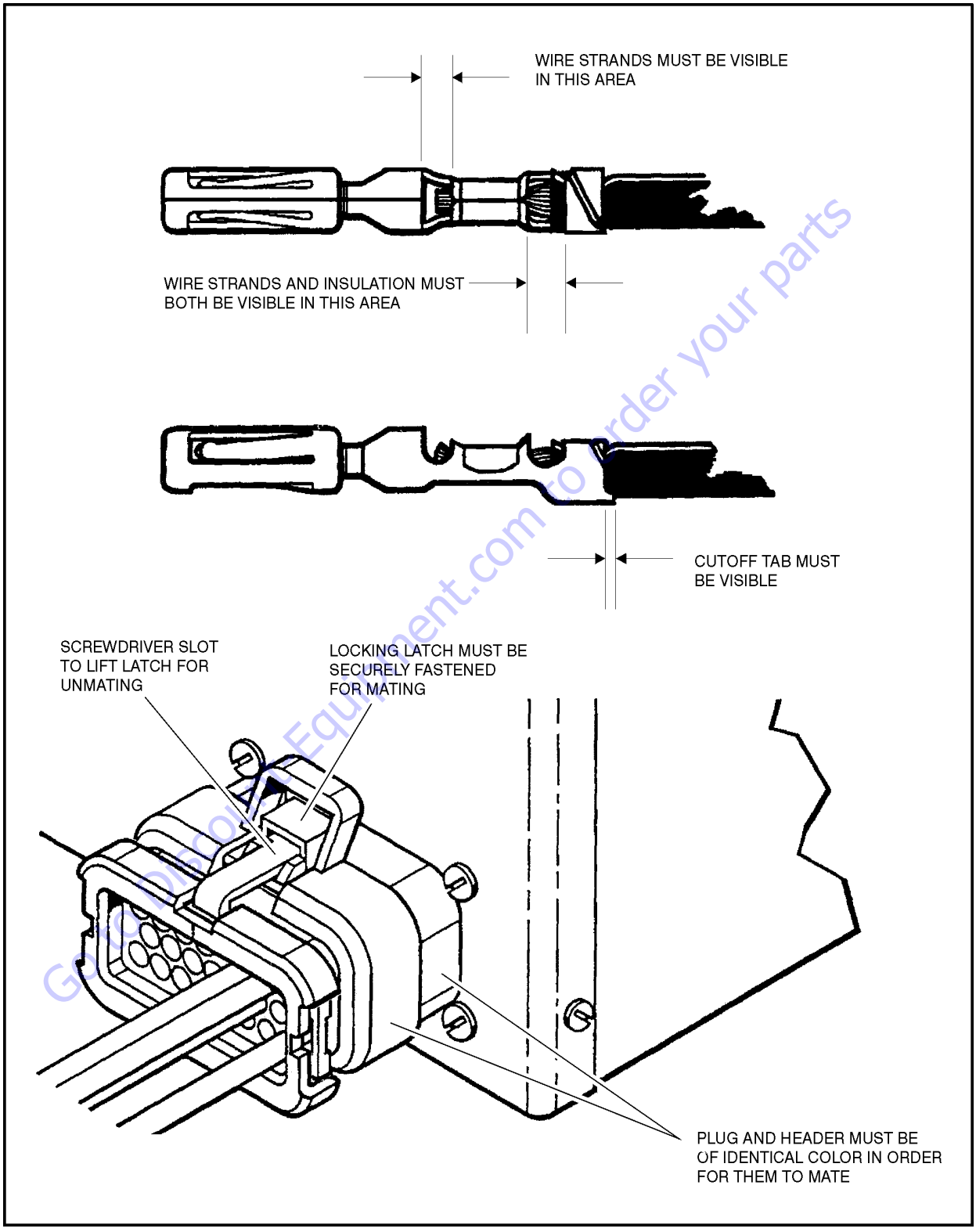


Figure 7-11. Connector Installation

7.5 DEUTSCH CONNECTORS

DT/DTP Series Assembly

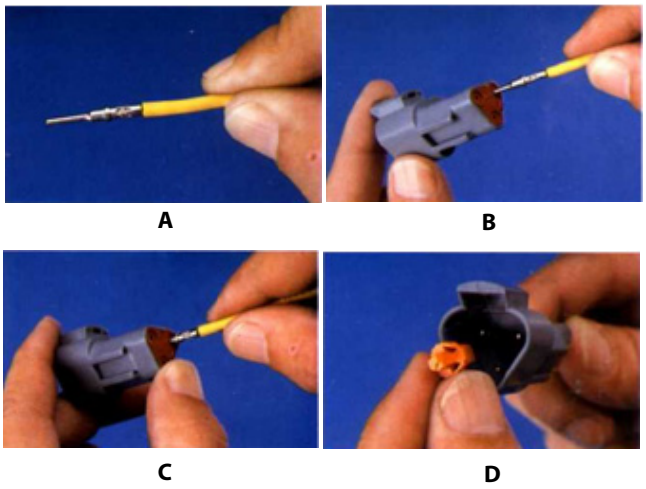


Figure 7-12. DT/DTP Contact Installation

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

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

DT/DTP Series Disassembly

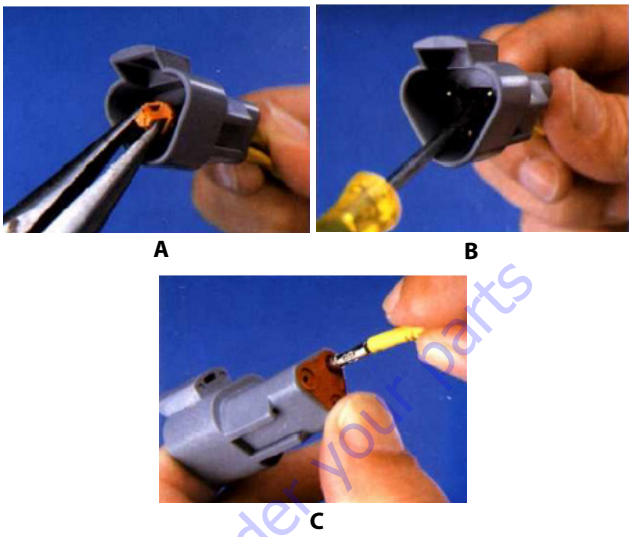


Figure 7-13. DT/DTP Contact Removal

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

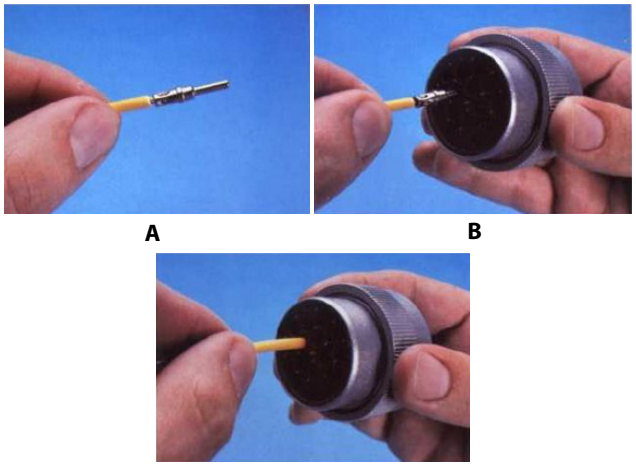


Figure 7-14. HD/HDP Contact Installation

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.

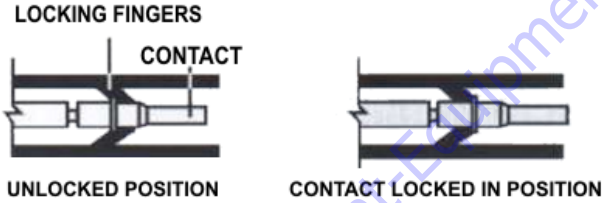


Figure 7-15. HD/HDP Locking Contacts Into Position

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

HD30/HDP20 Series Disassembly

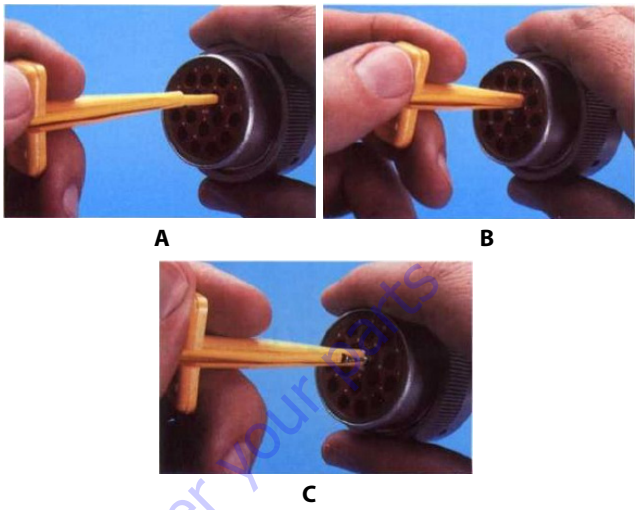


Figure 7-16. HD/HDP Contact Removal

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.

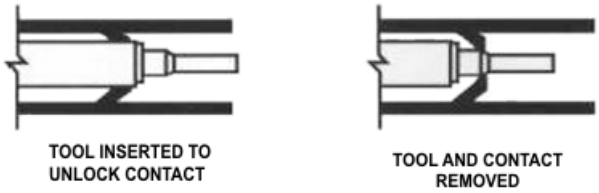


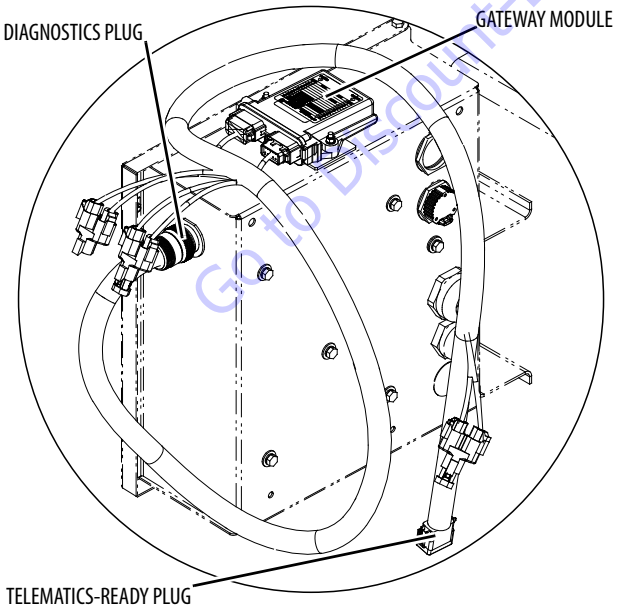
Figure 7-17. HD/HDP Unlocking Contacts

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

7.6 TELEMATICS GATEWAY

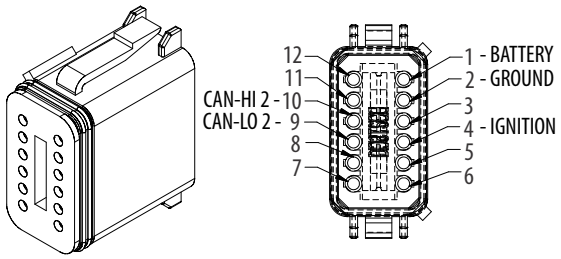
Personnel using machines equipped with an optional telematics gateway will be able to view the following data through their telematics device:

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. • 0% = Empty • 100% = Full	Percentage (%)
JLG Machine Faults: Active / Not-Active	• 00 - No Machine Faults • 01 - Active Machine Fault • 10 - Error • 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. 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:



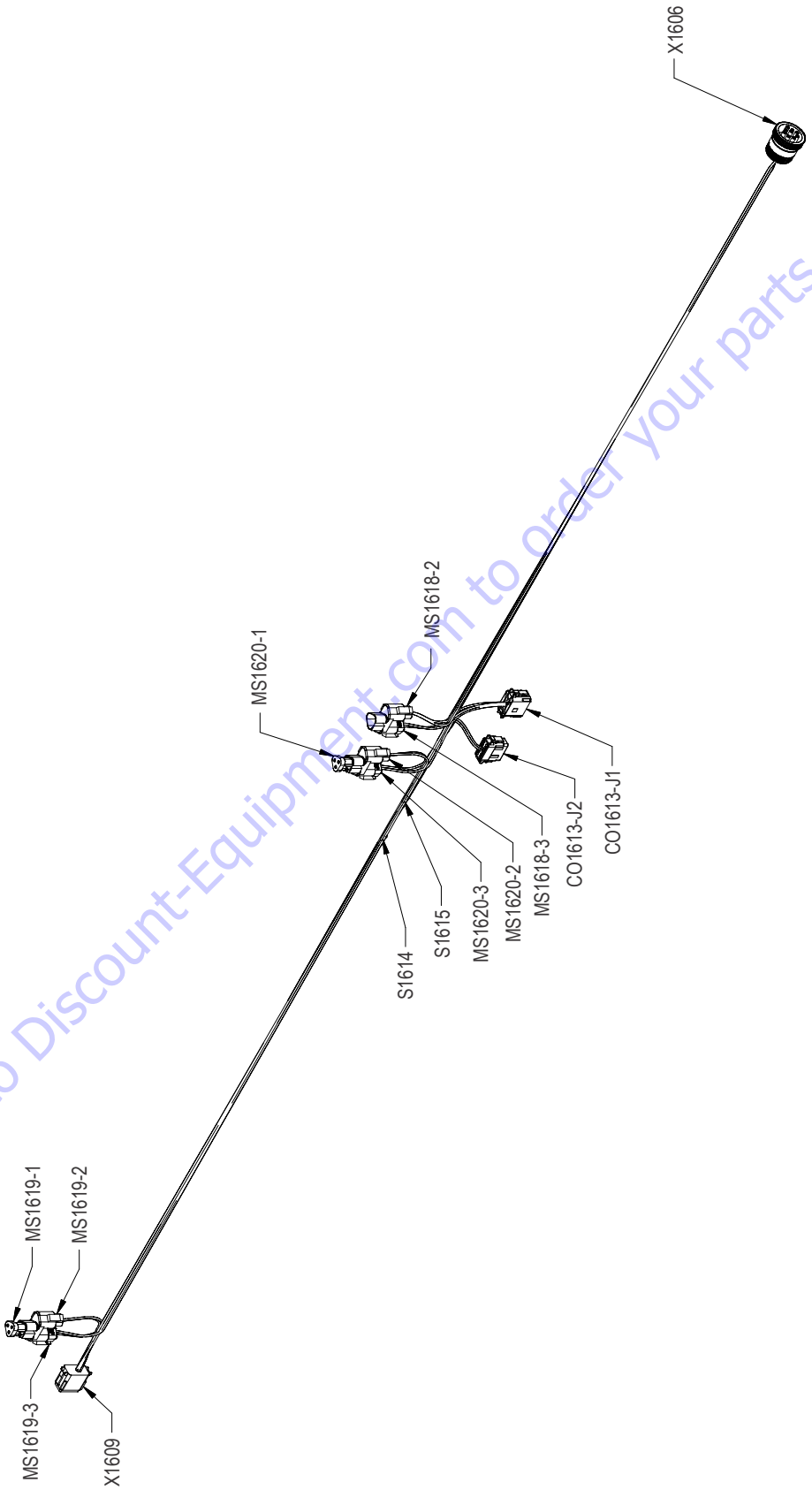


Figure 7-18. Telematics Gateway Harness - Sheet 1 of 3

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 7-19. 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 7-20. Telematics Gateway Harness - Sheet 3 of 3

7.7 ELECTRICAL SCHEMATICS

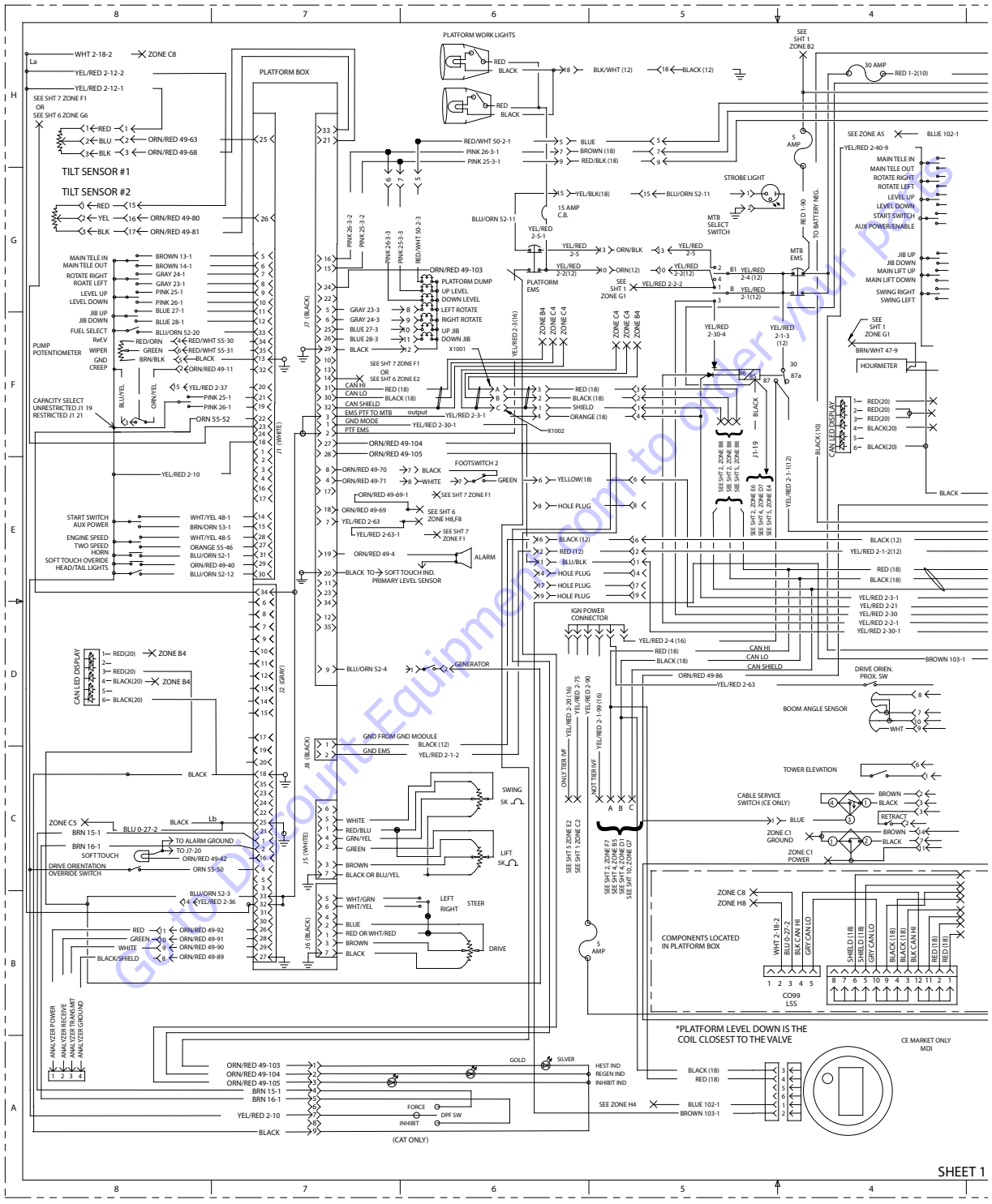


Figure 7-21. Electrical Schematic - Sheet 1 of 19

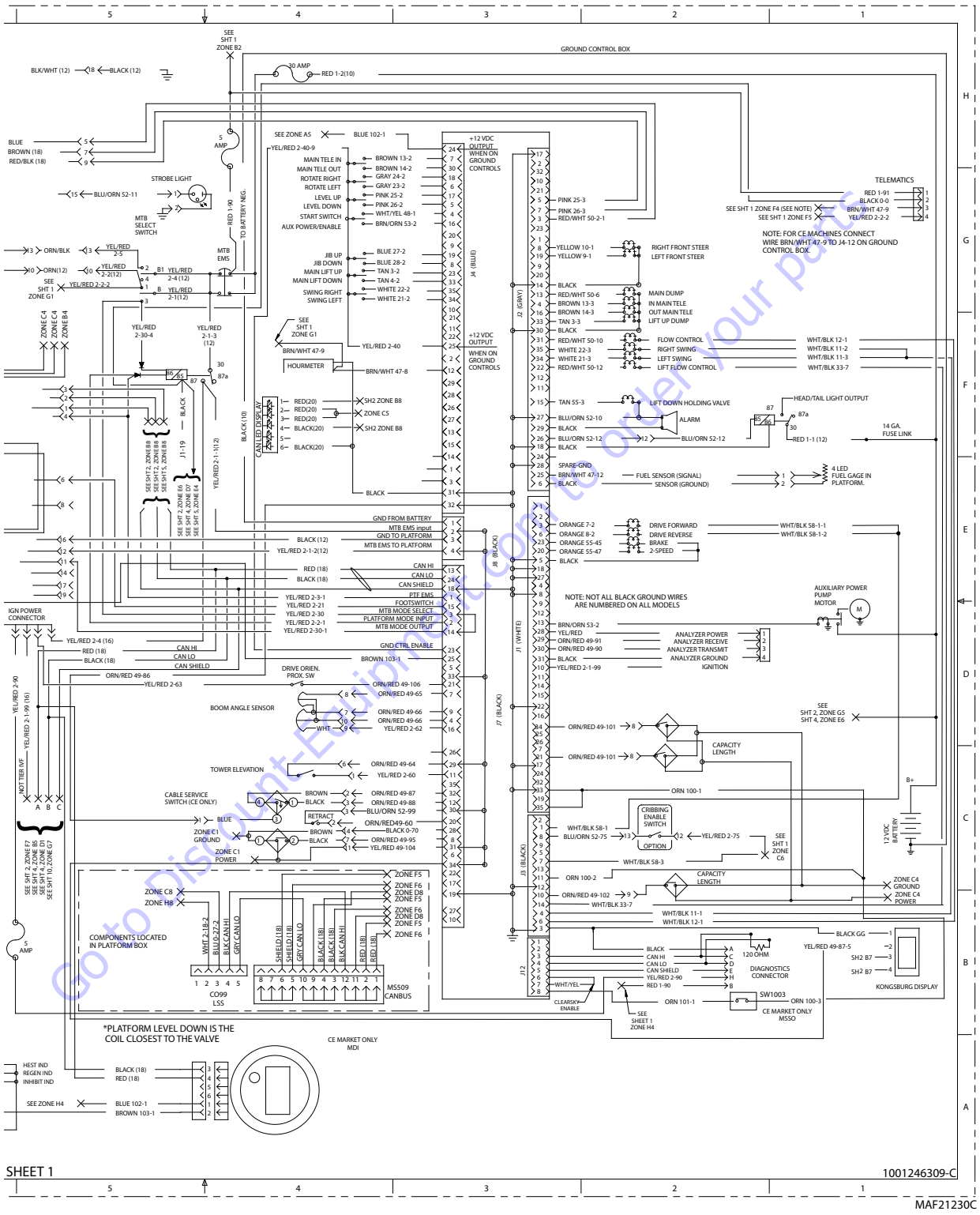


Figure 7-22. Electrical Schematic - Sheet 2 of 19

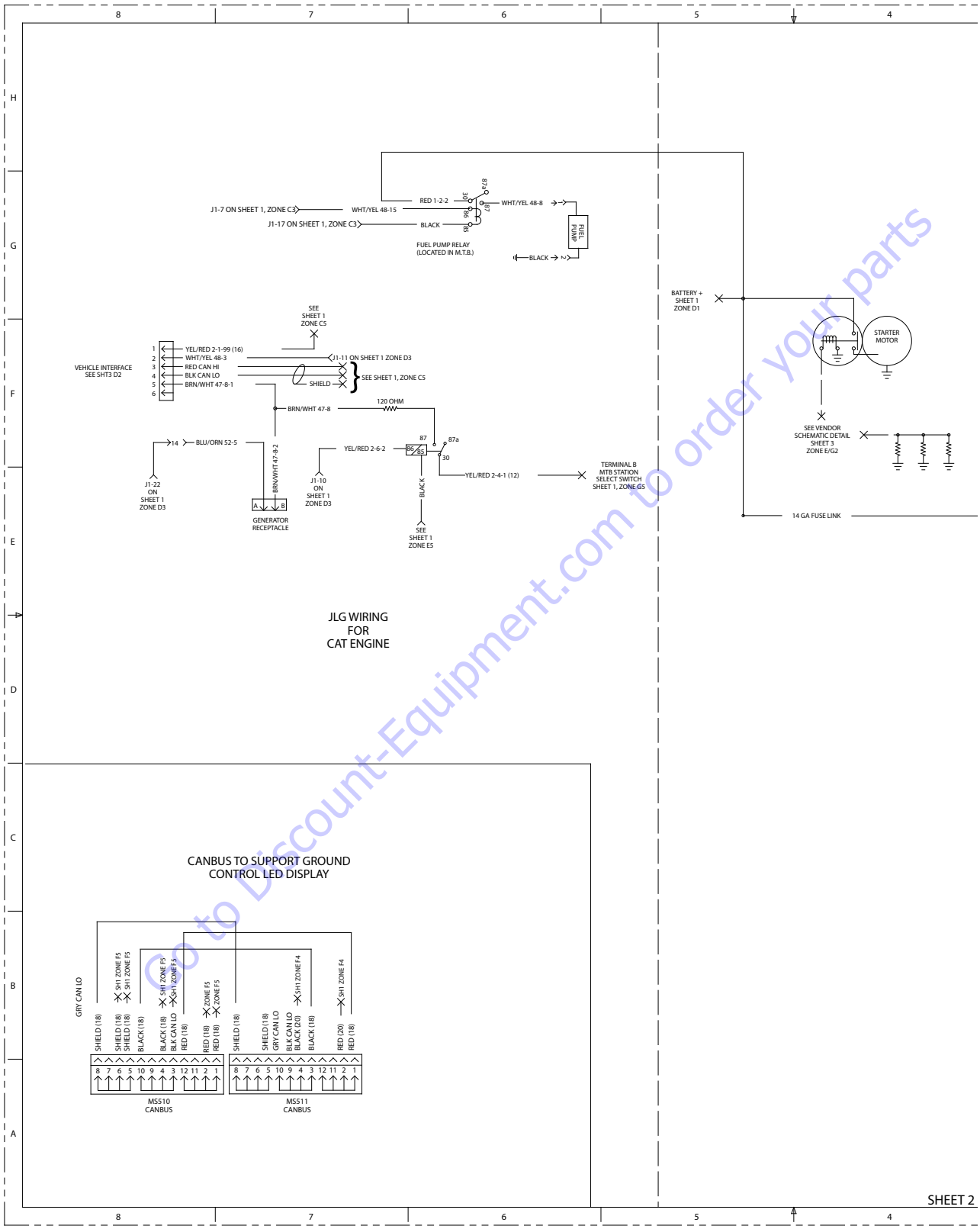
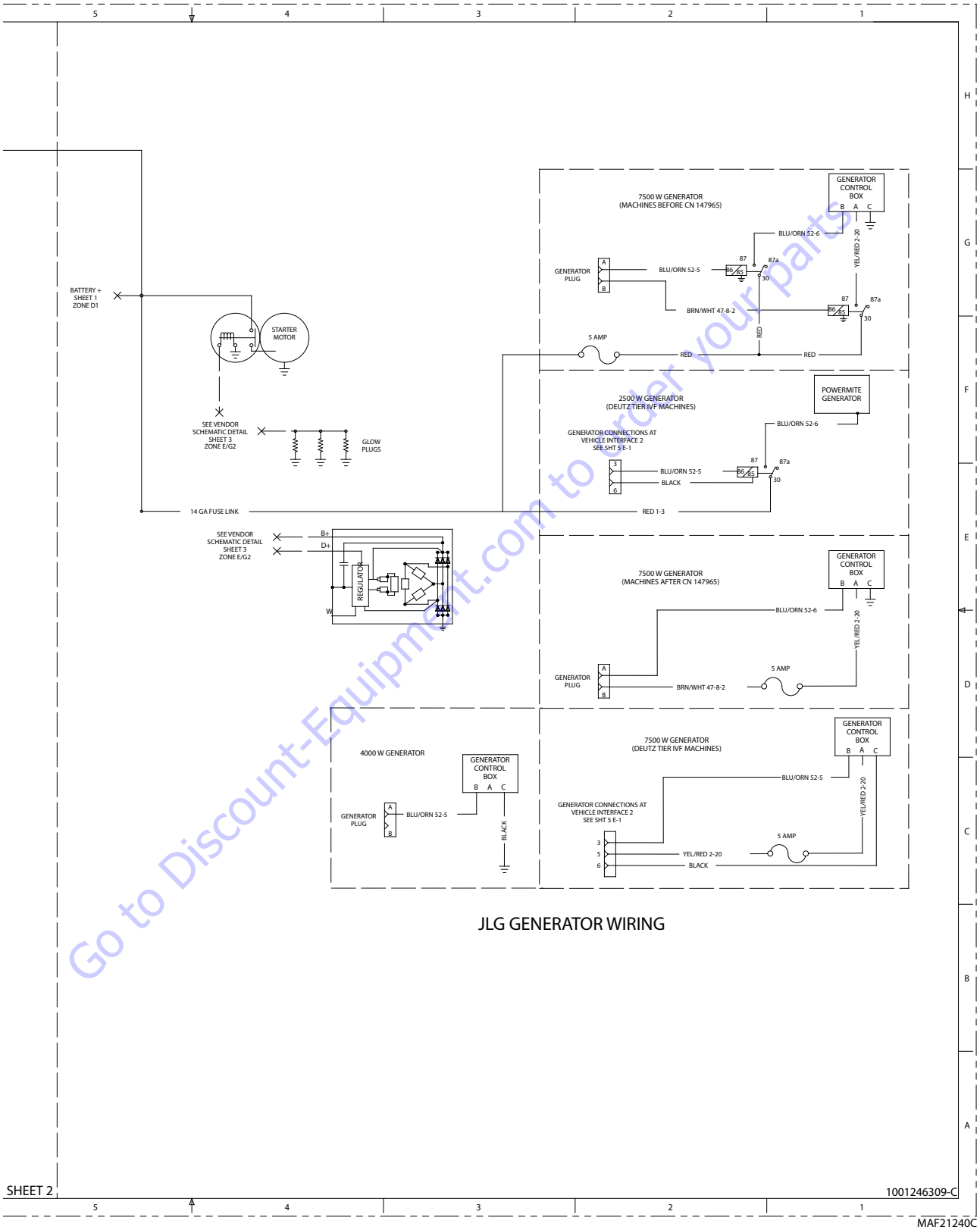


Figure 7-23. Electrical Schematic - Sheet 3 of 19



JLG GENERATOR WIRING

Figure 7-24. Electrical Schematic - Sheet 4 of 19

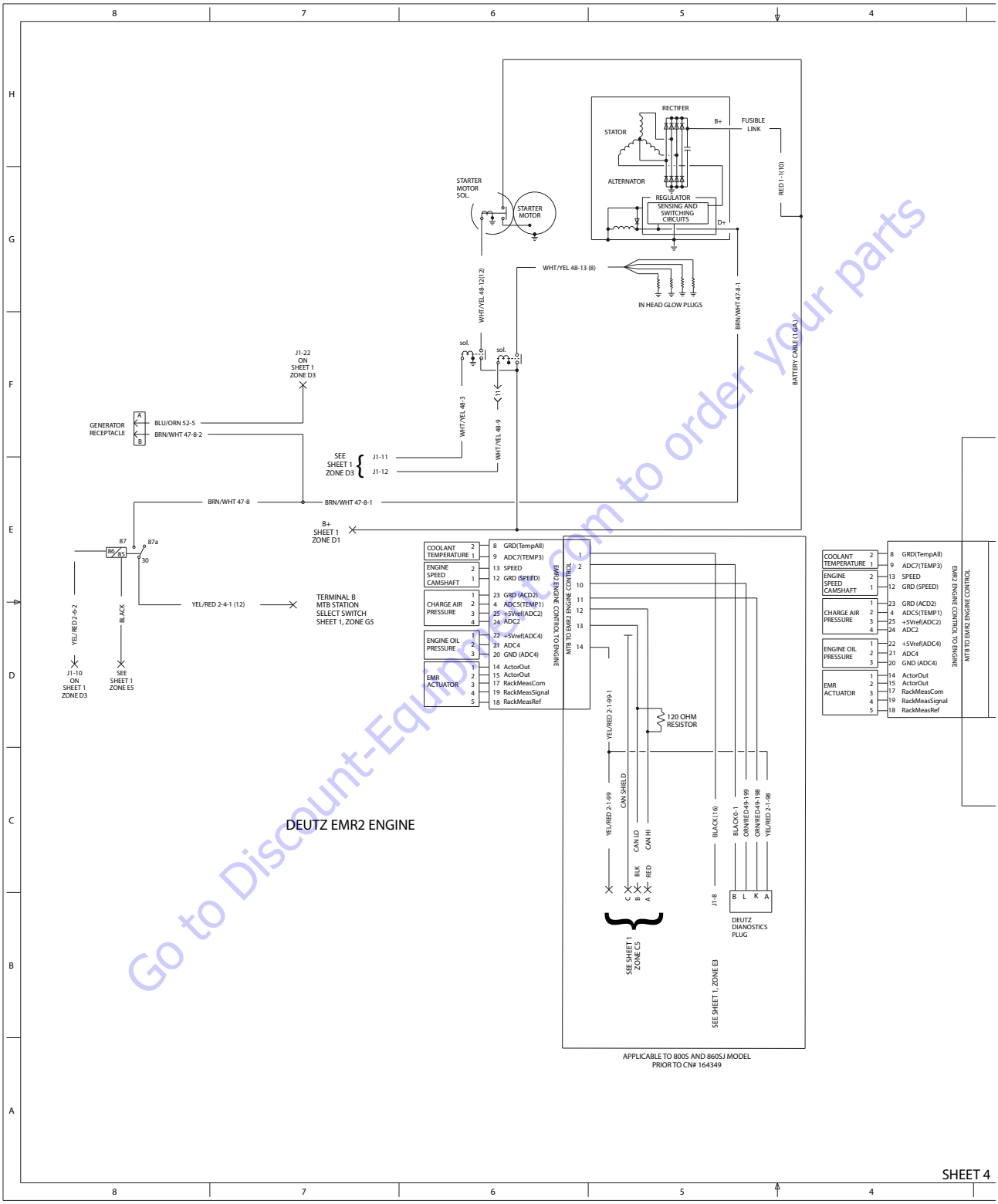


Figure 7-25. Electrical Schematic - Sheet 7 of 19

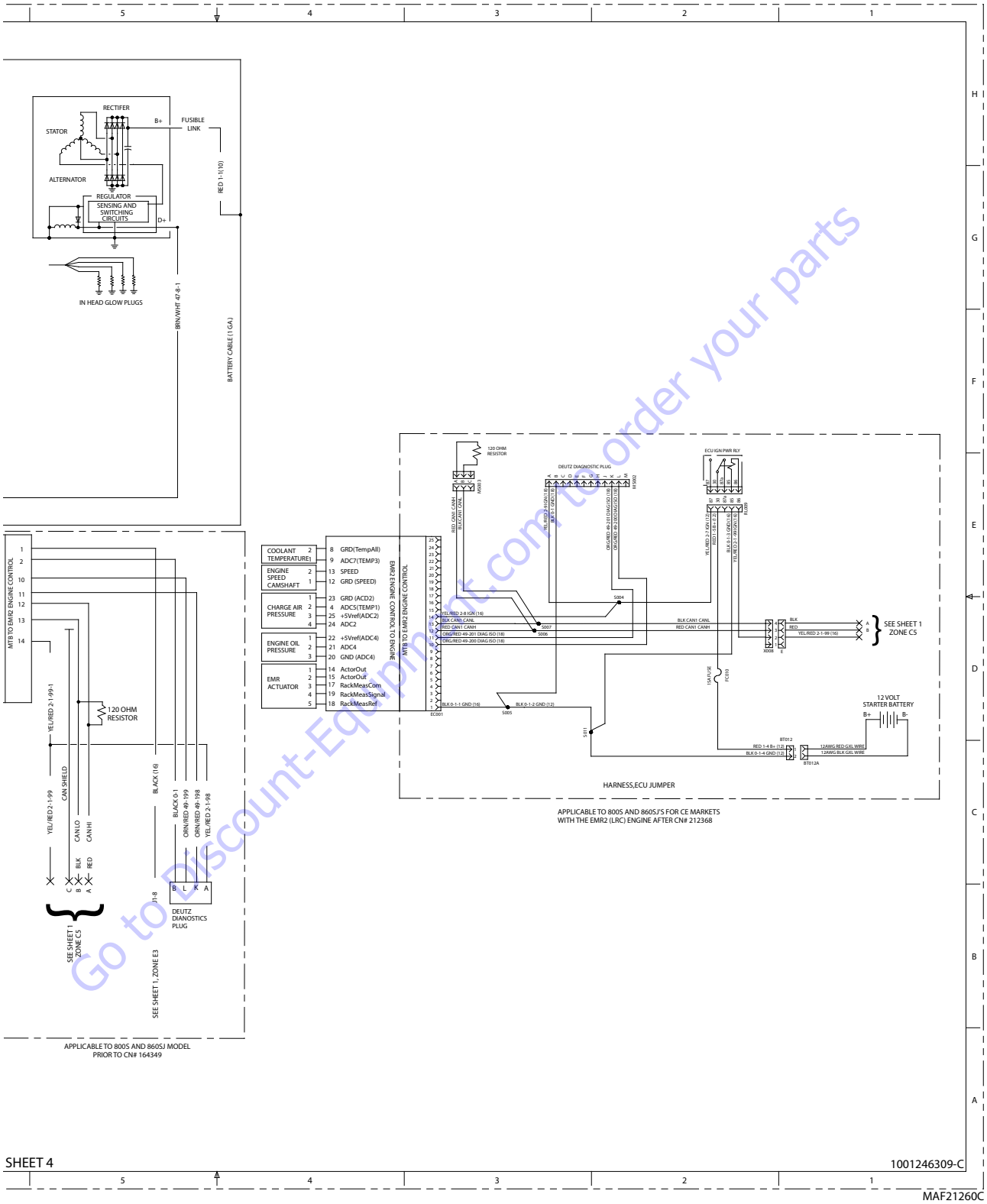


Figure 7-26. Electrical Schematic - Sheet 8 of 19

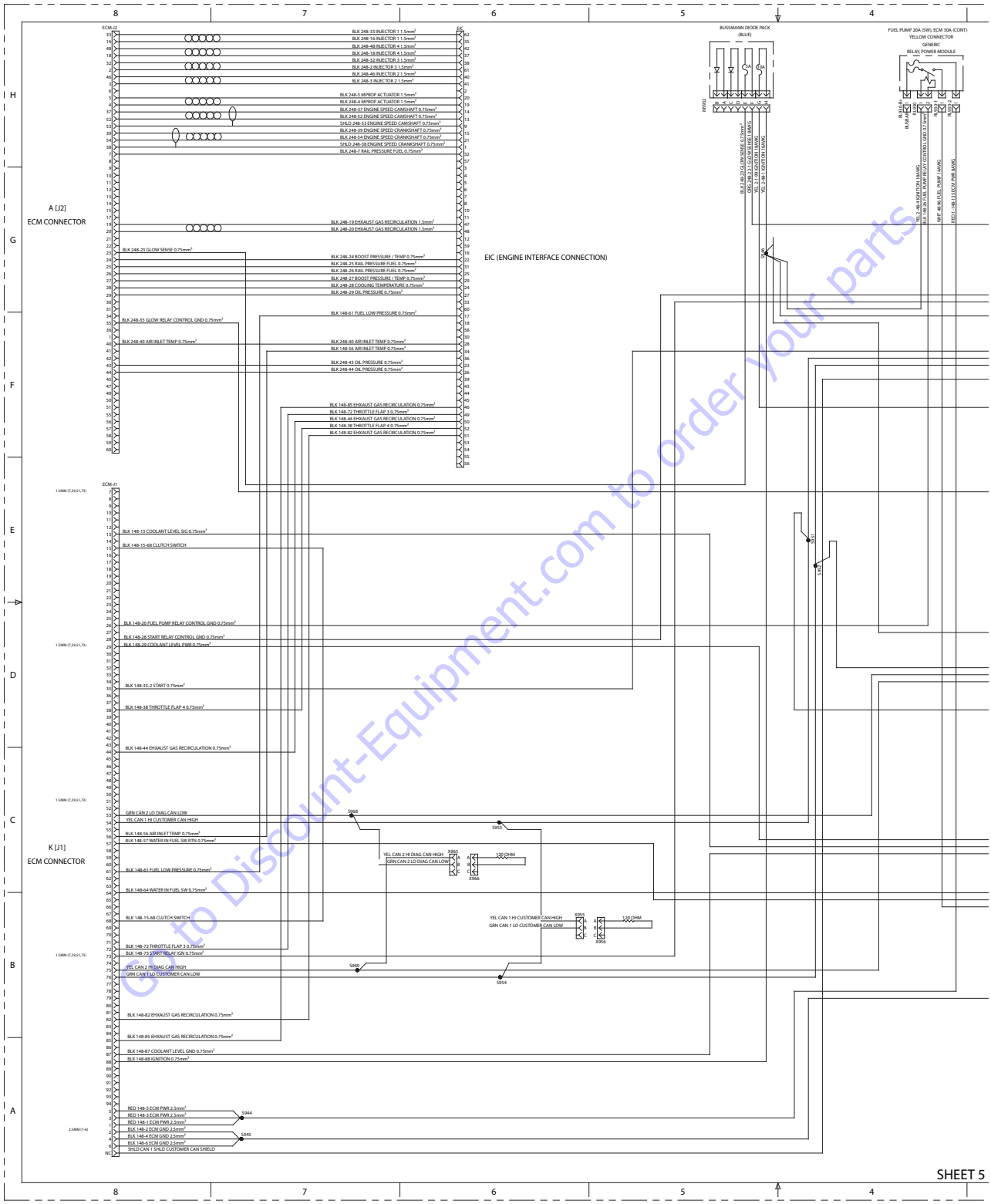


Figure 7-27. Electrical Schematic - Sheet 7 of 19

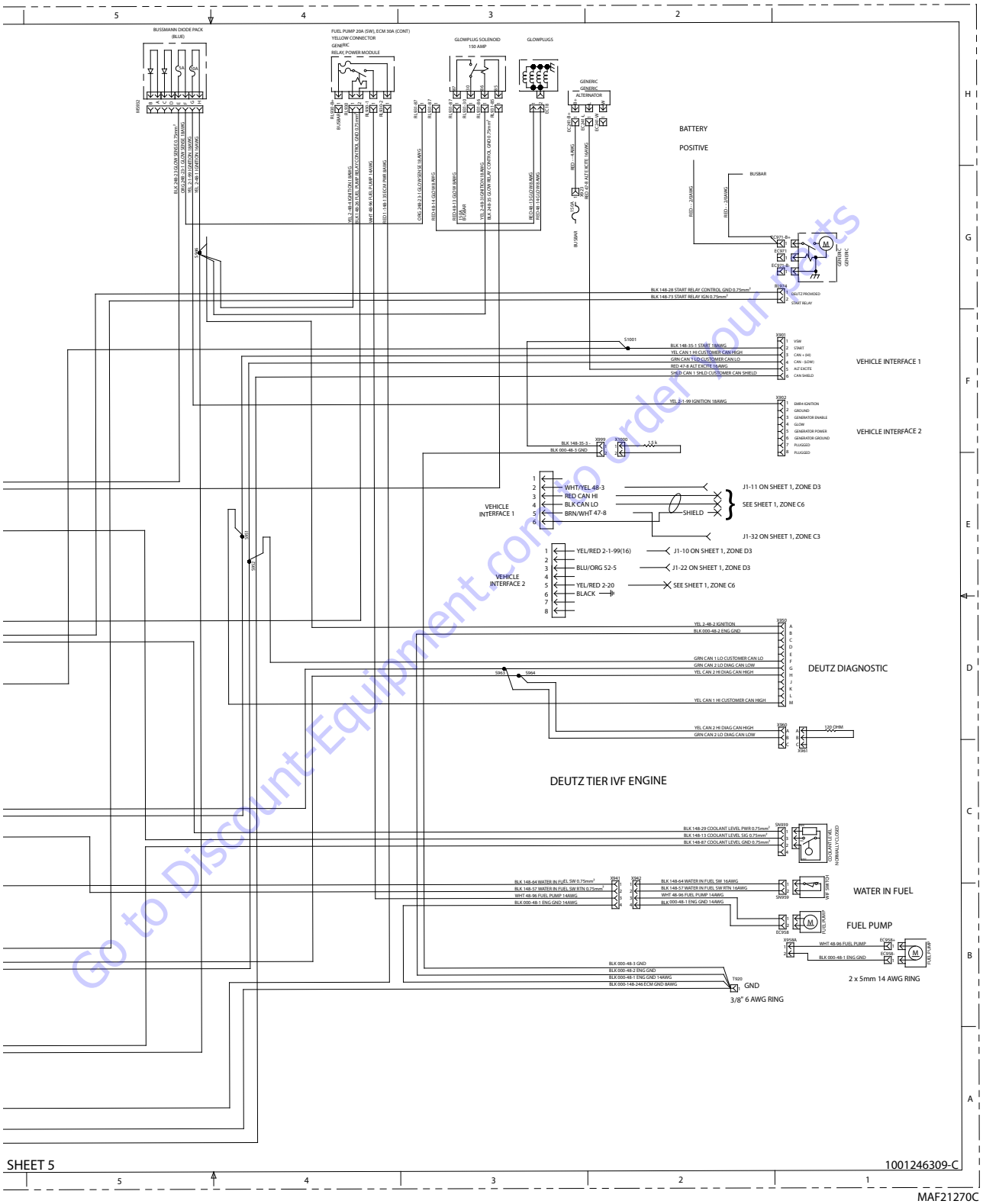


Figure 7-28. Electrical Schematic - Sheet 7 of 19

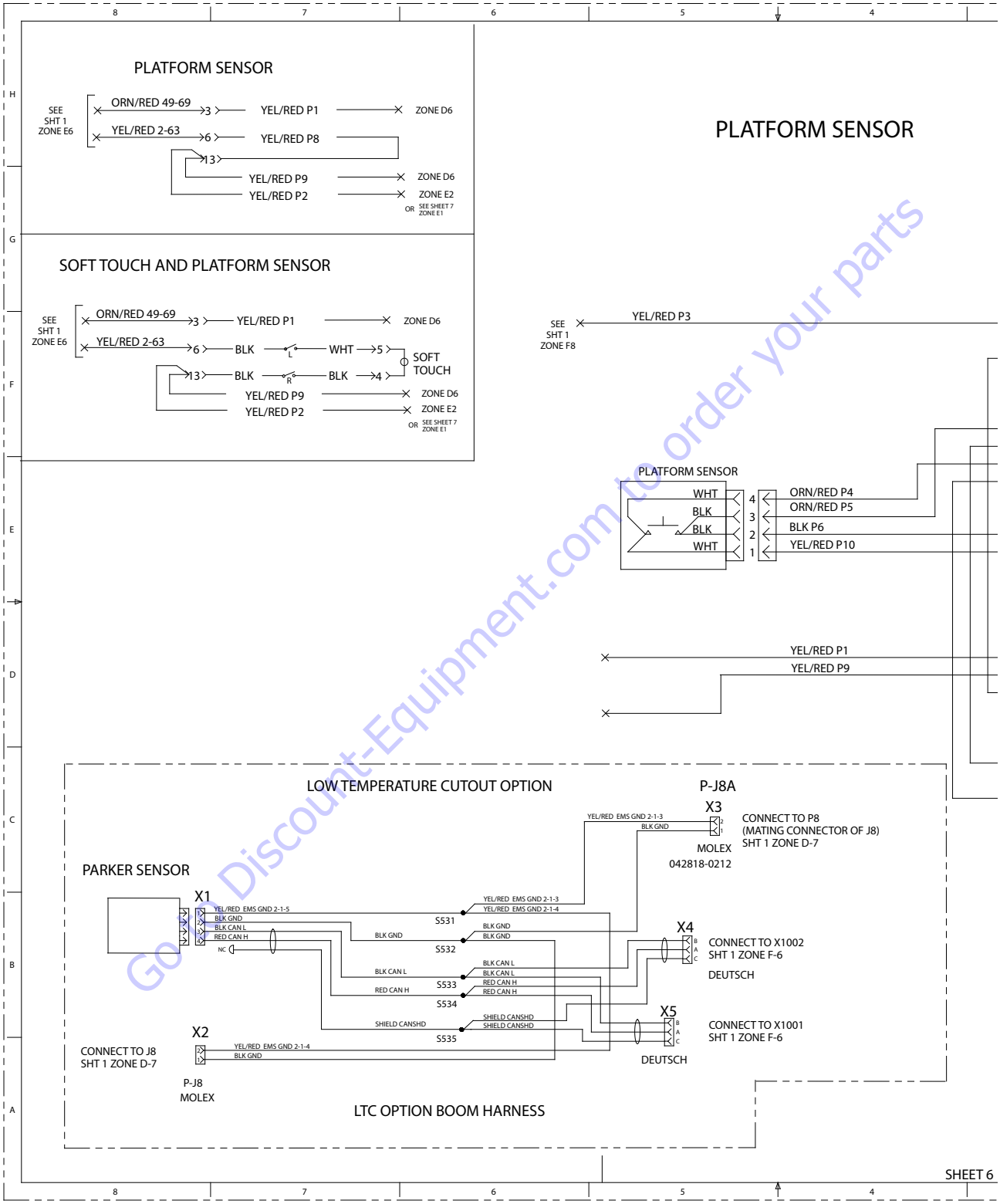


Figure 7-29. Electrical Schematic - Sheet 9 of 19

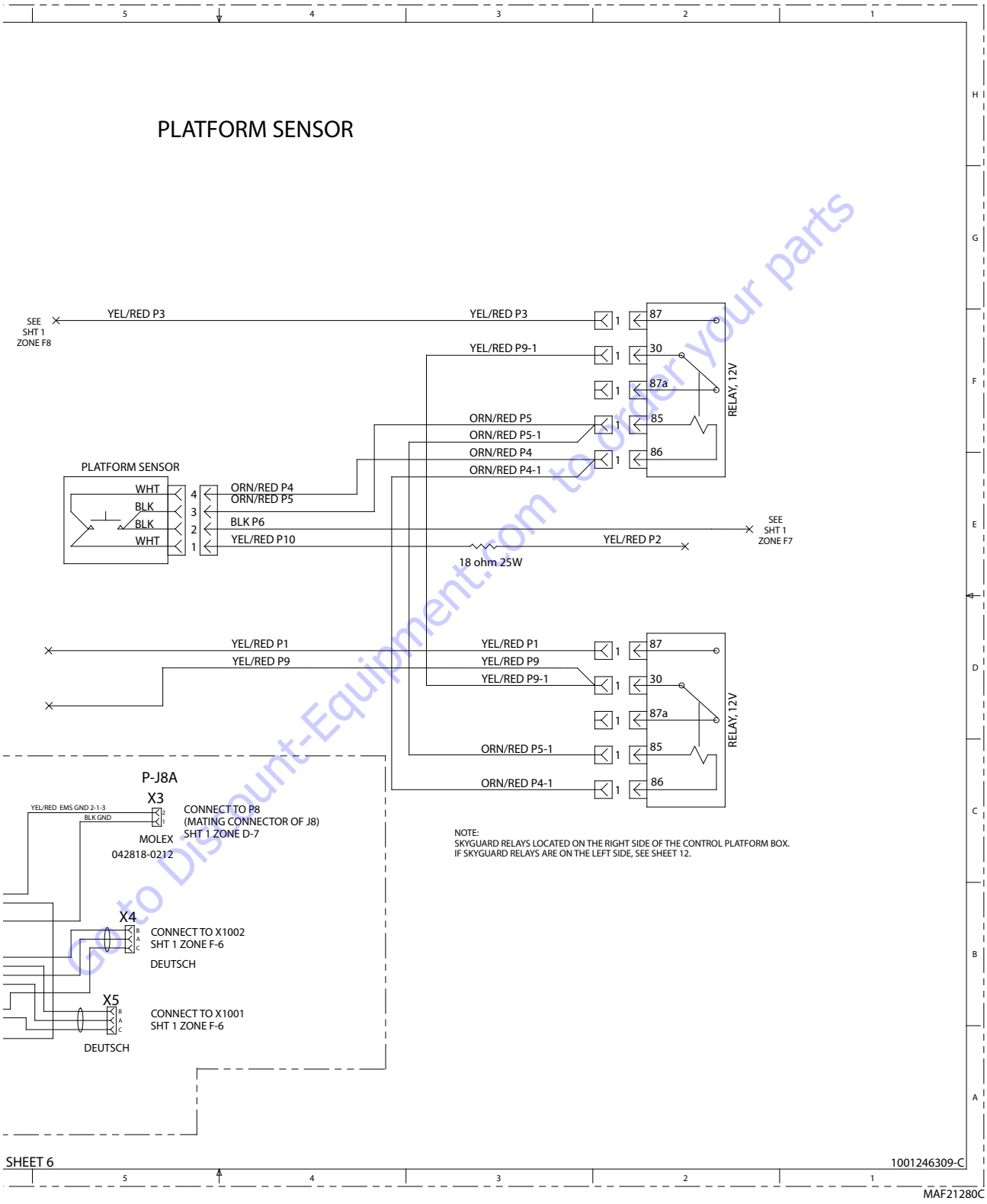


Figure 7-30. Electrical Schematic - Sheet 10 of 19

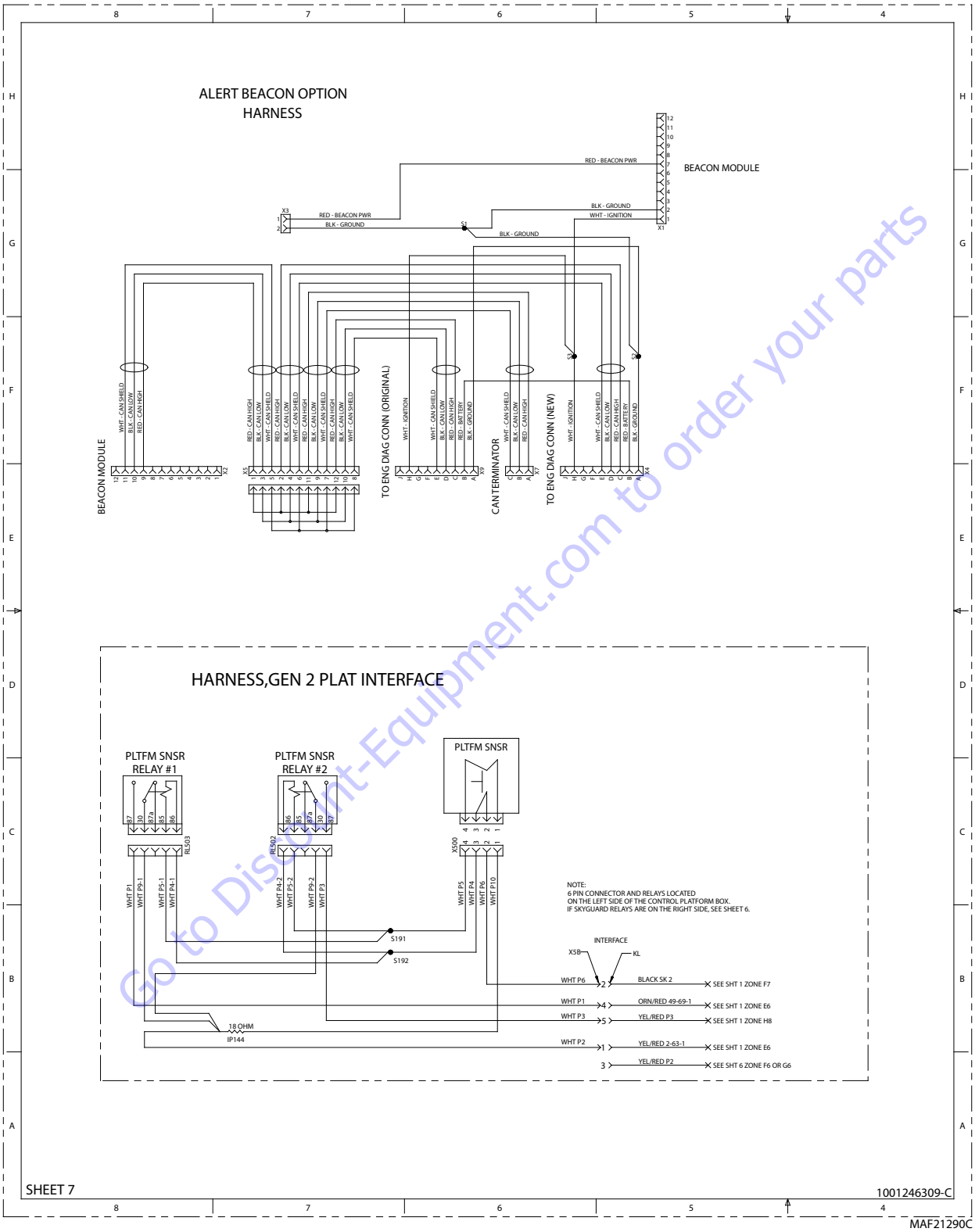


Figure 7-31. Electrical Schematic - Sheet 11 of 19

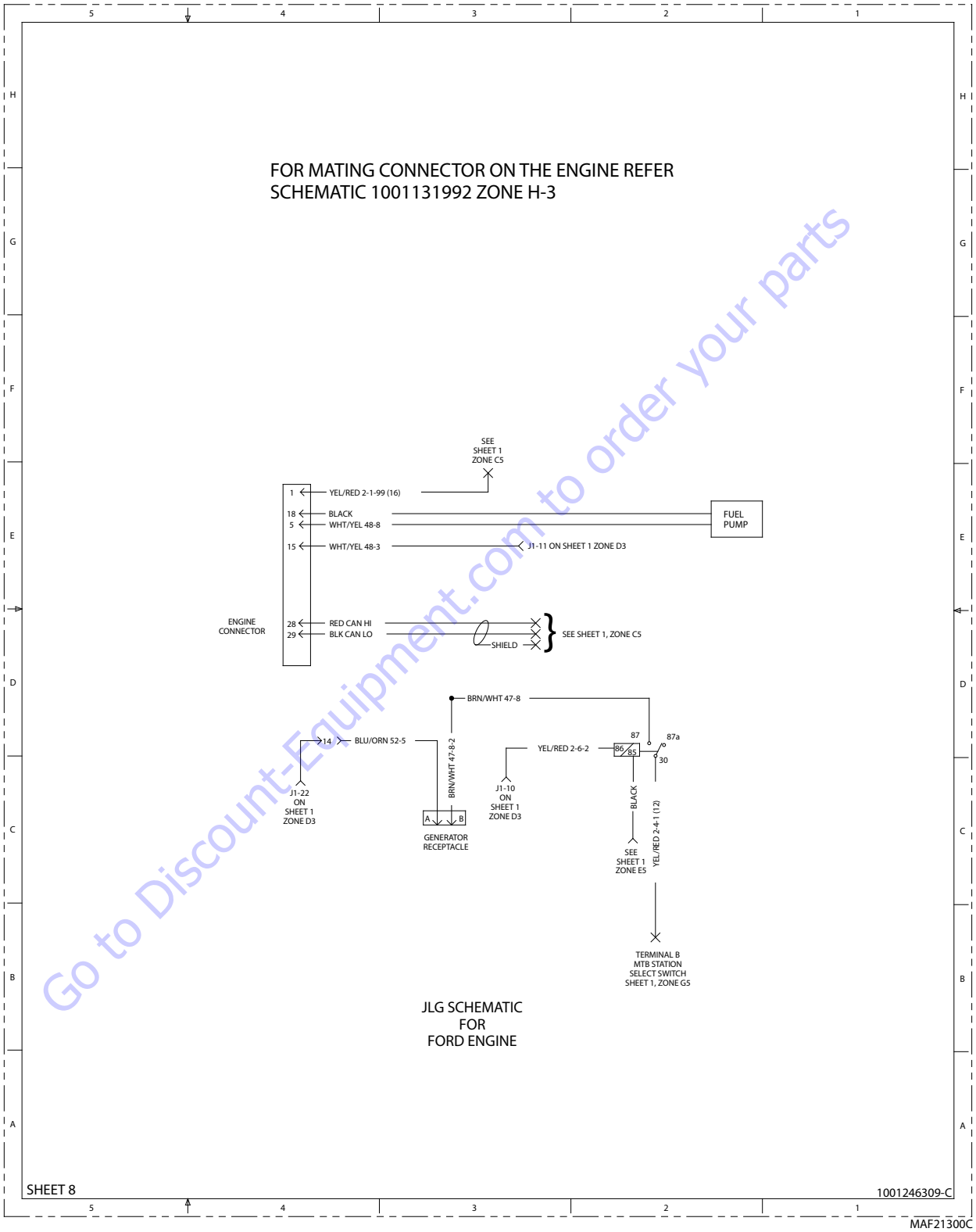


Figure 7-32. Electrical Schematic - Sheet 12 of 19

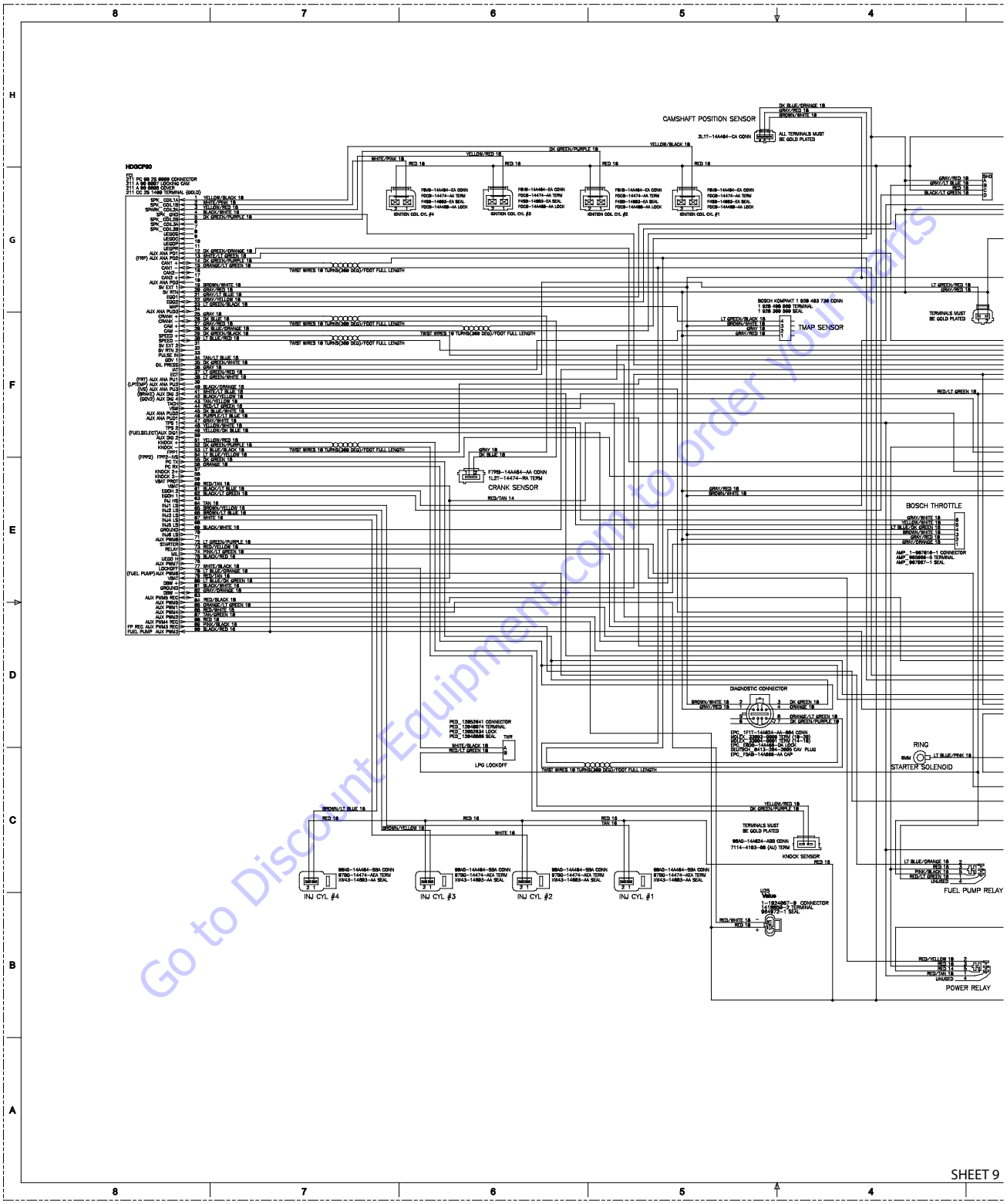


Figure 7-33. Electrical Schematic - Sheet 13 of 19

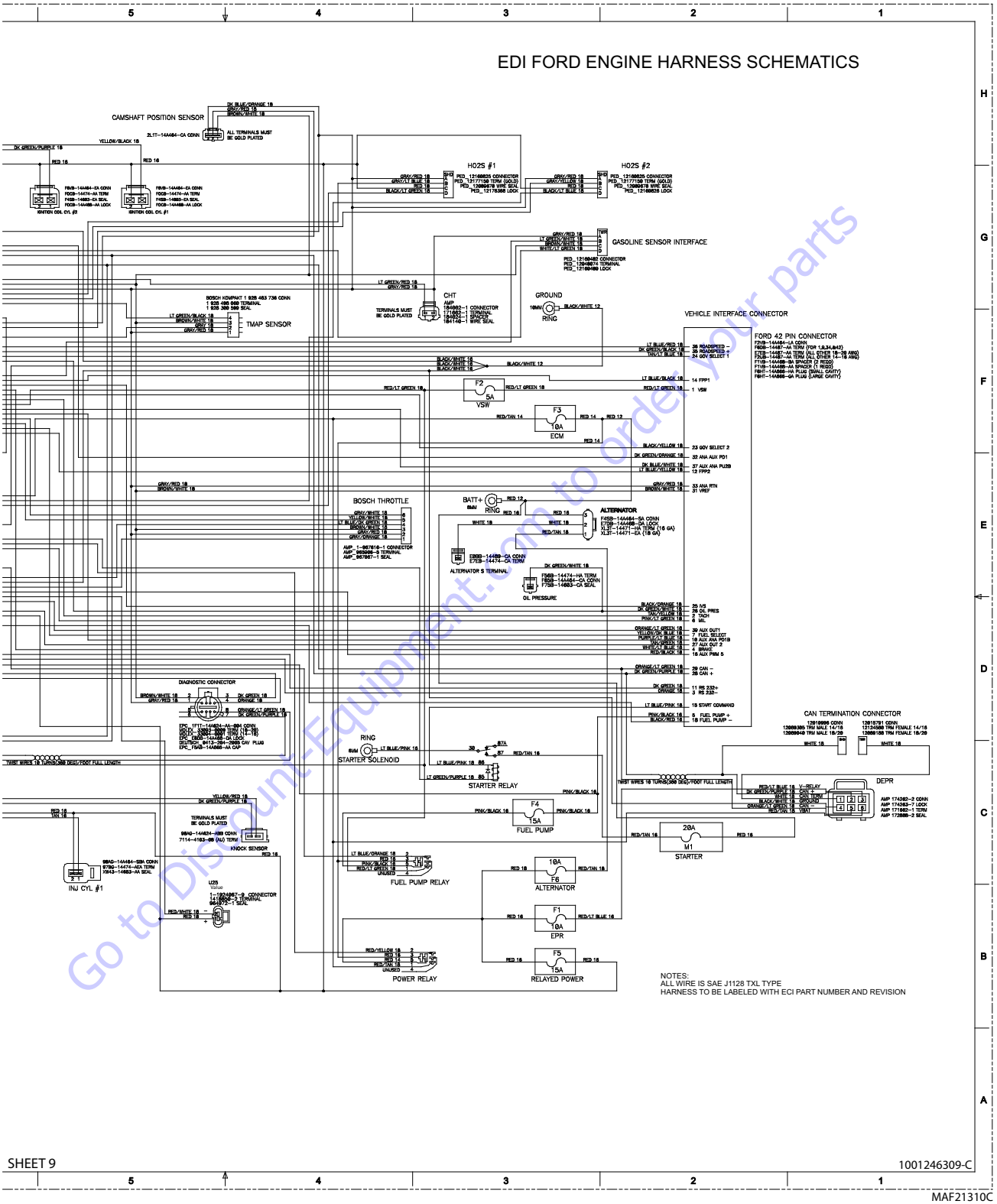


Figure 7-34. Electrical Schematic - Sheet 14 of 19

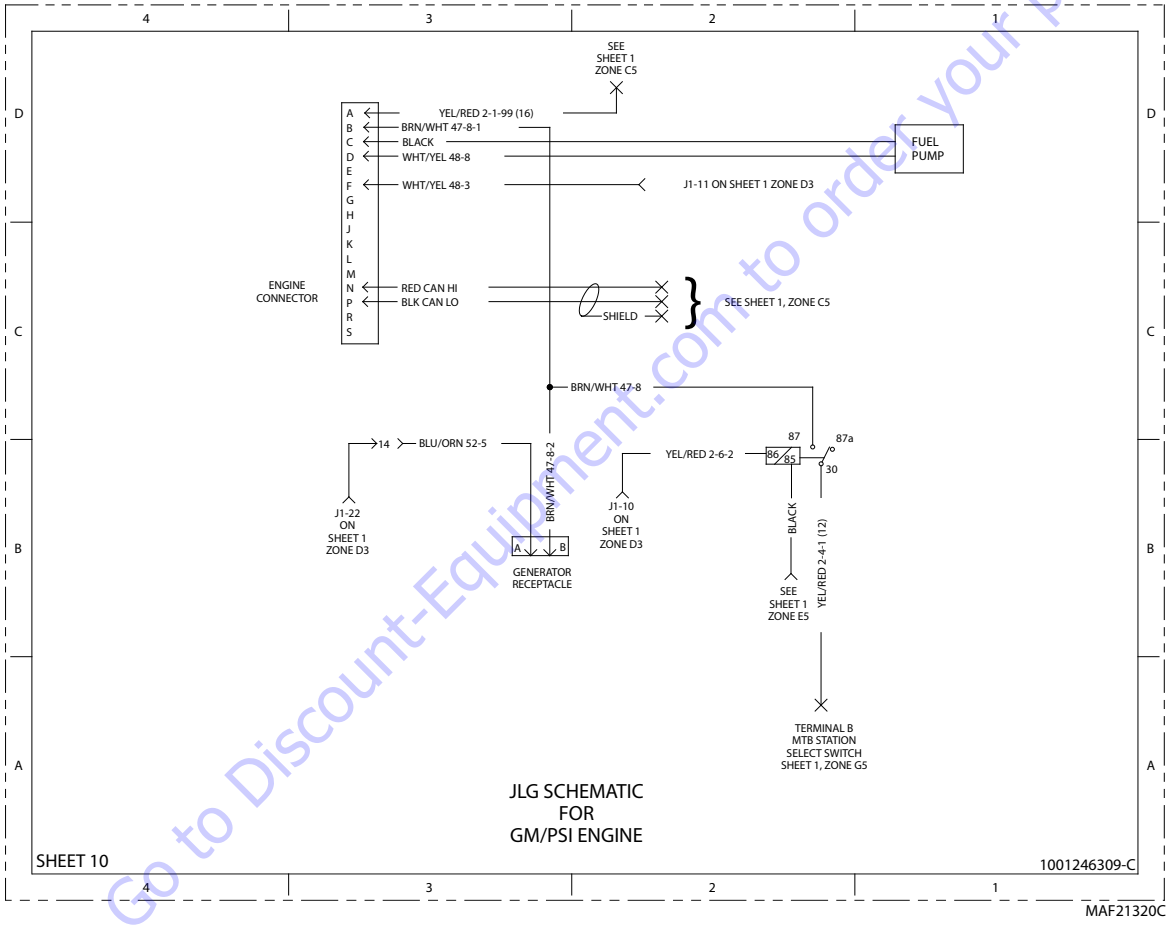


Figure 7-35. Electrical Schematic - Sheet 15 of 19

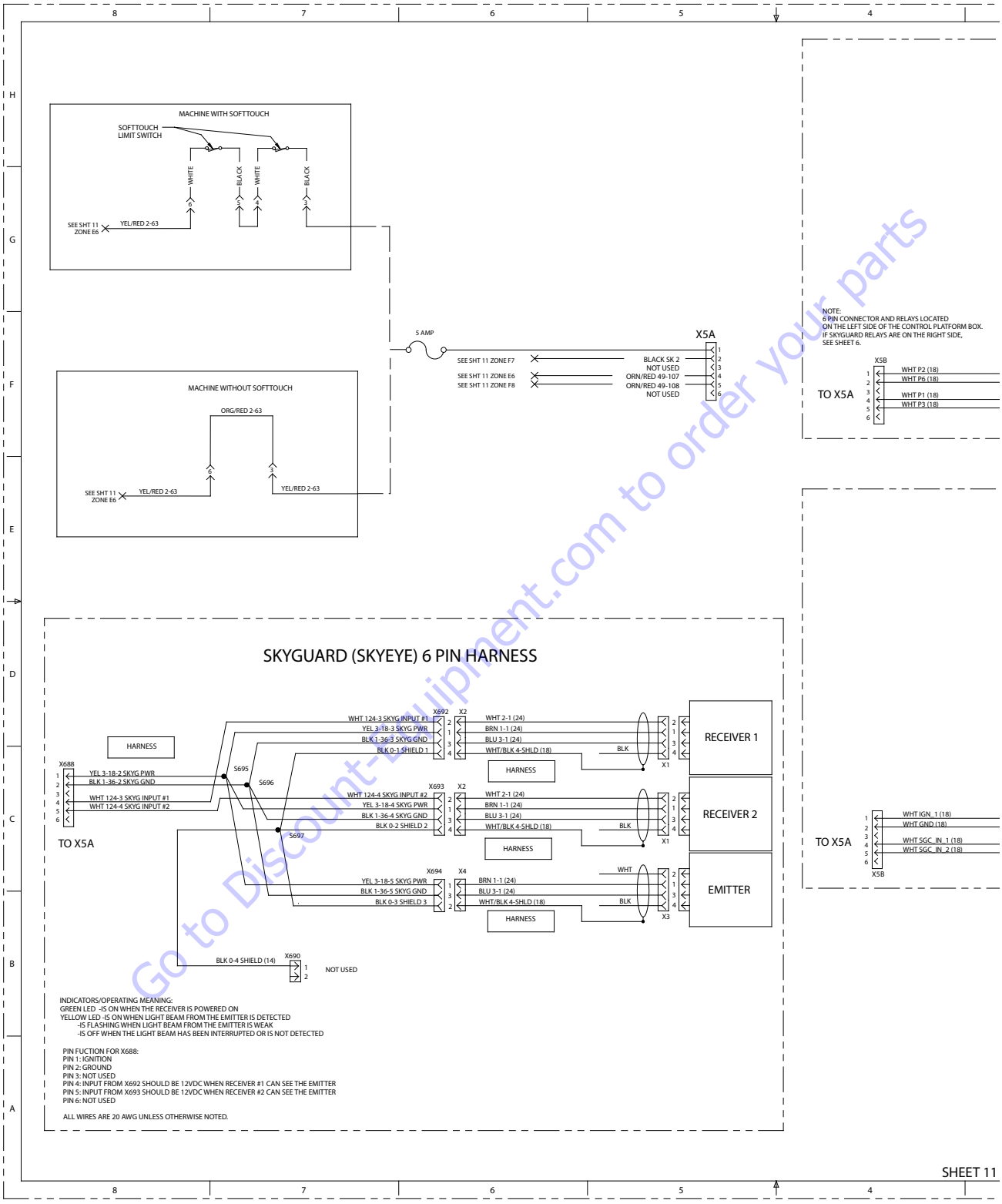


Figure 7-36. Electrical Schematic - Sheet 16 of 19

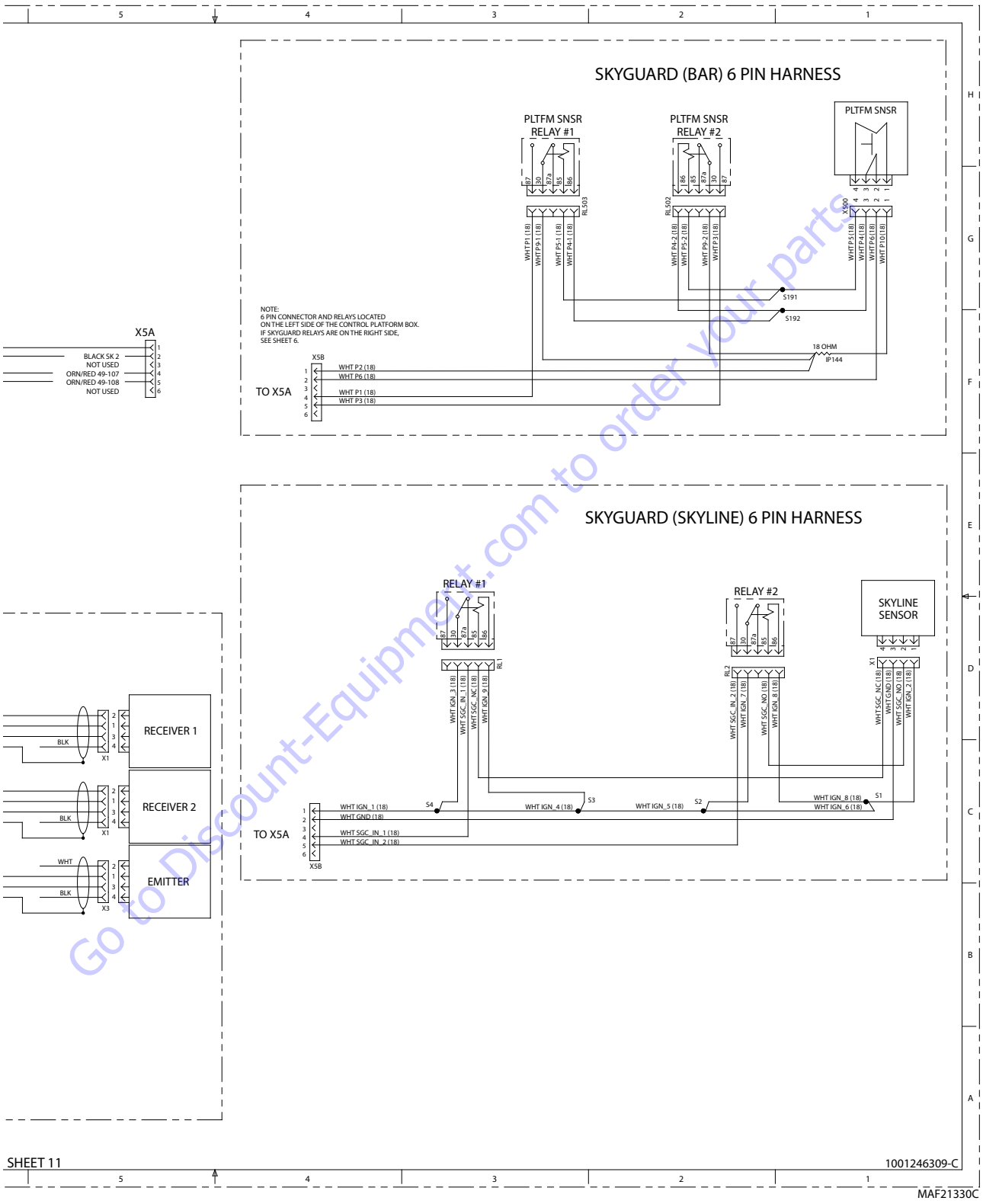


Figure 7-37. Electrical Schematic - Sheet 17 of 19

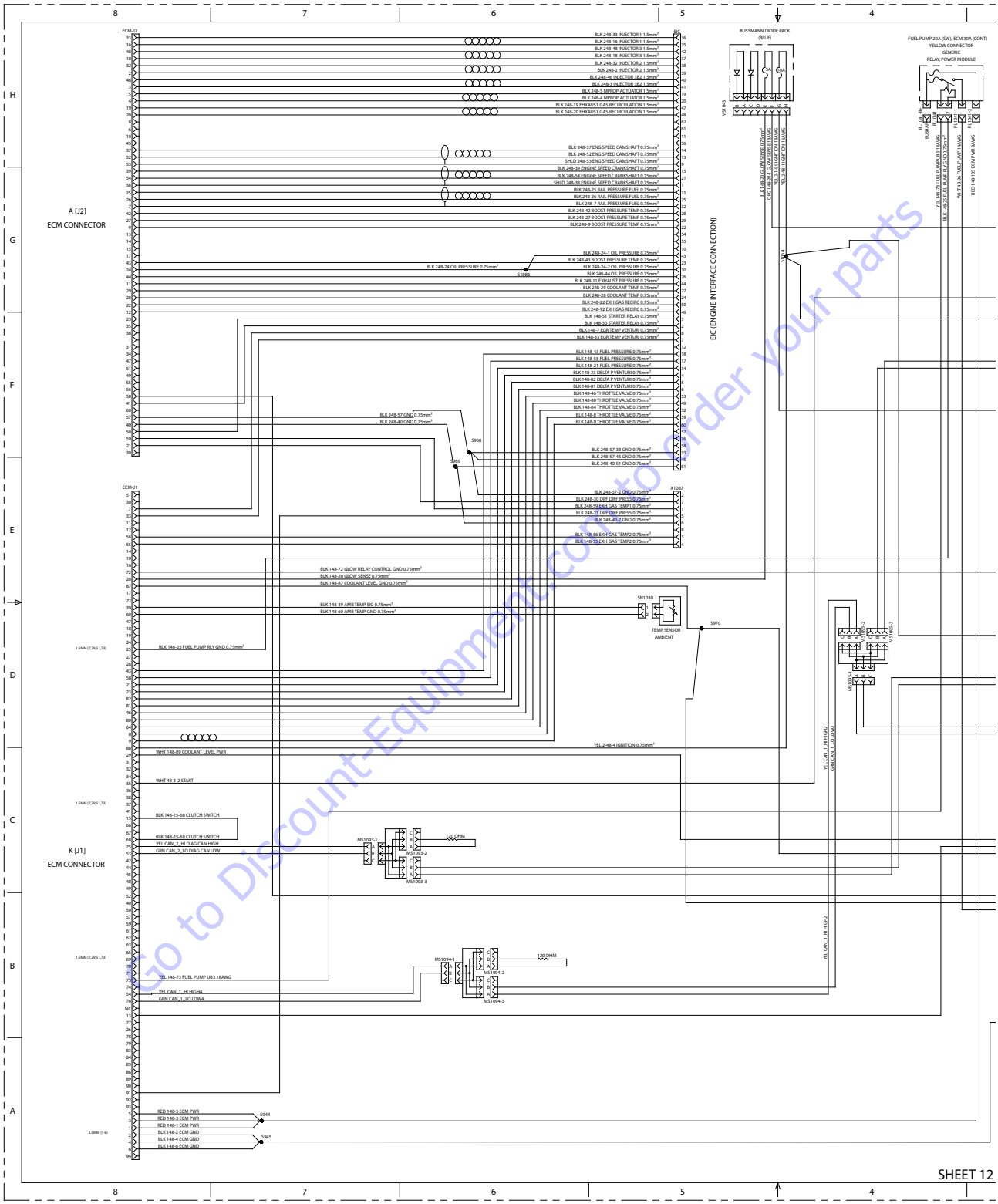


Figure 7-38. Electrical Schematic - Sheet 18 of 19

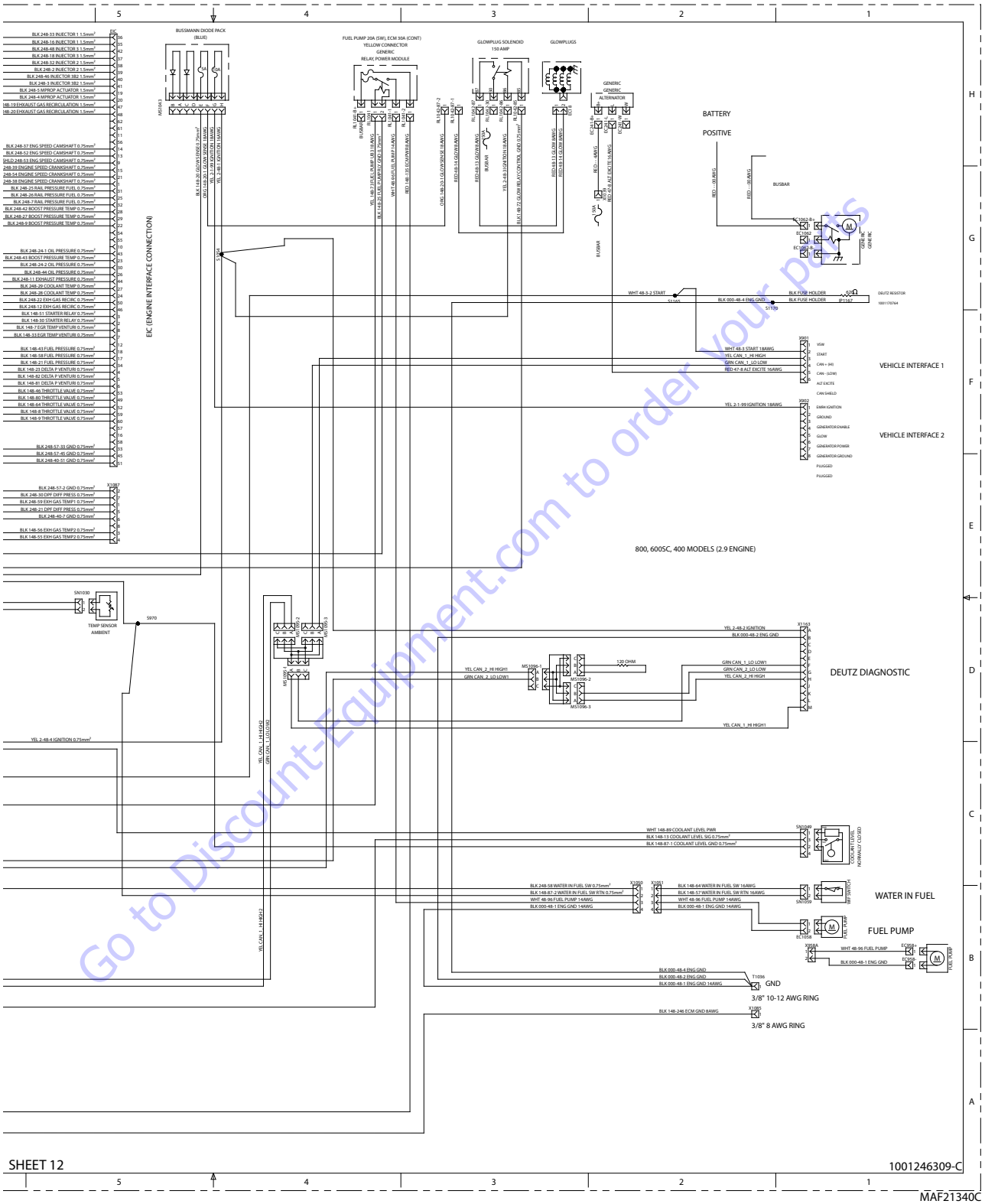
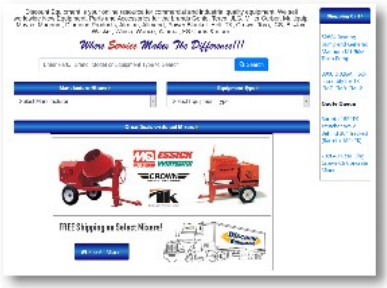


Figure 7-39. Electrical Schematic - Sheet 19 of 19

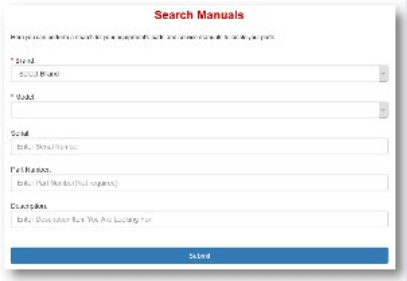
PARTS FINDER

Search Website by Part Number

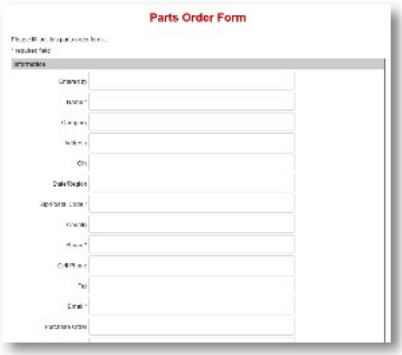
Discount Equipment



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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