

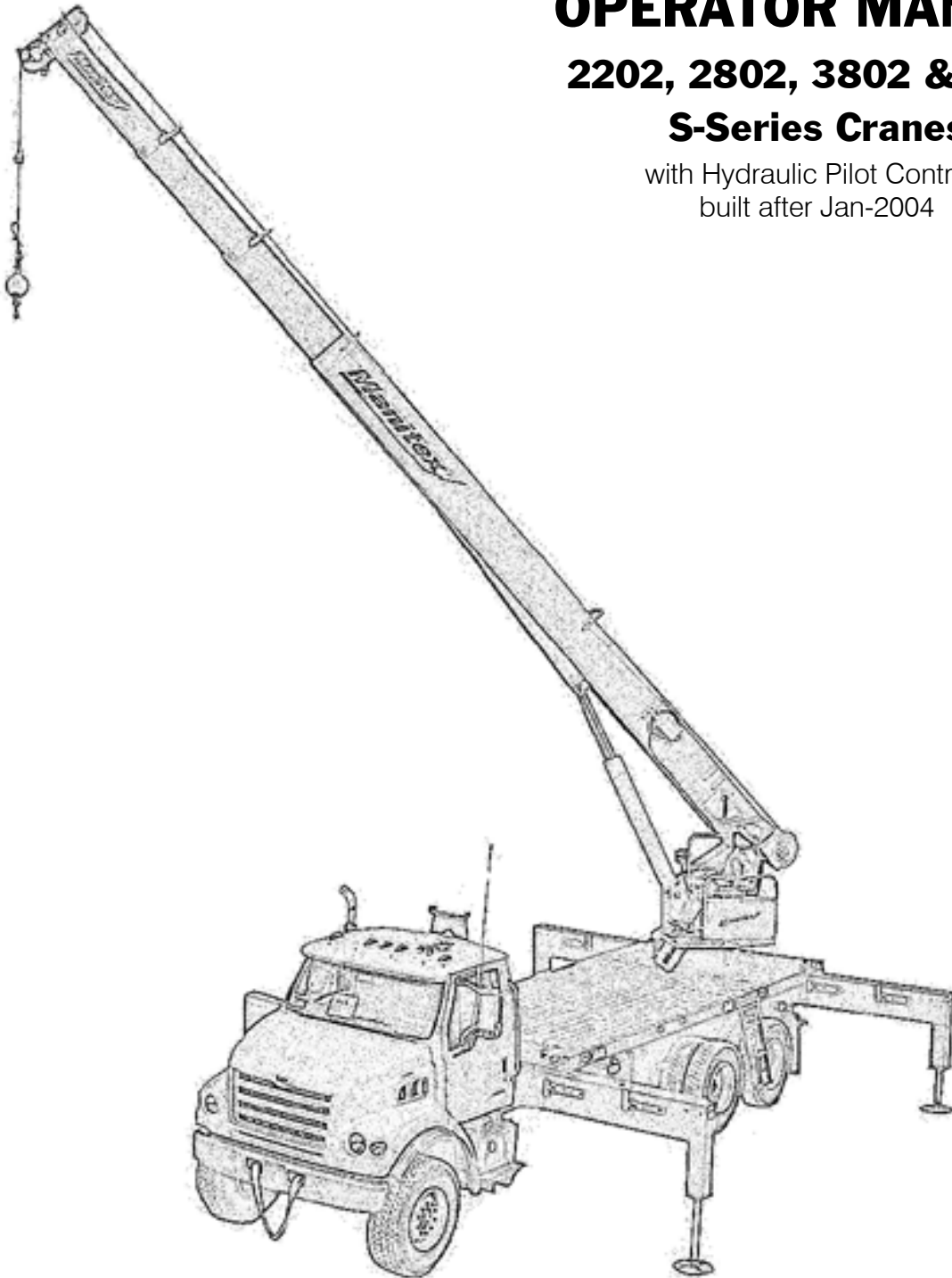


# OPERATOR MANUAL

**2202, 2802, 3802 & 4002**

**S-Series Cranes**

with Hydraulic Pilot Controls  
built after Jan-2004





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# Introduction

## Operator Manual Notice

Safe and efficient operation of a crane requires that it is maintained in proper working order and that operators and maintenance personnel are familiar with the controls and operating capabilities of the crane.

Before placing a crane in service, this manual and the accompanying AEM (Association of Equipment Manufacturers) Safety Manual must be read and understood in its entirety by each person responsible for operation and maintenance of the crane.

### CAUTION

**Failure to read and observe instructions in these manuals can result in death or serious injury to personnel and damage or destruction of equipment.**

The safety information in this manual is intended only as a guide to assist qualified personnel in safe operation and maintenance but it is no substitute for training, experience and common sense. Manitex cannot foresee all potential hazards or misapplications that will arise in the field, therefore, **safety remains the responsibility of the crane owner/operator**. Crane users who have not been properly trained in crane operation and safety by experienced crane operators should not be allowed to operate this equipment.

Existing federal, state and local laws, rules and regulations along with safety codes and insurance requirements take precedence over any information contained in this manual.

## Safety Messages

Safety messages are used throughout this manual to call attention to hazardous operating practices and maintenance procedures. The meaning of these safety messages is as follows:

### DANGER

**Danger is used to identify an immediate hazard that can result in loss of life or personal injury if the warning is ignored.**

### CAUTION

**Caution is used to identify a potential hazard that can result in loss of life or personal injury if the warning is ignored.**

**Important** is used to identify an operating practice or maintenance procedure that can result in damage to or destruction of equipment if warning is ignored.

**Note** is used to highlight an operation or maintenance procedure.

## **Service/Parts Inquiries**

All service inquiries and parts orders should be accompanied by the following information.

- Name, address and telephone number of the crane owner.
- Model and Serial Number of the crane.
- Part numbers or complete description of problem.

## **Incidents**

If a Manitex crane is involved in an incident where there is personal injury or property damage, notify our Product Support Center soon as possible. Provide details of the incident; include crane model, serial number, and photographs of the crane and scene of the incident (digital preferred).

## **Questions**

Manitex carries out a program of continuous product improvement. Because of this, Manitex reserves the right to change the information and specifications given in this manual at any time without notice.

If you have any questions about a Manitex crane or associated literature, please contact your distributor or our Product Support Center.

Manitex  
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Georgetown, TX 78626  
Telephone: (512) 942-3031  
Fax: (512) 942 3094

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# Chapter 1

## Safety and Operation

### General

The importance of safe operation cannot be over emphasized. Carelessness and neglect on the part of operators, job supervisors and planners, rigging personnel and job site personnel can result in their death or injury and costly damage to the crane or property.

As stated in the Introduction, the safety information in this manual is intended only as a guide to assist the qualified operator in safe operation and maintenance but it is no substitute for training, experience and common sense. Manitex cannot foresee all potential hazards or misapplications that will arise in the field, therefore, safety remains the responsibility of the crane owner/operator. Crane users who have not been properly trained in crane operation and safety by experienced crane operators should not be allowed to operate this equipment.

Always refer to ANSI/ASME B30.5-2000 standards for safe operation, inspection and maintenance. The subjects and material presented here are highlights of ANSI/ASME B30.5-2000 and are intended as general information only. Existing federal, state and local laws, rules and regulations along with safety codes and insurance requirements take precedence over any information contained in this manual.



**Failure to comply with safe operating practices and safety messages in this section may result in death or serious injury to operator and job site personnel and destruction of this crane. Read and understand instructions in this chapter and in Capacity Chart before attempting to operate this crane.**

### Safe Operating Practices

#### Operation Near High Voltage Power Lines

Operation of this crane near high voltage power lines shall be accordance with the following requirements.

#### Required Clearance for Normal Voltage in Operation Near High Voltage Power Lines and Operation in Transit with No Load and Boom Lowered.

| <i>Normal Voltage, kV (Phase to Phase)</i>                | <i>Minimum Required Clearance</i> |
|---|-----------------------------------|
| <b>Operation Near High Voltage Power Lines</b>            |                                   |
| to 50   | 10 ft.                            |
| Over 50 to 200  | 15 ft.                            |
| Over 200 to 350   | 20 ft.                            |
| Over 350 to 600   | 25 ft.                            |
| Over 500 to 750   | 35 ft.                            |
| Over 750 to 1000  | 45 ft.                            |
| <b>Operation in Transit with No Load and Boom Lowered</b> |                                   |
| to 0.75   | 4 ft.                             |
| Over 0.75 to 50   | 6 ft.                             |
| Over 50 to 345  | 10 ft.                            |
| Over 345 to 750   | 16 ft.                            |
| Over 750 to 1000  | 20 ft.                            |

Reference: ANSI B30.5

- Any overhead line shall be considered to be an energized power line unless and until the person owning the line or the electrical utility authority indicates that the line is not an energized power line.
- Before starting crane operations near electric power lines, the person responsible for the job shall notify the owner of the lines or his authorized representative providing them with all pertinent information and requesting their cooperation.
- For all operations where it is difficult for the operator to maintain the required clearance by visual means, a qualified signal person shall be provided. The signal person shall observe the clearance and give the operator timely warnings so as to maintain the minimum clearance.
- **Avoid electrocution!** If any part of the crane or the load contacts an energized electric power line, the operator shall not attempt to get off the crane. The operator shall remain at the controls until the contact has been cleared or the power line has been de-energized. Do not let anyone on the ground touch the crane.

The above requirements shall be adhered to even if the crane is equipped with cage-type boom guards, insulating links or proximity warning devices.

### Signals

- Signals to the operator shall be in accordance with the standard signals shown on the following pages unless communications equipment (telephone, radio, etc.) is used.
- For operations not covered in standard signals illustrations, or for special situations, additional signals may be required. In those cases, the signals used shall be agreed upon in advance by the operator and the signal person. The signals used should not conflict with or have the potential to be confused with the standard signals.
- If it is necessary to give other than the standard signals to the operator, all crane motions shall be stopped.
- The signal person shall:
  - Be qualified by experience with the operations and knowledgeable of the standard signals.
  - Position himself in clear view of the operator. The signal person's position shall give him a clear view of the load, the crane, and the operating area.
  - Direct the load so the load does not pass over personnel.
  - Keep unnecessary personnel out of the crane's operating area.

### Preparing for Road Travel

The following steps shall be taken before the truck is traveled after crane operations:

- The jib shall be stored, if equipped.
- The boom shall be in the boom rest before the outriggers and stabilizers are retracted.
- The load block or the overhaul ball shall be secured to the truck chassis at the front.
- The outriggers and stabilizers shall be fully retracted.

**Important** *Always retract front bumper stabilizer, if equipped, before retracting outriggers or rear stabilizers.*

- Access ladders must be in stored position and latched.
- All cab openings are to be closed and secured, if equipped.
- The PTO shall be disengaged.
- All loose items shall be stored or secured to the flatbed.
- The tires shall be inflated to the proper pressure.

The total weight of the truck, the crane and any load carried on the flatbed, shall not exceed the allowable gross vehicle weight.

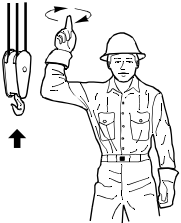
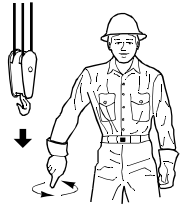
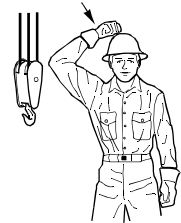
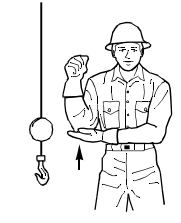
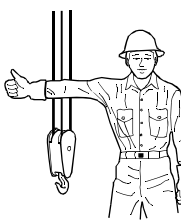
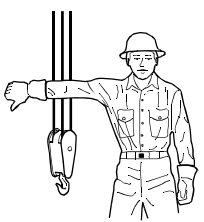
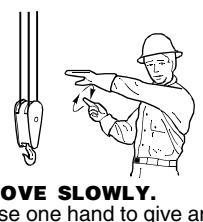
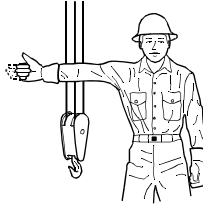
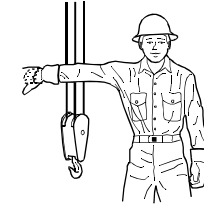
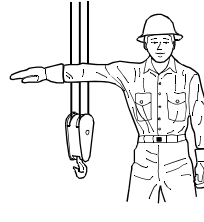
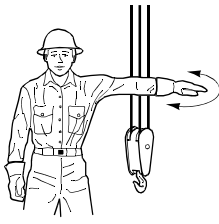
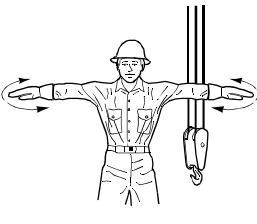
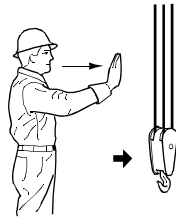
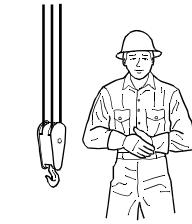
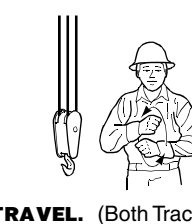

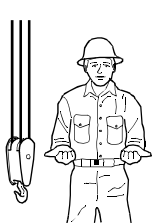
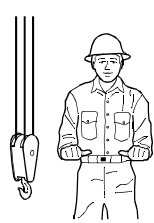
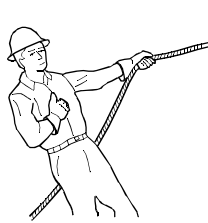
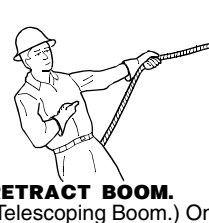
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|---|--|---|--|--|
|  <p><b>HOIST.</b><br/>With forearm vertical, forefinger pointing up, move hand in small horizontal circles.</p>  |  <p><b>LOWER.</b><br/>With arm extended downward, forefinger pointing down, move hand in small horizontal circles.</p>  |  <p><b>USE MAIN HOIST.</b><br/>Tap fist on head; then use regular signals.</p>   |  <p><b>USE WHIPLINE.</b><br/>(Auxiliary Hoist.) Tap elbow with one hand; then use regular signals.</p>   |  <p><b>RAISE BOOM.</b><br/>Arm extended, fingers closed, thumb pointing upward.</p>   |
|  <p><b>LOWER BOOM.</b><br/>Arm extended, fingers closed, thumb pointing downward.</p>  |  <p><b>MOVE SLOWLY.</b><br/>Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal. (Hoist slowly shown as an example.)</p> |  <p><b>RAISE BOOM &amp; LOWER LOAD.</b> With arm extended, thumb pointing up, flex fingers in and out as long as load movement is desired.</p> |  <p><b>LOWER BOOM &amp; RAISE LOAD.</b> With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.</p> |  <p><b>SWING.</b><br/>Arm extended, point with finger in direction of swing of boom.</p>  |
|  <p><b>STOP.</b><br/>Arm extended, palm down, move arm back and forth horizontally.</p>   |  <p><b>EMERGENCY STOP.</b><br/>Both arms extended, palms down, move arms back and forth horizontally.</p>  |  <p><b>TRAVEL.</b><br/>Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.</p>                   |  <p><b>DOG EVERYTHING.</b><br/>Clasp hand in front of body.</p>   |  <p><b>TRAVEL.</b> (Both Tracks.)<br/>Use both fists in front of body, making a circular motion about each other, indicating direction of travel; forward or backward.</p> |
|  <p><b>TRAVEL.</b> (One Track.)<br/>Lock the track on side indicated by raised fist. Travel opposite track in direction indicated by circular motion of other fist, rotated vertically in front of body.</p> |  <p><b>EXTEND BOOM.</b> (Telescoping Booms.)<br/>Both fists in front of body with thumbs pointing outward.</p>  |  <p><b>RETRACT BOOM.</b> (Telescoping Boom.)<br/>Both fists in front of body with thumbs pointing toward each other.</p>                     |  <p><b>EXTEND BOOM.</b> (Telescoping Boom.)<br/>One Hand Signal. One fist in front of chest with thumb tapping chest.</p>                      |  <p><b>RETRACT BOOM.</b> (Telescoping Boom.)<br/>One hand signal. One fist in front of chest, thumb pointing outward and heel of fist tapping chest.</p>                  |

Figure 1-1 Standard Hand Signals

## Setting the Outriggers

### Outrigger Warnings

**DANGER**

Avoid injury to personnel or damage to crane and property by adhering to the following safety precautions when operating outriggers and stabilizers.

- Warn all personnel to stand clear of outriggers and stabilizers before operating them.
- Set outrigger and stabilizer pads on flat, firm foundation that will support load placed on pads.
- Do not set pads in holes, on rocky ground, or on extremely soft ground. Use wood blocking or steel plates under pads, if necessary, to properly distribute loading on foundation.
- Fully retract outriggers and stabilizers before traveling in the truck.
- The material used under the outrigger pads shall be strong enough to prevent crushing, be free of defects, and be of sufficient length and width to prevent shifting or toppling over under load.
- Return control levers to OFF as soon as outriggers or stabilizers are fully extended or fully retracted, otherwise, oil will flow over relief valve, possibly causing damage to hydraulic system from overheating.
- Crane operations with outrigger or stabilizer jack cylinders retracted is prohibited.
- All crane operations shall be performed with the outriggers set on a firm foundation so the crane is level.

### Lifting over the Front

**DANGER**

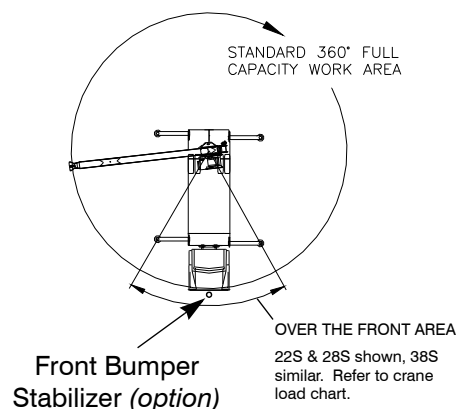
Do not lift or handle loads over the front of the truck (see Figure 1-2) unless the crane is level and the front tires or the optional front stabilizer is contacting the ground.

HEAVY LIFT models equipped with the short subframe option require that the front stabilizer is present and properly set when lifting or handling loads over the front.

Failure to comply with above may compromise crane stability when operating over the front resulting in tipping, possible personal injury and damage to crane or property.

Refer to “Leveling the Crane” for proper outrigger set-up instructions.

Figure 1-2 Area of Operation



### Outrigger Configurations

**Important** See *Outrigger Warnings*.

Outriggers may be extended to three distances - *Full*, *Intermediate* and *Retracted* - by use of Outrigger Pins.

**DANGER**

Crane capacities and range vary depending on outrigger configuration used. Only the Load Chart and Range Diagram that conforms to your outrigger set-up applies when determining applicable crane capacity and range for each specific lift.

#### ***FULL EXTENSION AND RETRACTED SETTINGS***

Before setting the outriggers, ensure that the Outrigger Pin for each outrigger is in the stowed position with the pin resting in the *upper* part of the slot as shown in Figure 1-3 or 1-4.

#### ***INTERMEDIATE EXTENSION***

Before setting the outriggers, lower the Outrigger Pin to the *lower* position in the slot as shown in Figure 1-3 or 1-4.

*Single-Stage Outriggers* — With the outriggers retracted, extend slowly until pin drops into hole in inner box.

*Double-stage Outriggers* — With the outriggers retracted, pins will immediately engage when it is lowered to the bottom position in the slot.

**DANGER**

All outriggers must be identically set to the same extension. Attempting to use different extensions can result in equipment damage, personal injury, and injuries to others.

### Single-Stage Outriggers

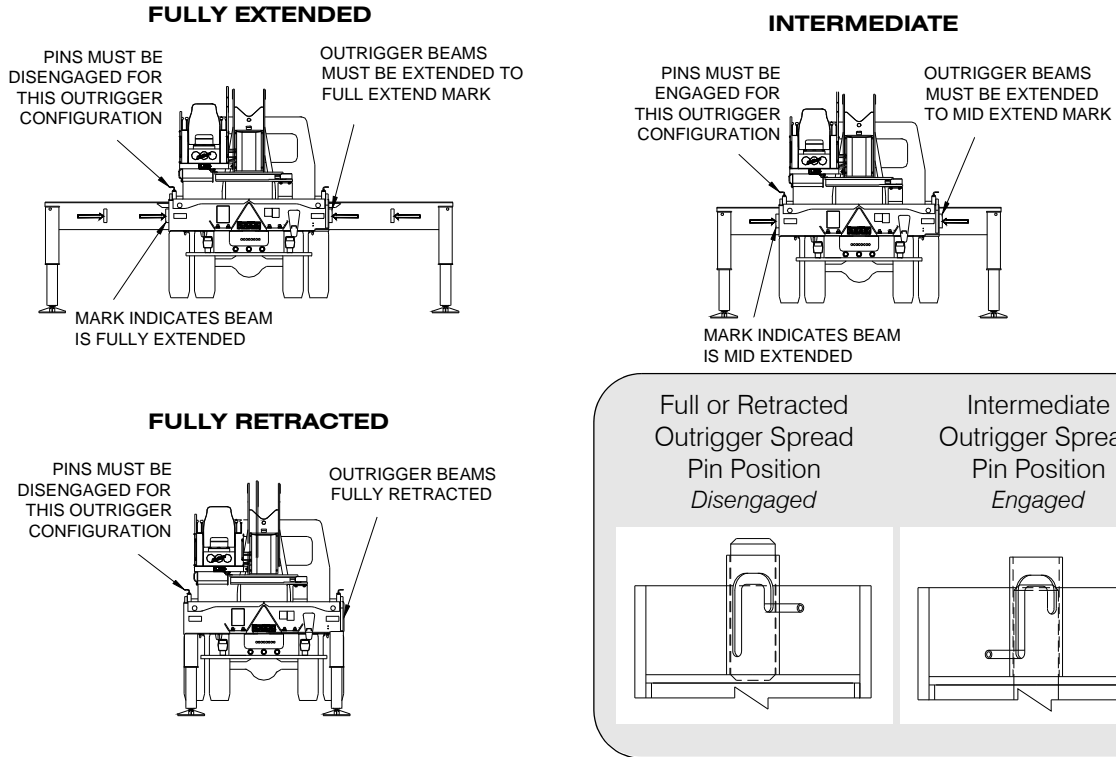


Figure 1-3 Outrigger Pin Positions and Configurations for Single-Stage Outriggers

### Dual-Stage Outriggers

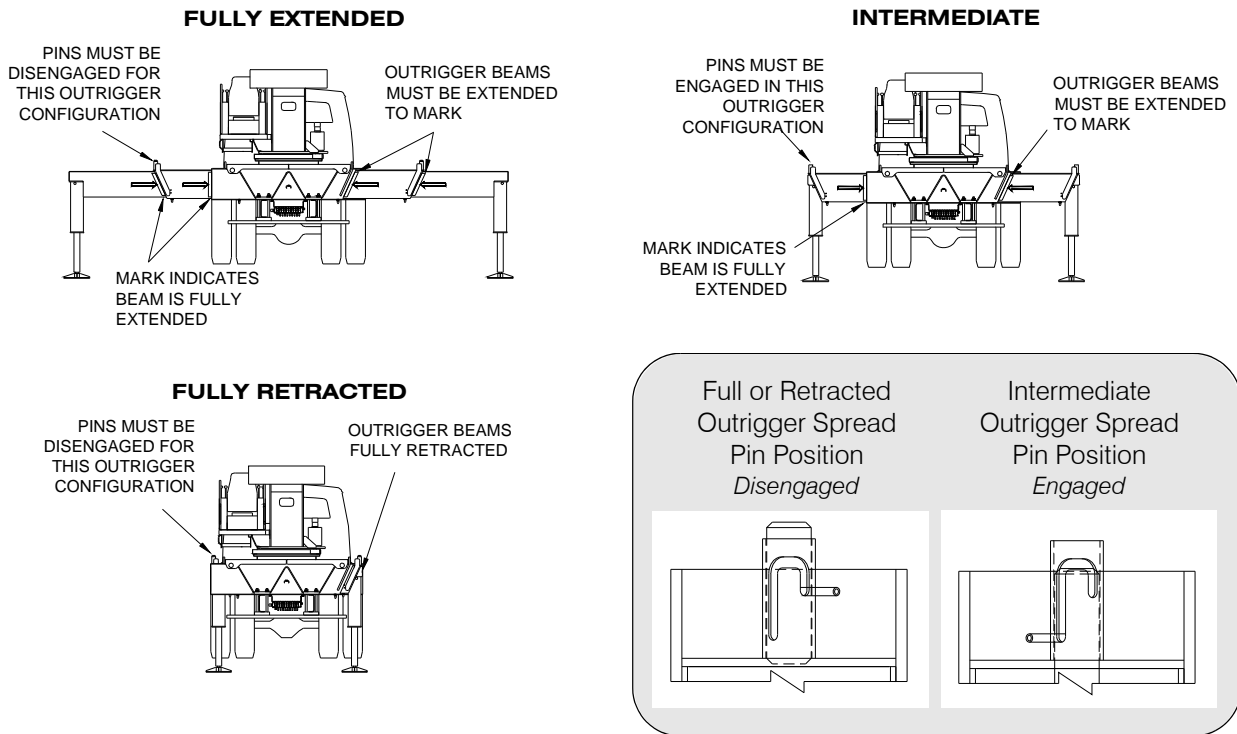


Figure 1-4 Outrigger Pin Positions and Configurations for Dual-Stage Outriggers

## Leveling the Crane



Before operating the outriggers, refer to *Setting the Outriggers* earlier in this chapter for outrigger warnings and notes.

If lifting over the front, be sure to pay particular attention to the following instructions regarding proper set-up of the front outriggers, front truck tires and front bumper stabilizer.

Do not operate the crane until the outriggers have been set-up in compliance with all warnings and instructions. Failure to comply can cause crane to tip possibly resulting in personal injury and damage to crane or property.

**Important** The crane outriggers must be set in the following sequence to prevent twisting the frame unnecessarily and to improve crane performance.

**Step 1** Ensure that the outrigger pin is in the correct position for the desired outrigger spread configuration before extending the outrigger beams. Refer to Figures 1-3 and 1-4 for illustrations of the various outrigger configurations.

### **FOR CRANES WITHOUT FRONT BUMPER STABILIZER**

**Step 2** Extend the front outrigger beams to the desired spread position, when properly extended the indicator arrow on each beam must be fully exposed.

**Step 3** Then, extend the front outrigger jack cylinders until front tires are **barely touching** the ground, adjust each jack cylinder to level the crane from side to side.

**Important** Due to the grade of the ground, it may become necessary to add cribbing under the front tires to ensure slight contact to firm footing as described above. See "Outrigger Warnings" earlier in this chapter for notes on cribbing if it becomes necessary.

**Note** If loads will not be lifted or carried over the front, then the front of the truck may be set-up with the tires completely off the ground.

**Step 4** Next, extend the rear outrigger beams to the spread position that matches the front outrigger spread, when properly extended the indicator arrow on each beam must be fully exposed.

**Step 5** Then, extend the rear outrigger jack cylinders simultaneously (operate both control levers for the jack cylinders at the same time) until the rear tires are completely off the ground; simultaneously adjust rear jacks to level the crane from front to rear.

### **FOR CRANES EQUIPPED WITH FRONT BUMPER STABILIZER**

**Step 2** Extend the front outrigger beams to the desired spread position, when properly extended the indicator arrow on each beam must be fully exposed.

**Step 3** Then, extend the front outrigger jack cylinders until front tires are **barely off** the ground, adjust each jack cylinder to level the crane from side to side.

**Step 4** Next, extend the rear outrigger beams to the spread position that matches the front outrigger spread, when properly extended the indicator arrow on each beam must be fully exposed.

**Step 5** Then, extend the rear outrigger jack cylinders simultaneously (operate both control levers for the jack cylinders at the same time) until the rear tires are completely off the ground; simultaneously adjust rear jacks to level the crane from front to rear.

**Step 6** Finally, extend the front bumper stabilizer until oil flows over the relief valve. At this point, the stabilizer will stop extending, ensuring the stabilizer is properly loaded.

**Important** If necessary, use cribbing under the front stabilizer pad to ensure that it extends against the ground to establish firm contact; see "Outrigger Warnings" earlier in this chapter for notes on cribbing.

## Retracting Outriggers



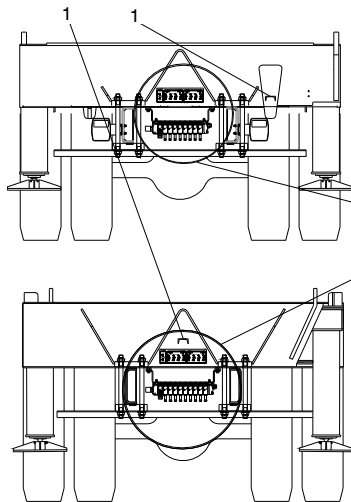
Never retract the outriggers unless the jib is stored and the boom is placed in the boom rest, failure to comply will compromise crane stability resulting in tipping, possible injury to personnel and damage to crane or property.

**Important** If so equipped, always retract front bumper stabilizer, before retracting crane outriggers.

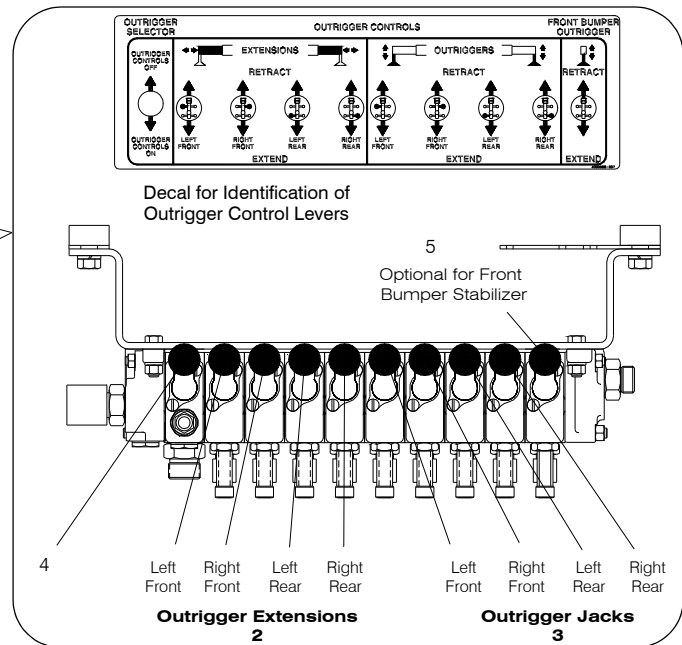
Once the boom is placed in the boom rest, proceed to retract outriggers in reverse order.



## Outrigger Controls



**Do not operate the crane until the outriggers have been set-up in compliance with all warnings and set-up instructions. For this information, refer to *Setting the Outriggers* earlier in this chapter.**



**Figure 1-5** Outrigger Controls (Rear View of Crane)

| Control and Position (Figure 1-5)   | Function  |
|---|---|
| <p><i>Note</i> 1. All extension and outrigger functions operate by actuating two (2) separate control levers. Selection of only one control lever will not activate the desired function.</p> <p>2. Outrigger controls are fully proportional providing a full range of operating speeds from minimum to maximum.</p> <p>To operate<br/> <b>First</b>, operate and hold the Outrigger Selector Lever (4).<br/> <b>Then</b>, actuate the desired Extension or Jack Control Lever (2 or 3).</p> |   |
| <p><b>1. Bubble Level</b></p>   | <p>Indicates how level the crane is from side to side and front to rear.</p>  |
| <p><b>2. Extension Control Levers</b></p> <p>Lever <b>DOWN</b> from OFF<br/>                     Lever <b>UP</b> from OFF</p>   | <p>Lever operate the specific outrigger extension selected, see decal for lever identification.</p> <p><b>EXTENDS</b> selected outrigger extension outward.<br/> <b>RETRACTS</b> selected outrigger extension inward.</p>   |
| <p><b>3. Outrigger Control Levers</b></p> <p>Lever <b>DOWN</b> from OFF<br/>                     Lever <b>UP</b> from OFF</p>   | <p>Lever operate the specific outrigger jack selected, see decal for lever identification.</p> <p><b>EXTENDS</b> selected outrigger jack downward.<br/> <b>RETRACTS</b> selected outrigger jack upward.</p>   |
| <p><b>4. Outrigger Selector Lever</b></p> <p>Lever <b>DOWN - ON</b></p> <p>Lever <b>UP</b> (spring returned) - <b>OFF</b></p>   | <p>Allows flow of hydraulic fluid to the outrigger control valve, thereby enabling extend or retract functions.</p> <p>Activates warning horn and increases engine speed. Prevents flow of hydraulic fluid to the outrigger control valve, thereby disabling extend or retract functions.</p> |
| <p><b>5. Front Stabilizer Lever</b> (Optional)</p> <p>Lever <b>DOWN</b> from OFF<br/>                     Lever <b>UP</b> from OFF</p>  | <p><b>EXTENDS</b> stabilizer downward.<br/> <b>RETRACTS</b> stabilizer upward.</p>  |

## Crane Controls and Indicators

Refer to Figures 1-6 thru 1-8.

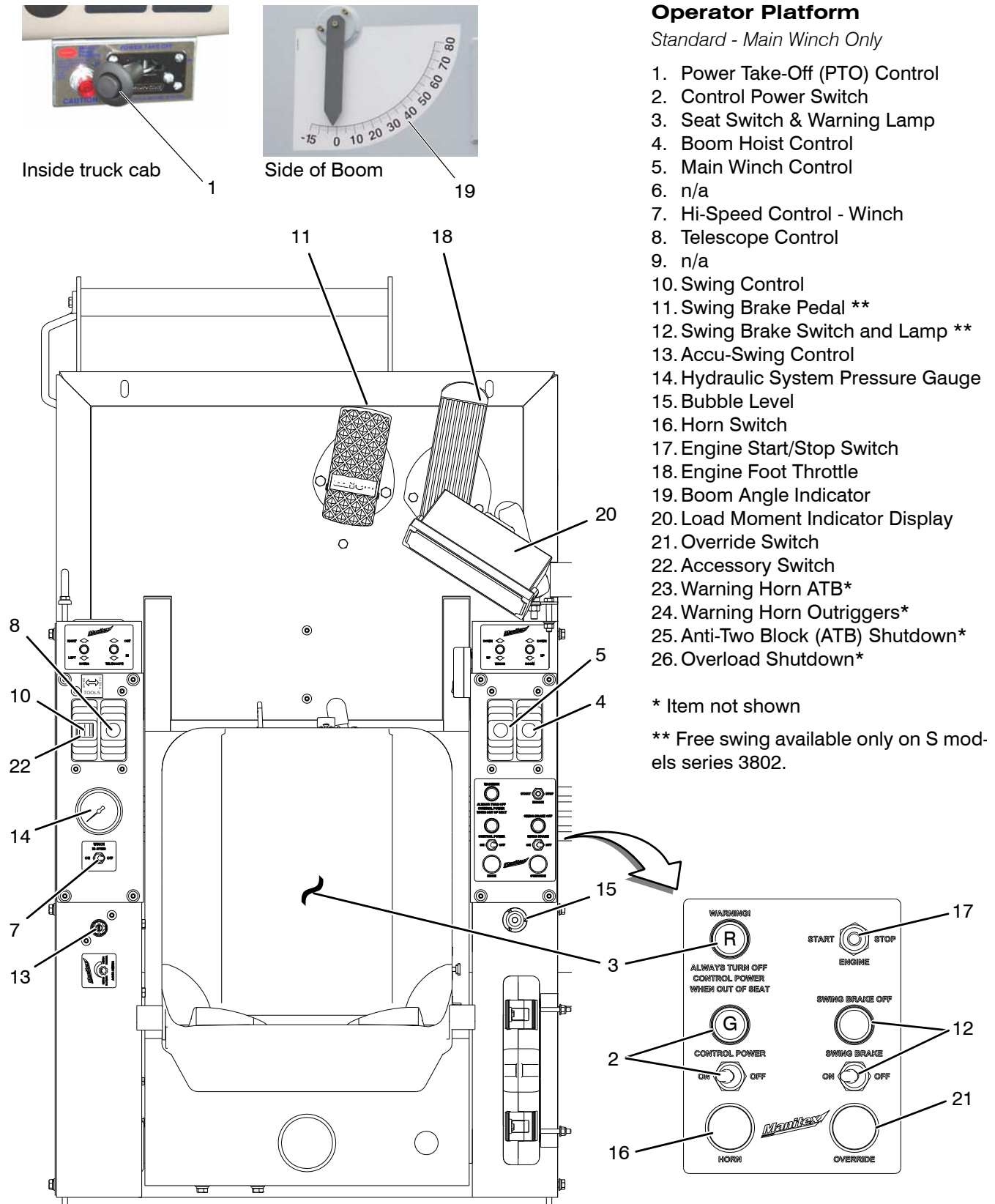


Figure 1-6 Operator Console Controls - Crane w/Main Winch only

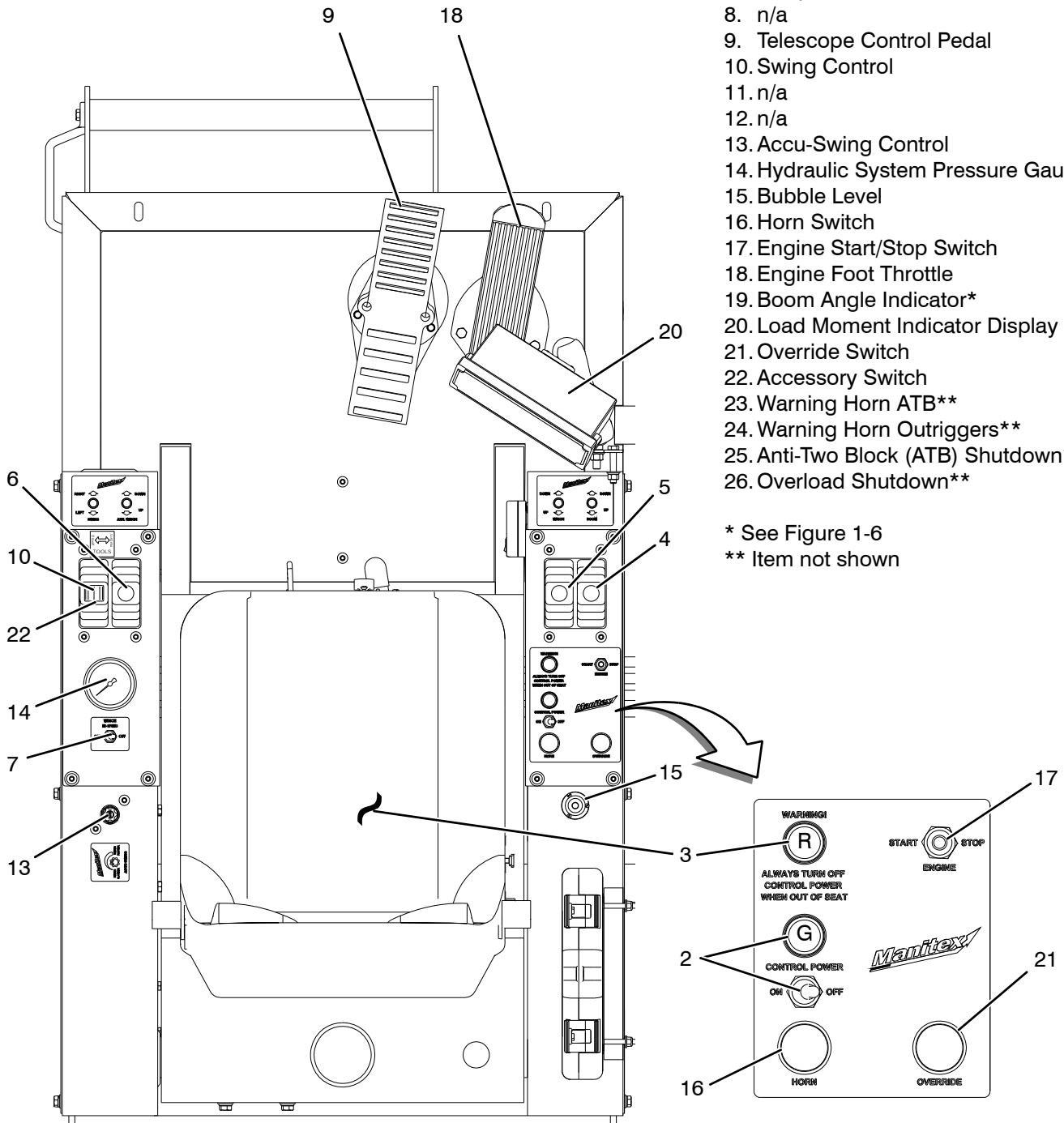
### Operator Platform

With Aux winch option, No free swing  
(Series 3802 & 4002 only)

1. Power Take-Off (PTO) Control \*
2. Control Power Switch and Lamp
3. Seat Switch & Warning Lamp
4. Boom Hoist Control
5. Main Winch Control
6. Aux Winch Control
7. Hi-Speed Control - Winch
8. n/a
9. Telescope Control Pedal
10. Swing Control
11. n/a
12. n/a
13. Accu-Swing Control
14. Hydraulic System Pressure Gauge
15. Bubble Level
16. Horn Switch
17. Engine Start/Stop Switch
18. Engine Foot Throttle
19. Boom Angle Indicator\*
20. Load Moment Indicator Display
21. Override Switch
22. Accessory Switch
23. Warning Horn ATB\*\*
24. Warning Horn Outriggers\*\*
25. Anti-Two Block (ATB) Shutdown\*\*
26. Overload Shutdown\*\*

\* See Figure 1-6

\*\* Item not shown



**Figure 1-7** Operator Console Controls - Crane w/Main & Aux Winch

### Operator Platform

With Free Swing, Main & Aux Winch options  
(Series 3802 & 4002 only)

1. Power Take-Off (PTO) Control \*
2. Control Power Switch and Lamp
3. Seat Switch & Warning Lamp
4. Boom Hoist Control
5. Main Winch Control
6. Aux Winch Control
7. Hi-Speed Control - Winch
8. n/a
9. Telescope Control Pedal
10. Swing Control
11. Swing Brake Pedal
12. Swing Brake Switch and Lamp
13. Accu-Swing Control
14. Hydraulic System Pressure Gauge
15. Bubble Level
16. Horn Switch
17. Engine Start/Stop Switch
18. Engine Foot Throttle
19. Boom Angle Indicator \*
20. Load Moment Indicator Display
21. Override Switch
22. Accessory Switch
23. Warning Horn ATB \*\*
24. Warning Horn Outriggers \*\*
25. Anti-Two Block (ATB) Shutdown \*\*
26. Overload Shutdown \*\*

\* See Figure 1-6

\*\* Item not shown

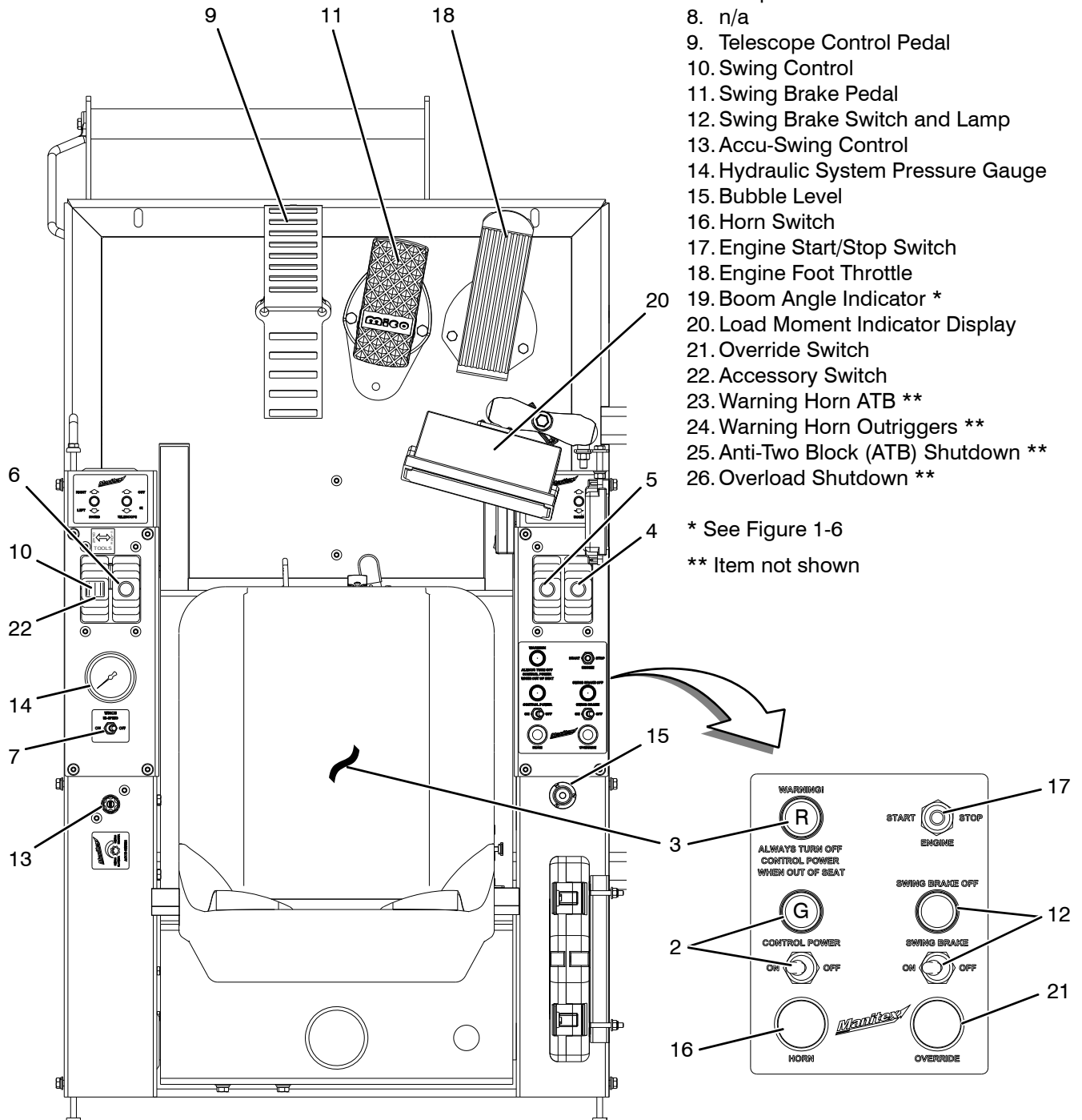


Figure 1-8 Operator Console Controls - Crane w/Free Swing, Main & Aux Winch

- Note** 1. The terms RIGHT, LEFT, FORWARD and BACK refer to the operator's right, left, front and rear when seated at the controls on the operator's platform.
2. Crane controls are fully proportional providing a full range of operating speeds from minimum to maximum.

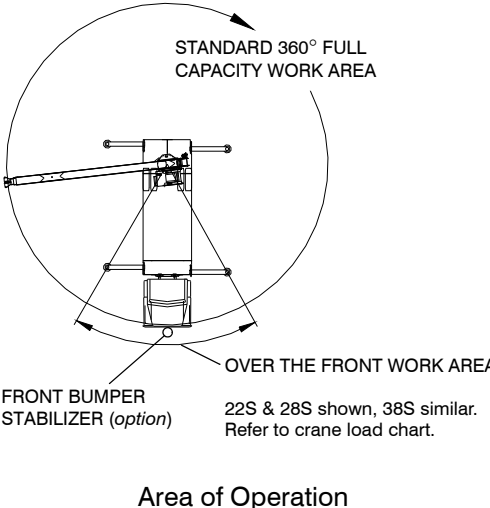
### Crane Controls and Positions

| Control and Position (Figure 1-6 thru 1-8)  | Function  |
|---|---|
| <p><b>1. Power Take-Off (PTO) Control</b></p>   | <p>Operation of the PTO will vary; refer to the manufacturer's manual in the truck cab for operating instructions.</p> <p><b>Important</b> Do not drive truck while PTO is engaged; hydraulic pump may be damaged.</p>  |
| <p><b>2. Control Power Switch</b></p> <p>Toggle <b>LEFT</b> (maintained)</p> <p>Toggle <b>RIGHT</b> (maintained)</p>                                      | <p>Activate switch to supply crane control levers with necessary pilot pressure to operate crane functions.</p> <p><b>ON</b> Activates crane function control levers; control power light (GREEN) is ON.</p> <p><b>OFF</b> Deactivates crane function control levers; control power light (GREEN) is OFF.</p> <p><b>Important</b> KEEP CRANE AND LOAD UNDER CONTROL. Never turn Crane Power Switch OFF while operating the crane. Bring all functions to a complete stop before turning Crane Power Switch OFF.</p> <p><b>Important</b> PREVENT UNEXPECTED SWING MOVEMENTS. If the crane is equipped with the Free Swing feature, ensure that the Swing Brake Switch is set to ON before activating the Crane Power Switch.</p> <p><b>Note</b> Crane Power Switch should be placed in <b>OFF</b> position if the crane operator gets out of the seat.</p> |
| <p><b>3. Seat Switch &amp; Warning Light</b></p> <p>Operator <b>OFF</b> seat</p> <p>Operator <b>IN</b> seat</p>   | <p>A seat switch and warning lights are provided to remind the operator to turn <b>OFF</b> the <b>Crane Power Switch</b> when appropriate.</p> <p>If the <b>Control Power Switch</b> is <b>ON</b>, the functionality of these operator aids are as follows:</p> <p>Warning horn sounds continuously, RED &amp; GREEN warning light flash. Get back <b>IN</b> seat or turn Control Power Switch <b>OFF</b>.</p> <p>Warning horn silent, RED warning light OFF.</p>   |
| <p><b>4. Boom Hoist Control</b></p> <p>Lever <b>FORWARD</b> from OFF</p> <p>Lever <b>BACK</b> from OFF</p> <p>Lever <b>CENTERED</b> (spring returned)</p> | <p><b>DOWN</b> (lower boom).</p> <p><b>UP</b> (raise boom).</p> <p><b>OFF</b> (counterbalance valve holds boom in position).</p> <p><b>Important</b> Return control lever to OFF as soon as boom is fully raised or fully lowered; otherwise, oil will flow over relief valve, possibly causing damage to hydraulic system from overheating.</p>  |

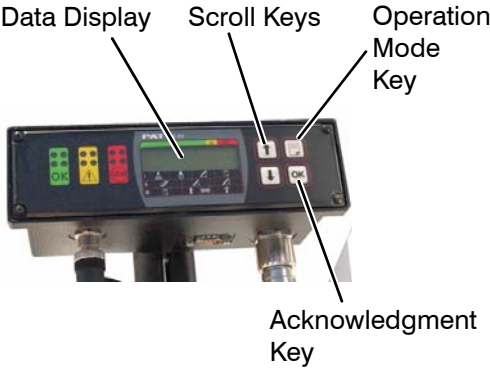
## Crane Controls and Positions

| Control and Position (Figure 1-6 thru 1-8)  | Function  |
|---|---|
| <b>5. Main Winch Control</b><br>Lever <b>FORWARD</b> from OFF<br>Lever <b>BACK</b> from OFF<br>Lever <b>CENTERED</b> (spring returned)        | <b>DOWN</b> (lower load).<br><b>UP</b> (raise load).<br><b>OFF</b> (spring-applied brake holds load in position).   |
| <b>6. Aux Winch Control</b><br>Lever <b>FORWARD</b> from OFF<br>Lever <b>BACK</b> from OFF<br>Lever <b>CENTERED</b> (spring returned)         | Option only available on Series 3802<br><b>DOWN</b> (lower load).<br><b>UP</b> (raise load).<br><b>OFF</b> (spring-applied brake holds load in position).<br><br><i>Note</i> See Section 2 “Rigging” for warnings and notes regarding proper usage of the auxiliary winch option.   |
| <b>7. HI-Speed Control - Winch</b><br>Toggle <b>LEFT</b> (maintained)<br>Toggle <b>RIGHT</b> (maintained)                                     | Position of switch also applies to the optional auxiliary winch.<br><b>HIGH SPEED</b> winch operation.<br><b>LO SPEED</b> winch operation.<br><br><i>Note</i> When HI Speed is activated, a solenoid valve changes the displacement of the 2-speed motor to increase line speed by 150%.<br><br><b>Important</b> This switch controls the two-speed motor of both main and optional aux winch simultaneously.   |
| <b>8. Telescope Control - Lever</b><br>Lever <b>FORWARD</b> from OFF<br>Lever <b>BACK</b> from OFF<br>Lever <b>CENTERED</b> (spring returned) | <b>OUT</b> (extend boom sections)<br><b>IN</b> (retract boom sections).<br><b>OFF</b> (counterbalance valve holds boom sections in position).<br><br><b>Important</b> Return control lever to OFF as soon as boom is fully extended or fully retracted; otherwise, oil will flow over relief valve, possibly causing damage to hydraulic system from overheating.<br><br><i>Note</i> Due to variations in loading, boom angle, and slider pad friction, the maximum load that can be telescoped cannot be specified. It is safe, however, to attempt to telescope the boom within the limits of the Capacity Chart.   |
| <b>9. Telescope Control - Pedal</b><br>Pedal <b>FORWARD</b> from OFF<br>Pedal <b>BACK</b> from OFF<br>Pedal <b>CENTERED</b> (spring returned) | Only available on Series 3802 with Aux winch option.<br><b>OUT</b> (extend boom sections)<br><b>IN</b> (retract boom sections).<br><b>OFF</b> (counterbalance valve holds boom sections in position).<br><br><b>Important</b> Return pedal to OFF as soon as boom is fully extended or fully retracted; otherwise, oil will flow over relief valve, possibly causing damage to hydraulic system from overheating.<br><br><i>Note</i> Due to variations in loading, boom angle, and slider pad friction, the maximum load that can be telescoped cannot be specified. It is safe, however, to attempt to telescope the boom within the limits of the Capacity Chart. |

## Crane Controls and Positions


| Control and Position (Figure 1-6 thru 1-8)  | Function  |
|---|---|
| <p><b>10. Swing Control</b></p> <p>Lever <b>FORWARD</b> from OFF<br/>Lever <b>BACK</b> from OFF<br/>Lever <b>CENTERED</b> (spring returned)</p>  <p>Area of Operation</p> | <p><b>DANGER</b> Crane may be continuously rotated in each direction, however, <b>DO NOT</b> lift or carry loads over the front of the truck unless all outrigger warnings and set-up instructions are followed. Failure to comply can cause crane to tip possibly resulting in personal injury and damage to crane or property.</p> <p>Swing <b>RIGHT</b> (clockwise).<br/>Swing <b>LEFT</b> (counterclockwise).<br/><b>OFF</b> (spring-applied brake holds boom in position).</p> <p><b>Important</b> <i>KEEP LOAD UNDER CONTROL. Bring crane to a smooth stop before changing direction of crane rotation.</i></p> <p><b>Important</b> <i>Always observe and operate within the Area of Operation restrictions applicable to your crane. The Area of Operation for your specific crane is specified in your crane's load chart.</i></p> <p>CRANES WITHOUT FREE SWING OPTION:</p> <p><b>Important</b> <i>Always move swing control lever gradually toward OFF to bring boom to a smooth stop. If control lever is suddenly released to OFF, swing brake will bring boom to an abrupt stop. This action will cause load to swing out from under boom point or jib point and can result in damage to boom or jib from side loading.</i></p> |
| <p><b>11. Swing Brake Control</b></p>   | <p>The proportional dynamic swing brake pedal is supplied when the crane is equipped with the <b>Free Swing</b> feature. Brake effectiveness increases in proportion to brake pedal travel.</p> <p><b>Important</b> <i>KEEP LOAD UNDER CONTROL. Bring crane to a smooth stop before changing direction of crane rotation.</i></p>   |
| <p><b>12. Swing Brake Switch</b></p> <p>Toggle <b>LEFT</b> (maintained)<br/>Toggle <b>RIGHT</b> (maintained)</p>  | <p>Brake switch is supplied when the crane is equipped with the <b>Free Swing</b> feature.</p> <p><b>ON</b> Static swing brake set; prevents crane from rotating, holds crane in position.<br/><b>OFF</b> Static swing brake released; crane is free to rotate.</p> <p><b>Important</b> <i>KEEP LOAD UNDER CONTROL. Bring crane to a smooth stop; DO NOT turn Swing Brake Switch ON while the crane is still rotating.</i></p>  |
| <p><b>13. Accu-Swing Control</b></p> <p>Turn knob <b>LEFT</b><br/>Turn Knob <b>RIGHT</b></p>  | <p>The Accu-Swing feature allows the operator to dial the swing speed to adjust for different operating conditions and operator experience.</p> <p><b>DECREASE</b> crane rotation speed.<br/><b>INCREASE</b> crane rotation speed.</p>  |
| <p><b>14. Hydraulic System Pressure Gauge</b></p>   | <p>Indicates the pressure in the circuit operating under the highest pressure.</p>  |

**Crane Controls and Positions**

| Control and Position (Figure 1-6 thru 1-8)  | Function  |
|---|---|
| <p><b>15. Bubble Level</b></p>  | <p>Indicates how level the crane is from side to side and from front to rear.</p>   |
| <p><b>16. Horn Switch</b><br/>Button <b>IN</b></p>  | <p>Activates truck horn</p>   |
| <p><b>17. Engine Start/Stop Switch</b><br/>Toggle <b>LEFT</b> (momentary)<br/>Toggle <b>RIGHT</b> (momentary)<br/>Toggle <b>CENTER</b> position</p>     | <p><b>START</b> engine<br/><b>STOP</b> engine<br/><b>RUN</b> Normal switch position, if started, allows engine to run for crane operations.</p> <p><b>CAUTION</b> Always stop engine before leaving crane unattended and before servicing crane.</p>  |
| <p><b>18. Engine Foot Throttle</b><br/>Pedal <b>DOWN</b><br/><br/>Pedal <b>UP</b> (spring returned)</p>   | <p><b>INCREASE</b> engine speed in relation to how far the pedal is depressed.<br/><b>DECREASE</b> engine speed.</p> <p><i>Note</i> The speed of any crane function depends on engine speed and on how far the control lever is moved in either direction.</p>  |
| <p><b>19. Boom Angle Indicator</b></p>  | <p>Indicates the angle of the boom (in degrees) above or below horizontal.</p>  |
| <p><b>20. Load Moment Indicator (LMI) Display</b> (If equipped)</p>  | <p>Present on cranes equipped with a load moment indicator (LMI) manufactured by PAT America Inc.</p> <p><i>Note</i> For specific LMI function, controls and display information, see separate PAT Operator Handbook; the manual is located with the Crane's Owner's Manuals or in the Truck Cab.</p> <p><b>CAUTION</b> The LMI system is intended as an operational aid only and is not a substitute for sound operating practices or operator experience and judgement. Operation and safety remains the responsibility of the Operator; always work within the limits of the load chart provided.</p> <p>Crane operating configuration codes (LMI operating codes) are listed on the Crane's Load Chart.</p> |
| <p><b>21. Override Switch (LMI/HYCAS/ATB Override)</b></p>  | <p>This momentary switch is used to bypass the overload shutdown system and the ATB override so the boom can be lowered from the maximum boom angle.</p> <p><b>OPERATION</b> Hold the button in and lower the boom. Once the boom has lowered a few degrees, the warning horn should stop. Release the button and continue to lower the boom to the desired angle.</p> <p><b>CAUTION</b> Only use override switch to lower boom from maximum angle. Do not use override switch for any other reason.</p>  |



## Crane Controls and Positions

| Control and Position (Figure 1-6 thru 1-8)   | Function   |
|--|--|
| <p><b>22. Hydraulic Accessory Valve Control</b><br/>(optional)</p> <p>Switch <b>LEFT</b> (momentary)<br/>Switch <b>RIGHT</b> (momentary)<br/>Switch <b>CENTER</b> position</p> | <p>Designed to supply power for hydraulic tools</p> <p><b>OPEN</b> hydraulic pressure to port A of acc valve<br/><b>CLOSE</b> Pressure to port B of accessory valve</p>  |
| <p><b>23. Warning Horn - Anti-Two-Block and Overload Protection</b><br/>(not shown)</p>  | <p>The horn BEEPS to warn the operator and surrounding personnel when any of the following conditions occur:</p> <ul style="list-style-type: none"> <li>■ Crane configuration has not been confirmed for LMI operation (at start-up).</li> <li>■ The load block or the overhaul ball is hoisted too high (lifts ATB weight on load line).</li> <li>■ The crane's capacity is exceeded.</li> </ul> <p><b>Important</b> When the warning horn sounds, immediately correct the offending condition (refer to the function description for the above conditions).</p> <p><b>Important</b> This horn also sounds when the operator leaves the seat at the operator station see items 2 &amp; 3.</p>                                   |
| <p><b>24. Warning Horn - Outriggers</b><br/>(not shown)</p>  | <p>The horn BEEPS to warn surrounding personnel when the crane's outriggers are being operated.</p> <p><b>Important</b> The horn becomes silent when the Outrigger Selector Lever is released, see "Outrigger Controls" item #4.</p>   |
| <p><b>25. Anti-Two-Block (ATB) Shutdown</b><br/>(not shown)</p>  | <p>When the loadblock or overhaul ball lifts the ATB weight, the warning horn sounds and the ATB system STOPS and prevents further operation of the WINCH UP, TELESCOPE OUT and BOOM DOWN functions.</p> <p><b>Important</b> On cranes with winches attached to the turret, always pay out load line while extending boom or booming down to prevent load block or overhaul ball from contacting two-block weight. Do not hoist load so high that load block or overhaul ball contacts two-block weight.</p> <p>To correct a two-block condition:</p> <ul style="list-style-type: none"> <li>■ Lower the load or retract the boom.</li> <li>■ Boom up (only applies to cranes equipped with turret attached winches).</li> </ul> |
| <p><b>26. Overload Shutdown</b><br/>(not shown)</p>  | <p>Activates warning horn and automatically stops and prevents further operation of the WINCH UP, TELESCOPE OUT and BOOM DOWN functions when the crane's capacity is exceeded.</p> <p> <b>If warning horn comes on due to overload, immediately correct overload condition; failure to do so may result in structural damage or tipping.</b></p> <p>To correct an overload condition:</p> <ul style="list-style-type: none"> <li>■ Lower the load to the ground, retract the boom or raise the boom.</li> </ul>   |

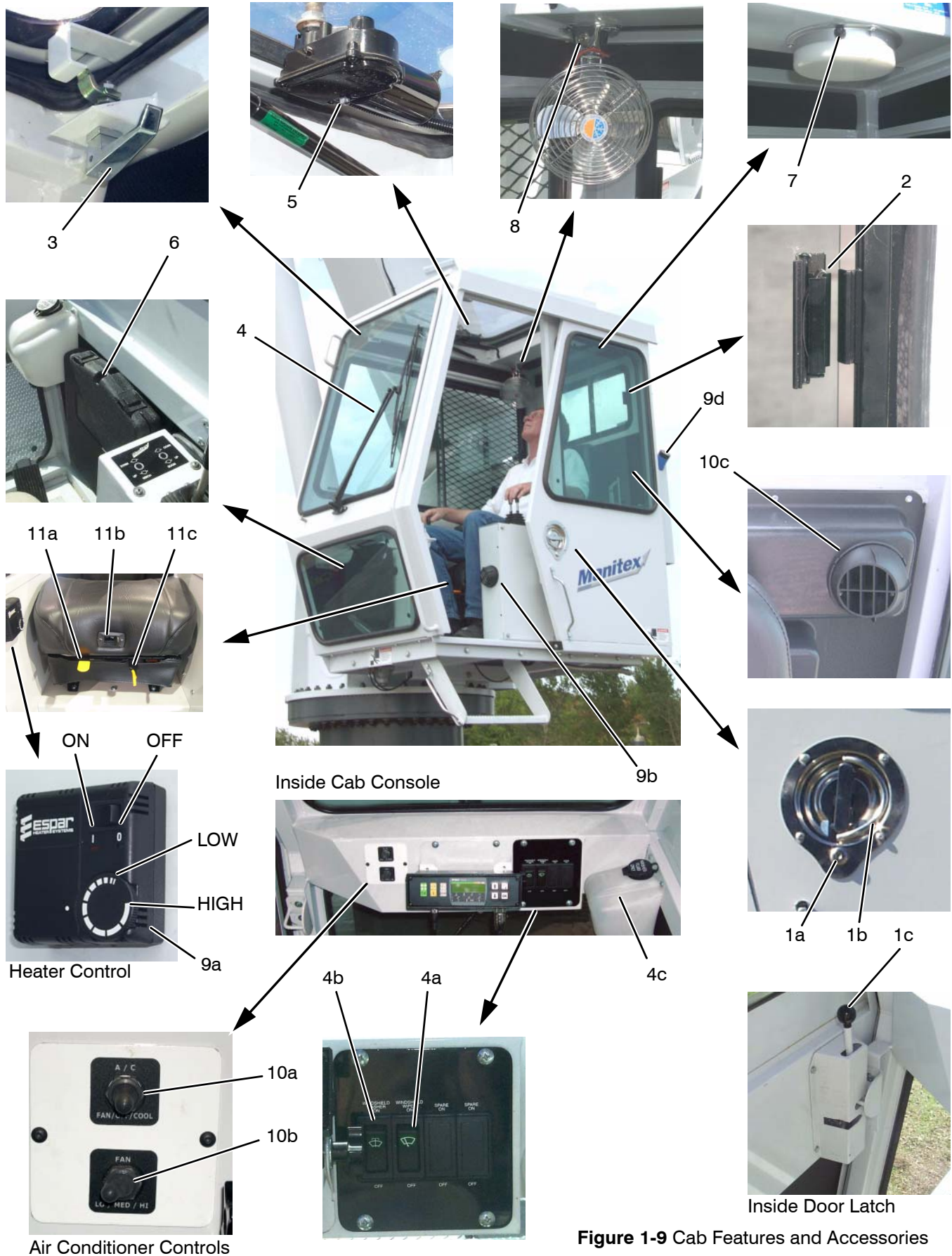


Figure 1-9 Cab Features and Accessories

## Cab Features and Accessories

| Accessory or Feature (Figure 1-9)   | Description   |
|---|---|
| <b>Note</b> Power to cab accessories is available when truck ignition is set to “run” and PTO control is engaged. |   |
| <b>1. Latch - Door</b>  | <p>Heavy duty chrome plated door latch with key lock for secured access. Door latch secures door in open or closed position.</p> <ol style="list-style-type: none"> <li>a. Key lock, 2 spare keys supplied.</li> <li>b. Flush mount outer handle, LIFT &amp; TWIST handle to unlatch, PULL towards rear of cab to open door.</li> <li>c. Door latch lever, PULL towards rear of cab to unlatch, open or close door as desired.</li> </ol>   |
| <b>2. Latch - Side &amp; Rear Window</b>  | Positive latch secures slider windows when closed shut.   |
| <b>3. Latch - Top Hatch</b>   | Hatch clamped shut by spring loaded latch mechanism. Handle swings down to unlock clamp, rotate handle to allow raising of hatch. Hatch is fitted with two gas cylinders to hold in open position.  |
| <b>4. Wiper - Front Glass</b>   | <p>Wiper equipped with an electric 2-speed motor and spray washer. Wiper controls mounted on switch panel on front console.</p> <ol style="list-style-type: none"> <li>a. OFF / SLOW / FAST Three position rocker switch controls wiper speed.</li> <li>b. OFF / ON Momentary switch activates spray washer.</li> <li>c. Front window washer fluid reservoir.</li> </ol>  |
| <b>5. Wiper - Top Hatch Glass</b>   | ON / OFF switch located on motor housing, single speed.   |
| <b>6. Document Holder</b>   | Plastic container holds crane’s operator manuals and load charts.   |
| <b>7. Cab Lamp - Internal</b>   | ON / OFF switch located on the lamp base.   |
| <b>8. Cooling Fan</b>   | Switch located at the base; toggle left or right for HI or LOW speeds, center position is OFF.  |
| <b>9. Cab Heater</b>  | <p>Cab heater is an option. Heater control box is mounted in the RH operator console side plate. Refer to heater manual located in the truck cab for operating warnings and instructions.</p> <ol style="list-style-type: none"> <li>a. Thermostat equipped with ON /OFF switch and temperature adjusting dial. Turn dial left to right to increase temperature setting.</li> <li>b. Heater vent, rotates to direct heated air.</li> <li>c. Air return, return ducting increases heating efficiency. (not shown, located behind operator seat on LH console)</li> <li>d. Diesel reservoir fill neck &amp; cap.</li> </ol> |

| Accessory or Feature (Figure 1-9) | Description   |
|-----------------------------------|---|
| <p><b>10. Air Conditioner</b></p> | <p>Cab air conditioner is an option. Air conditioner controls are mounted on the cab front console.</p> <ul style="list-style-type: none"> <li>a. A/C Switch <ul style="list-style-type: none"> <li>Switch OFF      Air conditioner unit is OFF, fan is OFF.</li> <li>Switch FAN      Fan runs constantly, air conditioner is OFF.</li> <li>Switch COOL     Air conditioner runs to cool cab interior.</li> </ul> </li> <li>b. Fan Switch <ul style="list-style-type: none"> <li>LO / MED / HI   Three position switch selects fan speed.</li> </ul> </li> <li>c. A/C Vent        One vent each side, behind the operator seat.</li> </ul>  |
| <p><b>11. Operator Seat</b></p>   | <p>Adjustable to accommodate operator preferences. Lever movements are described as if operator is seated.</p> <ul style="list-style-type: none"> <li>a. Front to back seat adjustment; to unlock move lever to the left; move seat to desired position and release lever to lock in place.</li> <li>b. Backrest tilt adjustment; move lever to the right to adjust Backrest tilt, release to lock in position.</li> </ul> <p><i>Note</i> Backrest tilt adjustment may be limited depending on seat position relative to cab rear wall.</p> <ul style="list-style-type: none"> <li>c. Seat height adjustment; move lever to the left and hold, allow seat to rise to maximum height, apply downward pressure to set height as desired, release and push lever to the right to lock in place.</li> </ul> |

## Chapter 2 Rigging

### Cutting Wire Rope

The wire rope must be tightly seized on both sides of the point where the wire rope will be cut, as shown in Figure 2-1.

Seize the wire rope with either seizing wire or annealed wire. The seizing will prevent the wire rope strands from unraveling and prevent distortion of the rope ends from the pressure applied during cutting.

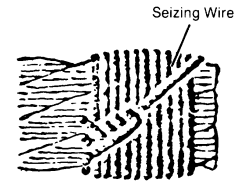


Figure 2-1 Wire Rope Seizing

### Anchoring Wire Rope to Drum

#### CAUTION

Prevent possibility of wire rope slipping out of drum pocket and dropping the load!

Use only the correct wedge corresponding to the wire size being used. See Parts Manual for exact part number of wedge to be used.

Remove all rough edges and burrs from wedge and drum pocket that may cut wire rope or prevent rope and wedge from seating properly in the pocket.

Dead end of wire rope and seizing must extend past end of wedge, but not out of drum pocket.

If dead end of wire rope is welded, seize the rope near the end and cut weld off before assembling to drum pocket. Weld will not allow strands of wire rope to adjust around the wedge resulting in high strands and wavy rope. This condition can seriously weaken the rope.

Insert the free end of the wire rope through the small opening in the drum pocket as shown in Figure 2-2.

Loop the wire rope and push the free end about three-quarters of the way back into the drum pocket.

Insert small end of the wedge and pull the slack out of the wire to seat the wedge and wire rope in the pocket.

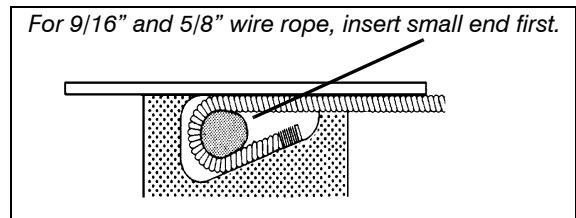


Figure 2-2 Anchoring Wire Rope to Drum

### Winding Wire Rope Onto Drum

Carefully inspect the drum and sheaves for defects that might cut the rope or cause excessive wear. If the defects cannot be corrected, replace the faulty part.

Apply tension to the wire rope as it is slowly wound onto drum. The first wrap must be tight against the drum flange for approximately three-fourths of the drum circumference. Tap the adjacent wraps against each other with a soft metal or wooden mallet.

**Important** All wraps of first layer must be tight against drum and against each other.

Voids or spaced wraps in first layer will permit movement and wedging action with subsequent layers. Wedging action will cause crushing and abrasion of wire rope. Never allow wire rope to cross wind.

## Anchoring Wire Rope to Wedge Socket

### For Installations using conventional wedge and sockets

#### CAUTION

Prevent possibility of wire rope slipping out of socket and drop-ping the load!

Use only the correct wedge and socket corresponding to the wire rope size being used. See Parts Manual for exact part number of wedge and socket required.

Remove all rough edges and burrs from wedge and socket that may cut wire rope or prevent rope and wedge from seating properly in the socket.

Do not replace shipping material (bolt, plastic strap or wire) in hole of wedge or socket after assembling. Discard these materials because they can prevent wedge and rope from seating properly in the socket.

Attach wire rope clip to dead end of wire rope after assembling wire rope to wedge and socket. Figure 2-3 shows correct clip attachments.

If dead end of wire rope is welded, seize end of wire rope and cut off weld before assembling to wedge and socket. Weld will not allow strands of wire rope to adjust around bend of wedge, resulting in high strands and wavy rope. This condition can seriously weaken the rope.

Assemble the wire rope and wedge to the socket so the live side of the wire rope is in a straight line with the socket pin hole. Correct and incorrect assemblies are shown in Figure 2-3.

Allow the dead end of the rope to extend past the end of the socket.

Pull on the live side of the wire rope enough to tighten the wedge in the socket.

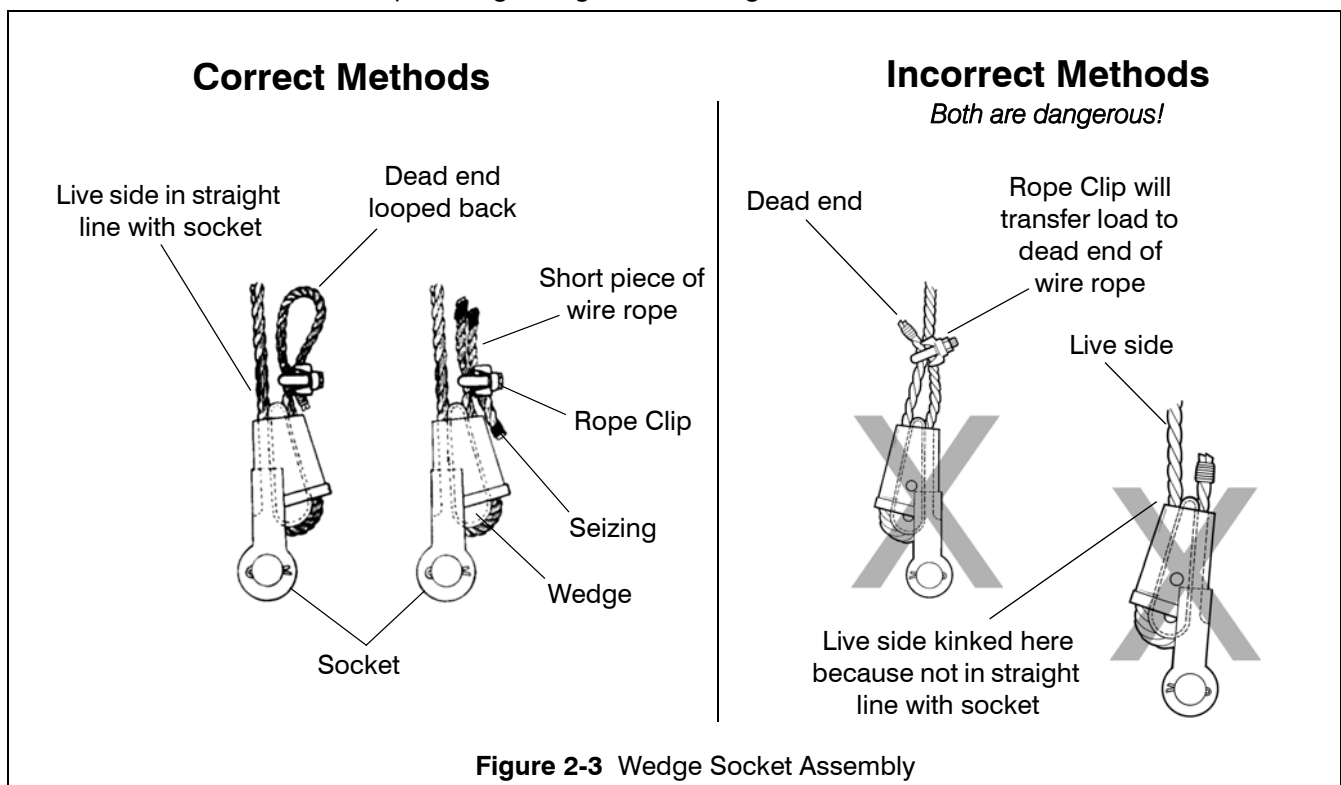


Figure 2-3 Wedge Socket Assembly

Attach a wire rope clip to the dead end of the wire rope using one of the Correct methods shown in Figure 2-3. The rope clip will aid in preventing the wire rope from being pulled out of the socket.

#### CAUTION

Do not attach dead end of wire rope to live side of wire rope with a wire rope clip. Wire rope clip will transfer load from live side of wire rope to dead end, seriously weakening attachment.

After the socket is pinned in place (to dead end on boom head, overhaul ball or loadblock), hoist the load slowly so the wedge and rope will seat firmly in the socket. Do not shock load the socket and wedge.

## For installations using the Crosby “Terminator” wedge and socket

**Note** The following text is taken from the Crosby Terminator application sheet.

### WARNING

- Loads may slip or fall if the Wedge Socket is not properly installed.
- A falling load can seriously injure or kill.
- Read and understand these instructions before installing the Wedge Socket.
- Do not side load the Wedge Socket.
- Apply first load to fully seat the Wedge and Wire Rope in the socket. This load should be of equal or greater weight than loads expected in use.
- Do not interchange wedges between S-421T and US422T or between sizes.

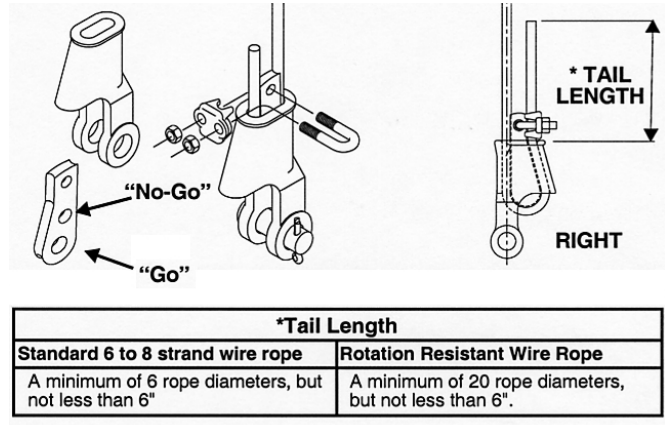


Figure 2-4 Terminator Wedge Socket Assembly

### Important Safety Information - Read and Follow

#### INSPECTION/MAINTENANCE SAFETY

- Always inspect socket, wedge and pin before using.
- Do not use part showing cracks.
- Do not use modified or substitute parts.
- Repair minor nicks or gouges to socket or pin by lightly grinding until surfaces are smooth. Do not reduce original dimension more than 10%. Do not repair by welding.
- Inspect permanent assemblies annually, or more often in severe operating conditions.
- Do not mix and match wedges or pins between models or sizes.
- Always select the proper wedge and socket for the wire rope size.

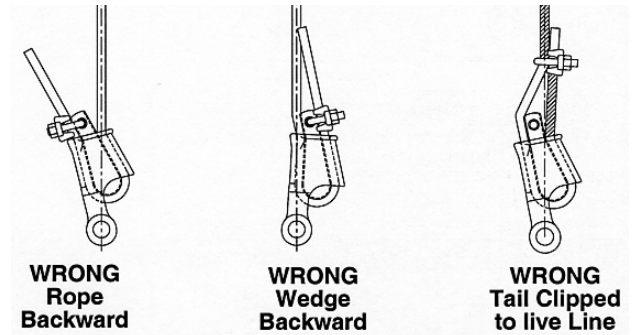


Figure 2-5 Incorrect assembly examples

#### ASSEMBLY SAFETY

- Use only with standard 6 to 8 strand wire rope of designated size. For intermediate size rope, use next larger size socket. For example: When using 9/16" diameter wire rope use a 5/8" size Wedge Socket Assembly. Welding of the tail on standard wire rope is not recommended. The tail length of the dead end should be a minimum of 6 rope diameters but not less than 6" (See Figure 2-4).
- To use with Rotation Resistant wire rope (special wire rope constructions with 8 or more outer strands) ensure that the dead end is welded, brazed or seized before inserting the wire rope into the wedge socket to prevent core slippage or loss of rope lay. The tail length of the dead end should be a minimum of 20 rope diameters but not less than 6" (See Figure 2-4).
- Properly match socket, wedge and clip (See Table 2-1) to wire rope size.
- Align live end of rope, with center line of pin (See Figure 2-4).
- Secure dead end section of rope. (See Figure 2-4).
- Tighten nuts on clip to recommended torque. (Table 2-1)
- Do not attach dead end to live end or install wedge backwards (See Figure 2-5).
- Use a hammer to seat Wedge and Rope as deep into socket as possible before applying first load.

| Rope Size      | 3/8 | 1/2 | 5/8 | 3/4 | 7/8 | 1   | 1 1/8 |
|----------------|-----|-----|-----|-----|-----|-----|-------|
| Clip Size      | 3/8 | 1/2 | 5/8 | 3/4 | 7/8 | 1   | 1 1/8 |
| *Torque Ft/lbs | 45  | 65  | 95  | 130 | 225 | 225 | 225   |

*\* The tightening torque values shown are based upon the threads being clean, dry, and free of lubrication.*

**OPERATING SAFETY**

- Apply first load to fully seat the Wedge and Wire Rope in the socket. This load should be of equal or greater weight than loads expected in use.
- Efficiency rating of the Wedge Socket termination is based upon the catalog breaking strength of Wire Rope. The efficiency of a properly assembled Wedge Socket is 80%.
- During use, do not strike the dead end section with any other elements of the rigging (two blocking).

**Breaking In Wire Rope**

After installing a new wire rope, break in the wire rope by operating it several times under light load and at reduced speed. This practice will allow the wire rope to form its natural lay and the strands to seat properly.

Some stretch will occur during the break-in period causing a reduction in the wire rope's diameter as the strands compact around the core.

The dead wraps of wire rope on the winch drum can become slack during operation, even if the utmost care is used during installation of the wire rope. This slackening is caused by the normal stretch that occurs in a new wire rope under tension and periodically throughout the wire rope's life from release of the load.

**Important** When slackness is noted, the dead wraps of wire rope should be tightly rewound onto the drum. If left incorrect, a wedging action with subsequent layers will occur, and the resultant abrasion will cause broken wires in the dead wraps.

**Reeving**

Reeving diagrams for the wire rope are shown in Figures 2-7 and 2-8. The number of parts of line used depends on the load to be lifted. Refer to the Capacity Chart for your specific crane to determine reeving requirements for the various loads that can be lifted.

Make sure the wire rope travels through each cable guide on the boom and on the jib, if erected.

The Manitex S-Series crane incorporates a "quick reeve" boom head. When used with our optional "quick reeve" load blocks, this feature allows the rigger to reeve multiple parts of line without removing the wedge and socket from the wire rope.

**CAUTION**

Ensure that all wire rope retaining pins are in place at all times. This will ensure that the wire rope remains in the sheave groove if they should become unloaded. Failure to comply will allow the wire rope to exit the sheave groove possibly causing damage to the wire rope and sheaves. Refer to Figure 2-6.

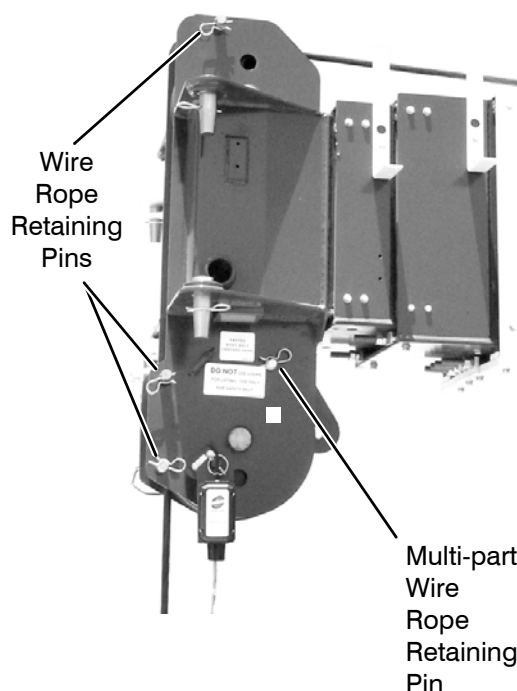
After the wire rope is reeved, make sure the Anti-Two-Block (ATB) system is properly installed:

- Check that the ATB counterweight is connected to the limit switch and the counterweight is installed on the correct part of the line. Refer to Figure 2-7 or 2-8.
- If the load is to be handled with the jib, see Erecting Jib later in this chapter for proper installation of cable. See Figure 2-18.

**Important** Do not shorten length of chain/lanyard on ATB counterweight, if shortened, a two-block condition may occur.

- If the ATB system is equipped with an override flag, check that it is not installed on the switch lanyard thereby overriding the switch.

After verifying the installation, test the ATB warning horn and shutdown for proper operation before placing the crane in service. Refer to Daily Maintenance Checks in Chapter 6.



**Figure 2-6** Wire Rope Retaining Pins  
(All must be in place at all times)



### Three-Sheave Boom Head

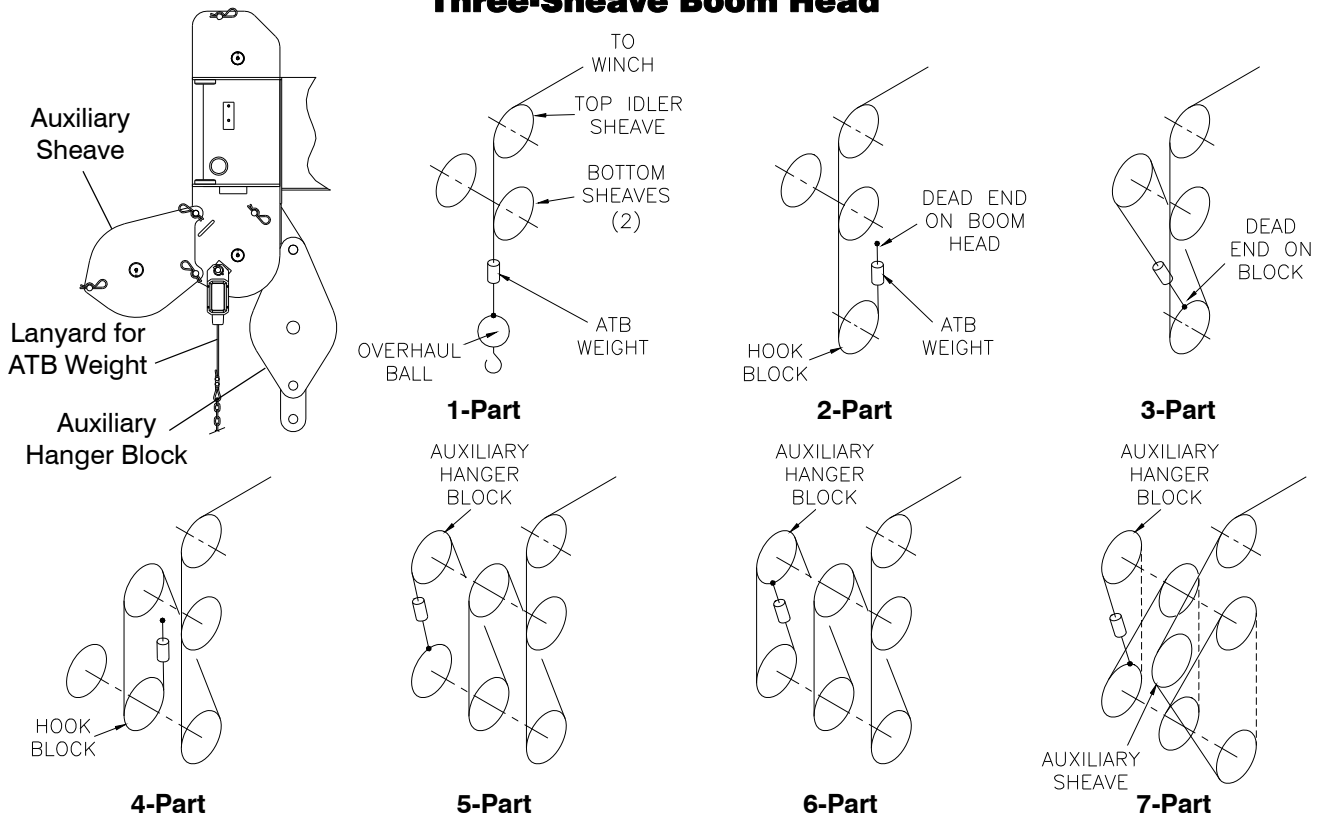


Figure 2-7 Load Line Reeving — Three-Sheave Boom Head

### Five-Sheave Boom Head

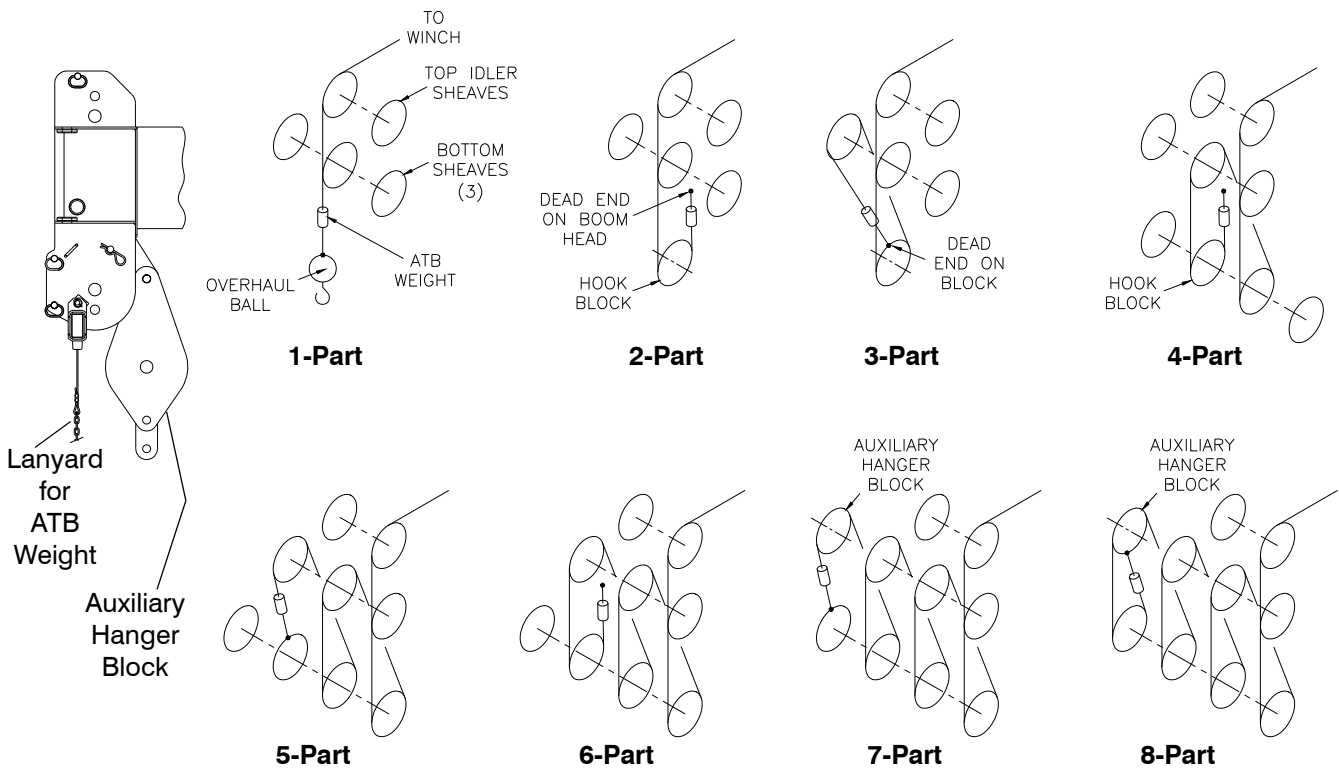


Figure 2-8 Load Line Reeving — Five-Sheave Boom Head

## Installing the Auxiliary Sheave

### Cranes equipped with Main and Auxiliary Winches

The Auxiliary Sheave is required when the machine is equipped with an Auxiliary Winch. The Auxiliary Sheave assembly attaches to the boom point to provide the operator with a second readily available reeving option.

The Auxiliary sheave bracket assembly weighs about sixty pounds and takes approximately ten minutes to install. The only tool that may be required is a hammer to tap in and seat the hitch pins.

### Installing the Auxiliary Sheave Bracket Assembly

Retract the boom completely and lower it to its lowest position.

Remove the two hairpin cotter clips and hitch pins from the lower section of the boom head, see Figure 2-6.

Lift the auxiliary sheave bracket assembly into position and align the mounting holes, ensure that the main load line is seated against the lower head sheave and insert the two hitch pins to secure the bracket in place. Light taps with a hammer may be required to firmly seat the pins.

**Important** Hitch pins also serve as wire rope retainers, therefore, be sure the main load line is seated in the sheave groove and held in place by the pins.

Attach the hairpin cotter clips securely to the hitch pins.

Remove the wire rope retainer at the auxiliary sheave bracket and also at the top of the boom head, refer to Figure 2-9.

Move the auxiliary wire rope over the center sheave at the top of the boom head, see Figure 2-9, and also over the auxiliary sheave, place rope in sheave grooves.

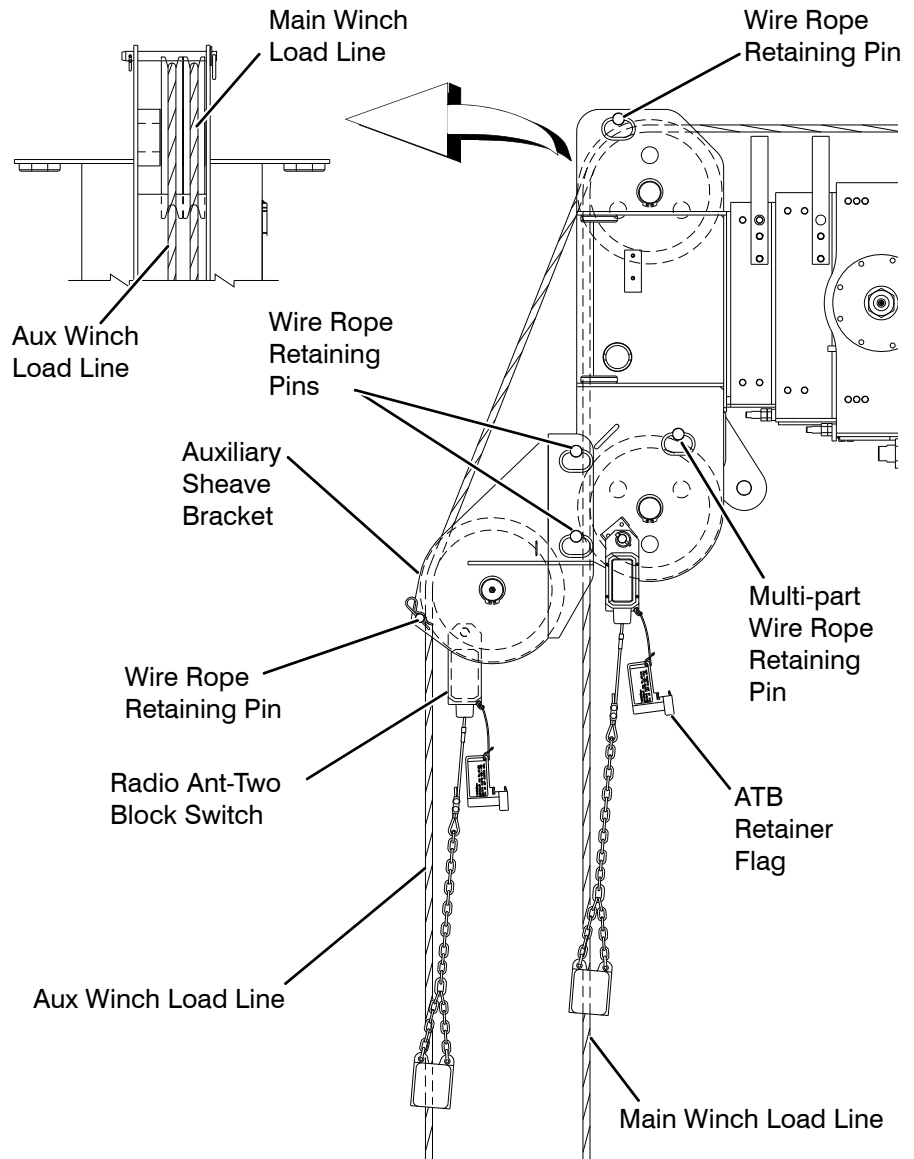
Reinstall both wire rope retainer pins and hairpin cotter clips.

The Auxiliary Sheave is now physically secured to the boom; proceed to install ATB Switch and weight.

**Important** Hitch Pins and wire rope retainers must always be present on boom head and auxiliary sheave bracket. Hitch pins also serve as a retainer for the Main Winch load line to prevent the rope from leaving the sheave area. Do not operate crane unless all hitch pins and retaining pins are present and correctly installed.

### Installing the Auxiliary Sheave ATB Switch

Attach the ATB switch to the post on the side of the auxiliary sheave bracket and secure in place with lynch pin provided. Ensure that the switch is free to rotate on the post



**Figure 2-9** Rigging for operations using Main or Aux Winch

Assemble the ATB weight to the auxiliary load line and attach the ATB chain to the lanyard on the ATB switch at the auxiliary sheave bracket using the chain connector provided.

Test to ensure the ATB warning horn and shutdown operate properly at both the auxiliary sheave and the boom head. Refer to Daily Checks in Section 4.

Both the Main and Auxiliary Sheaves now have active ATB Switches.

### Warnings and Notes for Auxiliary Winch Operations

#### CAUTION

**Prevent a two-block condition. ATB weights must be installed on BOTH main and auxiliary load lines and attached to the corresponding ATB switch at all times. When operating winch and boom functions, both load lines are live and can only be protected if the ATB systems are properly installed.**

**Do not handle any load with either the auxiliary or main loadline until the ATB warning horn and shutdown are operational.**

**Failure to comply may result in a two block condition possibly causing injury to surrounding personnel or damage to crane or property.**

#### CAUTION

**Simultaneous lifts, using the auxiliary and main winch load lines, are UNSAFE and are NOT permitted. Failure to comply may result in possible injury to operator, surrounding personnel or damage to crane or property**

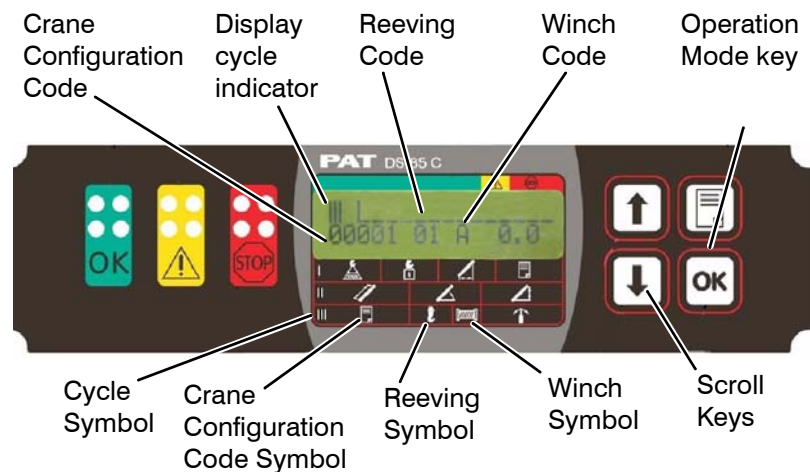
- Cranes equipped with both main and auxiliary Winches must have both ATB switches installed and active at all times during crane operations. If either of the two switches fails or is inactive the ATB system will shutdown the **HOIST UP, TELESCOPE OUT and BOOM DOWN** functions.
- Both switches must be installed and operational at all times even if only one of the winch systems is to be used.
- Before using the auxiliary winch, ensure that the LMI setting for Aux winch operations is selected, see Figure 2-10. To switch between winch settings do the following:

- Press the operation mode key.
- Verify crane configuration mode, change if necessary using scroll keys then select by pressing OK key.
- Select winch, use scroll key to set to Auxiliary Winch, select by pressing OK key.
- Confirm reeving (parts of line), use scroll keys to change setting if necessary, select by pressing OK key.
- The system should be ready to operate; the third display cycle on the panel should show the letter “A” at the winch symbol position, indicating that the aux winch is selected. Main winch setting is designated by the letter “M” in the same symbol position.
- To show the level III display information, cycle through the different displays using the scroll keys.

#### CAUTION

**Only operators who are thoroughly familiar with the load capacity charts and the use and operation of the LMI system shall set the operating code. To assure the LMI is properly programmed, verify that the operating code shown in the data display and the load capacity chart match the lifting configuration of the crane.**

**Failure to properly program the LMI with the correct operating code will prevent the system’s ability to aid the operator in monitoring crane operations possibly resulting in damage to crane or property.**



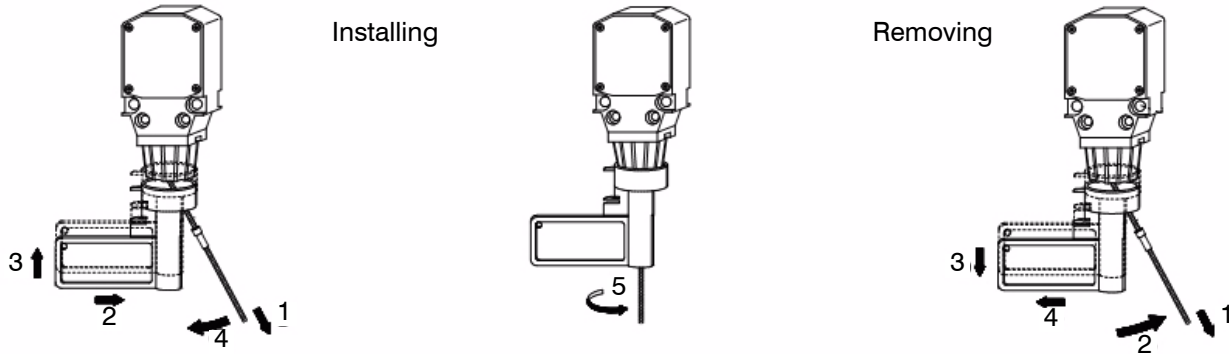
**Figure 2-10** LMI set for Aux Winch operation w/1-part Line

### Removing the Auxiliary Sheave

The Auxiliary sheave bracket assembly will have to be removed temporarily if it becomes necessary to change the parts of line configuration at the main boom point. To remove the Auxiliary sheave bracket assembly, reverse the installation procedure.

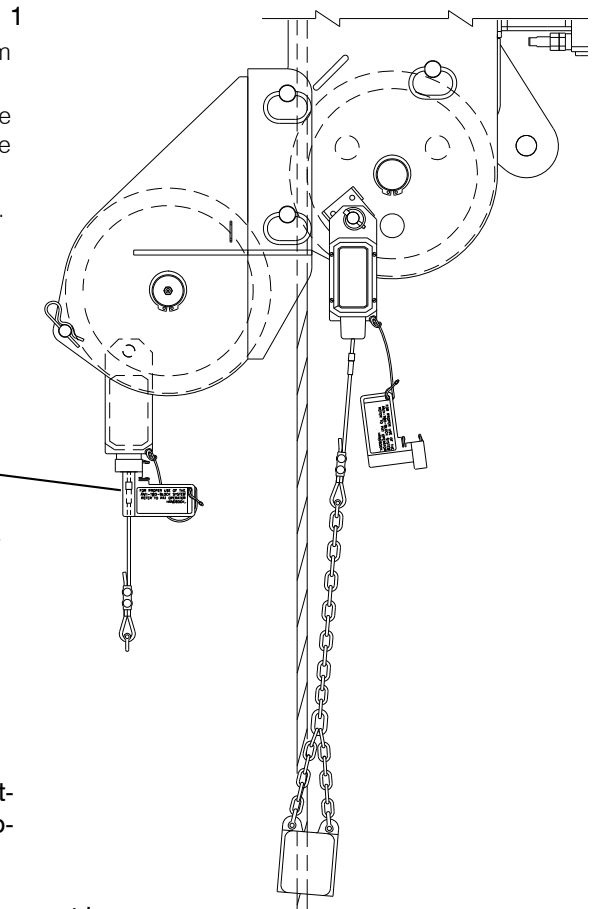
**Important** Be sure to re-install the Auxiliary sheave bracket assembly and corresponding ATB switch. As previously stated, the crane will operate normally only if both Main and Auxiliary ATB systems are operational.

**Note** If you elect not to reeve the Auxiliary load line at this time, secure it to the winch at the turret and override the ATB switch by installing the retainer flag on the lanyard. When the retainer flag is properly installed, the switch will continue to communicate with the receiver to allow Main winch operations, see Figure 2-11.



**TO INSTALL FLAG:**

1. Pull the cable out of the switch and bend back parallel to the boom and hold (1).
2. Slide the retainer from left side with its slot over the cable between the crimped stop and the switch (2). Push it firmly straight onto the cable guide of the Anti Two-Block switch (3).
3. Straighten the cable completely into the slot and release the cable (4).
4. Turn the flag of the retainer for best visibility for the operator (5).
5. Remove by performing steps in order shown.



Override Retainer Flag installed on lanyard (see caution note below).

**Important** Do not leave the retainer flag installed as shown for extended periods of time. This measure should only be taken while the crane is in use in this configuration.

**To conserve the transmitter's batteries** always remove the retainer flag to allow the switch to enter into sleep mode.

**Note** When a transmitter enters into sleep mode, the crane acts as if it is two-blocked.

For more information about proper ATB switch storage and battery conservation, refer to the PAT radio ATB or LMI manual provided with the crane.

Figure 2-11 Auxiliary Sheave not in use

**CAUTION**

Using the retainer flag in this manner is an **OVERRIDE** and defeats the intended purpose of the ATB system. Remove the retainer flag from the switch's lanyard when the load line is re-installed. Failure to do so may result in a two block condition possibly causing injury to surrounding personnel or damage to crane or property.

## Quick-Reeve Load Block

### Wire Rope Installation



1. Lower Crane boom to horizontal position and engage crane swing lock.

**CAUTION** Crane swing motion during wire rope installation can cause tipping of the Quick-Reeve block.

2. Ensure ground support is firm and level within 5 °.

**CAUTION** Soft or uneven ground may lead to tipping of the Quick-Reeve block.

3. Place Quick-Reeve block in the folded position in line and forward of the boom as illustrated in Figure 2-12.

**CAUTION** Improper placement will produce reeving forces that can cause tipping of the block.

4. Remove Rope Guard Keeper Pins at (A) - Figure 2-12.
5. Remove Rope Guard Pins (B).
6. Remove boom sheave guards.
7. Pull wire rope from the hoist drum and pass wire rope over the first boom and block sheave then over the second boom sheave. Ensure load line pull is always against the boom and never against the block.

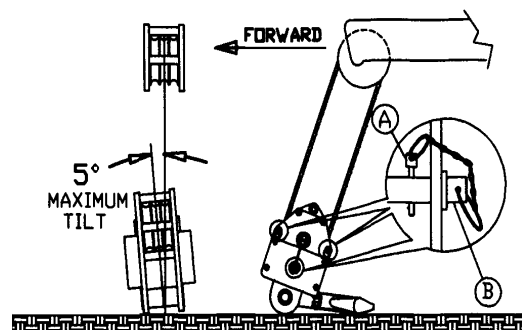


Figure 2-12 Quick-Reeve Load Block Pins

**CAUTION** Load line pull applied against block may cause tipping of the block.  
Avoid injury. Never stand on block.

8. If multiple part reeving, repeat Step 7 for the next boom and block sheave until reeving is complete.
9. Install wedge socket on wire rope if not already installed.
10. Assemble wedge socket to boom or block dead end connection. Ensure connecting pin keeper is properly installed.
11. Replace Rope Guard Pins (B).

**Note** OSHA invokes ASME B30.5, which requires the sheaves in the lower load block shall be equipped with close-fitting guards that will prevent ropes from becoming fouled when the block is lying on the ground with loose ropes.

12. Replace Rope Guard Keeper Pins (A).
13. Replace boom sheave wire rope guards.
14. Lift block to hanging position by raising boom.

**CAUTION** Stand clear while lifting block off the ground.

## Wire Rope Removal

1. Lower crane boom to near horizontal position and engage crane upper swing lock.

**CAUTION**

**Crane swing motion during wire rope removal may cause tipping of block.**

2. Ensure ground support is firm and level within 5 °.

**CAUTION**

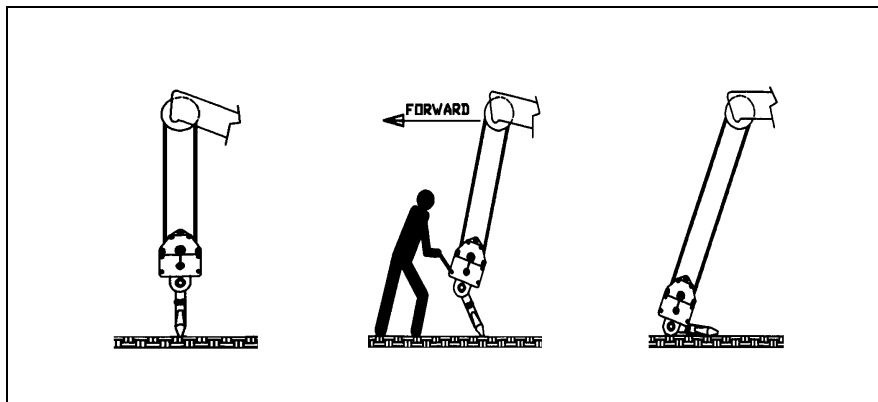
**Soft or uneven ground may lead to tipping of the block.**

3. Rotate hook into position as shown in Figure 2-13.
4. Lower Quick-Reeve block with hoist drum until hook touches ground.
5. Use a tagline to pull block forward and lower boom simultaneously to start block folding.
6. Continue to pull block forward and lower boom until block rests on ground in folded position.
7. Remove Rope Guard Keeper Pins (A), see Figure 2-12.
8. Remove Rope Guard Keeper Pins (B).
9. Remove boom sheave guards.
10. Disassemble wedge socket from dead end connection.
11. Pull wire rope and wedge socket around first block and boom sheave.

**CAUTION**

**Avoid possible injury. Do not allow wedge socket to fall from boom sheave and never stand on block.**

12. If multiple part reeving, repeat Step 11 for the next boom and block sheave until wire rope removal is complete.
13. Replace Rope Guard Pins (B).
14. Replace Rope Guard Keeper Pins (A).
15. Proceed with next rigging arrangement.



**Figure 2-13** Quick-Reeve Wire Rope Removal

## Erecting and Storing Jib



Exceeding jib ratings or failing to comply with jib operating conditions and restrictions given on the crane's Capacity Chart will result in structural damage to crane components, collapse of crane, or tipping.

Read all instructions on Capacity Chart before handling any load with jib.

Do not attempt to erect jib until outriggers and stabilizers are properly set.

Do not retract outriggers and stabilizers until jib is stored and boom is lowered onto boom rest.

Use these formulas to determine the minimum distances required for the side swing-around and rear clearances for the truck when erecting or storing the jib. The lengths are found in the crane's range diagram.

$$\begin{aligned} & \text{Retracted boom length} \\ & + \text{Fixed jib length or } \textit{retracted} \text{ telescopic jib length} \\ & + 10 \text{ Feet} \\ \hline & \textit{Minimum side swing-around clearance from centerline of crane rotation.} \end{aligned}$$

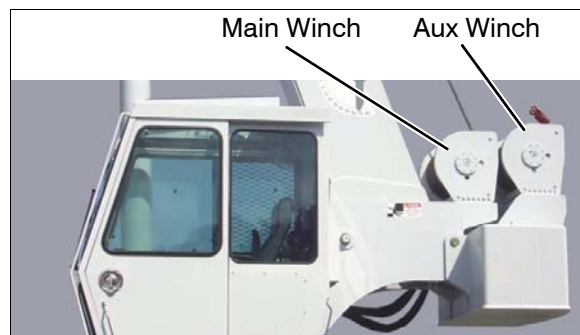
$$\begin{aligned} & \text{Retracted boom length} \\ & + \textit{Extended} \text{ telescopic jib length (or fixed jib length)} \\ & + 10 \text{ Feet} \\ \hline & \textit{Minimum rear clearance from centerline of crane rotation.} \end{aligned}$$

### Erecting Jib

**Important** For machines equipped with a main and auxiliary winch; only the load line from the main winch (front) can be reeved for lifting off the jib point. Do not use the load line from the rear winch on jib; damage to wire rope and rope retaining pins will occur.

**Important** Be sure to install hairpin cotters to retain all pins.

- To make lifts with the Jib, the crane must be rigged with a single part of line. Therefore, if the crane is rigged with a load block, break down the rigging to a single part of line and install the Manitex supplied overhaul hook ball.
- Using all applicable safety precautions, operate the crane systems to raise and swing the boom clear of boom support.
- Keeping the boom above horizontal, operate the telescope lever to extend the boom about three fourths (3/4) its total extended length and lower the headache ball onto the ground.
- Operate the telescope lever, retract boom fully allowing headache ball and wire rope to stay in its extended position. At same time lowering boom to allow access to anti-two block (ATB) counterweight and boom head.
- With boom lowered remove the two (2) hair pins on the anti-two block weight. Remove the weight from the wire rope and let it hang on the ATB switch.
- Remove the wire rope retaining pins from the boom head and temporarily lay the wire rope to left side of boom head, out of the way of jib attach lugs. With wire rope off to the side, re-install only the lower wire rope retaining pin (or pins) in boom head at this time. See Figure 2-14.



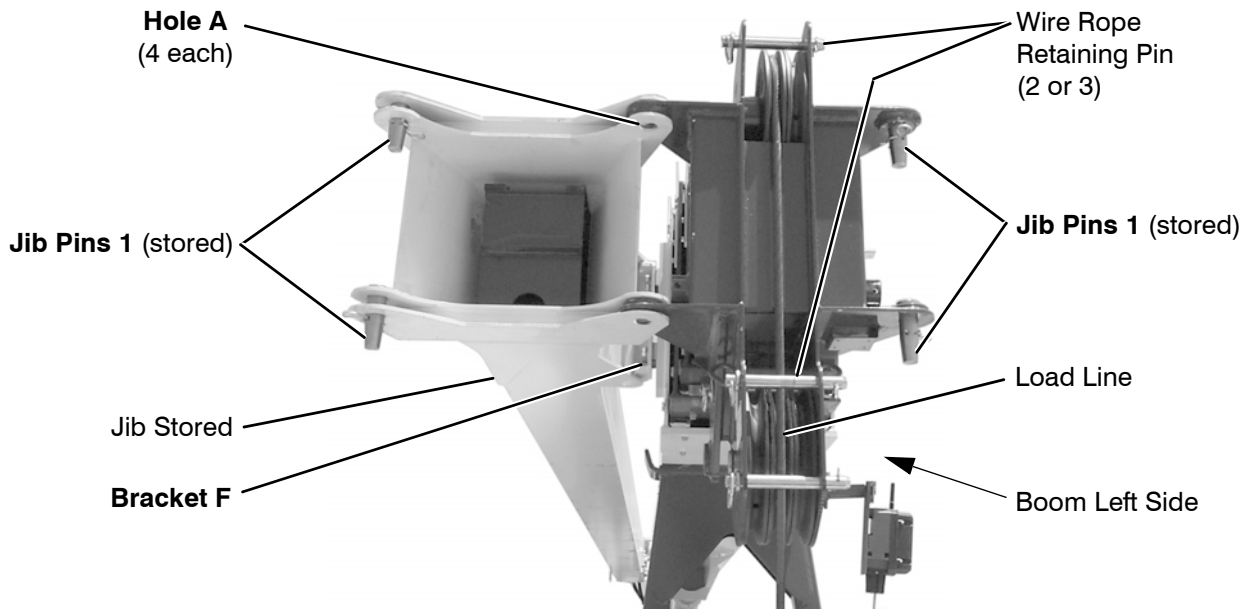


Figure 2-14 Jib Mounting Holes on Typical boom head

**CAUTION**

**Do not attempt to telescope the boom at this time. Severe damage to the boom and/or jib may occur if a premature attempt is made to telescope the boom.**

- Remove the four **Jib Pins (1)** from jib base and boom head, see Figure 2-14.
- Install two **Jib Pins (1)** to fasten the jib to **Holes A** on the right side of the boom head.
- Raise the boom to horizontal.

**CAUTION**

**During the next few steps the jib will swing around uncontrolled if boom is not placed in a horizontal position.**

- Fasten a tagline, approximately fifteen feet long, to the bar at the jib point shown in Figure 2-16.
- Remove **Pin 2** from **Bracket B** shown in Figure 2-15.

**CAUTION**

**Do not remove Pin 2 until Jib Pins (1) are installed on right side of boom head, otherwise, jib may fall from boom causing serious injury to personnel.**

- Extend the boom approximately nine inches so **Bracket C**, shown in Figure 2-15, is clear of **Bracket B**.

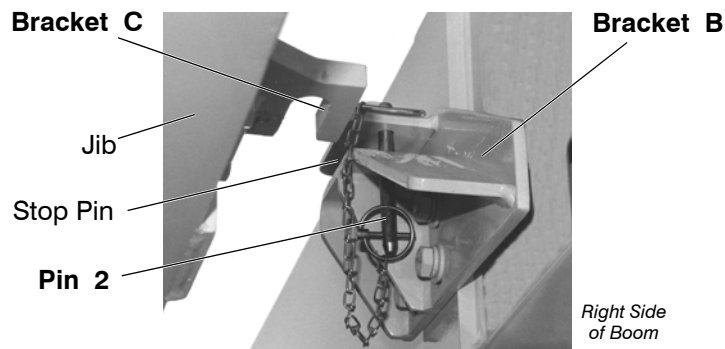


Figure 2-15 Typical Jib Brackets

- Swing the jib to the extended position with the tagline.
- Lower the boom so the boom head can be reached from the ground.
- Install the two remaining **Jib Pins (1)** to fasten the jib to **Holes A** on the left side of the boom head.



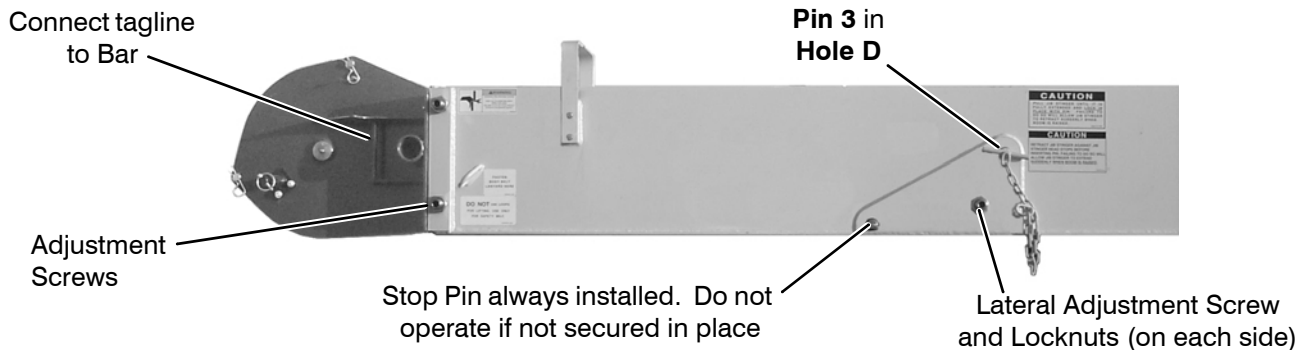
■ **If the telescopic jib will be operated in the extended position, proceed as follows:**

- Remove **Pin 3** from **Hole D**, refer to Figure 2-16.
- Pull the jib stinger out until it is fully extended. Raise the boom if the jib point touches the ground.
- Re-install **Pin 3** in **Hole D** and secure with hairpin cotter, refer to Figure 2-16.

*Note* Pin 3 cannot be installed unless the jib stinger is extended completely.

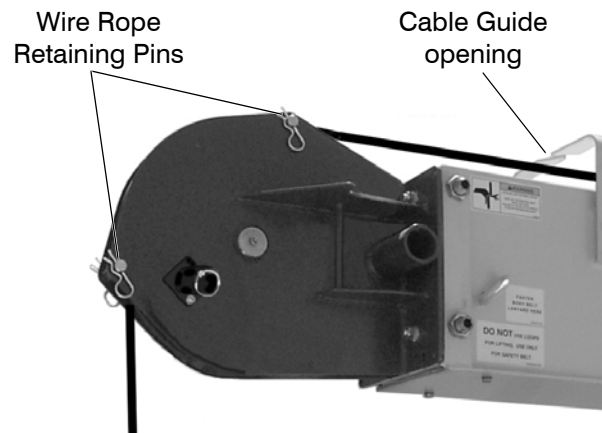
**CAUTION**

**Do not proceed unless Pin 3 is installed in Hole D and secured in place with cotter pin. Failure to do so will allow jib stinger to retract suddenly when boom is raised. Do not operate crane unless Stop Pin, Lateral Adjustment Screw and Locknuts are also correctly installed, refer to Figure 2-16.**



**Figure 2-16** Typical Jib Point and Telescopic Jib Stinger Pin

- Lay wire rope over top sheave of boom head and re-install wire rope retaining pin, secure with hair pin.
- Lay wire rope along top plate of jib, at the jib base, insert wire rope through wire rope cable guide using the notch at the top of the guide.
- Remove jib wire rope retainer pins at the jib head. Lay wire rope on jib head sheave groove and re-install retaining pins, secure pin with hair pin, see Figure 2-17.
- If open wedge socket was removed due to multiple part line reeving, re-install open wedge wire rope socket onto end of wire rope, see Figures 2-3 through 2-5.



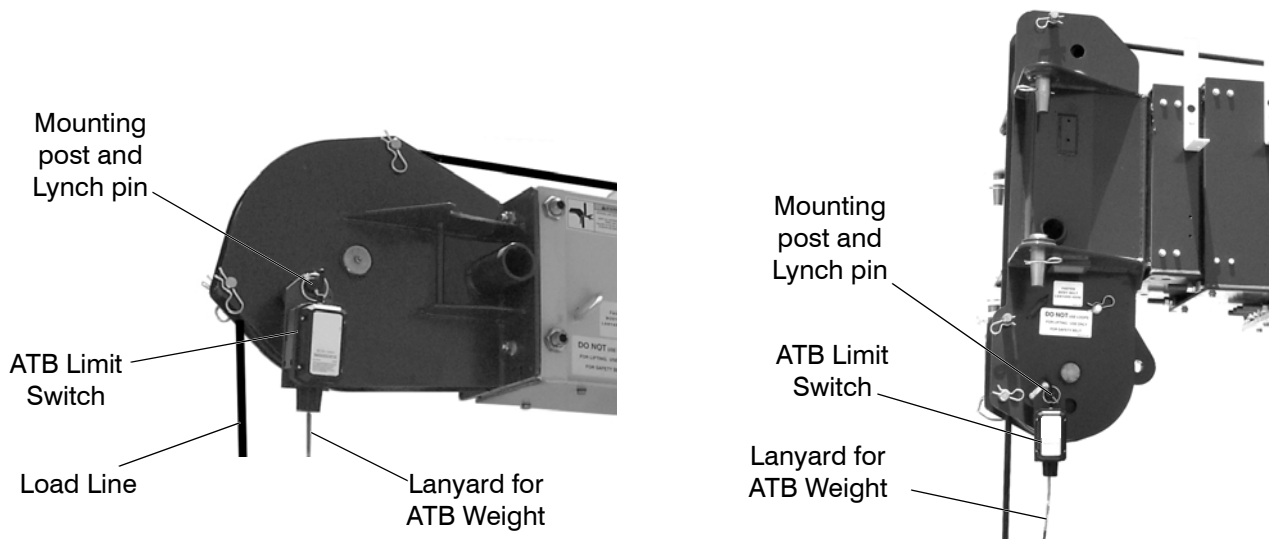
**Figure 2-17** Typical Jib Head

### Preparing Anti-Two Block System for Jib Operation

After erecting the Jib, the ATB must be configured to operate from the Jib head. The S-Series crane is equipped with a radio ATB system. Refer to Figure 2-18

- Remove the ATB switch and weight from boom head, see Figure 2-18.
- Install ATB switch and weight on post on the left side of the jib head and secure with lynch pin provided.
- Install ATB weight around Load Line.

- Proceed to “Checking Operational Aids”.



**Figure 2-18** Radio ATB Switch on Boom and Jib Heads.

### CHECKING OPERATIONAL AIDS

- Set the Load Moment Indicator (LMI) to the correct operating code for the jib. Refer to LMI Operating Codes in the Load Chart.
- Test the ATB warning horn and shutdown for proper operation, refer to Daily Checks in Chapter 6.
- For pre-operational testing of LMI, Radio ATB, or Radio Load Cell consult each system’s operator manual. A copy of each applicable manual has been placed in your crane’s Owner Manual Package or in the truck cab.



**Do not handle any load with jib until ATB warning horn and shutdown are operational, otherwise, a two-block condition may occur.**

**Do not handle any load with the Jib until the LMI has been set to the proper operating mode. Failure to do so will prevent the LMI system from properly monitoring the load capacity of the crane, possibly resulting in damage to crane or property.**

*Note* At this point the ATB circuit and LMI is enabled for lifting from the jib point.

## Storing Jib

### Preparing Anti-Two Block System for Main Boom Operation

After storing the Jib, the ATB must be configured to operate from the boom head. The S-Series crane is equipped with either a hard-wired or radio ATB system. Refer to the following topics and set-up your ATB components depending on your system.

- Using all applicable safety precautions, operate the crane systems to position the boom in area over the rear of the truck where easy access to the jib and boom components is possible.
- Retract the boom to within one (1) foot of its fully retracted position.
- Lower the boom until the jib head can be reached from the ground.
- Remove the ATB switch and weight from jib head. For safekeeping re-install the lynch pin on the post.
- Install ATB switch and weight on post on the left side of the boom head and secure with lynch pin, see Figure 2-18.
- Proceed to breakdown the jib.

## Breaking down the Jib

**Important** Be sure to install hairpin cotters to retain pins.

- Remove the load line from the end of the jib and pull it out of the way towards the left side of the boom. Be sure to replace the wire rope retaining pins.
- If the telescopic jib stinger is extended, proceed as follows:
  - Remove **Pin 3** from **Hole D**, shown in Figure 2-16.
  - Push the jib stinger all the way in so the jib point is snug against the jib base.

**Note** Two people may be needed to retract the stinger into the jib base. Insert a pipe through the tube at the jib point to assist in this operation. Ideally, the pipe should be long enough to accommodate a person on each side.

- Replace **Pin 3** in **Hole D**.

### CAUTION

**Push jib stinger in until jib point snug against jib base before installing Pin 3. Failing to do so will allow jib stinger to extend suddenly when jib swings around, the boom is raised, or when traveling.**

- Fasten a tagline, approximately fifteen feet long, to the bar on the jib point, refer to Figure 2-16.
- Remove the two **Jib Pins (1)** from **Holes A**, on the left side of the boom head, refer to Figure 2-14.
- Raise the boom to horizontal.
- Swing the jib to the stored position along side of the boom with the tagline.
- Retract the boom so **Bracket C**, on the jib engages the stop pin in **Bracket B** on the boom, refer to Figure 2-19.

### CAUTION

Do not remove Jib Pins 1 on right side of boom head until Pin 2 is installed, otherwise, jib may fall from boom causing serious injury to personnel.

- Install **Pin 2** in **Bracket B** and secure with keeper pin, refer to Figure 2-19.
- Remove remaining two Jib Pins (1) from **Holes A**, on the right side of the boom head, refer to Figure 2-14.

**Note** Store **Jib Pins (1)** as shown in Figure 2-14 and secure in place with hairpin cotters.

**Important** Do not extend boom until Jib Pins (1) are removed when Pin 2 is installed; otherwise, brackets will be damaged.

- Assemble the load line to the sheaves on the boom. Be sure to replace the wire rope retaining pins.
- If the overhaul ball will be used, assemble the ATB weight to the load line.
- If multiple-part reeving will be used, install the load block and, if necessary, the auxiliary sheave. Be sure to pass the dead end of the load line through the ATB weight, refer to Figure 2-7 or 2-8.

## CHECKING OPERATIONAL AIDS

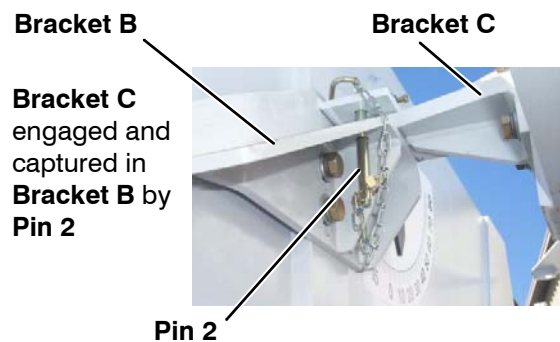
- Reset the Load Moment Indicator (LMI) to the correct operating code for the boom and crane configuration. Refer to the LMI Operating Codes in Load Chart.
- Test the ATB warning horn and shutdown for proper operation, refer to *Daily Checks* in Chapter 6.
- For pre-operational testing of LMI, Radio ATB, or Radio Load Cell consult each system's operator manual. A copy of each applicable manual has been placed in your crane's Owner Manual Package or in the truck cab.

### CAUTION

**Do not handle any load with boom until ATB warning horn and shutdown are operational, otherwise, a two-block condition may occur.**

**On LMI cranes, do not handle any load until the LMI has been set to the proper operating mode that matches the crane configuration. Failure to do so will prevent the LMI system from properly monitoring the load capacity of the crane, possibly resulting in damage to crane or property.**

**Note** At this point the ATB circuit and LMI is enabled for lifting from the boom point.



**Figure 2-19** Jib Bracket C captured

## Adjusting Jib

Storing and deploying the Jib may become difficult if misalignment exists between the Jib and Boom head. Adjust jib storage brackets to shift the jib vertically and horizontally as required to set the jib at the proper height and align pin holes (**Hole A**), refer to Figure 2-14.

**Bracket F** (see Figure 2-20) adjusts vertically to position the jib foot just above the boom head lugs. Setting this bracket properly prevents the jib foot from striking the boom head when the Jib is stored. Install shims behind **Bracket F** so **Holes A** on the right side of the boom head line up with holes on the jib. Perform this adjustment with the boom fully retracted and the jib stored.

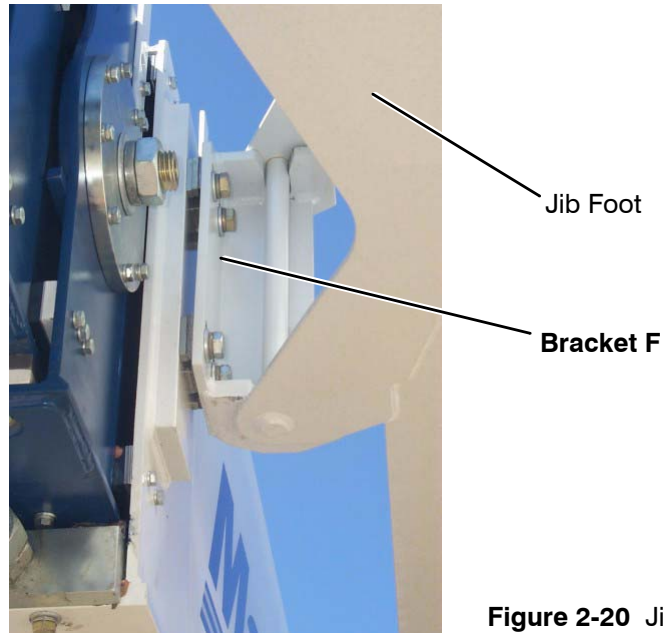
**Bracket B** (see Figure 2-21) also adjusts vertically. Adjust bracket height so that jib **Bracket C** meets the bottom of the ramp thus facilitating storing of Jib along the boom.

It should be necessary to perform these adjustments only when the pins have worn to the point that they allow the jib to sag while attempting to store the jib.

### Alignment Screws

#### *Telescopic Jib Only*

Adjust the alignment screws, shown in Figure 2-16, so the jib stinger (when fully extended) is centered in the jib base. Be sure to tighten the locknuts to retain the adjustment.



**Figure 2-20** Jib Bracket F



**Figure 2-21** Jib Bracket B

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## Chapter 3 Lubrication

### **CAUTION**

Avoid injury! Bring all crane functions to complete stop and turn engine OFF before lubricating crane. If necessary, spot grease fittings at access points, then stop engine.

Attach CAUTION sign to start controls to warn personnel that crane is being serviced and engine must not be started.

Do not operate crane until all guards and covers have been securely replaced and all maintenance equipment has been removed.

## General

To insure proper operation of this crane, all points requiring lubrication must be serviced with the correct lubricant at the proper interval. All normal wear points requiring lubrication are covered in this section, except for the truck. Lubricate and maintain truck according to instructions in manufacturer's manual.

## Intervals

The intervals given in this section are based on normal operating conditions.

Any increase or decrease in these intervals shall be preceded by a complete analysis of how the crane is performing.

Bearings or bushings that are too warm, excessive play in moving parts, excessive or abnormal wear in gears, and rust accumulation are indications of a lack of lubrication. If these conditions are found, the lube interval for the faulty part should be shortened.

**Important** Before lengthening intervals, check that all parts are receiving an adequate supply of clean lubricant, otherwise, parts will be damaged from a lack of lubrication.

A laboratory analysis of oil from hydraulic tank and each gear box shall be a major factor used in determining whether oil-change intervals should be lengthened or shortened.

## Over-Lubrication

Over-lubrication is not only wasteful but also harmful.

- Oil or grease that drips onto walkways can be slippery and cause injuries to personnel.
- Too high of an oil level can cause churning and foaming of the oil and result in excessive heat and overflow from the hydraulic tank or gear boxes.
- An extra shot of grease, if too stiff or under too much pressure, can pop out a bearing seal.

## Service Tips

- Check oil levels before start-up so the oil has had a chance to run down from the gear box walls and all moving parts.
- Avoid introducing dirt into the hydraulic tank or gear boxes. Carefully clean the area around dipsticks, level plugs, fill plugs and breathers before removing them.
- Securely replace level plugs, fill plugs, drain plugs and breathers. Clean any spillage.
- Keep oil and grease dispensers and containers tightly closed and stored in a dirt and moisture free location.
- Clean grease fittings before and after applying grease.
- Apply grease until the bearing is full so grit cannot enter. Wipe away excess grease.
- Do not use tape style sealers; use only liquid style.

## Oil Can Points

Oil all pins not equipped with grease fittings with engine oil every month even if the crane is not being operated.

## Wire Rope

The wire rope must be lubricated on a regular basis to maintain its strength and lengthen its useful life. Refer to *Wire Rope Maintenance* in Chapter 5 for lubrication instructions.

## Oil Capacities

| <i>Item</i>             | <i>Amount</i> | <i>Oil Type</i> |
|-------------------------|---------------|-----------------|
| <b>Hydraulic System</b> |               |                 |
| 2202 & 2802 Series      | 70 gal        | Hydraulic       |
| 3802 & 4002 Series      | 100 gal       | Hydraulic       |
| <b>Swing Reducer</b>    |               |                 |
| All                     | 4 qt          | Gear            |
| <b>Winch</b>            |               |                 |
| 2202 & 2802 Series      |               |                 |
|                         | Gear Products | 2-1/2 qt        |
|                         | Braden        | 3-1/2 qt        |
| 3802 & 4002 Series      |               |                 |
|                         | Braden        | 3-1/2 qt        |
|                         | Tulsa         | 2 qt            |

## Lubrication Specifications

### Grease

Use lithium base, multi-purpose EP grease for all bearings except the swing reducer upper bearings.

Use EP heavy fiber type wheel bearing grease for the swing reducer upper bearings.

### Open Gear Oil

The slewing ring gear teeth must be lubricated with a heavy oil with the following characteristics.

- Resists being thrown off by turning gears.
- Resists being washed off by water.
- Resists thinning out and dripping off at hottest operating temperature.
- Resists becoming so thick that it chips or peels off at coldest operating temperature.

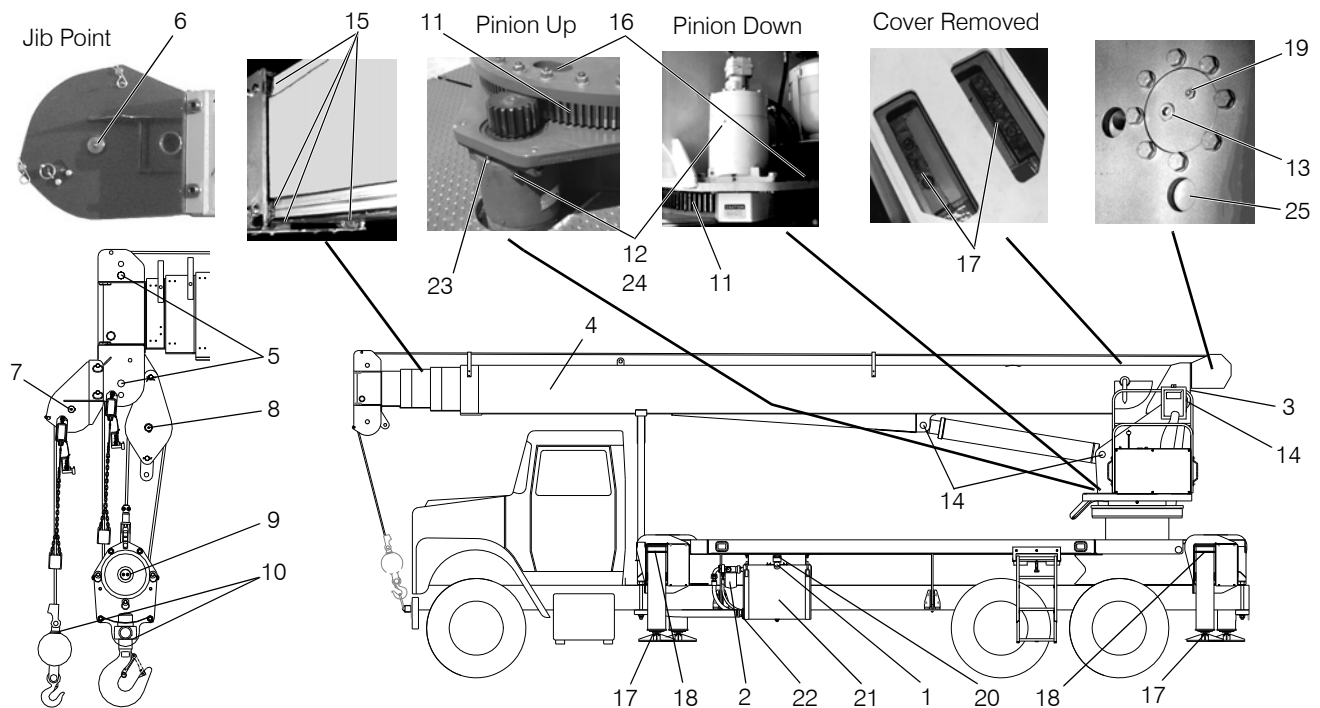
### Gear Oil

Use SAE 90 multi-purpose EP gear oil.

### Antiwear Hydraulic Oil

| <i>Hydraulic System Operating Temperature Range*</i> | <i>ISO Viscosity Grade</i> |
|--|----------------------------|
| -21°C to 60°C (-5°F to 140°F)                        | 22                         |
| -15°C to 77°C (5°F to 170°F)                         | 32                         |
| -9°C to 88°C (15°F to 190°F)                         | 46                         |
| -1°C to 99°C (30°F to 210°F)                         | 68                         |

\* Temperatures shown are cold (ambient) start-up to maximum operating. During cold start-up, avoid high-speed operation of hydraulic components until the system is warmed up to provide adequate lubrication.



**Figure 3-1 Lubrication Points**  
**Lubrication Points**

| <i>Identification (Figure 3-1)</i>                  | <i>Lubricant</i>     | <i>Service</i> | <i>Interval</i>                  | <i>Note</i> |
|---|----------------------|----------------|----------------------------------|-------------|
| 1. Hydraulic Tank Fill Cap                          | Hydraulic Oil        | Check Level    | Daily                            | 1           |
| 2. Hydraulic Filter                                 | —                    | Check Pressure | Daily                            | 2           |
| 3. Retract Sheaves & Extend Sheave (124' Boom only) | Grease               | Grease Gun     | Weekly                           | 3           |
| 4. Extend and Retract Sheaves                       | Grease               | Grease Gun     | Weekly                           | 4           |
| 5. Boom Point Sheaves (1 fitting each sheave)       | Grease               | Grease Gun     | Weekly                           | —           |
| 6. Jib Point Sheave                                 | Grease               | Grease gun     | Weekly                           | —           |
| 7. Auxiliary Sheave (Not Shown)                     | Grease               | Grease Gun     | Weekly                           | —           |
| 8. Auxiliary Block                                  | Grease               | Grease gun     | Weekly                           | —           |
| 9. Load Block Sheave (1 or 2 fittings)              | Grease               | Grease Gun     | Weekly                           | —           |
| 10. Load Block Trunnion or Overhaul Ball Swivel     | Grease               | Grease Gun     | Weekly                           | —           |
| 11. Slewing Ring Gear Teeth                         | Open Gear Oil        | Brush or Spray | Weekly                           | 5           |
| 12. Swing Reducer                                   | Gear Oil             | Check Level    | Weekly                           | 6           |
| 13. Winch   | Gear Oil             | Check Level    | Weekly                           | 6           |
| 14. Boom and Hoist Cylinder Pivot Pins              | Grease               | Grease Gun     | Weekly                           | 16          |
| 15. Boom Slider Pads                                | Grease               | Brush or Swab  | Monthly                          | 9           |
| 16. Slewing Ring Bearing                            | Grease               | Grease Gun     | Monthly                          | 8           |
| 17. Ball Cavity (outrigger float pads)              | Grease               | Brush or Swab  | Monthly                          | 10          |
| 18. Outrigger Slider Pads                           | Grease               | Brush or Swab  | Monthly                          | 10          |
| 19. Winch Vent Plug                                 | —                    | Clean          | Monthly                          | 11          |
| 20. Hydraulic Tank Breather                         | —                    | Replace        | Every 3 Months                   | 12          |
| 21. Hydraulic Tank                                  | Hydraulic Oil        | Change         | Semiannually                     | 13          |
| 22. Suction Strainer                                | —                    | Clean          | At oil change                    | —           |
| 23. Swing Reducer Upper Bearings                    | Wheel Bearing Grease | Grease Gun     | Annually                         | 14          |
| 24. Swing Reducer                                   | Gear Oil             | Change         | Annually                         | —           |
| 25. Winch   | Gear Oil             | Change         | Every 1000 Hours or Semiannually | 15          |



## Lubrication Points Notes

1. Fill hydraulic tank so oil level is between high and low marks on tank sight gauge. To check the oil level, the crane must be on level surface and in the normal roading position; i.e., the boom must be in the boom rest and all outriggers fully retracted.
2. Check the gauge after start-up each day and periodically throughout each work shift. Replace element if gauge reads 25 psi when engine is at high idle and oil is warm.
3. Retract sheave(s) on boom first section are accessible through rear of boom. Fittings are located on each end of sheave pin or on exposed side of sheave.  
For 124' boom, the extend sheaves on the first section are accessible through rear of boom. For the retract sheave on the second section access holes are provided on the boom base.
4. Boom must be fully extended to expose all grease fittings through holes on each side of the boom sections. Fittings are located on each end of sheave pins.



**Do not place hands or tools into any opening in boom sections while power is on or boom sections are moving.**

5. Open gear oil must be brushed or sprayed on each gear tooth; do not rely on gear rotation to distribute oil.
6. Fill to bottom of plug opening.
7. Grease fittings on cylinders are located on the middle of cylinder pin tubes. Fitting on the boom pivot is located on the center of the tube and accessible from the rear of the boom.
8. The slewing ring has two grease fittings on the inner ring and are accessible through the slotted or round access hole in the turret bottom plate. The access hole is located on the side opposite the operator platform. The crane must be rotated 180° from the stored position to access the second grease fitting using the same access hole in the turret. Apply five shots of grease in each fitting.
9. Fully extend boom and apply a light coat of grease to both sides and bottom of each boom section in areas of slider pad contact.

Fully retract boom. Remove cover from rear of boom base to expose top rear slider pads. Coat top rear slider pads with grease. Extend boom as necessary to expose each set of slider pads. Replace cover after greasing.



**Do not place hands or tools into any opening in boom sections while power is on or boom sections are moving.**

*Note* Chattering or jerking of the boom indicates more frequent lubrication of the boom and pads is required. For recommended boom break-in procedure see chapter 6 under "Boom Service"

10. Refer to Figure 3-2 for lubrication of outrigger slider pads and ball cavity.
11. Clean vent plug by soaking in solvent. Spring loaded pin must move in and out freely. Do not paint over vent plug. Never replace vent plug with a solid plug.
12. Do not attempt to clean breather; if needed, replace at earlier intervals.
13. See Chapter 6 for oil change procedure.
14. *Pinion Up Cranes* — Swing boom slowly in both directions while greasing to completely fill bearing.

*Note Pinion Down cranes* - No greasing is necessary, pinion bearing is self lubed.

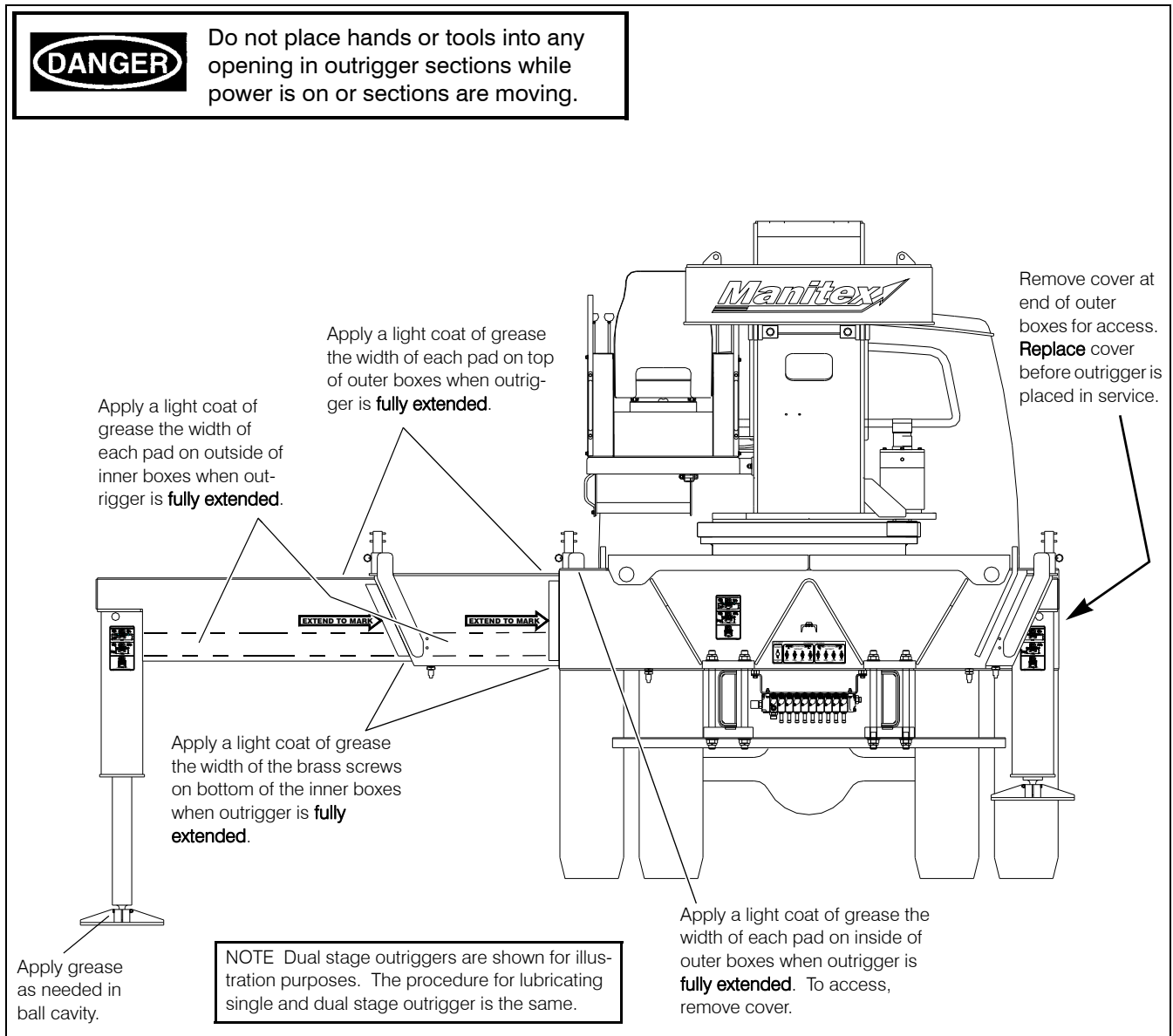
15. Models 2200 & 2800 series, to drain winch oil, boom must be horizontal.

To drain winch oil, align plug in drum with drain hole in bottom of side plate. Screw a short piece of 1-inch pipe into large hole in drum. Insert a 3/8-inch drive extension through pipe and remove plug. Replace plug and remove pipe after oil has drained.



**Do not place fingers, pipe, or drive extension into hole in side plate until winch drum has stopped turning and engine is OFF.**

16. Grease fittings on cylinders are located on the middle of cylinder pin tubes. Fitting on the boom pivot is located on the center of the tube and accessible from the rear of the boom.



**Figure 3-2** Outrigger and Ball Cavity Lubrication

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## Chapter 4 Capacities



Overloading this crane or failing to comply with operating conditions and restrictions given on Capacity Chart can result in structural damage to crane components, collapse of crane, or tipping.

Read all instructions on Capacity Chart before operating crane.

Do not lift any load without first determining total load to be lifted and maximum radius at which load can be lifted.

### CAUTION

Radius shall govern load rating. Only use boom angle as a guide in positioning boom near corresponding radius for a given load.

**EXCEPTION:** Boom angle shall govern load rating of jib when boom is not fully extended.

### Load Rating

The load ratings given on the Capacity Chart do not exceed a maximum stability tipping factor of 85 percent.

The main boom and jib load ratings above the heavy line on the Capacity Chart are based on the crane's hydraulic or structural competence and not on stability.

The main boom and jib load ratings below the heavy line are stability limited capacities and do not exceed 85 percent of tipping.

Before lifting any load, the operator shall ensure that:

- The crane is properly mounted on a truck that meets factory specifications.
- The crane is properly counterweighted, if required.
- The outriggers and stabilizers are extended on a firm, uniformly supporting surface so crane is level in all directions.
- The exact weight of the load to be lifted is known.
- The weight of the stored jib, if equipped, and all load handling devices are deducted from the load ratings given on the Capacity Chart. See Total Load near end of section.
- The area of operation shown on the Capacity Chart is not exceeded.
- The load rating has been reduced to compensate for wind, ground conditions, out-of-level conditions, and the dynamic effects of swinging, hoisting, and lowering the load.

*Note* This model crane has been given a stability test in compliance with ANSI B30.5 requirements. If the crane owner mounts the crane on the truck, he may have to perform a stability test in compliance with special instructions furnished by Manitex on request.

### Total Load

The weight of the stored jib, if equipped, and all load handling devices are considered part of the total load. To determine the total load to be lifted, use the following worksheet.

### Component Weights

See Deductions on Capacity Chart.

|  | <i>Pounds</i> |
|--|---------------|
| 1. Stored Jib (if equipped) . . . . .                                      | _____         |
| 2. Overhaul Ball or Load Block - See manufacturer's nameplate. . . . .     | _____         |
| 3. Auxiliary Block (if installed) . . . . .                                | _____         |
| 4. Auxiliary Sheave (if installed). . . . .                                | _____         |
| 5. Hose Reel (if equipped) . . . . .                                       | _____         |
| 6. 2-Man Steel Basket (empty weight) - See basket nameplate. . . . .       | _____         |
| 7. 1-Man Steel Basket (empty weight) - See basket nameplate. . . . .       | _____         |
| 8. 1-Man Fiberglass Basket (empty weight) - See basket nameplate . . . . . | _____         |
| 9. Slings and all other Load Handling Devices. . . . .                     | _____         |

### Totals

- A. Total Component Weights (ADD 1 through 9). . . . . \_\_\_\_\_
- B. Weight of Load to be Lifted. . . . . \_\_\_\_\_
- C. Total Load to be Lifted (ADD A and B) . . . . . \_\_\_\_\_

Once the total load has been determined, refer to the Capacity Chart to determine the maximum radius at which the load can be handled. . . . . \_\_\_\_\_ ft.

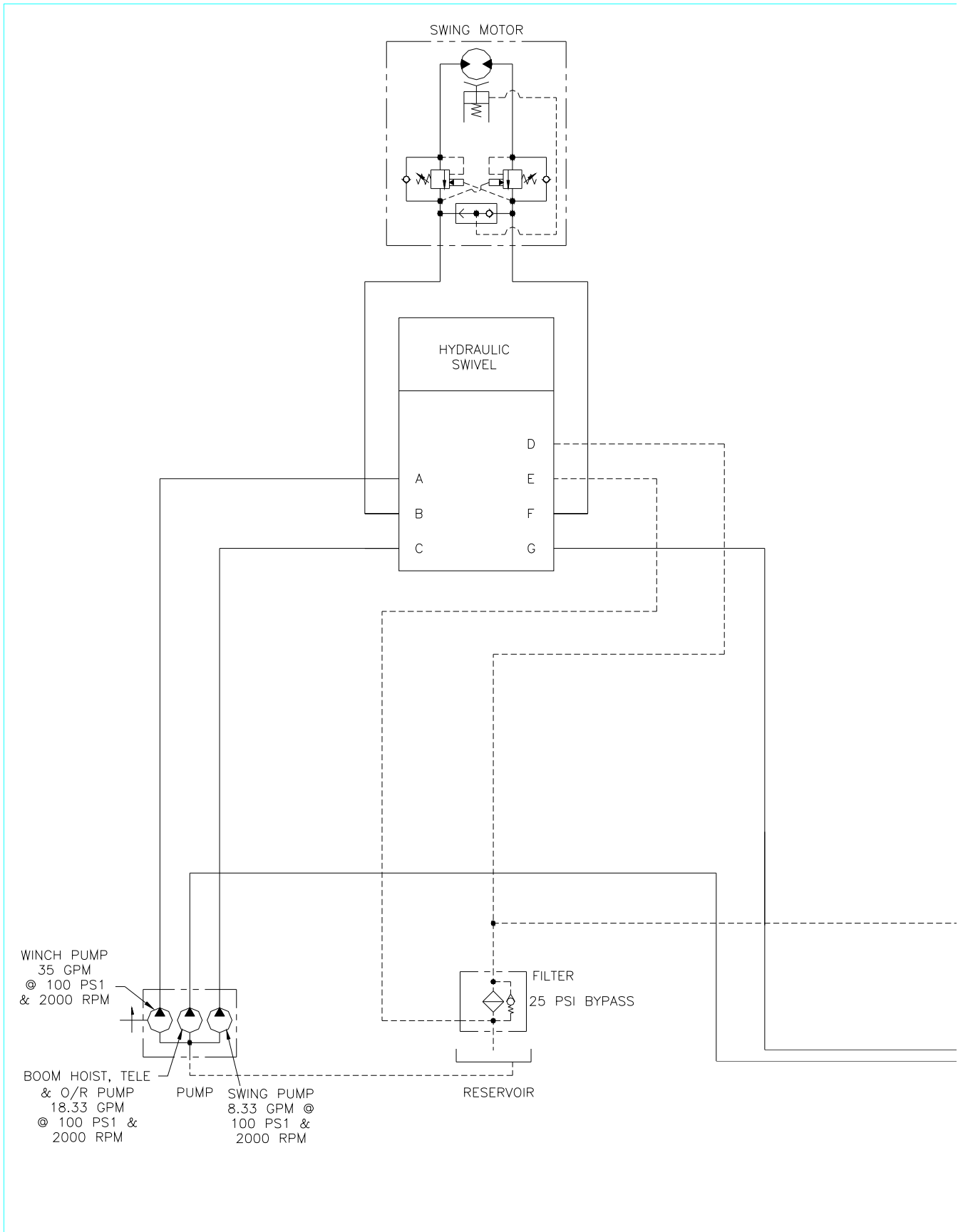
Refer to the Capacity Chart to verify the parts of line required to handle the total load to be lifted.

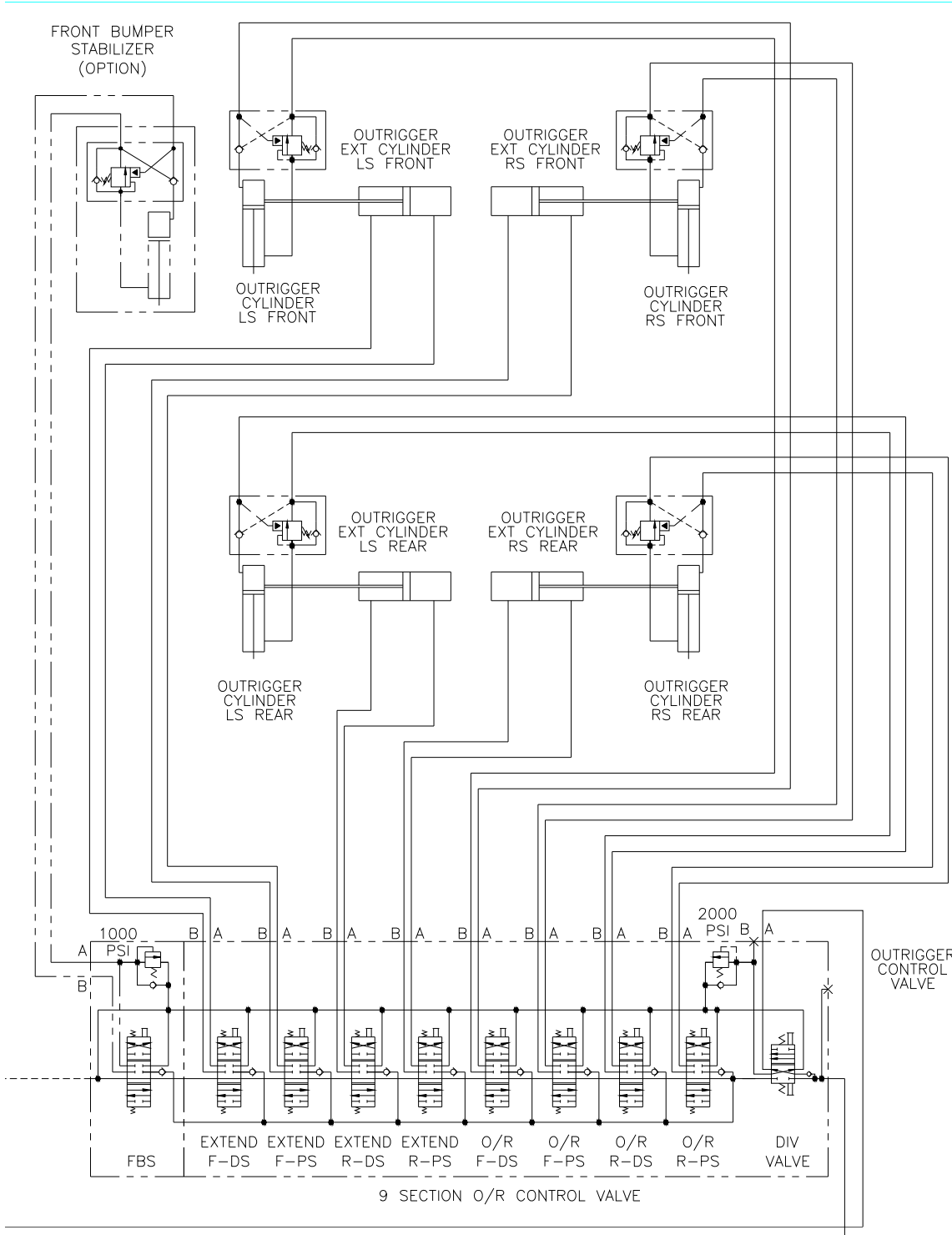
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## **Chapter 5**

# **System Schematics**

### Hydraulic Schematic - 2202 & 2802 Series





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| EO 01-04      |  |
| NEW RELEASE   |  |

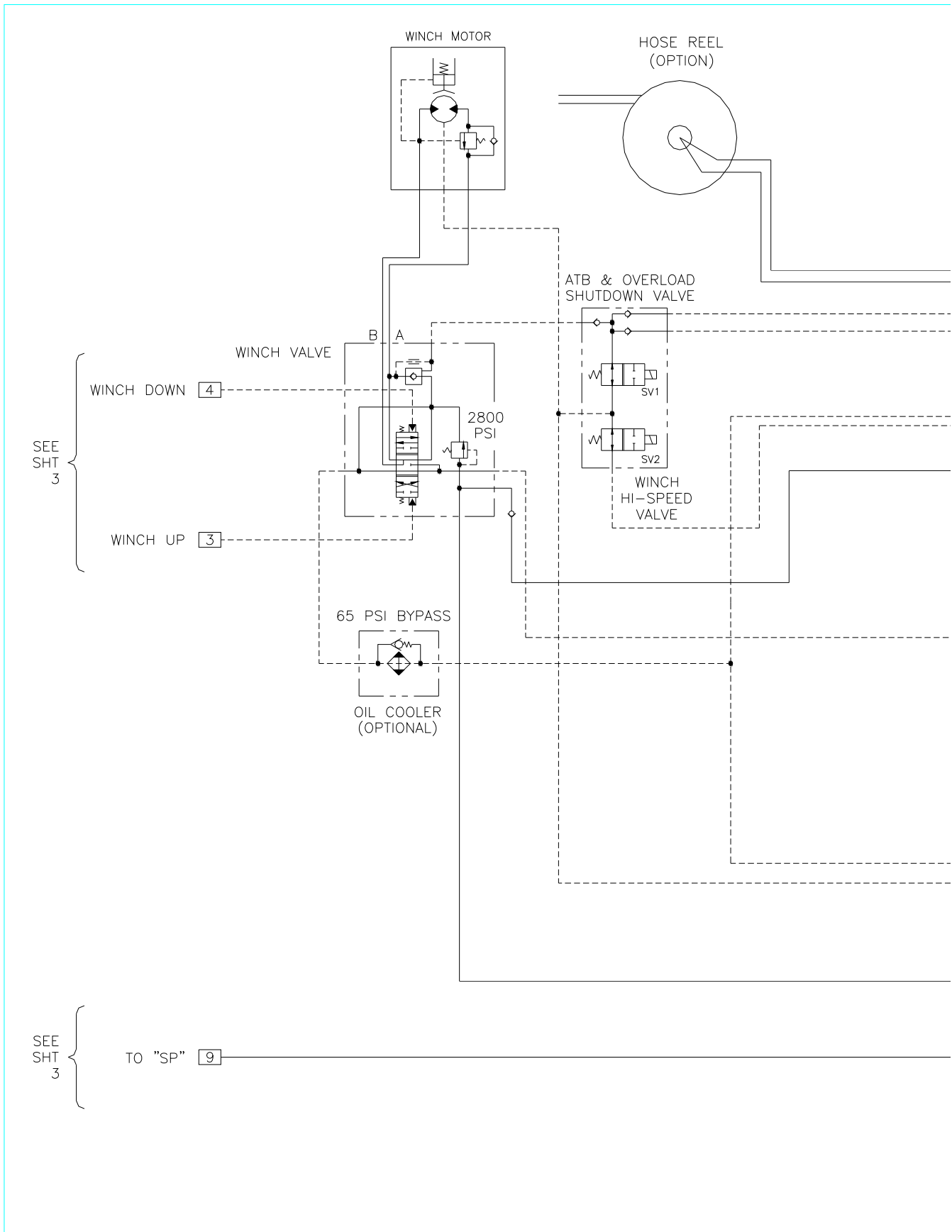
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**Manitex**

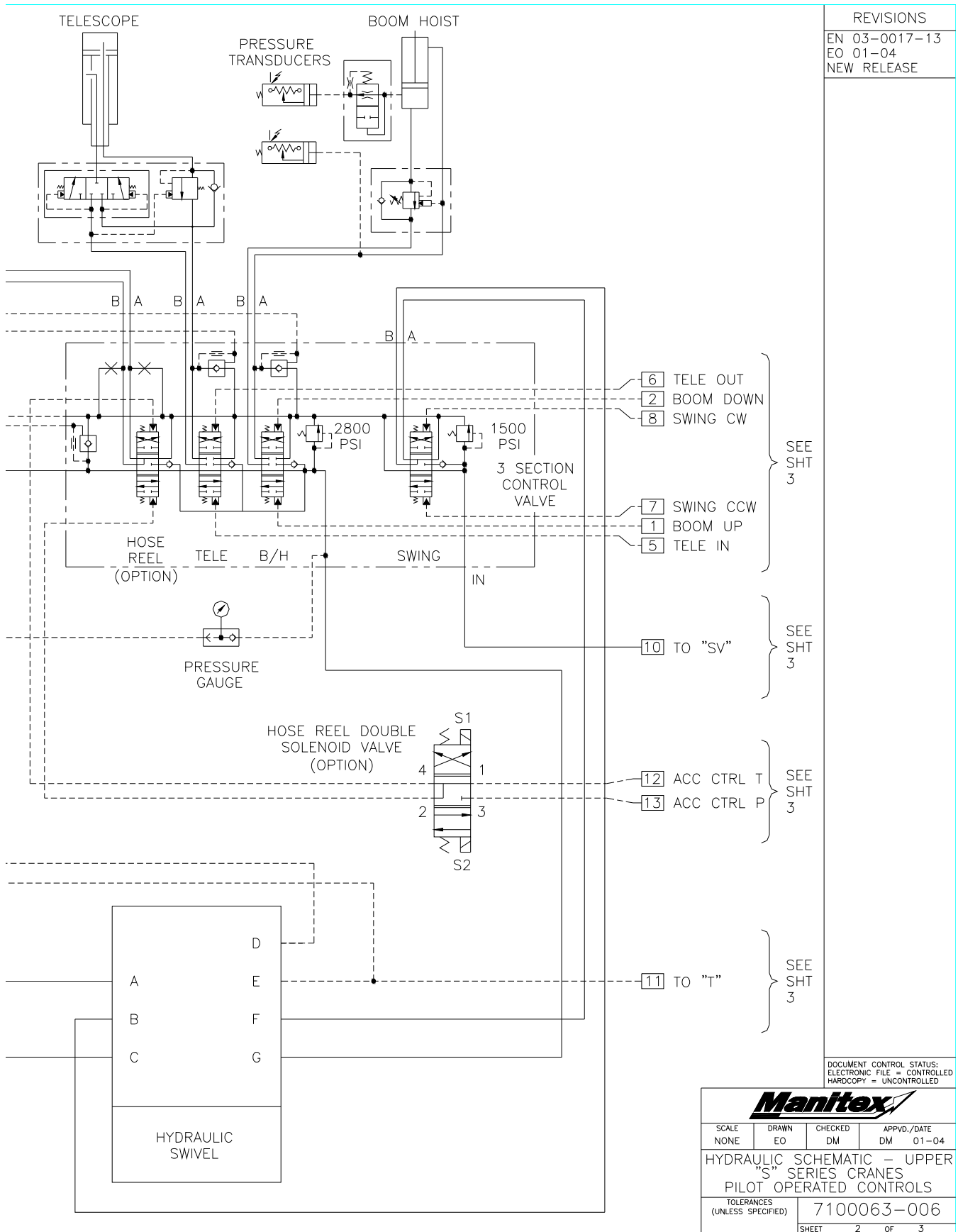
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HYDRAULIC SCHEMATIC - LOWER "S" SERIES CRANES  
PILOT OPERATED CONTROLS

|                               |             |
|-------------------------------|-------------|
| TOLERANCES (UNLESS SPECIFIED) | 7100063-006 |
| SHEET                         | 1 OF 3      |



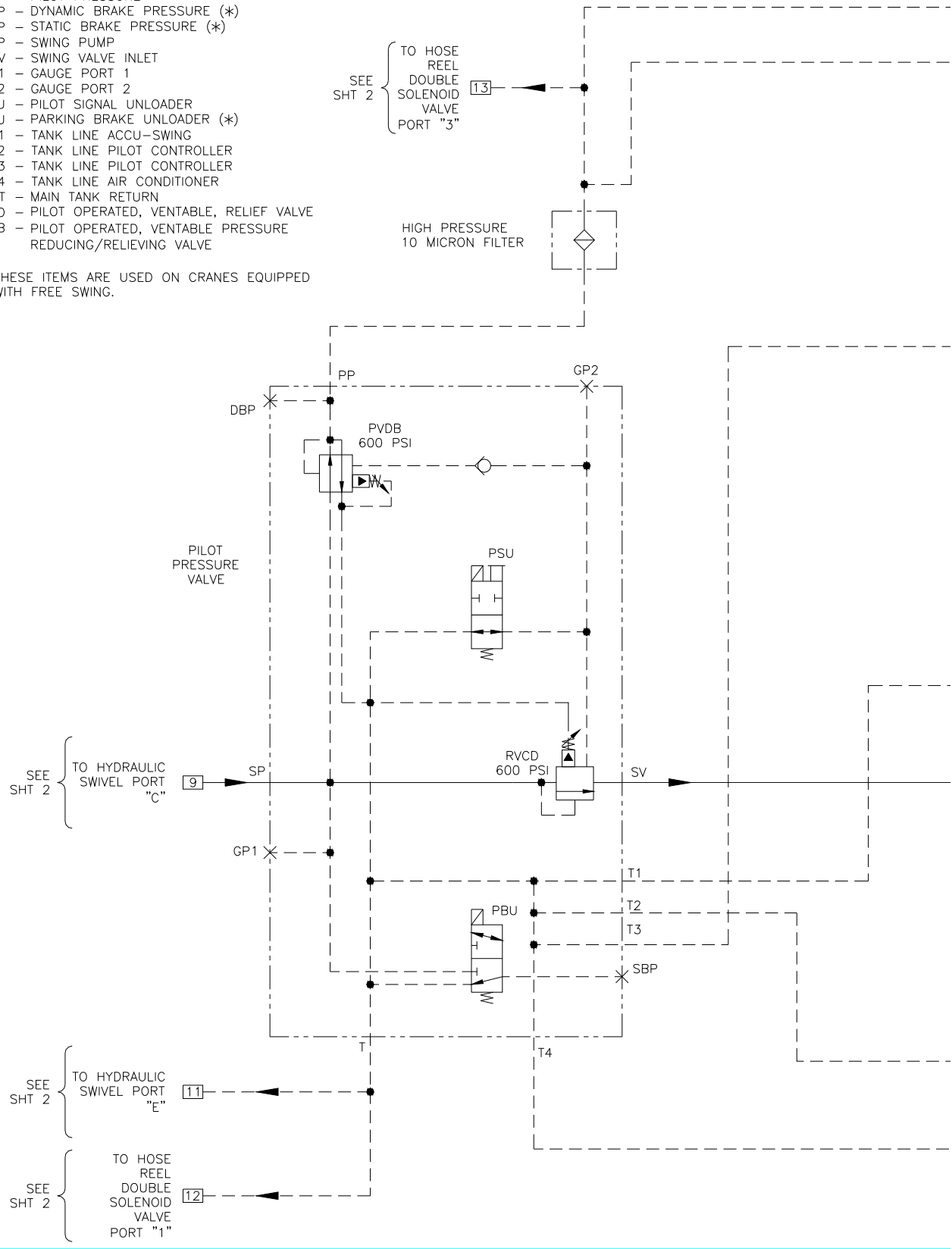




PILOT PRESSURE VALVE NOMENCLATURE

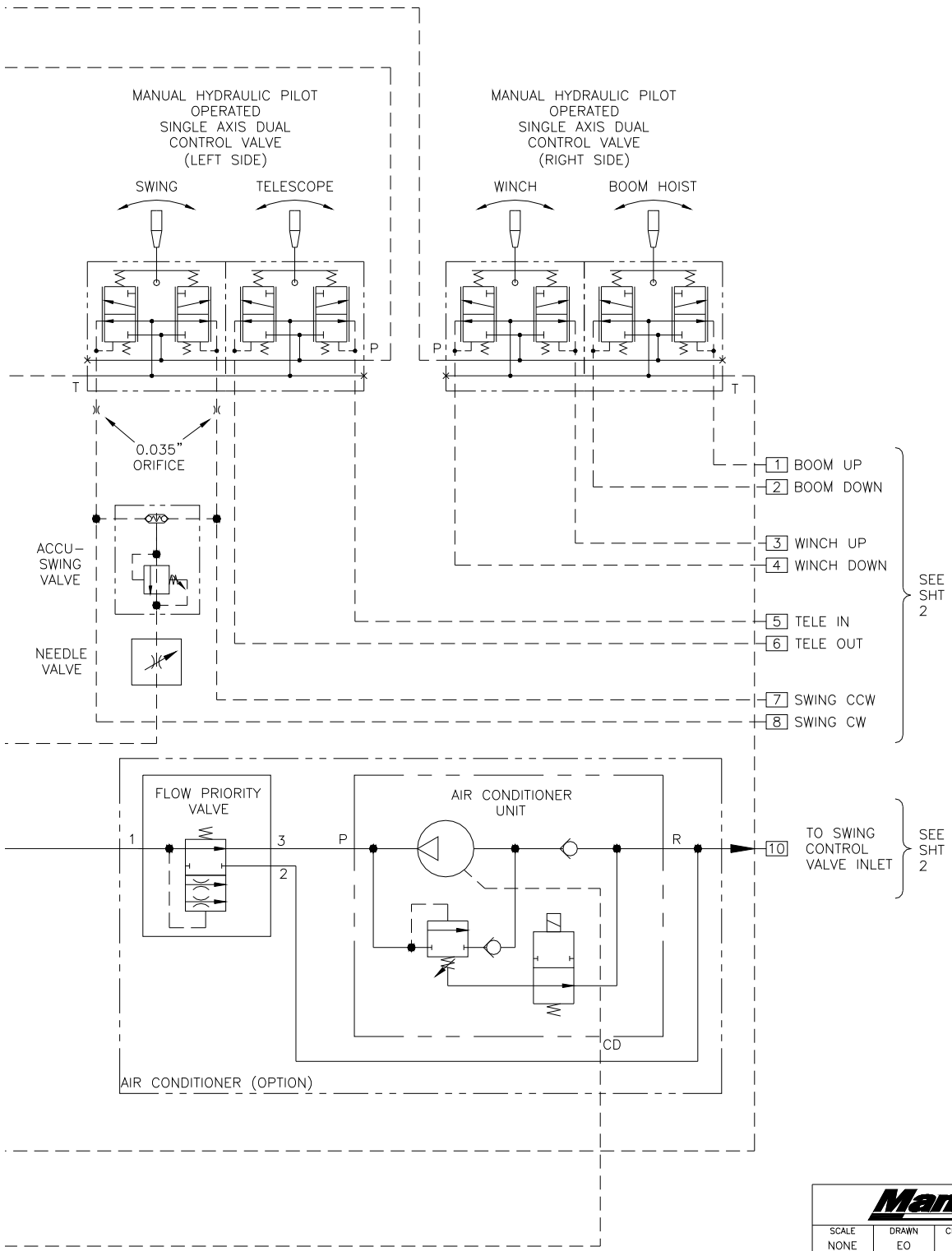
- PP – PILOT PRESSURE
- DBP – DYNAMIC BRAKE PRESSURE (\*)
- SBP – STATIC BRAKE PRESSURE (\*)
- SP – SWING PUMP
- SV – SWING VALVE INLET
- GP1 – GAUGE PORT 1
- GP2 – GAUGE PORT 2
- PSU – PILOT SIGNAL UNLOADER
- PBU – PARKING BRAKE UNLOADER (\*)
- T1 – TANK LINE ACCU-SWING
- T2 – TANK LINE PILOT CONTROLLER
- T3 – TANK LINE PILOT CONTROLLER
- T4 – TANK LINE AIR CONDITIONER
- T – MAIN TANK RETURN
- RVCD – PILOT OPERATED, VENTABLE, RELIEF VALVE
- PVDB – PILOT OPERATED, VENTABLE PRESSURE REDUCING/RELIEVING VALVE

\* THESE ITEMS ARE USED ON CRANES EQUIPPED WITH FREE SWING.



REVISIONS

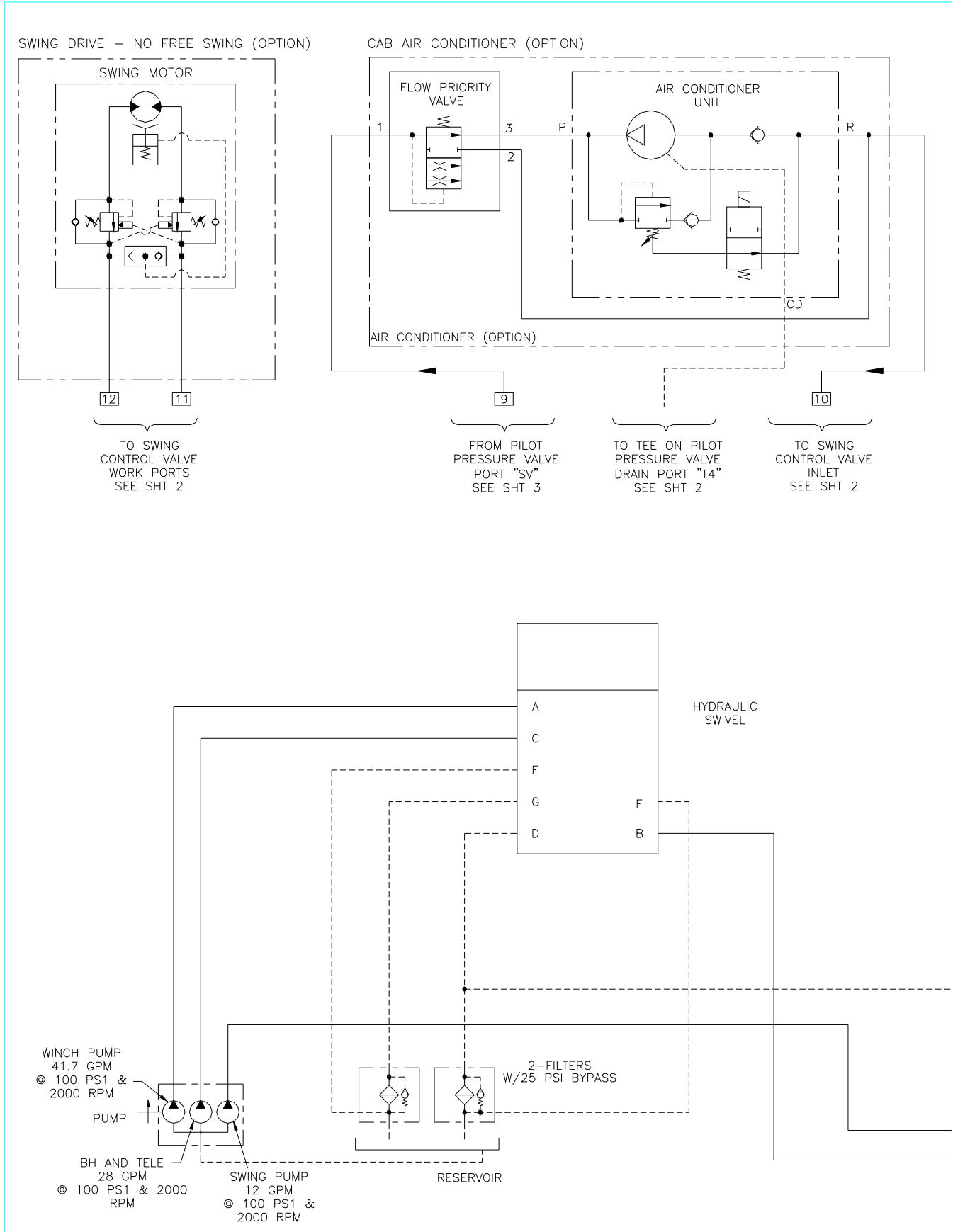
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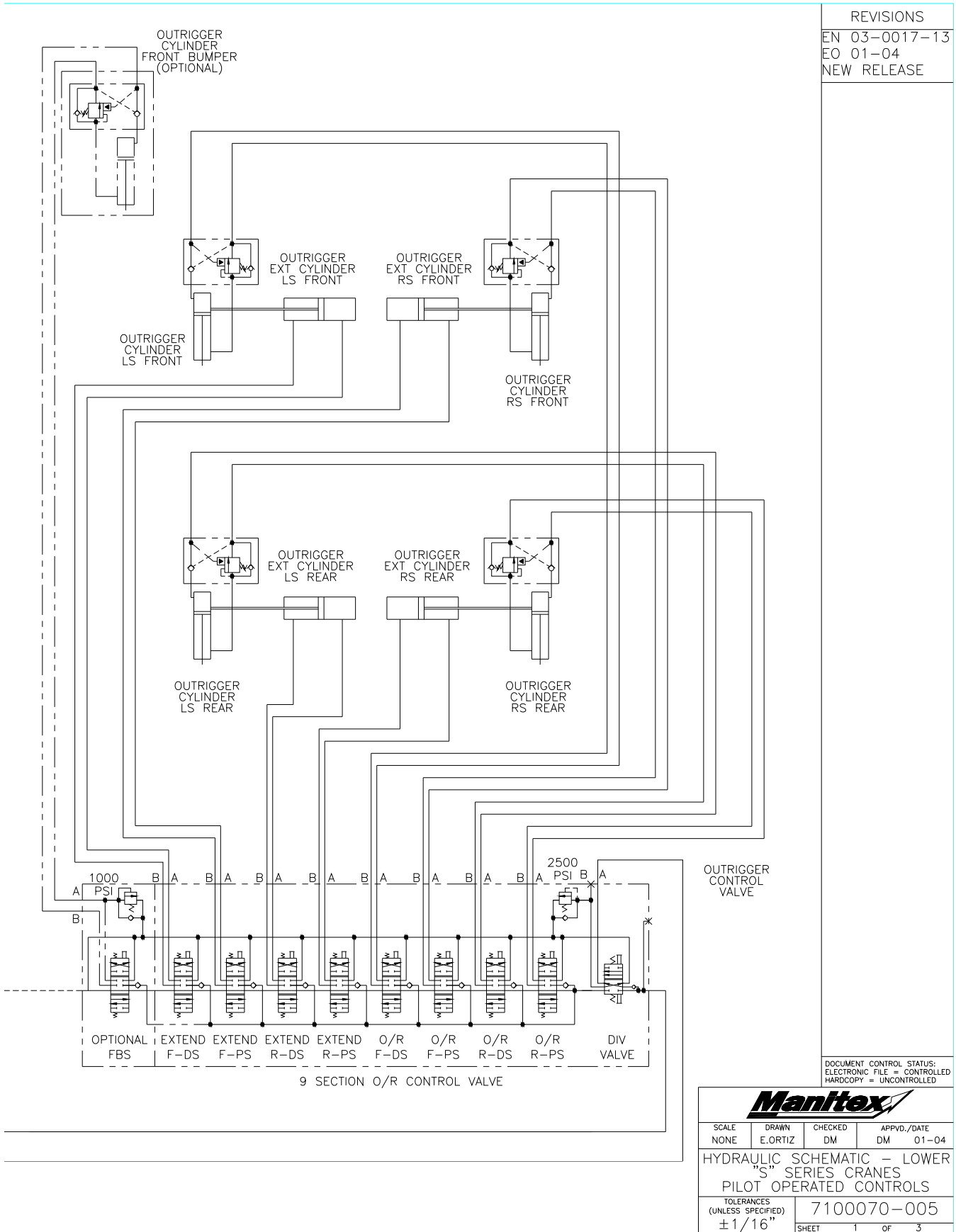


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| HYDRAULIC SCHEMATIC<br>"S" SERIES CRANES<br>PILOT OPERATED CONTROLS |             |               |                         |
| TOLERANCES<br>(UNLESS SPECIFIED)                                    |             | 7100063-006   |                         |
| SHEET   |             | 3 OF 3        |                         |

### Hydraulic Schematic - 3802, 4002 Series





| REVISIONS     |
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| NEW RELEASE   |

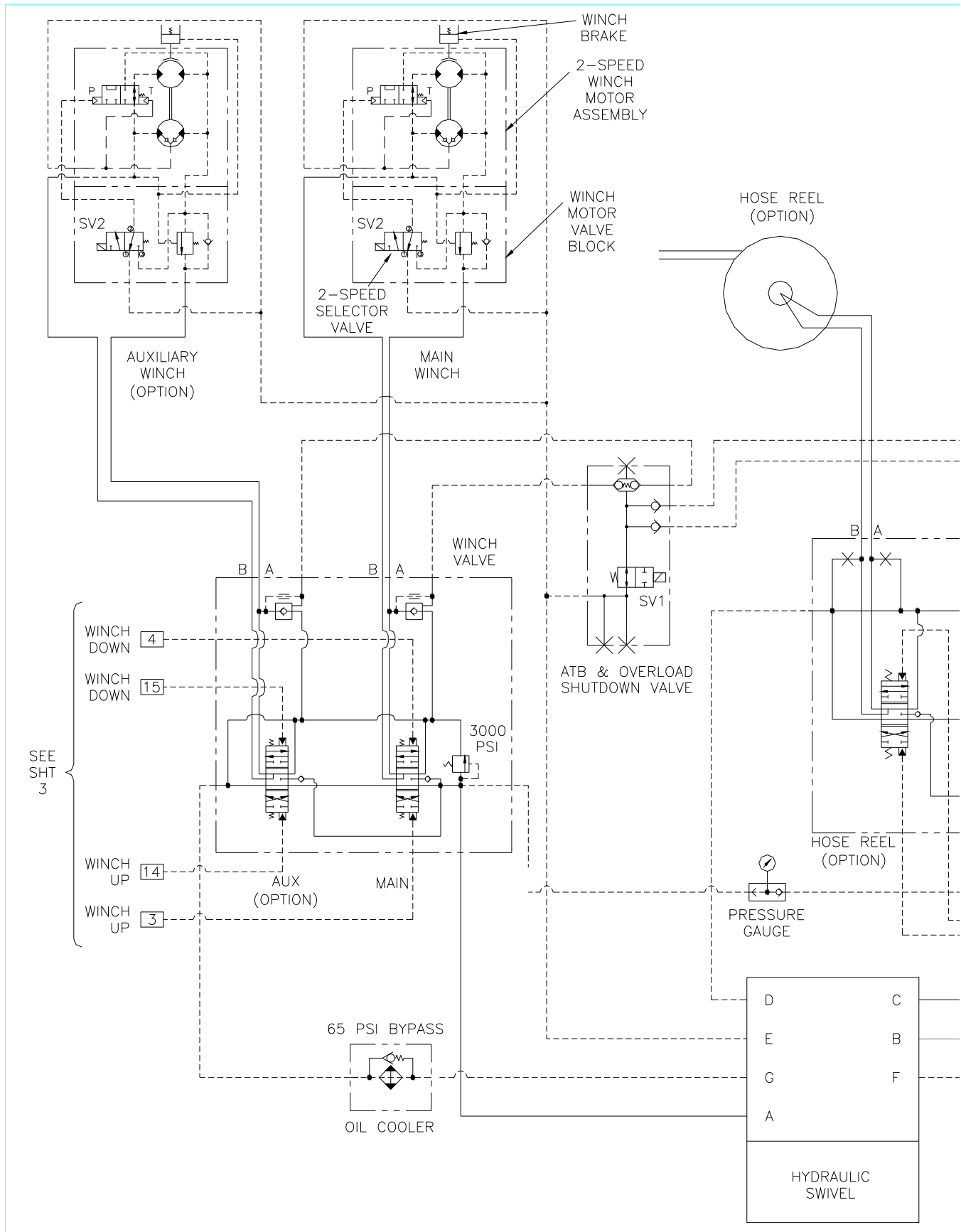
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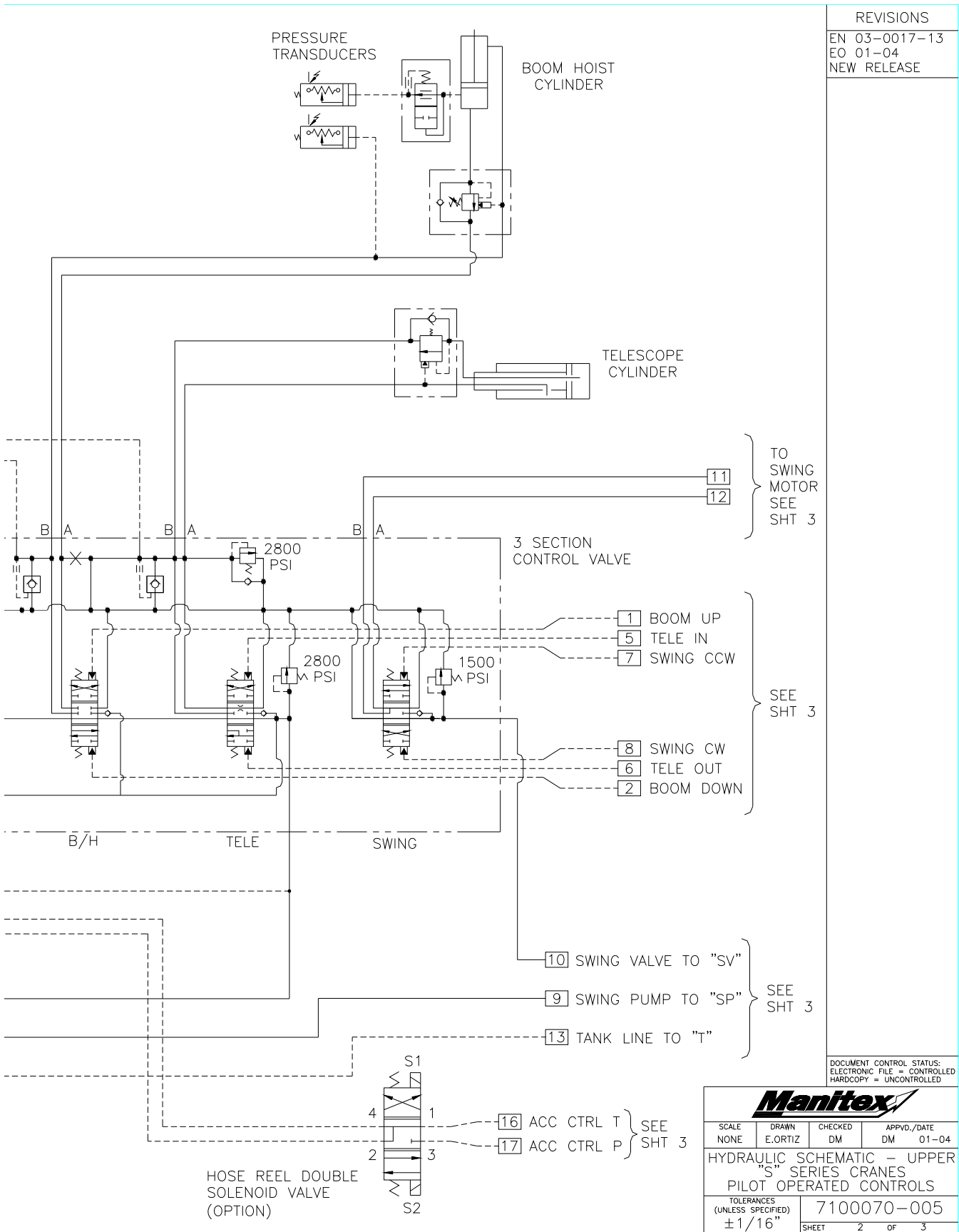
**Mantex**

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HYDRAULIC SCHEMATIC - LOWER "S" SERIES CRANES  
 PILOT OPERATED CONTROLS

|  |              |
|--|--------------|
| TOLERANCES<br>(UNLESS SPECIFIED)<br>±1/16" | 7100070-005  |
|  | SHEET 1 OF 3 |





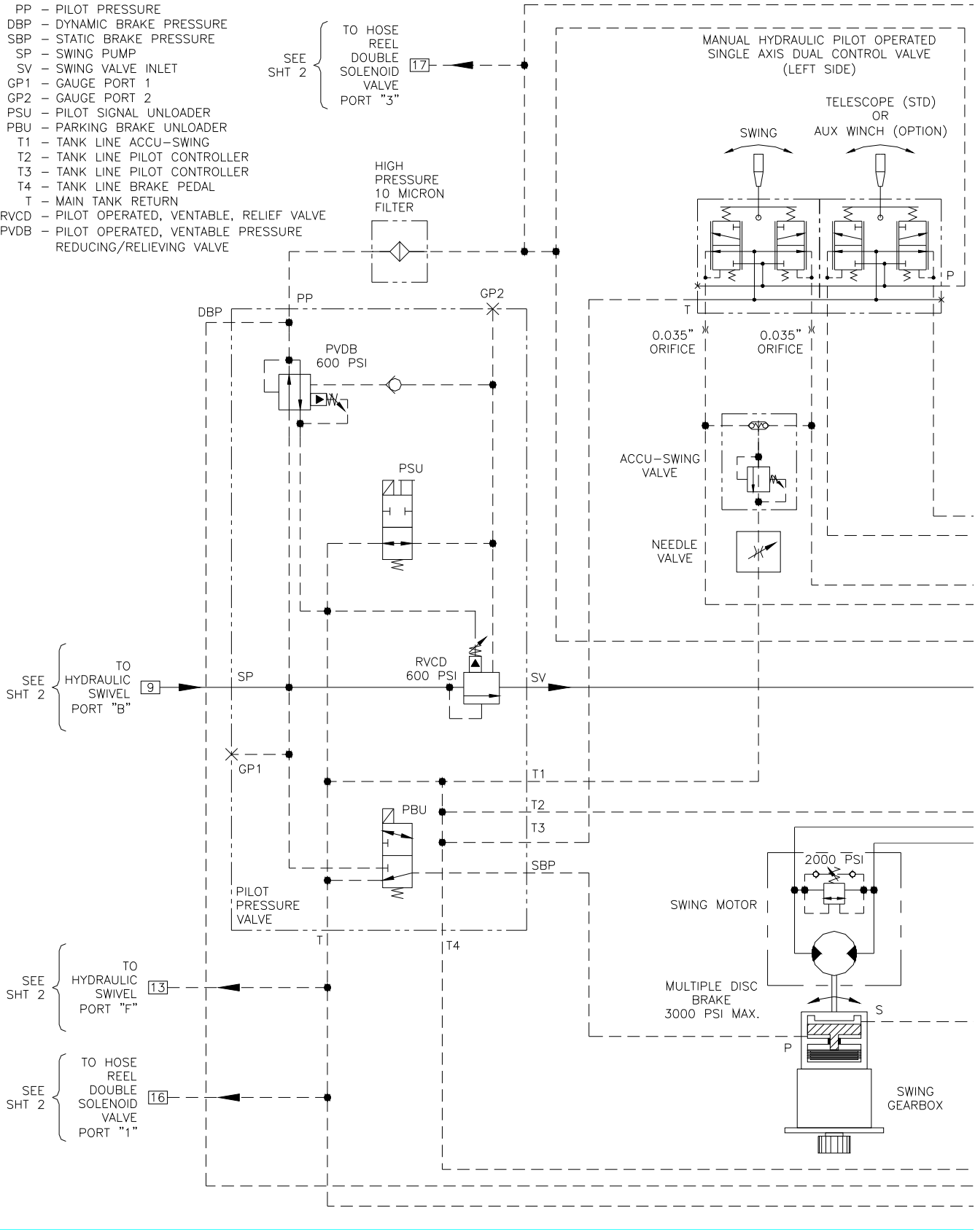
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| HYDRAULIC SCHEMATIC - UPPER<br>"S" SERIES CRANES<br>PILOT OPERATED CONTROLS |                  |               |                         |
| TOLERANCES<br>(UNLESS SPECIFIED)<br>± 1/16"                                 |                  | 7100070-005   |                         |
| SHEET   |                  | 2 OF 3        |                         |

PILOT PRESSURE VALVE NOMENCLATURE

- PP - PILOT PRESSURE
- DBP - DYNAMIC BRAKE PRESSURE
- SBP - STATIC BRAKE PRESSURE
- SP - SWING PUMP
- SV - SWING VALVE INLET
- GP1 - GAUGE PORT 1
- GP2 - GAUGE PORT 2
- PSU - PILOT SIGNAL UNLOADER
- PBU - PARKING BRAKE UNLOADER
- T1 - TANK LINE ACCU-SWING
- T2 - TANK LINE PILOT CONTROLLER
- T3 - TANK LINE PILOT CONTROLLER
- T4 - TANK LINE BRAKE PEDAL
- T - MAIN TANK RETURN
- RVCD - PILOT OPERATED, VENTABLE, RELIEF VALVE
- PVDB - PILOT OPERATED, VENTABLE PRESSURE REDUCING/RELIEVING VALVE

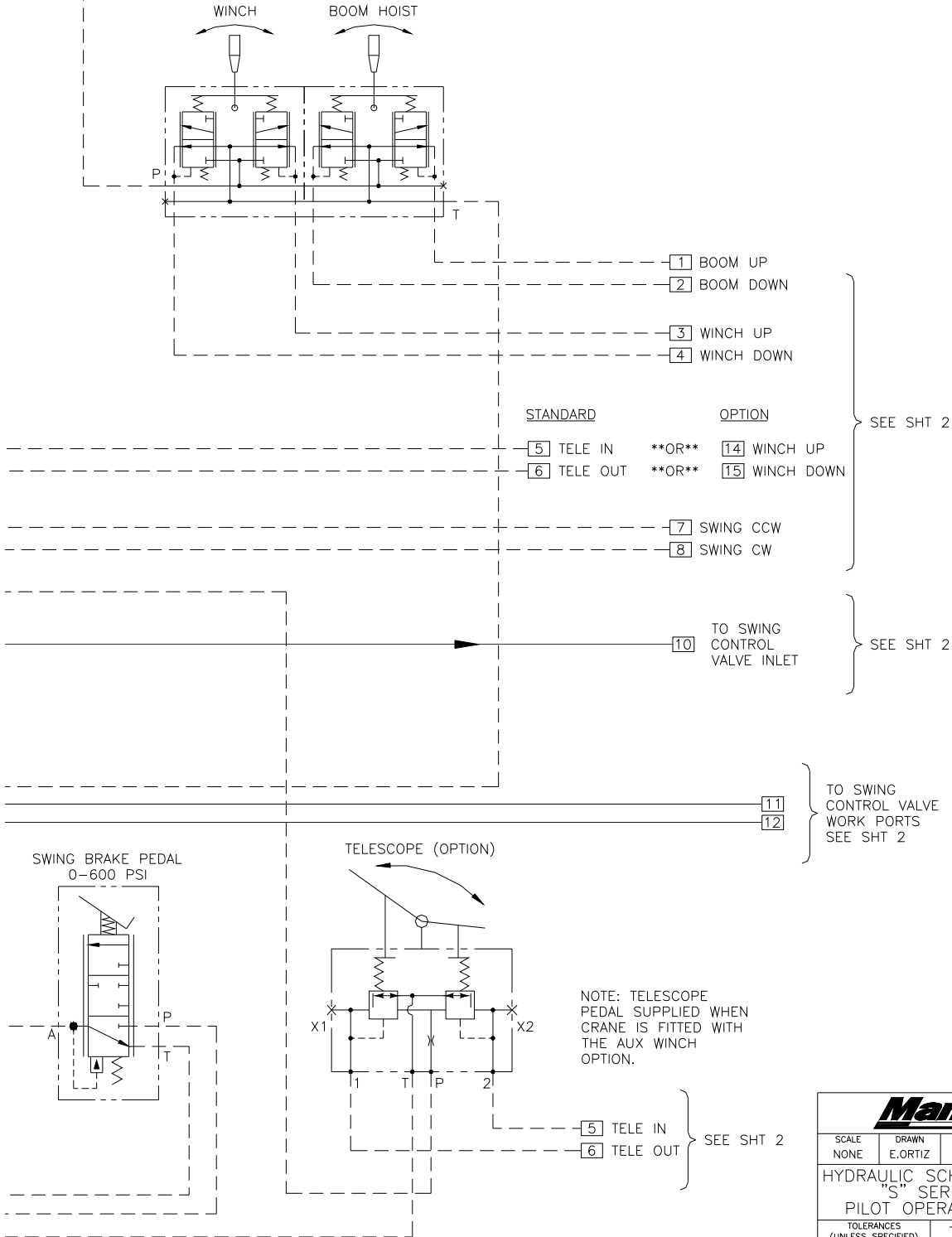




REVISIONS

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EO 01-04  
NEW RELEASE

MANUAL HYDRAULIC PILOT OPERATED  
SINGLE AXIS DUAL CONTROL VALVE  
(RIGHT SIDE)

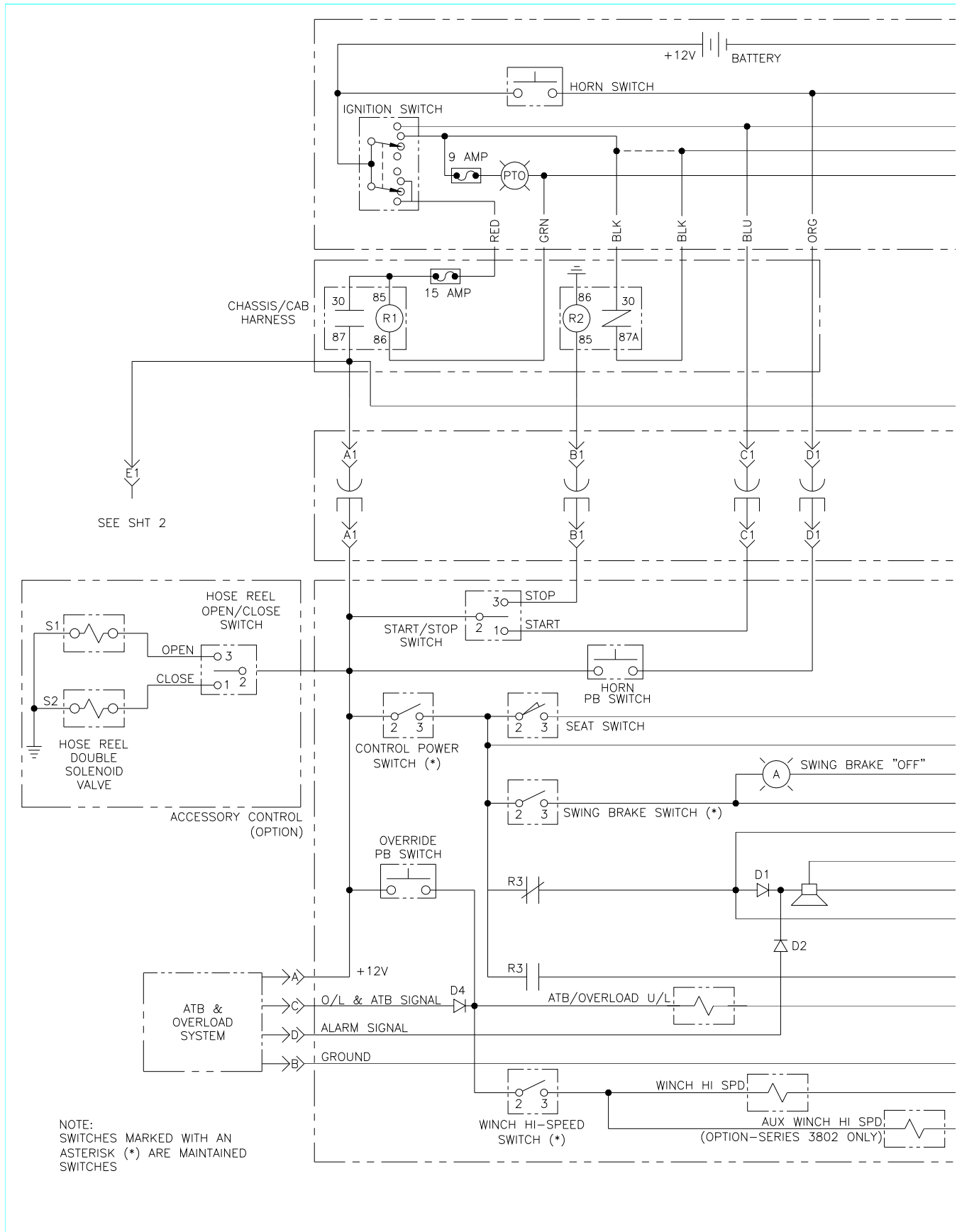


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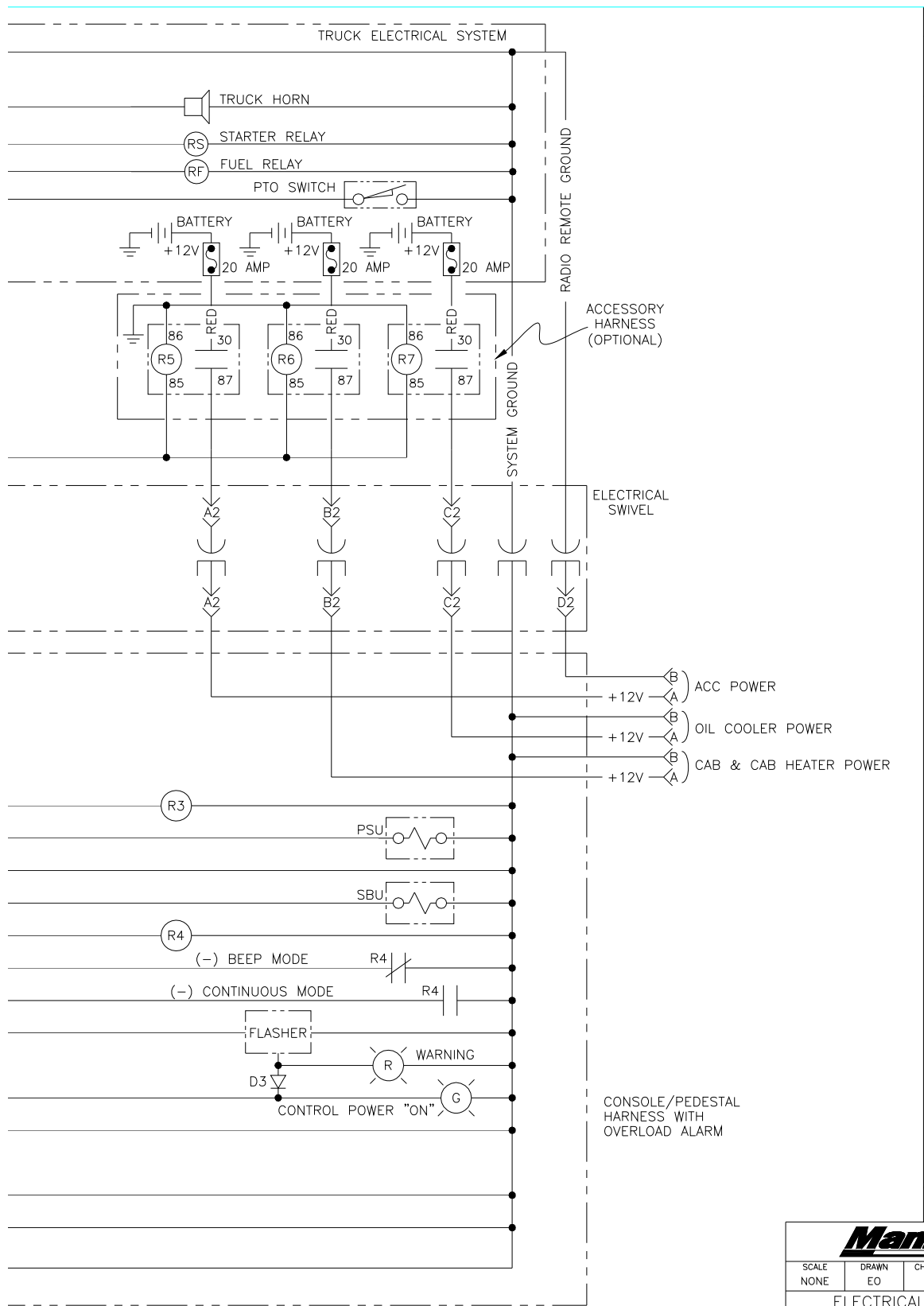


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| TOLERANCES<br>(UNLESS SPECIFIED)<br>±1/16"                                  |                  | 7100070-005   |                         |
| SHEET   |                  | 3 OF 3        |                         |

**Electrical Schematic - 2202, 2802, 3802, 4002 Series**



NOTE:  
SWITCHES MARKED WITH AN  
ASTERISK (\*) ARE MAINTAINED  
SWITCHES

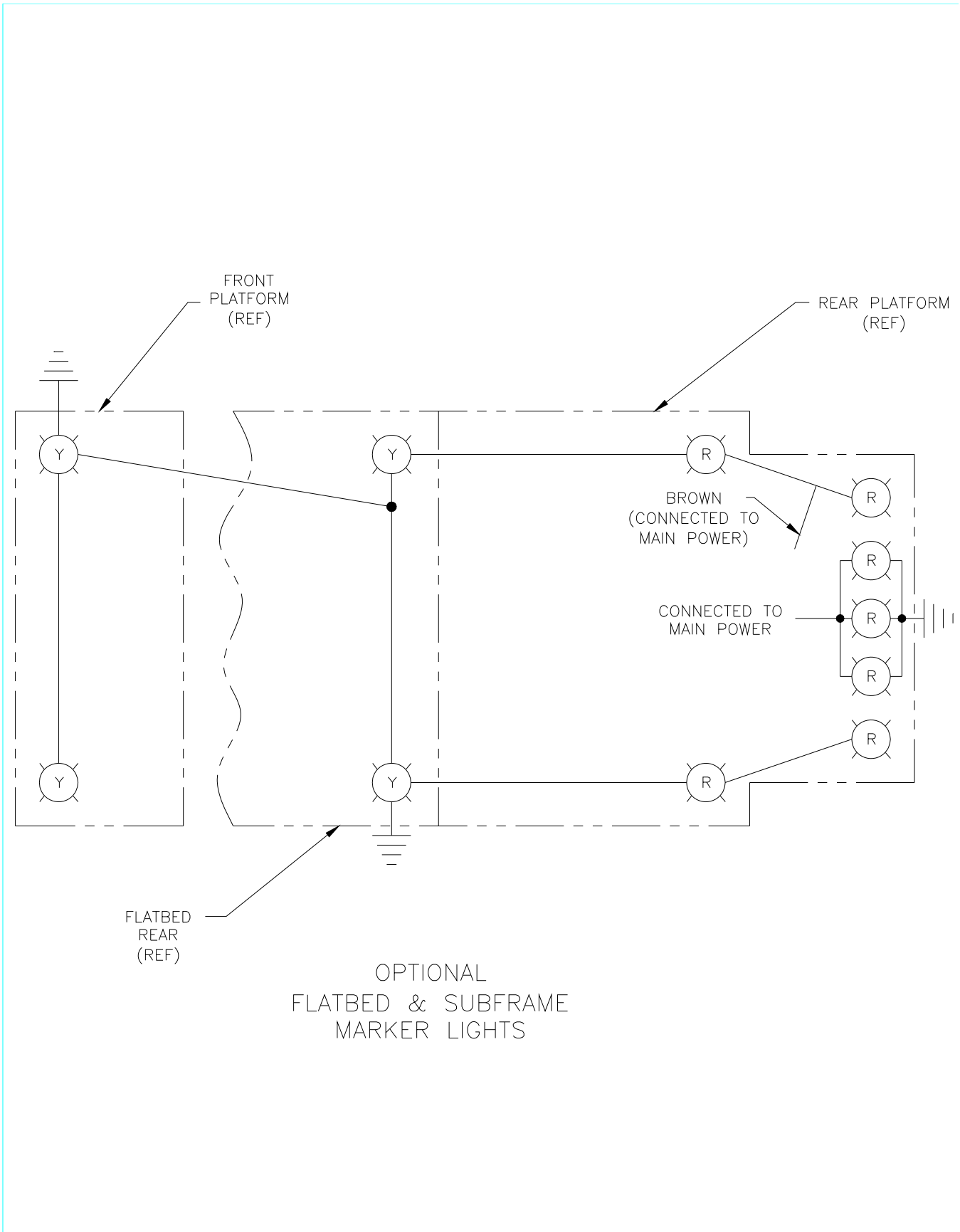


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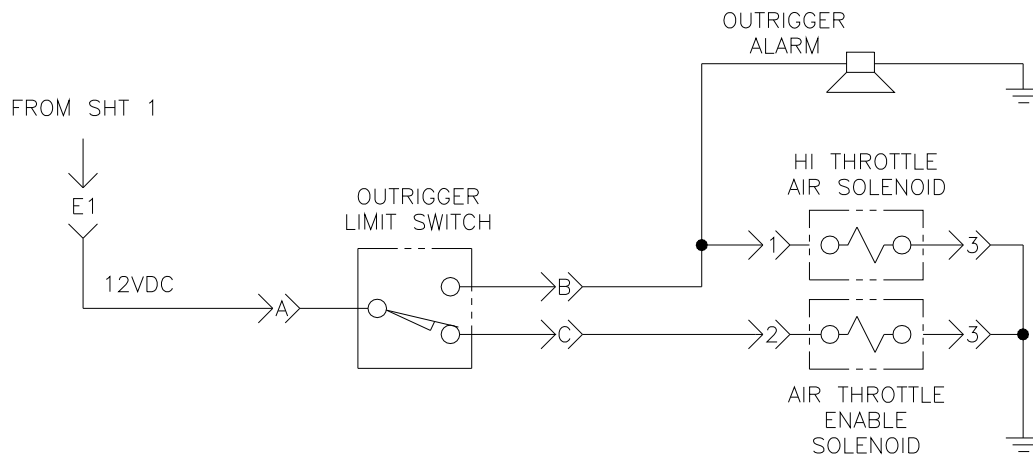
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| ELECTRICAL SCHEMATIC<br>MODEL "S" SERIES DS85 LMI<br>WITH PILOT CONTROLS |             |               |                                |
| TOLERANCES<br>(UNLESS SPECIFIED)<br>± 1/16"                              |             | 7200137-001   |                                |
| SHEET  |             | 1 OF 2        |                                |

NOTE:  
ALL RELAY COILS AND RELAY CONTACTS ARE SHOWN  
DE-ENERGIZED



| REVISIONS     |
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| EN 03-0017-08 |
| EO 11-03      |
| NEW RELEASE   |



DOCUMENT CONTROL STATUS:  
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| ELECTRICAL SCHEMATIC<br>MODEL "S" SERIES DS85 LMI<br>WITH PILOT CONTROLS |             |               |                                |
| TOLERANCES<br>(UNLESS SPECIFIED)<br>± 1/16"                              | 7200137-001 |               |                                |
|  | SHEET       | 2             | OF 2                           |



## Chapter 6

# Maintenance and Repair

**Important** This section does not contain maintenance and repair instructions for the truck. Refer to the truck manufacturer's manual for instructions pertaining to the truck.

### Safety

#### CAUTION

Prevent injury to personnel or damage to crane and property. Take the following precautions when making maintenance checks, adjustments, or repairs to crane.

- Apply truck parking brakes.
- Lower all loads to ground so wire rope is slack.
- Move all controls to OFF.
- Disengage Power Take-Off (PTO) and turn engine OFF.
- Attach CAUTION sign to start controls warning personnel that crane is being serviced and must not be started.
- Do not place hands or tools into any opening in boom sections while power is on or boom sections are moving.
- Do not perform maintenance, adjustment, or repair procedures unless authorized to do so. Make sure all applicable instructions have been read and are thoroughly understood.
- Do not check for hydraulic leaks with hands. Oil under pressure can penetrate human skin causing serious injury. Oil under pressure can be nearly invisible; therefore, check for hydraulic leaks with a piece of cardboard or wood
- Hydraulic oil is flammable; do not check inside hydraulic tank with open flame.
- Do not alter specified flow and pressure settings. Higher than specified flow and pressure can cause damage to crane and hydraulic components. Lower than specified flows and pressures can result in loss of control.
- Do not weld or burn close to hydraulic lines and components without first placing a protective cover over them.
- Do not remove cylinders until working parts are resting on ground or are securely blocked from movement.
- Components are heavy. Do not attempt to lift them by hand; use a chain hoist, jacks, or blocking.
- Do not place crane back into service until all guards and covers have been securely replaced and all service equipment has been removed.
- Personnel getting on or off the crane must do so only while the truck is parked. Do not attempt to get on or off the crane while it is moving.
- This crane has ladders for climbing on and off the crane from either side. Crane owner/user shall provide sturdy ladders for personnel to gain access to components that cannot be reached from the ground, operator platform or top of flatbed. Do not allow personnel to climb onto winch or top of boom; use a sturdy ladder to gain access to these locations.

### Storing Components

Store new components, such as, valves, pumps, motors, cylinders, hoses, tubes and fittings in a clean, dry indoor location.

Do not unpack components or remove port plugs until the components are needed.

Once unpacked, carefully inspect each component for damage that may have occurred during shipping.

Fittings, hoses, and tubes that are not equipped with shipping caps or plugs must be carefully cleaned before they are used. Flush the fittings, hoses, and tubes with clean hydraulic oil. Then seal all openings until use at assembly.

**Important** Do not use rags to plug openings. Use clean plastic shipping plugs and caps.

## Labeling Components at Disassembly

Before disconnecting wires, hoses, or tubes, tag them for proper identification at reassembly.

Before removing a component, such as a pump, motor, or a valve, match-mark its mounting position with relation to the adjacent component.

Before disassembling any multiple section component, such as a pump, motor or a valve, match-mark the position of each section with relation to each other. Do not mix parts from one section with those from another; keep parts segregated.

Before removing shims, tie them together and identify their location.

## Cleanliness

Before removing a component from the crane, thoroughly, clean the area around it to prevent dirt from entering the mating component or the hydraulic system. Cover all openings with plastic to prevent dirt and water from entering.

Carefully clean the area around fittings before disconnecting hoses and tubes. Install plastic plugs or caps on the ends of hoses and tubes and the mating ports of all components to prevent dirt and water from entering.

Disassemble components on a clean work bench that is free from dust, dirt, metal particles and other contaminants.

Use tools that are clean and in proper working order.

Clean metal parts in nonflammable safety solvent. Clean rubber parts in warm water and soap. Lubricate all parts with clean oil at assembly.

## Torque Values

The fasteners that must be torqued to a specific value are identified in Table 6-1 and shown in Figure 6-1. Refer to drawings in the crane's Schematics and Parts Manual for torque values.



**Loose or improperly torqued subframe mounting studs and slewing ring mounting bolts will cause studs or bolts to fail, possibly allowing crane to come off truck.**

**Important** Observe following precautions when installing fasteners; failure to do so will seriously weaken attachment.

- Make sure each fastener is of correct size length and grade. If in doubt, refer to Parts Manual for specifications.
- Do not interchange Grade-5 fasteners with Grade-8 fasteners and vice versa refer to Figure 6-1 for identification.
- Use Grade-8 nuts with Grade-8 bolts.

**Note** Use Grade-2 nuts with Grade-5 bolts. Grade-2 nuts do not have any grade markings.

- Use hardened flat washers under head of screws and under each nut of bolts and studs.
- Make sure threads are clean and free of burrs.
- Use a torque wrench that is properly calibrated. Check calibration of torque wrench on a regular basis.
- Torque fasteners to proper torque values shown on drawings in crane's Schematics and Parts Manual.

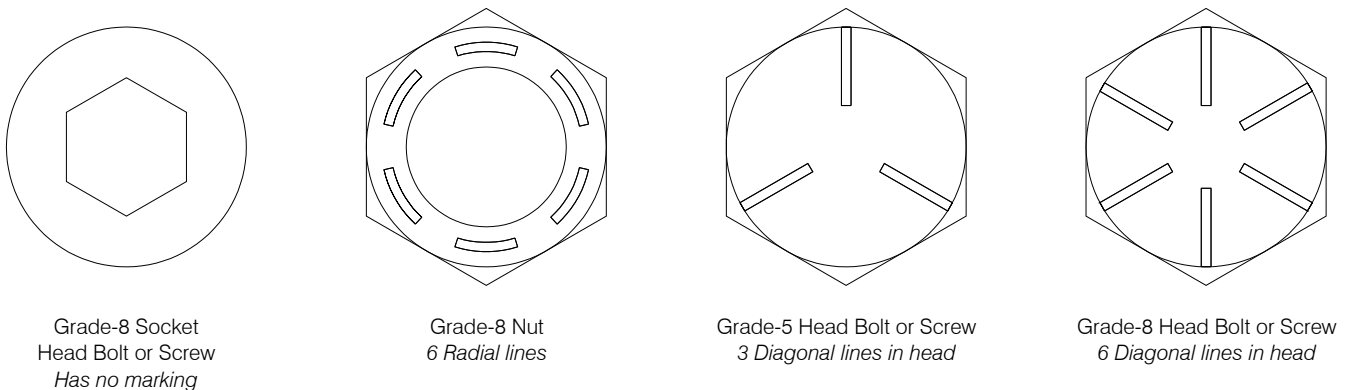
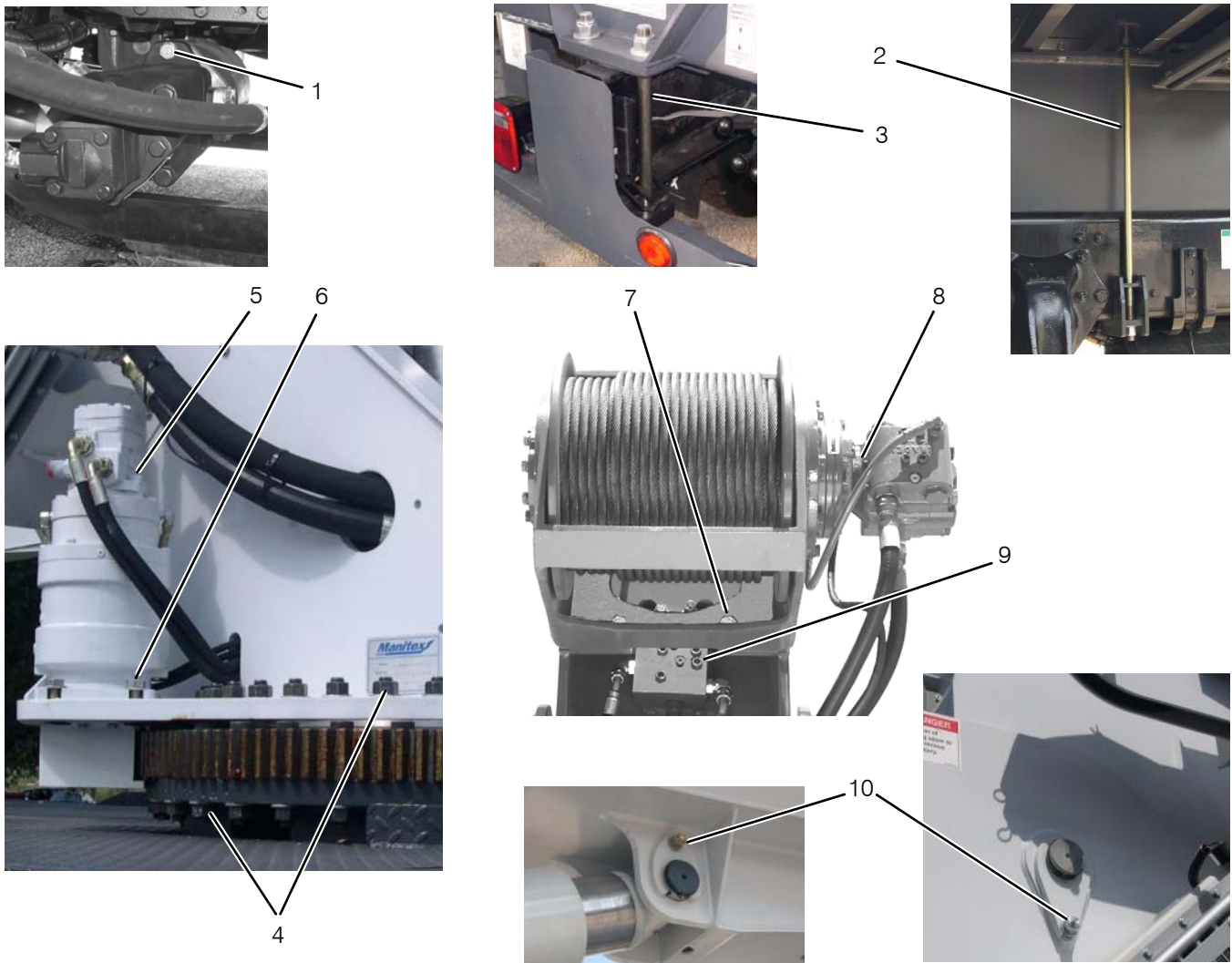


Figure 6-1 Fastener Grade Markings



**Table 6-1 Torque Values**

| Item | Description                        | Fastener    |         | Torque<br>Ft-Lb |
|------|------------------------------------|-------------|---------|-----------------|
|      |                                    | Size        | Grade   |                 |
| 1    | Pump Mounting Screws               | 1/2-13 UNC  | 5       | 55              |
|      |                                    | 5/8-11 UNC  | 5       | 110             |
| 2    | Subframe Bracket Stud - Mid        | 3/4-10 UNC  | Special | 200             |
| 3    | Subframe Bracket Stud - Ends       | 1-8 UNC     | Special | 440             |
|      |                                    | 1 1/4-7 UNC | Special | 840             |
| 4    | Slewing Ring Bolts                 | 5/8-11 UNC  | Special | 200             |
|      |                                    | 3/4-10 UNC  | Special | 350             |
|      |                                    | 7/8-9 UNC   | Special | 550             |
| 5    | Swing Reducer Motor Bolts          | 1/2-13 UNC  | 5       | 55              |
| 6    | Swing Reducer Mounting Bolts       | 3/4-10 UNC  | 5       | 200             |
|      |                                    | 3/4-10 UNC  | 8       | 280             |
| 7    | Winch Mounting Bolts               | 5/8-11 UNC  | 5       | 110             |
|      |                                    | 3/4-10 UNC  | 8       | 280             |
| 8    | Winch Motor Mounting Screws        | 1/2-13 UNC  | 5       | 55              |
| 9    | Telescope Manifold Mounting Screws | 1/2-13 UNC  | 8       | 80              |
| 10   | Pin Retaining Screws               | 5/8-11 UNC  | 5       | 110             |



**Figure 6-2** Fastener Locations

## Maintenance Checks

### General

The following is a list of safety and preventive maintenance checks that should be made to maintain the safety, dependability and productivity built into the crane.

### Inspection Intervals

The intervals given are provided as a guide only. Follow these intervals until adequate experience is gained to establish intervals that meet your operating conditions.

Any increase or decrease in the intervals should be preceded by a complete analysis of crane performance. Carefully study previous maintenance and repair records before making any changes in the intervals.

### Records

Dated and signed records of all defects and repairs must be kept on file so future maintenance needs can be accurately forecast.

### Repairs

Any hazardous or abnormal conditions found while making the maintenance checks must be corrected **before the crane is placed back into service**. All adjustments and repairs must be made by authorized personnel only.

*Note* Maintenance checks that require the engine to be running and the Power Take-Off (PTO) to be engaged are identified with a ✓.

## CAUTION

**Take every precaution to prevent injury from moving parts when power is on.**

### Daily Checks

- Perform the daily lube services.
- Clean all debris and dirt from the crane.
- Check for fluid and air leaks.
- Verify all guards, covers, and platforms are securely in place.
- Inspect the crane for signs of damage.
- Inspect the wire rope for signs of wear and damage.
- Check the wire rope for proper spooling on the winch drum and reeving through all sheaves. Check that all sheaves turn freely.
- Make sure the load line is properly fastened to the load block or the overhaul ball.
- Check the load block or the overhaul ball whichever is being used, for loose or missing nuts, screws, and cotter pins. Observe during operation for indications of inadequate performance.
- Check all slings and other loose gear to be used to make lifts are safe for operation.
- Inspect the hook latch for proper operation.
- Check that the Capacity Chart is present at each control station.
- Perform all daily inspections according to the prime mover and PTO manufacturers' specifications.
- ✓ ■ Test the anti-two-block/overload warning horn.
  - Start the truck engine and engage the PTO.
  - Lift the anti-two-block weight by hand so the chain is slack.
  - The warning horn should sound and the Winch Up, Telescope Out and Boom Down functions should be inoperable.
  - Release the weight so it hangs freely. The warning horn should go off and all crane functions should be operable.
- ✓ ■ Test the overload warning system.
  - Identify a known load and a near overload radius for the load from the capacity chart. Lift and luff the load to the determined radius. The overload warning horn and shutoff device should sound. The Winch Up, Telescope Out and Boom Down functions should be inoperable. Refer to PAT LMI Operator Handbook for further instructions, if equipped with LMI.

*Note* The crane may simulate an overload condition when the boom is raised to 80° and hydraulic pressure is allowed to build on the extend side of the hydraulic cylinder. To lower the boom from this position, do the fol-

lowing.

1. Press the override button and lower the boom. The warning buzzer will stop sounding once the boom has lowered a few degrees.
2. Release the override button and continue to lower the boom to the desired angle.

- ✓ ■ Test the Load Moment Indicator (LMI) (if equipped).
  - Refer to Pre-Operation Inspections section in the PAT LMI System Operator's Handbook for daily check routine to be performed. The PAT LMI Operator's Handbook is part of the package issued with the crane.
- ✓ ■ Check for proper operation of the engine and PTO.
- ✓ ■ Check for proper operation of all accessory devices such as horn, start/stop switch and so forth.
- ✓ ■ Check for proper operation of each crane function in response to control lever movements.

*Note* All crane controls, when set to *Off* or returned to the *Neutral* position, must bring the crane function to a complete stop and maintain its position.

- Remove all rust, corrosion, and dirt from the oil cooler core to ensure proper heat transfer. Steam clean the core, if necessary.

*Note* The oil cooler fan comes on only when the temperature of the hydraulic oil rises to 120°F.

### Weekly Checks

- Perform the daily and weekly lube services.
- Perform the daily inspection checks.
- Check all mechanical control linkage for excessive wear and binding; oil the linkage as required.
- Clean the vent plug on the winch.
- Check for missing bolts, pins, keeper plates, retaining rings, and cotter pins.
- Check the winch drum and all sheaves for excessive wear, cracks or other damage.
- ✓ ■ Check the boom angle indicators and readout on the LMI, if equipped, for accuracy over the full range of boom elevation.
- ✓ ■ Check LMI, if equipped. Refer to separate PAT LMI Operator's Handbook weekly check routine to be performed.

### Monthly Checks

- Perform the daily, weekly and monthly lube services.
- Perform the daily and weekly maintenance checks.
- Check the boom and all structural components of the crane for deformed, cracked or corroded members. Pay close attention to all welds.
- Clean, prime and paint any rusted surfaces.
- Thoroughly inspect the wire rope for damage.
- Check that the hook and hook housing on the load block and the swivel on the overhaul ball rotate freely without excessive play. Faulty operation indicates faulty bearings or inadequate lubrication.
- Check the load block or the overhaul ball for signs of overloading; spread side plates, elongated holes, bent or elongated tie bolts, and cracks.
- Check the gap between the shank and the barrel of the swivel on the overhaul ball. The gap must not exceed 1/16 inch.
- Carefully check the hook on the load block or the overhaul ball for signs of distortion or cracks.

**Important** Hooks are to be discarded if cracks exist or if throat opening is 15 percent more than original throat opening. Hooks should also be discarded if bent or twisted more than 10° from plane of normal configuration.

- Check that the wire rope clip is tight at the dead end wedge socket.
- Inspect all electrical wiring and devices for malfunctioning, signs of deterioration, and dirt or moisture accumulation.
- Inspect all hydraulic hoses and tubes for the following.
  - Evidence of excessive scrubbing or abrasion on the outer surface of hoses, tubing, and fittings.
  - Dented, kinked or cracked tubing.
  - Evidence of leakage at the surface of hoses caused by blistering or abnormal deformation of the outer cover.
  - Leakage at threaded, clamped or welded connections.
- ✓ ■ Check the hydraulic pumps and motors for the following.
  - Loose bolts or fasteners.
  - Leaks at joints between sections.

- Shaft seal leaks.
- Unusual noise and vibration.
- Loss of operating speed or pressure.
- Excessive heating of the oil.
- Check the hydraulic valves for the following.
  - Cracks in the valve housings.
  - Leaks at the spools or between the sections.
  - Sticking spools.
- Check the hydraulic cylinders for the following.
  - Drift caused by internal leakage.
  - Rod seal leakage.
  - Leaks at welded joints.
  - Scored, nicked or dented cylinder rods.
  - Dented case (barrel).
  - Loose or deformed rod eyes or connecting joints.
- Check that all nameplates and safety decals are readable and securely attached at the proper locations on the crane.
- Check all control levers for proper adjustment.
- ✓ ■ Check the foot throttle settings for the proper engine speed.

### **Semiannual Checks**

- Perform the daily, weekly, monthly and semiannual lube services.
- Perform the daily, weekly, and monthly maintenance checks.
- Tighten all fasteners on the crane. Tighten those fasteners that require torquing to the specified value, including slewing ring bolts.
- ✓ ■ Check the adjustment of the crowd rope system in the boom.
- Check the boom slider pads for wear and proper adjustment.
- ✓ ■ Check relief valve settings for all crane functions, refer to Hydraulic Schematic.

### **Annual Checks**

- Perform all lube services.
- Perform the daily, weekly, monthly and semiannual maintenance checks.
- Check each hook for cracks using a nondestructive test.
- ✓ ■ Check the Foot Air Throttle controller for correct settings, operating performance and leakage. Replace rubber and all worn parts as needed.

## Wire Rope Maintenance

### Lubrication

New wire rope is lubricated during manufacturing, however, this lubrication is adequate only for initial storage and the early stages of operation. The wire rope must be lubricated at regular intervals to prevent the damaging effects of corrosion and to reduce wear.

The lubrication interval and the type of lubricant to be used depend on the type of wire rope, the severity of duty and the type of corrosive elements the wire rope is subjected to, therefore, contact the nearest wire rope dealer for lubrication recommendations.

The wire rope must be properly protected at all times. The gaps between the strands and wires must be filled with lubricant to provide a complete seal. Use one of the methods shown in Figure 6-3 to lubricate the wire rope. For maximum penetration, the lubricant should be applied where the wire rope opens up as it travels around a sheave or winds onto the drum.

The wire rope must be clean and dry before applying the lubricant. An air jet, steam, and a wire brush are some suggested cleaning methods.

### Inspection

It is impossible to predict when a wire rope will break, however, regular careful inspection will indicate when the potential for breakage exists.

The wire rope needs to be visually inspected each work shift for obvious signs of gross damage by a qualified person.

Each month, the entire length of wire rope must be thoroughly and carefully inspected by a qualified person. This interval also applies to any rope being placed into service that has been idle for one month or longer.

A dated and signed report of the wire rope's condition at each inspection interval must be kept on file at all times. The data from these reports can then be used to determine when the wire rope needs to be replaced.

When inspecting the wire rope, pay particular attention to the condition of the wire rope in the following areas.

- Pick-Up Points—sections of wire rope that are repeatedly stressed during each lift, such as those sections in contact with sheaves.
- End Attachments—the point where a fitting is attached to the wire rope or the point where the wire rope is attached to the drum.
- Abuse Points—points where the wire rope is subjected to abnormal scuffing and scraping.

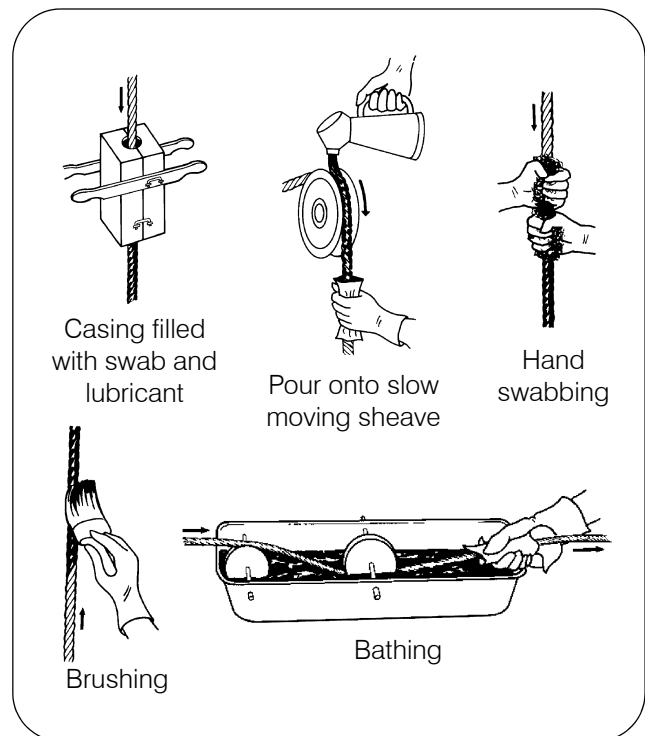


Figure 6-3 Lubricating Wire Rope

## Replacement

No precise rules can be given for determining when to replace a wire rope. Wire rope replacement depends upon the good judgment of the qualified person making the inspection and the comparison of the data recorded on previous inspection reports. Any deterioration resulting in an appreciable loss of wire rope strength is sufficient cause for removing the wire rope from service.

Guidelines for replacement are listed in the following paragraphs.

- Six randomly distributed broken outer wires in one rope lay length or three broken outside wires in one strand of one rope lay length. Refer to Figure 6-4.
- One broken outside wire at the point the wire contacts the core. The broken wire will have worked its way out of the rope structure and either protrude or loop out from the rope structure. Additional inspection of this area of the wire rope is required to determine if there is core damage.
- Wear of one-third the original diameter of outside wires.
- Kinking, crushing, bird-caging, core protrusion or any other damage resulting in distortion of the rope structure.
- Evidence of heat damage from any cause.
- Reductions from the nominal diameter of more than the following limits.
  - 1/64 Inch for rope diameters through 5/16 inch.
  - 1/32 Inch for rope diameters 3/8 inch through 1/2 inch.
  - 3/64 Inch for rope diameters 9/16 inch through 3/4 inch.
  - 1/16 Inch for rope diameters 7/8 inch through 1-1/8 inch.
  - 3/32 Inch for rope diameters 1-1/4 inch through 1-1/2 inch.

*Note* Measure the wire rope diameter only across the crowns of the strands so the true diameter is measured as shown in Figure 6-5.

- Core failure. This type of damage is usually indicated by a reduction in the nominal diameter or by an increase in rope lay length. When a reduction in diameter or an increase in rope lay length is noted, open up the wire rope as shown in Figure 6-6 and carefully inspect the core. The wire rope should be replaced if any wires in the core are broken.
- Severe corrosion.

## Sheave and Drum Inspection

Proper operation of the sheaves and the winch drum has a direct affect on wire rope wear; therefore, the sheaves and winch drum must be inspected monthly for the following defects.

- Check the depth, width, and contour of each sheave using a groove gauge as shown in Figure 6-7. Replace sheaves that have over or undersized grooves.
- Replace the winch drum or any sheave that has broken or cracked flanges.
- Check that the winch drum and all sheaves turn true on the shafts. If the drum or any sheave has a wobble to it, replace the bearings.

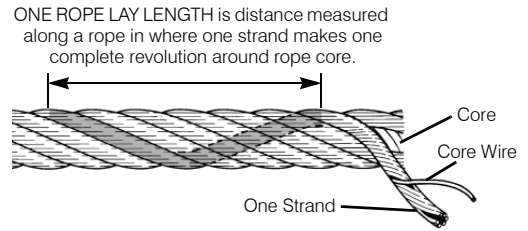


Figure 6-4 Rope Lay Length

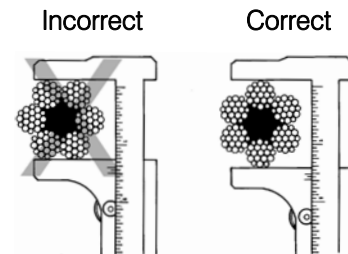


Figure 6-5 Measuring Wire Rope Diameter

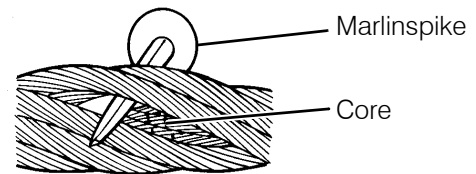


Figure 6-6 Wire Rope Core Inspection

Observe groove to see if contour of gauge matches contour at bottom of sheave groove. Replace sheave if groove is too small or too large.

Proper fitting sheave groove should support wire rope of 135-150 degrees of rope circumference.

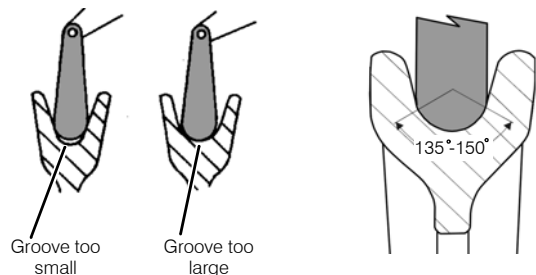


Figure 6-7 Sheave Inspection Measurement

## Replacing Hydraulic Filter Element

Refer to Figure 6-8.

Replace the filter element when the pressure gauge on the head reads 25 psi with the engine at high idle and the oil warm from operation. The filter has a 25 psi bypass that opens when the element is plugged with dirt.

**Important** Do not operate crane when filter is bypassing oil (gauge reads 25 psi); otherwise, unfiltered oil will be drawn into system and faulty operation or damage to parts will occur.

- Stop engine.
- Remove and discard the old element.
- Wipe clean the base of the filter head.
- Apply clean oil to the gasket on the new element.
- Thread the new element onto the head until the gasket contacts the head. Hand tighten the element an additional 3/8-1/2 turn. Do not use a wrench to tighten element.
- Check the element for leaks during operation. If necessary, tighten the element until the leak stops.

## Replacing Hydraulic Tank Breather

**Note** If equipped with a spin-on breather, replace it at least once every three months. Do not attempt to clean and reuse the breather.

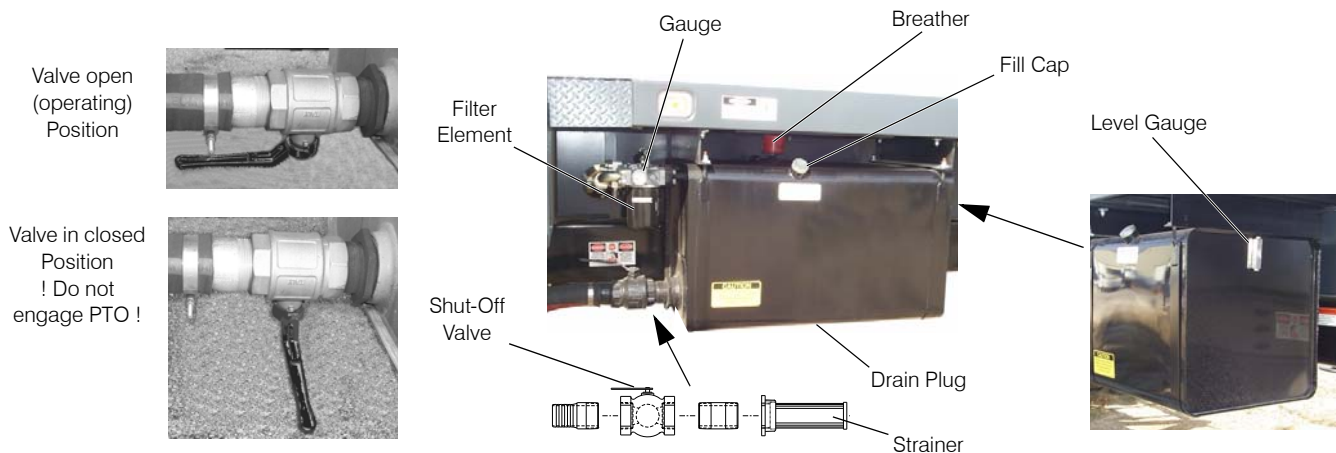


Figure 6-8 Hydraulic Tank

- Remove and discard the old breather.
- It is not necessary to apply thread sealant to the threads of the breather. Install the new breather hand tight; do not tighten with a wrench.

## Changing Oil

Drain and refill the hydraulic system every six months unless an alternate interval has been established by an oil analysis program.

- Operate the crane until the oil is at its normal operating temperature. This step will help prevent impurities from settling in the system.
- Move all controls to OFF and stop engine.
- Remove the drain plug from the bottom of the tank to drain the oil, see Figure 6-8.

**Note** Crack open one of the hydraulic fittings in a line at the high point of the system. This step will vent the system so that all of the oil drains out. Tightly close fitting once oil has drained.

- Thoroughly clean all dirt from the access cover on the tank and remove the access cover.
- Clean out any sediment from inside the tank.
- Remove and clean the suction strainer. Soak in solvent and blow out with compressed air. Securely install the strainer.
- Replace the cover on the hydraulic tank. Replace gasket if necessary.
- Replace the filter element

- Replace the spin-on breather.
- Clean any metal particles from the drain plug. Install and securely tighten the drain plug.

*Note* If a new pump or motor has been installed, fill all ports with clean oil before connecting any lines. This step will provide initial lubrication of the unit.

- Fill the hydraulic tank to the proper level with approved hydraulic oil, see Lubrication Section.

**Important** Filter new oil through a 25-micron element when filling tank.

- Connect and securely tighten any hydraulic lines that are disconnected.
- Open suction line shut-off valve before starting engine or engaging PTO; otherwise, the pump will cavitate and be ruined. See Figure 6-8.
- Start the engine, engage the PTO, and operate the pump for at least two minutes with no load at lowest possible rpm. During this priming period, the pump should run smoothly and not develop excessive heat.
- Gradually increase speed and operate all functions (cylinders and motors) to purge all air from the system. Operation will be sluggish or erratic until all air is purged.
- Once the functions are operating smoothly, speed and loading can be increased to normal.
- Stop the engine.
- Fill the hydraulic tank to the proper level.

**Important** If hydraulic system is extremely dirty (gum or lacquer formation on parts indicated by jerky, sluggish, or erratic operation) repeat Changing Oil procedure after next 48 hours of operation.

## Adjusting Levels

Check the adjustment of the bubble levels on the control console and at rear of truck every month using the following procedure.

- Extend all outriggers and level the crane using the level gauge at rear of truck.
- Raise the boom to the maximum angle of 80° and fully retract the boom.

### CAUTION

**Do not swing boom over either side of truck until this step has been performed; otherwise, crane may tip over.**

- Place an accurate carpenter's level on either side of the turret, see Figure 6-9. Do not lay the level across the top of the bolts.
- Adjust the outriggers so the crane is level from front to rear according to the carpenter's level.
- Swing the boom 90° over either side of the truck and adjust the outriggers so the crane is level from side to side according to the carpenter's level.
- Repeat Adjusting Levels procedure until the crane is level with all tires off the ground.
- Check the bubble level at the outrigger control station and at the operator console. If necessary, adjust the levels as follows.

*Note* Verify the spring washer is installed correctly. The cone shaped washer should be installed with the large diameter bearing against the bubble level. If not installed correctly, the spring will not spring back into shape when the fasteners are loosened.

- Loosen adjusting screws, see Figure 6-10, until spring under level is no longer compressed.
- Preload spring by tightening adjusting screws evenly. Do not overtighten as this will cause loss of adjustment range.
- Turn adjusting screws until the bubble is centered in the circle.



Figure 6-9 Carpenter Level

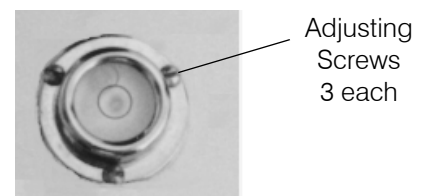


Figure 6-10 Bubble Level



## Boom Service

### Recommended Boom/Slider Pad Break In

Frequent lubrication of the top rear boom slider pads and bottom plate of the powered boom sections is required during machine break in to prevent boom chatter and slider pad damage. As the slider pads seat against the boom shims and sliding surfaces, it is important to check all related slider pad fasteners for proper torque on regular intervals.

*Note* Loctite-242 or equal thread lock is used on all of the top rear and most of the bottom forward slider pad fasteners. If loose hardware is found, reapplication of thread lock is required. Follow manufacture's recommendations to ensure best results.

Frequency of lubrication and duration of break in period will vary depending on use. In normal use, the boom slider pads should be lubed daily for the first two weeks and at least once a week after that. More frequent lubrication will be required on job sites requiring frequent extension and retraction of the boom. Chattering or jerking of the boom indicates more frequent lubrication is required. Lubrication intervals will become less frequent as the unit breaks in. The duration of the break in period is approximately 2-3 months.

### Inspection and Lubrication

#### *Bottom forward and side pads:*

With the crane properly set up on outriggers and leveled, fully extend the boom over rear of the unit and lower the boom point to the ground while insuring the hook is kept close to the ground while lowering. Apply extreme pressure (EP) chassis lube lubrication to the sliding surfaces of the powered sections. Manitex recommends using a 2"-3" nap roller to apply a thin film of lubrication. Refer to figure 6-12.

Inspection and lubrication of internal lube points in the boom can be performed at this time as well. Consult the operator's manual for table of lubrication points.

Use the boom hoist function to raise the boom to 65-75° and fully retract the boom. Retracting the boom from low boom angles will scrub the lubrication from the powered sections.

#### *Top Rear Pads:*



**Do not place hands or tools into openings in boom sections until engine or prime mover is shut OFF. Keep arms, hands, and fingers away from moving boom components. Ensure the prime mover is shutdown when servicing the boom. Serious injury will result if boom is telescoped while hands are in openings.**

With the boom in the boom rest, remove the inspection cover from the top of the boom base. There are up to four sets of top rear slider pads. Inspect each slider pad for loose hardware and shims. Apply a 1/2" thick coating of extreme pressure grease to the pads of each section with a spatula or similar tool. The boom will have to be extended slowly to bring each set of slider pads into view in the access area for inspection and lubrication. Refer to figure 6-11.

Raise the boom to 65-75° and fully extend the boom to carry lubrication up inside the powered sections.

### Slider Pad Adjustment/Replacement

Refer to the Boom Assembly drawings in the crane's Parts Manual for identification of slider pads and shims used with the crane being serviced.

Shims are matched to slider pads and are not interchangeable. It is possible to have more shims on one side of the boom than on the other side, as long as the boom is straight. Shims come in three thicknesses.

0.0478-inch (3/64-inch) (18 ga)

0.0747-inch (5/64-inch) (14 ga)

0.1345-inch (9/64-inch) (10 ga)

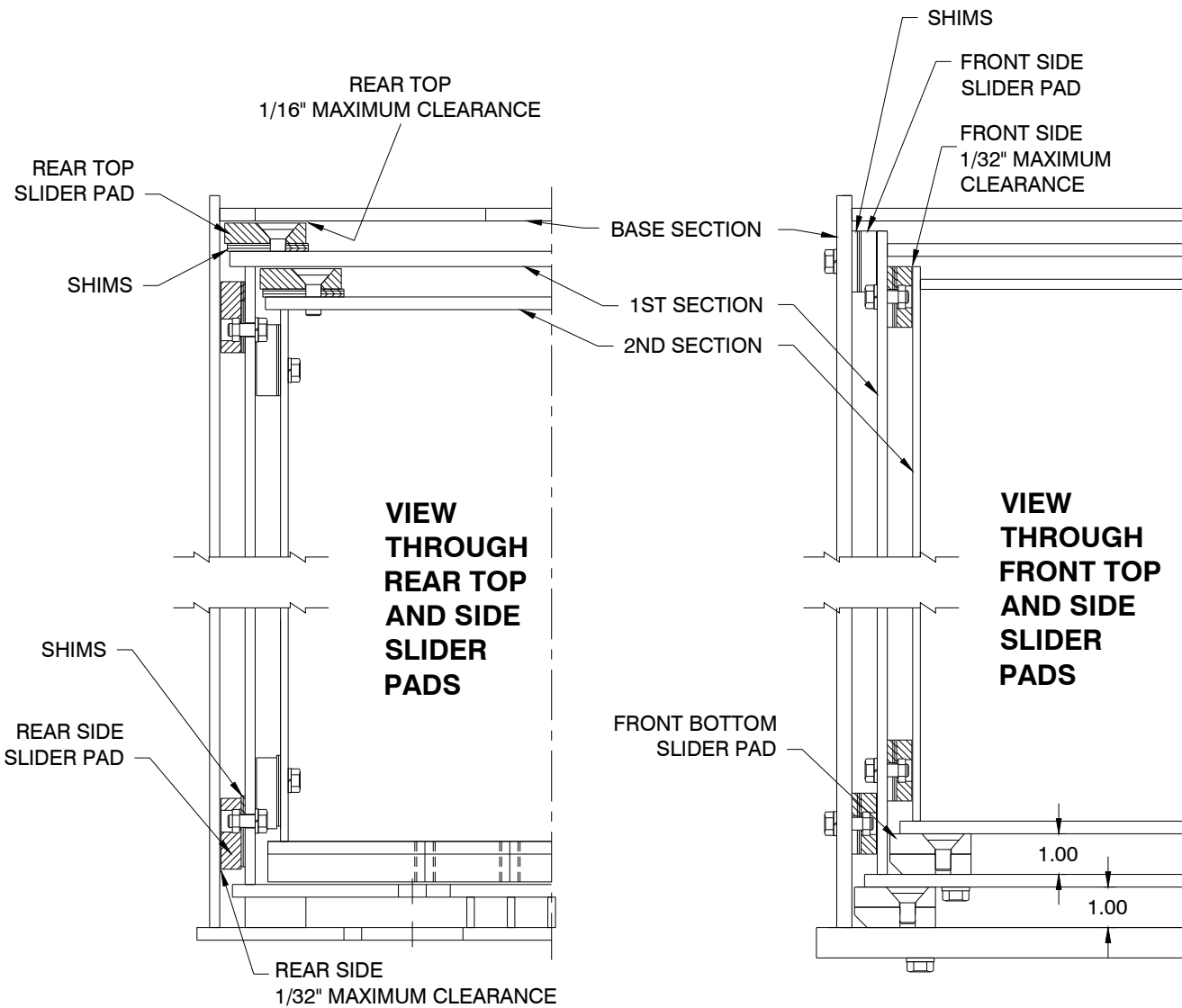
Some procedures or steps may be different, depending on the number of boom sections. When there is a difference, the steps will be noted.

Disregard the references to section numbers, such as fourth and fifth, if they don't apply to the boom being serviced.

**Table 6-2 Slider Pads: 77 Ft 3-Section Boom**

| Size and Description |                             | Where Used                          | New Thickness | Replace Thickness |
|----------------------|-----------------------------|-------------------------------------|---------------|-------------------|
| 5" Pad               | 2-Hole with Threaded Insert | Front Side: All                     | 3/8 Inch      | 1/4 Inch          |
| 7" Pad               | 2-Hole with Threaded Insert | Rear Side: All                      | 1/2 Inch      | 3/8 Inch          |
| 7" Pad               | 3-Hole                      | Extend Sheave Bracket-Tele Cyl      | 1/2 Inch      | 3/8 Inch          |
| 9" Pad               | 3-Hole, Self-Lube           | Rear Top: 2nd<br>Front Bottom: 1st  | 1/2 Inch      | 3/8 Inch          |
| 11" Pad              | 3-Hole, Self-Lube           | Rear Top: 1st<br>Front Bottom: Base | 1/2 Inch      | 3/8 Inch          |

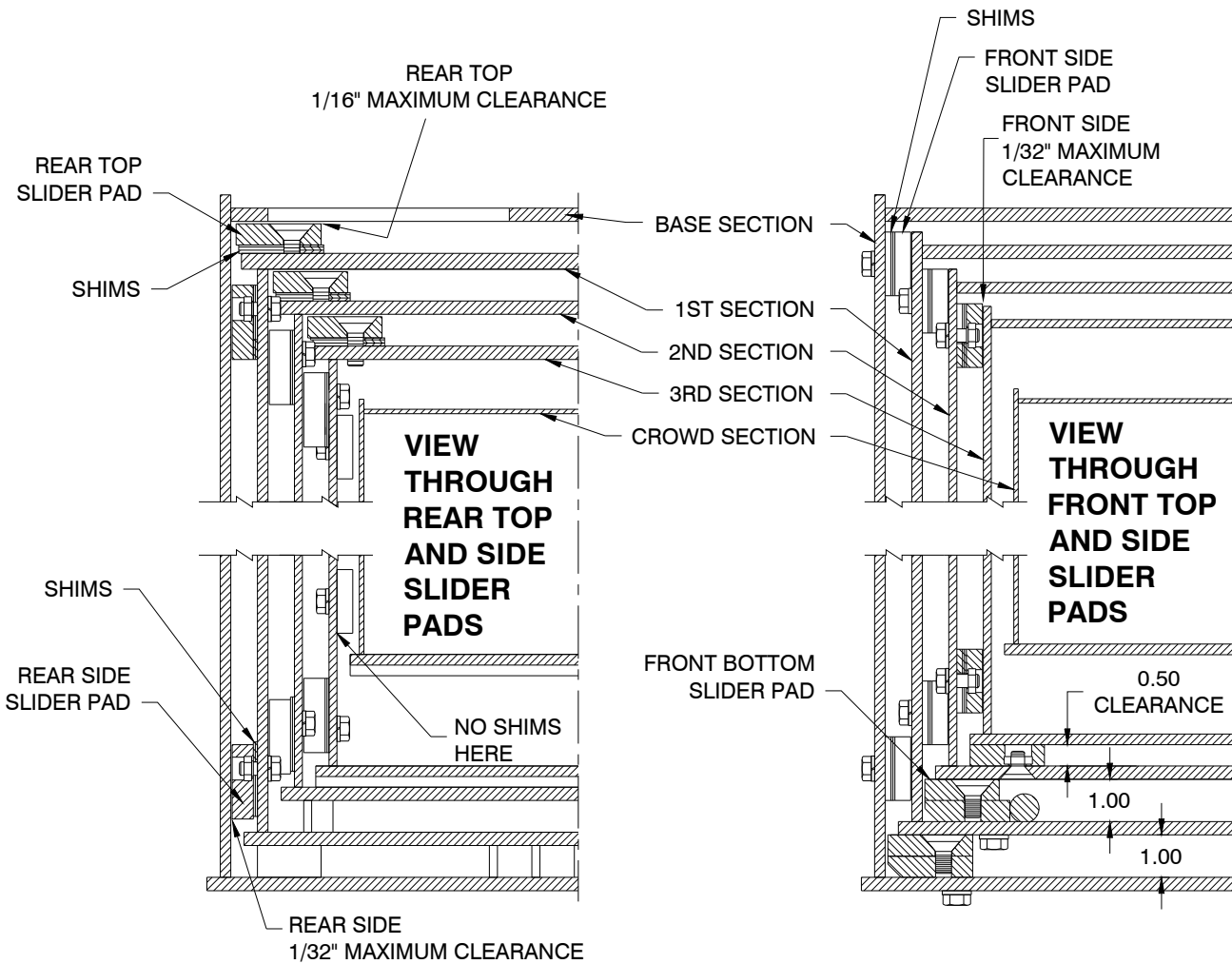
Visual verification of pad size used is required; different models may require different pads. Table is for reference only. Refer to Boom Assembly drawings in Parts Manual before ordering parts for boom being serviced.



**Table 6-3 Slider Pads: 101 Ft 4-Section Boom**

| Size and Description |                                     | Where Used                                 | New Thickness | Replace Thickness |
|----------------------|-------------------------------------|--|---------------|-------------------|
| 4 1/2" Pad           | 2-Hole                              | Front Bottom: Crowd                        | 3/8 Inch      | 1/4 Inch          |
| 5" Pad               | 2-Hole                              | Front Side: Crowd                          | 3/8 Inch      | 1/4 Inch          |
| 5" Pad               | 2-Hole with Threaded Insert         | Front Side: All<br>Rear Side: 3rd (inside) | 3/8 Inch      | 1/4 Inch          |
| 7" Pad               | 2-Hole with Threaded Insert         | Rear Side: 1st, 2nd, 3rd                   | 1/2 Inch      | 3/8 Inch          |
| 7" Pad               | 2-Hole, Self-Lube w/Threaded Insert | Front Bottom: 2nd                          | 1/2 Inch      | 3/8 Inch          |
| 7" Pad               | 3-Hole                              | Extend Sheave Bracket-Tele Cyl             | 1/2 Inch      | 3/8 Inch          |
| 7" Pad               | 3-Hole, Self-Lube                   | Rear Top: 2nd, 3rd                         | 1/2 Inch      | 3/8 Inch          |
| 9" Pad               | 3-Hole, Self-Lube                   | Rear Top: 1st<br>Front Bottom: Base, 1st   | 1/2 Inch      | 3/8 Inch          |

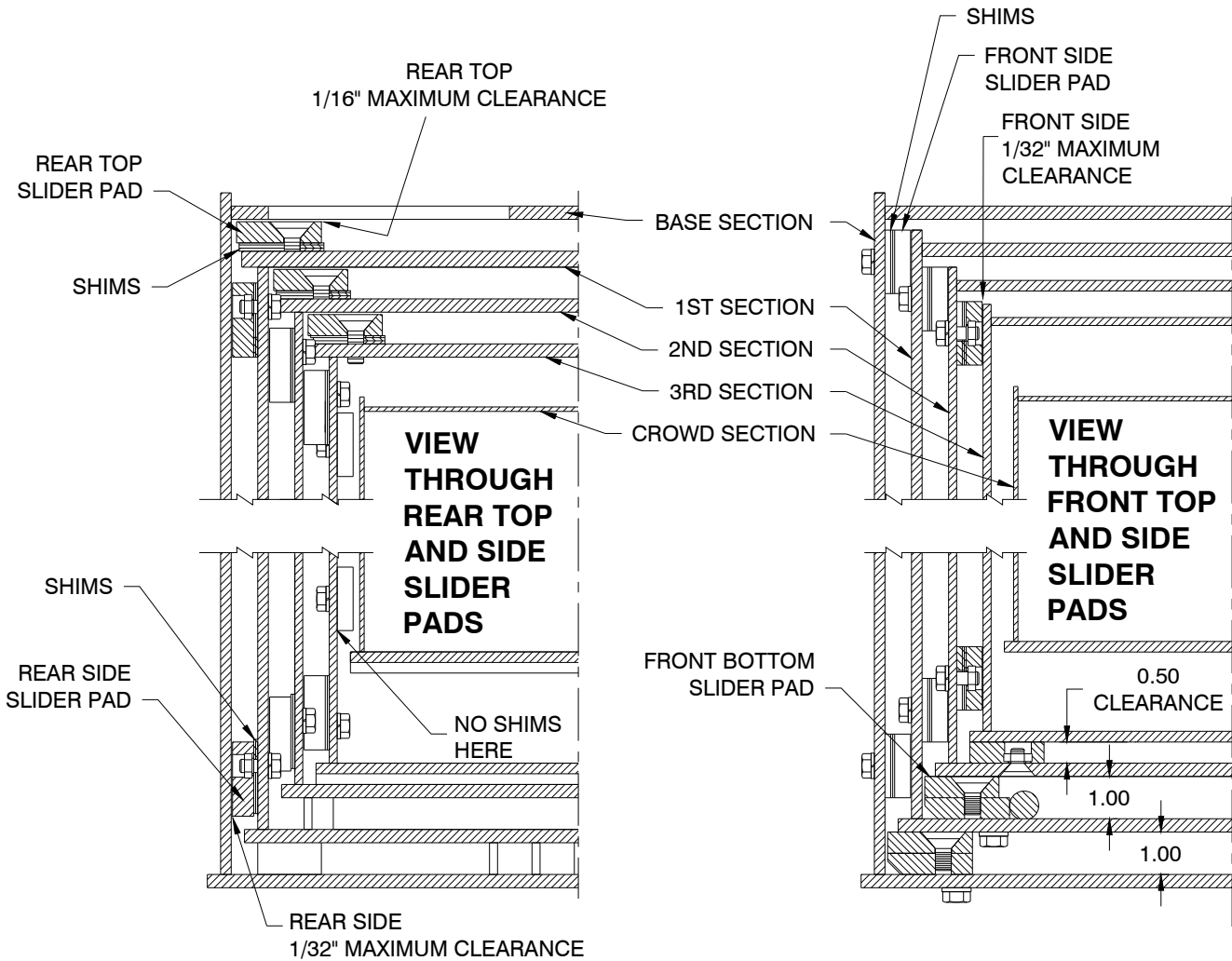
Visual verification of pad size used is required; different models may require different pads. Table is for reference only. Refer to Boom Assembly drawings in Parts Manual before ordering parts for boom being serviced.



**Table 6-4 Slider Pads: 92 Ft & 102 Ft 4-Section Booms**

| Size and Description |                                     | Where Used   | New Thickness | Replace Thickness |
|----------------------|-------------------------------------|--|---------------|-------------------|
| 4 1/2" Pad           | 2-Hole                              | Front Bottom: Crowd                                | 3/8 Inch      | 1/4 Inch          |
| 5" Pad               | 2-Hole                              | Front Side: Crowd                                  | 3/8 Inch      | 1/4 Inch          |
| 5" Pad               | 2-Hole with Threaded Insert         | Front Side: All<br>Rear Side: 3rd (inside)         | 3/8 Inch      | 1/4 Inch          |
| 7" Pad               | 2-Hole with Threaded Insert         | Rear Side: 1st, 2nd, 3rd                           | 1/2 Inch      | 3/8 Inch          |
| 7" Pad               | 3-Hole                              | Extend Sheave Bracket-Tele Cyl                     | 1/2 Inch      | 3/8 Inch          |
| 9" Pad               | 3-Hole, Self-Lube                   | Rear Top: 1st, 2nd, 3rd<br>Front Bottom: Base, 1st | 1/2 Inch      | 3/8 Inch          |
| 9" Pad               | 2-Hole, Self-Lube w/Threaded Insert | Front Bottom: 2nd                                  | 1/2 Inch      | 3/8 Inch          |

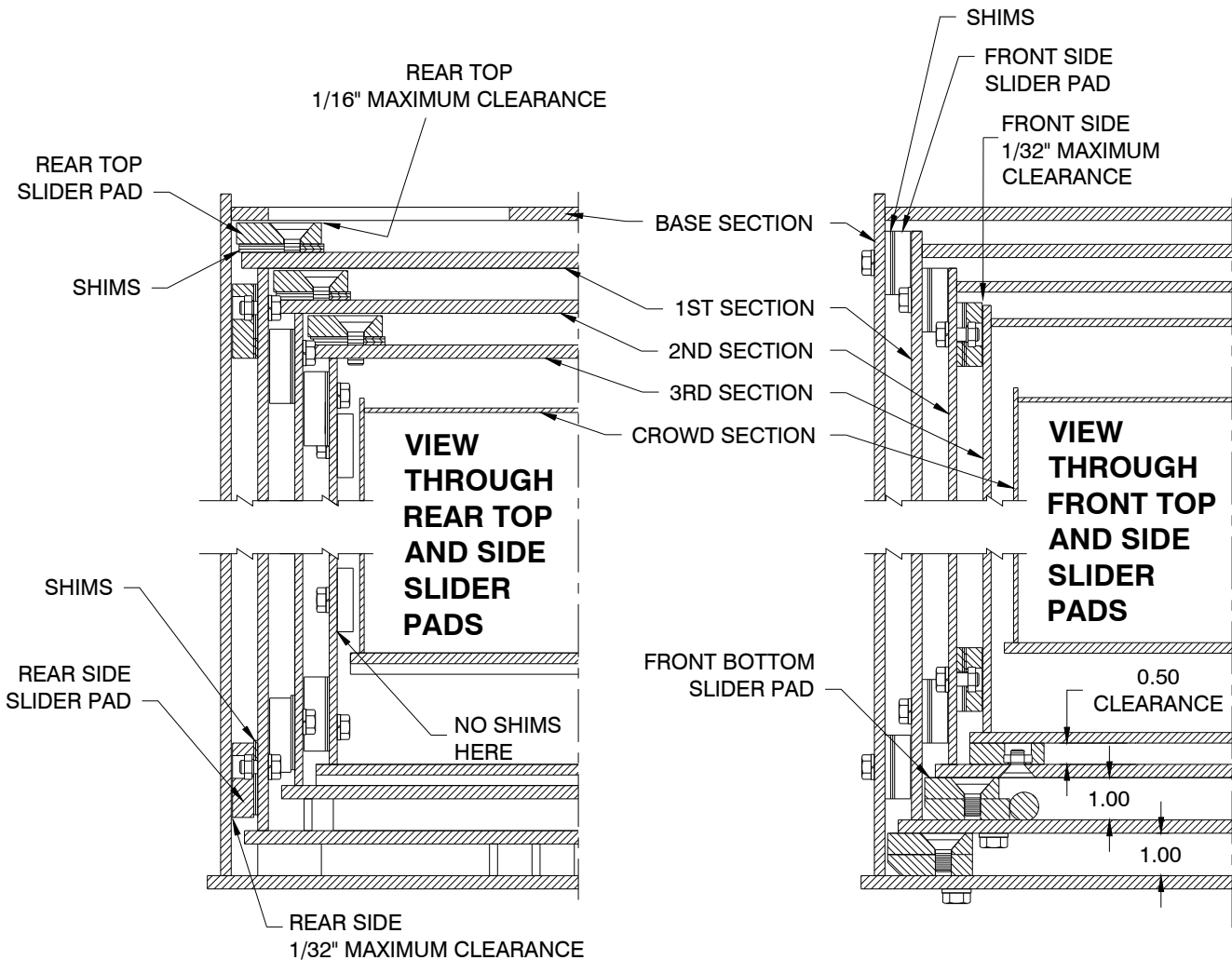
Visual verification of pad size used is required; different models may require different pads. Table is for reference only. Refer to Boom Assembly drawings in Parts Manual before ordering parts for boom being serviced.



**Table 6-5 Slider Pads: 100 Ft 4-Section Boom**

| Size and Description |                                     | Where Used                                 | New Thickness | Replace Thickness |
|----------------------|-------------------------------------|--|---------------|-------------------|
| 4 1/2" Pad           | 2-Hole                              | Front Bottom: Crowd                        | 3/8 Inch      | 1/4 Inch          |
| 5" Pad               | 2-Hole                              | Front Side: Crowd                          | 3/8 Inch      | 1/4 Inch          |
| 5" Pad               | 2-Hole with Threaded Insert         | Front Side: All<br>Rear Side: 3rd (inside) | 3/8 Inch      | 1/4 Inch          |
| 7" Pad               | 2-Hole with Threaded Insert         | Rear Side: 1st, 2nd, 3rd                   | 1/2 Inch      | 3/8 Inch          |
| 7" Pad               | 3-Hole                              | Extend Sheave Bracket-Tele Cyl             | 1/2 Inch      | 3/8 Inch          |
| 9" Pad               | 3-Hole, Self-Lube                   | Rear Top: 2nd, 3rd<br>Front Bottom: 1st    | 1/2 Inch      | 3/8 Inch          |
| 9" Pad               | 2-Hole, Self-Lube w/Threaded Insert | Front Bottom: 2nd                          | 1/2 Inch      | 3/8 Inch          |
| 11" Pad              | 3-Hole, Self-Lube                   | Rear Top: 1st<br>Front Bottom: Base        | 1/2 Inch      | 3/8 Inch          |

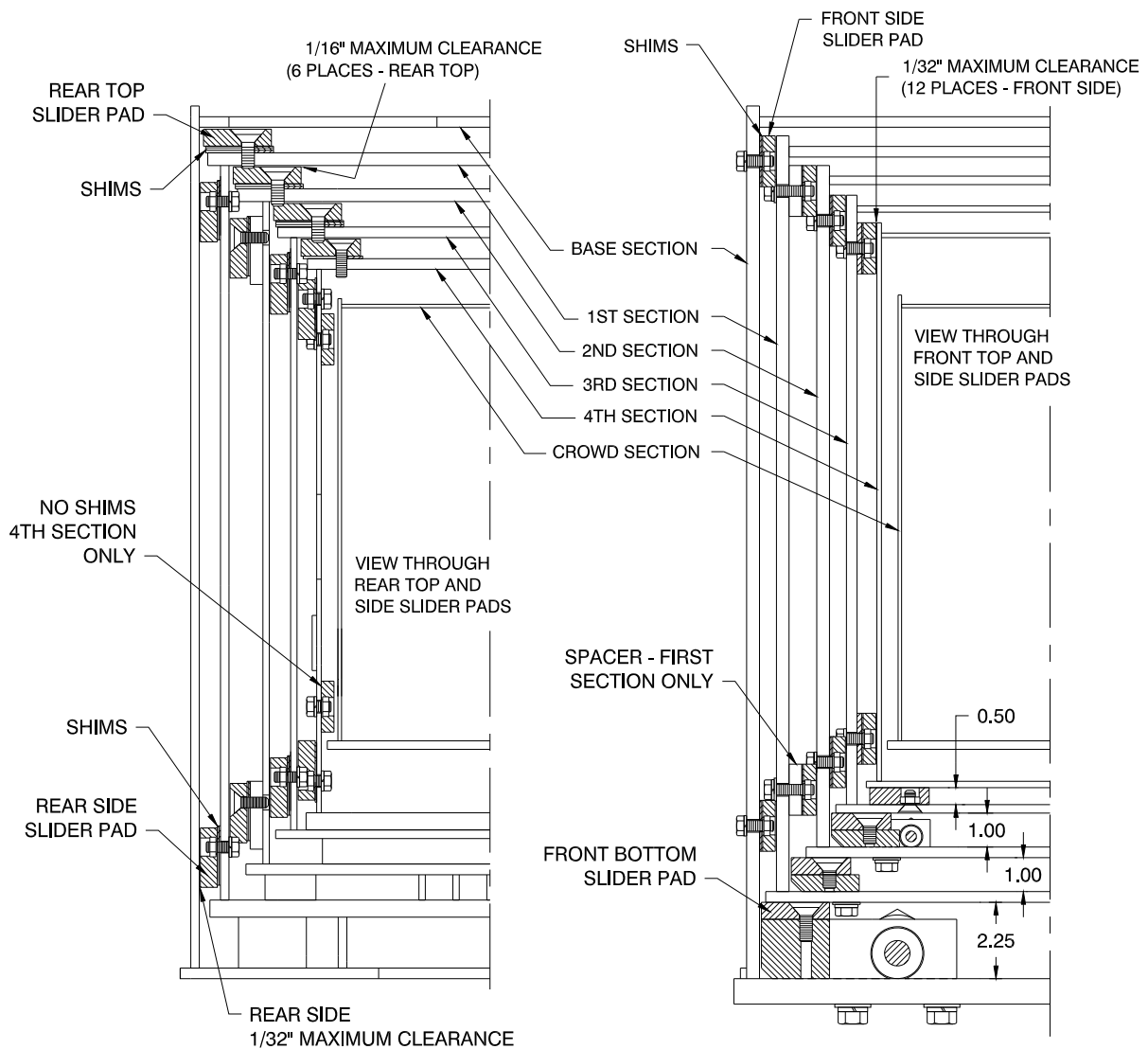
Visual verification of pad size used is required; different models may require different pads. Table is for reference only. Refer to Boom Assembly drawings in Parts Manual before ordering parts for boom being serviced.



**Table 6-6 Slider Pads: 124 Ft 5-Section Boom**

| Size and Description |                                     | Where Used                                       | New Thickness | Replace Thickness |
|----------------------|-------------------------------------|--|---------------|-------------------|
| 4 1/2" Pad           | 2-Hole                              | Front Bottom: Crowd                              | 3/8 Inch      | 1/4 Inch          |
| 5" Pad               | 2-Hole                              | Front Side: Crowd                                | 3/8 Inch      | 1/4 Inch          |
| 5" Pad               | 2-Hole with Threaded Insert         | Front Side: All<br>Rear Side: 4th (inside)       | 3/8 Inch      | 1/4 Inch          |
| 7" Pad               | 2-Hole with Threaded Insert         | Rear Side: 1st, 3rd, 4th                         | 1/2 Inch      | 3/8 Inch          |
| 7" Pad               | 2-Hole, Self-Lube w/Threaded Insert | Front Bottom: 3rd                                | 1/2 Inch      | 3/8 Inch          |
| 7" Pad               | 3-Hole                              | Rear Side: 2nd<br>Extend Sheave Bracket-Tele Cyl | 1/2 Inch      | 3/8 Inch          |
| 7" Pad               | 3-Hole, Self-Lube                   | Top Rear: 4th                                    | 1/2 Inch      | 3/8 Inch          |
| 9" Pad               | 3-Hole, Self-Lube                   | Rear Top: 3rd<br>Front Bottom: 1st, 2nd          | 1/2 Inch      | 3/8 Inch          |
| 11" Pad              | 3-Hole, Self-Lube                   | Rear Top: 1st, 2nd<br>Front Bottom: Base         | 1/2 Inch      | 3/8 Inch          |

Visual verification of pad size used is required; different models may require different pads. Table is for reference only. Refer to Boom Assembly drawings in Parts Manual before ordering parts for boom being serviced.



## Rear Top Slider Pads

Refer to Tables 6-2 thru 6-6 and Figure 6-11.

- Remove the access cover from the rear of the boom base.
- Retract the boom so rear top slider pads on the last section line up with the access holes in the rear of the boom.
- Stop engine.

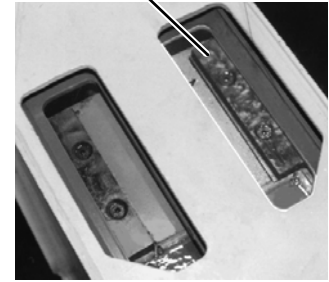
**DANGER**

**Do not place hands or tools into holes in boom sections until engine is OFF.**

**Serious injury will result if boom is telescoped while hands or tools are in holes.**

- Measure the thickness of the slider pads. Replace both slider pads if either has worn to the dimension given in Tables 6-2 thru 6-6.
- Measure the clearance between rear top slider pads and the adjacent section.
- If necessary, loosen the mounting screws and add shims under the slider pads to provide the clearance given in Tables 6-2 thru 6-6.
- Securely tighten the mounting screws to the torque specifications on the appropriate boom assembly drawing after the shims are installed.
- Repeat procedure for each section.

Top Slider Pads



**Figure 6-11** Top slider pads (Rear top slider pads viewed through access holes)

## Front and Rear Side Slider Pads

Refer to Tables 6-2 thru 6-6 and Figure 6-12.

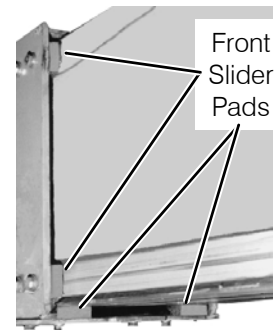
*Note* Rear side slider pads can only be replaced and adjusted when the boom is disassembled.

**DANGER**

**Do not place hands or tools between boom sections until engine is OFF. Serious injury will result if boom is telescoped while hands or tools are between sections.**

**between sections.**

- Extend the boom approximately six inches.
- Stop engine.
- Measure the thickness of front side slider pads. Replace all of the front side slider pads for the respective section if any front side slider pad has worn down to the thickness given in Tables 6-2 thru 6-6.
- Fully extend the boom and stop engine.
- Adjust the sections from side to side so the boom is as straight as possible. If necessary, add shims behind the front side slider pads to keep the boom straight.
- Securely tighten the mounting screws to the torque specifications on the appropriate boom assembly drawing after the shims are installed.



**Figure 6-12** Side and bottom pads

**Important** End of mounting screws for front side slider pads must not rub against adjacent section. If necessary, install washers under head of mounting screws so screws fully engage nuts in slider pads, but do not rub against section.

## Front Bottom Slider Pads

See Tables 6-2 thru 6-6 and Figure 6-12.

- Extend the boom approximately eight inches.
- Stop engine.

**DANGER**

**Do not place hands or tools between boom sections until engine is OFF. Serious injury will result if boom is telescoped while hands or tools are between sections.**

- Measure the thickness of front bottom slider pads. Replace both front slider pads for the respective section if either slider pad has worn to the dimension given in Tables 6-2 thru 6-6.

*Note* It will be necessary to lift the ends of the sections with a hoist to remove and adjust the front bottom slider pad. Front bottom slider pads are fastened to mounting pads, therefore, the mounting pads must be

removed to gain access to the slider pads. On four- and five-section booms, be sure to readjust extend and retract ropes after replacing the mounting pads between the first and second sections.

- Measure the clearance between the sections. If necessary, add shims under the front bottom slider pads to provide the clearance given in the illustrations in Tables 6-2 thru 6-6.
- Securely tighten the mounting screws to the torque specifications on the appropriate boom assembly drawing after the shims are installed.

## Crowd Rope Adjustment

### General

When numbers in parentheses are used to identify the ropes being adjusted, they are the same item numbers used in the bill of material list on the Boom Assembly drawings.

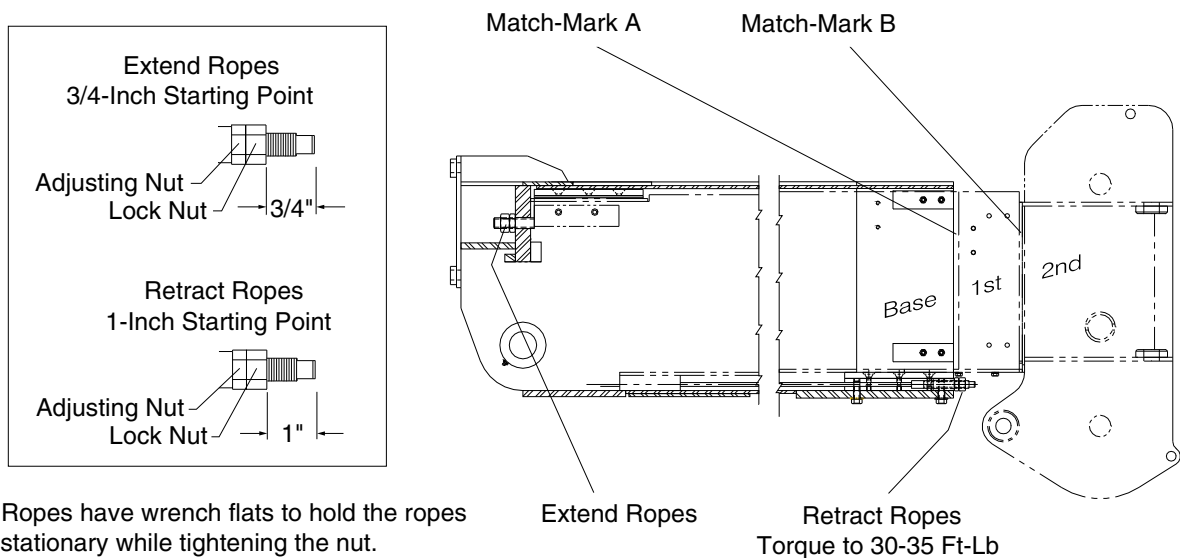
Table 6-7 is used to determine the number of turns for the adjusting nut required to move the boom section 1/8 inch. For example, if the rope being adjusted has an adjusting nut of 7/8 inch, then 3-1/2 turns will move the section 1/8 inch.

| <i>Adjusting Nut Size</i>  | <i>Number of Turns</i> | <i>Distance Section Moves</i> |
|--|------------------------|-------------------------------|
| 5/8 Inch   | 2-3/4                  | 1/8 Inch                      |
| 7/8 Inch   | 3-1/2                  | 1/8 Inch                      |
| 1 Inch   | 2                      | 1/8 Inch                      |
| 1-1/4 Inch   | 1-3/4                  | 1/8 Inch                      |
| 1-1/2 Inch   | 1-1/2                  | 1/8 Inch                      |
| <i>Note Extend and retract ropes have wrench flats to hold the ropes stationary while tightening the nuts.</i> |                        |                               |

### Three-Section Boom

Refer to Figure 6-13.

1. Check that the adjusting nuts and the locking nuts are loose on the extend and retract ropes.
2. Fully retract the boom. Ensure the second section has stopped against the first. If necessary, push against the end of the second section to further ensure the boom is fully retracted.
3. Put a match-mark on the side of the first section flush with the end of the base section; this will be match-mark A. Put a match-mark on the side of the second section flush with the end of the first section; this will be match-mark B.
4. Fully extend the boom and stop engine.



Note - Ropes have wrench flats to hold the ropes stationary while tightening the nut.

Figure 6-13 Typical Three-Section Boom Ropes and Match Marks



5. Tighten the adjusting nut on each extend rope until the distance from the end of each extend rope to the edge of each nut is 3/4-inch.



**Do not place hands or tools into any opening in boom sections while power is on or boom sections are moving.**

6. Visually inspect the extend rope tension through the sight hole in the side of the boom section. Tighten the adjusting nut on the loosest rope until all extend ropes are tensioned equally.
7. Torque the adjusting nut on both retract ropes to 30-35 ft/lb.
8. Fully retract the boom while watching the end of the sections; note which section stops first.
9. Extend the boom approximately six inches and repeat previous step as slowly as possible. Release the telescope control lever to OFF as soon as the corresponding sections stops.
10. Determine the remaining stroke to fully retract the boom.
  - A. If the second section stopped first, measure the remaining stroke between match-mark A on the first section and the end of the base section.
  - B. If the first section stopped first, measure the remaining stroke between match-mark B on the second section and the end of the first section.
11. If the remaining stroke is greater than 1/8-inch proceed as follows.

**Important** Refer to Table 6-7 for number of turns required for each type of rope.

- A. If the second section stopped first.
  1. Loosen the adjusting nut on the retract ropes the correct number of turns for each 1/8 inch of remaining stroke.
  2. Tighten the adjusting nut on the extend ropes the correct number of turns for each 1/8 inch of remaining stroke.
- B. If the first section stopped first.
  1. Loosen the adjusting nut on the extend ropes the correct number of turns for each 1/8 inch of remaining stroke.
  2. Tighten the adjusting nut on the retract ropes the correct number of turns for each 1/8 inch of remaining stroke.
- C. Repeat previous steps until the remaining stroke is 1/8 inch or less.
12. Re-check the torque of retract ropes.
13. Replace all lock nuts and securely tighten.

#### Four-Section Boom

Refer to Figure 6-14.

1. Remove the access cover from the top of the base section at rear.



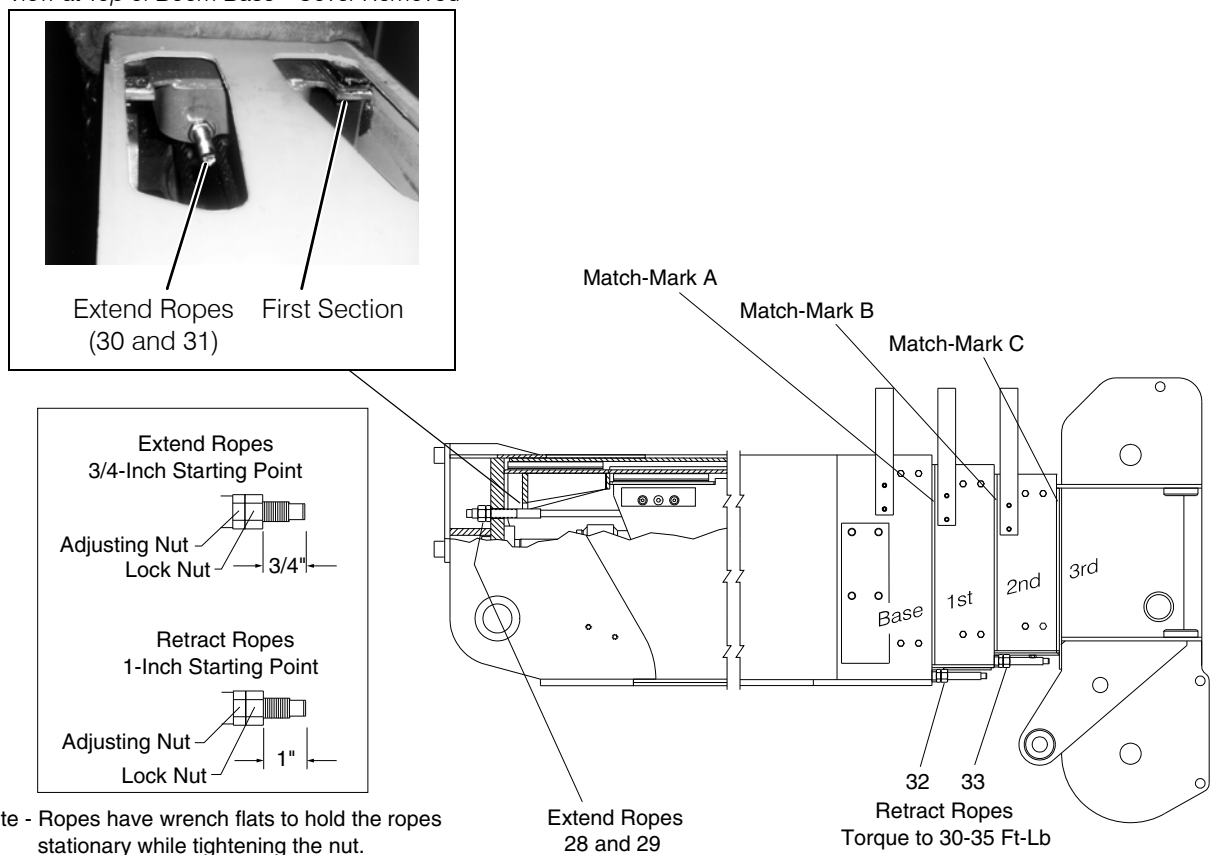
**Do not place hands or tools into any opening in boom sections while power is on or boom sections are moving.**

2. Loosen the adjusting nut and the lock nut on each extend rope (28 and 29) and on retract ropes (33) so the ropes are slack.
3. Visually inspect the extend rope tension (30 and 31) through the sight hole in the side of the first section. Remove the lock nuts and tighten the adjusting nut on the loosest rope until both ropes are tensioned equally.

**Important** If lock nuts are not removed in this step, damage to nuts or base section will result when boom is retracted later.

4. Tighten the adjusting nut on each retract rope (32) until the distance from the end of each rope to the outside edge of the adjusting nut is one inch.
5. Fully retract the boom.
6. Put a match-mark on the side of the first section flush with the end of the base section; this will be match-mark A.  
Put a match-mark on the side of the second section flush with the end of the first section; this will be match-mark B.  
Put a match-mark on the side of the third section flush with the end of the second; this will be match-mark C.

View at Top of Boom Base - Cover Removed



Note - Ropes have wrench flats to hold the ropes stationary while tightening the nut.

Figure 6-14 Typical Four-Section Boom Ropes and Match Marks

7. Extend the boom until ropes are accessible through cut-out on top of boom, see Figure 6-14, and stop engine. Tighten the adjusting nut on each extend rope (28 through 31) until the distance from the end of each rope to the outside edge of the adjusting nut is 3/4 inch.
8. Fully extend the boom and stop engine.
9. Visually inspect the extend rope tension (30 and 31) through the sight hole in the side of the boom section. Tighten the adjusting nut on the loosest rope until both ropes are tensioned equally.
10. Torque the adjusting nut on both retract ropes (33) to 30-35 ft/lb.
11. Fully retract the boom while watching the third and second sections, note whether the third section stops before match-mark B aligns itself with the end of the first section.
12. Extend the boom approximately six inches and repeat previous step as slowly as possible. Release the telescope lever to OFF as soon as the third section stops or as soon as match-mark B is aligned, whichever occurs first.
13. Determine the remaining stroke to fully retract the boom, as follows.
  - A. If the third section stopped first, measure the remaining stroke between match-mark B on the second section and the end of the first section.
  - B. If match-mark B aligned itself first, measure the remaining stroke between the third and second sections at location C.
14. If the remaining stroke is greater than 1/8-inch, proceed as follows.

**Important** Refer to Table 6-7 for number of turns required for each type of rope.

- A. Extend the boom until ropes are accessible through cut-out on top of boom, see Figure 6-14, and stop engine.
- B. If the third section stopped first.
  1. Loosen the adjusting nut on each retract rope (33) the correct number of turns for each 1/8 inch of remaining stroke.
  2. Tighten the adjusting nut on each extend rope (30 and 31) the correct number of turns for each 1/8 inch of remaining stroke.

- C. If match-mark B aligned first.
1. Loosen the adjusting nut on each extend rope (30 and 31) the correct number of turns for each 1/8 inch of remaining stroke.
  2. Tighten the adjusting nut on each retract rope (33) the correct number of turns for each 1/8 inch of remaining stroke.
- D. Repeat previous steps until the remaining stroke is 1/8 inch or less.
15. Recheck the torque of the adjusting nut for retract ropes (33).
16. Extend the boom until ropes are accessible through cut-out on top of boom, see Figure 6-14, and stop engine. Looking through the holes in the boom section, visually check the tension of extend ropes (28 and 29). Tighten the adjusting nut on the loosest ropes until all four ropes are tensioned equally.
17. Torque the adjusting nut on each retract rope (32) to 30-35 ft/lb.
18. Fully retract the boom while watching the second and first sections, note which section stops first.
19. Extend the boom approximately six inches and repeat previous step as slowly as possible. Release the telescope control lever to OFF as soon as the corresponding section stops.
20. Determine the remaining stroke to fully retract the boom as follows.
- A. If the second section stopped first, measure the remaining stroke between match-mark A on the first section and the end of the base section.
  - B. If the first section stopped first, measure the remaining stroke between match-mark B on the second section and the end of the first section.
21. If the remaining stroke is greater than 1/8 inch, proceed as follows.
- Important** Refer to Table 6-7 for number of turns required for each type of rope.
- A. Extend the boom approximately eight feet and stop engine.
  - B. If the second section stopped first.
    1. Loosen the adjusting nut on each retract rope (32) the correct number of turns for each 1/8 inch of remaining stroke.
    2. Tighten the adjusting nut on each extend rope (28 and 29) the correct number of turns for each 1/8 inch of remaining stroke.
  - C. If the first section stopped first.
    1. Loosen the adjusting nut on each extend rope (28 and 29) the correct number of turns for each 1/8 inch of remaining stroke.
    2. Tighten the adjusting nut on each retract rope (32) the correct number of turns for each 1/8 inch of remaining stroke.
  - D. Repeat previous steps until the remaining stroke is 1/8 inch or less.
22. Recheck the torque of the adjusting nut for retract ropes (32).
23. Replace all lock nuts and securely tighten.
24. Cycle the boom two or three more times and check that all boom sections are properly synchronized per the above instructions. If not, check which sections require readjustment and perform the proper adjustment procedure for those sections.
25. Repeat until the boom is properly synchronized.
26. Recheck the torque of the adjusting nut for each retract rope (32 and 33).
27. Replace the access cover on the base section.

### Five-Section Boom

Refer to Figure 6-15.

1. Remove the access covers from the top and rear of the base section.



**Do not place hands or tools into any opening in boom sections while power is on or boom sections are moving.**

2. Loosen the adjusting nut and the lock nut on each extend rope (28 and 29) and on retract ropes (33) so the ropes are slack.
3. Visually inspect the extend rope tension (30 and 31) through the sight hole in the side of the boom section. Remove the lock nuts and tighten the adjusting nut on the loosest rope until both ropes are tensioned equally.

**Important** If lock nuts are not removed in this step, damage to nuts or first section will result when boom is retracted later.

4. Tighten the adjusting nut on each retract rope (32) until the distance from the end of each rope to the outside edge of the adjusting nut is one inch.
5. Fully retract the boom.
6. Put a match-mark on the side of the second section flush with the end of the first section; this is match-mark A. Put a match-mark on the side of the third section flush with the end of the second section; this is match-mark B. Put a match-mark on the side of the fourth section flush with the end of the third section; this is match-mark C. Put a match-mark on the side of the first section flush with the end of the base section; this is match-mark D.
7. Extend the boom until ropes are accessible through cut-out on top of boom, see Figure 6-15, and stop engine. Tighten the adjusting nut on each extend rope (28 through 31) until the distance from the end of each rope to the outside edge of the adjusting nut is 3/4 inch.
8. Fully extend the boom and stop engine.
9. Visually inspect the extend rope tension (30 and 31) through the sight hole in the side of the boom section. Tighten the adjusting nut on the loosest rope until both ropes are tensioned equally.
10. Torque the adjusting nut on both retract ropes (33) to 30-35 ft/lb.
11. Fully retract the boom while watching the fourth and third sections, note whether the fourth section stops before match-mark B aligns itself with the end of the second section.
12. Extend the boom approximately six inches and repeat previous step as slowly as possible. Release the telescope lever to OFF as soon as the fourth section stops or as soon as match-mark B is aligned, whichever occurs first.

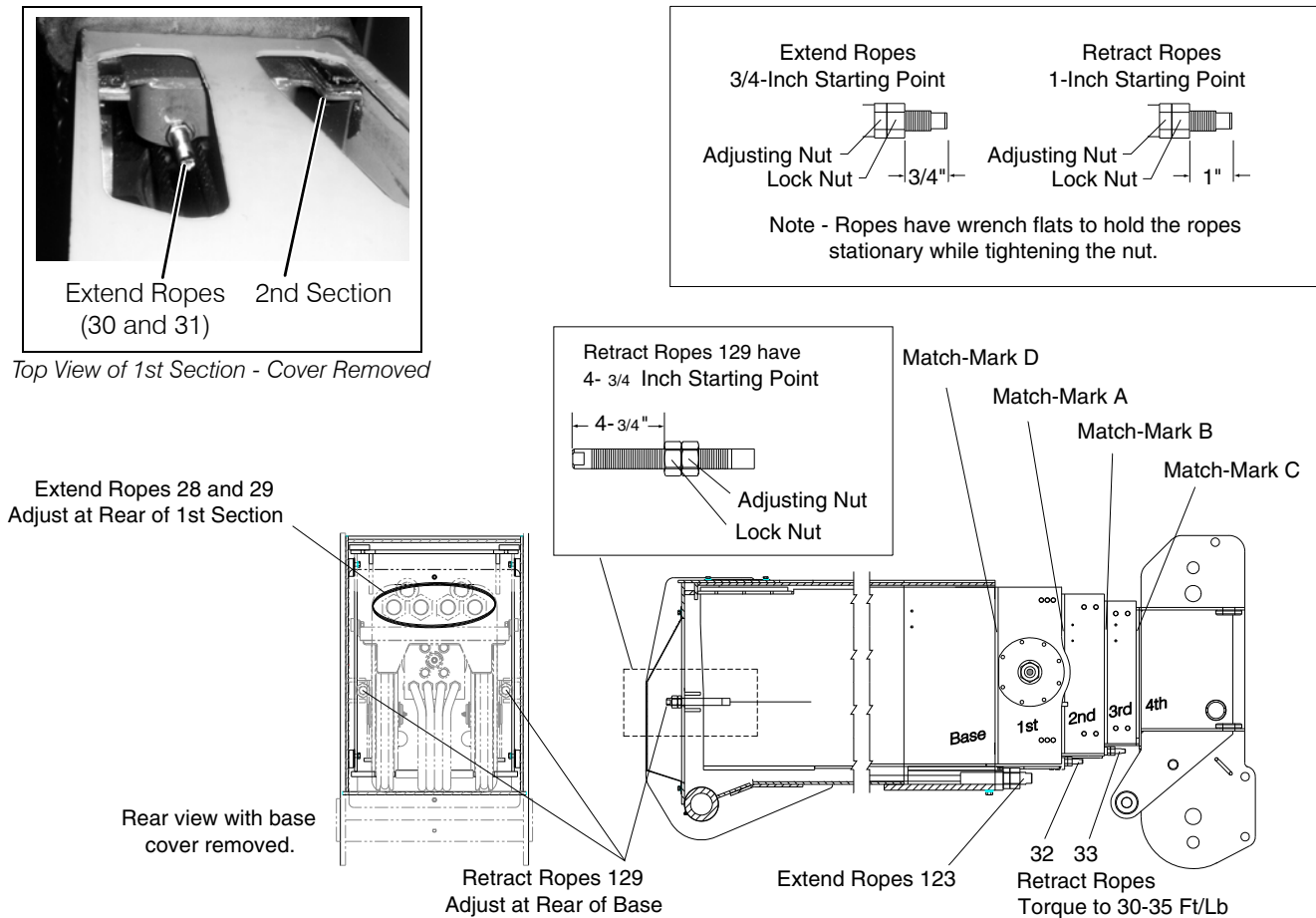


Figure 6-15 Typical Five-Section Boom Ropes and Match Marks

13. Determine the remaining stroke to fully retract the boom, as follows.
  - A. If the fourth section stopped first, measure the remaining stroke between match-mark B on the third section and the end of the second section.
  - B. If match-mark B aligned itself first, measure the remaining stroke between the fourth and third sections at location C.

14. If the remaining stroke is greater than 1/8 inch, proceed as follows.

**Important** Refer to Table 6-7 for number of turns required for each type of rope.

- A. Extend the boom until ropes are accessible through cut-out on top of boom, see Figure 6-15, and stop engine.
  - B. If the fourth section stopped first.
    - 1. Loosen the adjusting nut on each retract rope (33) the correct number of turns for each 1/8 inch of remaining stroke.
    - 2. Tighten the adjusting nut on each extend rope (30 and 31) the correct number of turns for each 1/8 inch of remaining stroke.
  - C. If match-mark B aligned first.
    - 1. Loosen the adjusting nut on each extend rope (30 and 31) the correct number of turns for each 1/8 inch of remaining stroke.
    - 2. Tighten the adjusting nut on each retract rope (33) the correct number of turns for each 1/8 inch of remaining stroke.
  - D. Repeat previous steps until the remaining stroke is 1/8-inch or less.
15. Recheck the torque of the adjusting nut for retract ropes (33).
16. Extend the boom until ropes are accessible through cut-out on top of boom, see Figure 6-15, stop engine. Looking through the access holes in the first section, visually check the tension of extend ropes (28 and 29). Tighten the adjusting nut on the loosest ropes until all four ropes are tensioned equally.
17. Torque the adjusting nut on each retract rope (32) to 30-35 ft/lb.
18. Fully retract the boom while watching the third and second sections, note which section stops first.
19. Extend the boom approximately six inches and repeat previous step as slowly as possible. Release the telescope control lever to OFF as soon as the corresponding section stops.
20. Determine the remaining stroke to fully retract the boom as follows.
- A. If the third section stopped first, measure the remaining stroke between match-mark A on the second section and the end of the first section.
  - B. If the second section stopped first, measure the remaining stroke between match-mark B on the third section and the end of the second section.
21. If the remaining stroke is greater than 1/8 inch, proceed as follows.

**Important** Refer to Table 6-7 for number of turns required for each type of rope.

- A. Extend the boom until ropes are accessible through cut-out on top of boom, see Figure 6-15, and stop engine.
  - B. If the third section stopped first.
    - 1. Loosen the adjusting nut on each retract rope (32) the correct number of turns for each 1/8 inch of remaining stroke.
    - 2. Tighten the adjusting nut on each extend rope (28 and 29) the correct number of turns for each 1/8 inch of remaining stroke.
  - C. If the second section stopped first.
    - 1. Loosen the adjusting nut on each extend rope (28 and 29) the correct number of turns for each 1/8 inch of remaining stroke.
    - 2. Tighten The adjusting nut on each retract rope (32) the correct number of turns for each 1/8 inch of remaining stroke.
  - D. Repeat previous steps until the remaining stroke is 1/8 inch or less.
22. Recheck the torque of the adjusting nut for retract ropes (32).
23. Fully retract the boom while watching the base and first sections, note whether the first section stops before match-mark D aligns itself with the end of the base section.
24. Extend the boom approximately six inches and repeat previous step as slowly as possible. Release the telescope lever to OFF as soon as the first section stops or as soon as match-mark D is aligned, whichever occurs first.
25. Determine the remaining stroke to fully retract the boom, as follows.
- A. If the first section stopped first, measure the remaining stroke between match-mark D on the first section and the end of the base section.
  - B. If match-mark D aligned itself first, measure the remaining stroke between the first and base sections.
26. If the remaining stroke is greater than 1/8 inch, proceed as follows.
- A. Extend the boom approximately 15 inches and stop engine.
  - B. If the first section stopped first.

1. Loosen the adjusting nut on each retract rope 129 the correct number of turns for each 1/8 inch of remaining stroke.

**Important** *The starting point for rope 129 is 4-3/4 inches from the plate. Use only full size nut for both adjusting and locking nut, see Figure 6-15.*

2. Tighten the adjusting nut on each extend rope 123 the correct number of turns for each 1/8 inch of remaining stroke.

C. If match-mark D aligned first.

1. Loosen the adjusting nut on each extend rope 123 the correct number of turns for each 1/8 inch of remaining stroke.
2. Tighten The adjusting nut on each retract rope 129 the correct number of turns for each 1/8 inch of remaining stroke.

D. Repeat previous steps until the remaining stroke is 1/8 inch or less.

27. Replace all lock nuts and securely tighten.
28. Cycle the boom two or three more times to ensure synchronization.
29. Repeat until the boom is properly synchronized.
30. Replace the access covers on the base section.

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# Chapter 7

## Hydraulic System Troubleshooting

### General

The following troubleshooting information is provided as a general guide to identify, locate and correct problems that may be experienced with the hydraulic system of this crane.

It is expected that all troubleshooting and testing will be performed by a qualified hydraulic technician.

### Troubleshooting Steps

A good troubleshooting program should include the following steps.

- Know the System.
    - Study the Hydraulic Schematic.
    - Know what the relief valve settings and pump outputs should be.
  - Ask the operator.
    - Ask how did the crane acted when it started to fail or what is unusual about the crane's operation.
    - Ask if any valve setting was changed.
    - Discuss how the crane is being used and when preventive maintenance is being performed; many problems can be traced to abuse of the crane or poor maintenance.
  - Operate the Crane.
    - How is the crane's performance? Is any function slow, erratic, or not operating at all?
    - Do the controls feel solid or spongy?
    - Smell any unusual odors? Any signs of smoke?
    - Hear any unusual noises? Where, at what speeds, and during what cycles?
  - Inspect the Crane
    - Inspect the entire crane for any signs of trouble.
    - Inspect the hydraulic tank. Is the oil at the proper level? Is the oil foamy or milky? Does the oil smell scorched? Does the oil appear too thin, too thick, or excessively dirty?
    - Is the filter bypassing (clogged with dirt)? If so, replace the element.
    - Feel the tank and the lines. Are they hotter than normal? Are they caked with dirt, mud, or dry oil? Is the paint peeled from any components? Are there kinked or collapsed hoses or tubes?
    - Inspect all lines for oil leaks.
    - Check for air leaks, usually accompanied by a sucking sound.
    - Look closely at each component. Inspect for cracked welds, hairline cracks in housings, and loose mounting bolts or tie bolts.
  - List the Problems.
    - Make a list of the problems found while inspecting the crane.
  - Reach a Conclusion.
    - Study the list of problems and determine the possible causes using the Troubleshooting List as a guide.
- Note* If all of the hydraulic circuits are bad, the problem is in a component common to all circuits, such as the pump. If, on the other hand, only one circuit is bad, concentrate on the parts of that circuit.
- Take Corrective Action.
    - Once the problem has been isolated and the possible cause has been determined, take the necessary corrective action.
    - Fully test the crane before returning it to service.

### Troubleshooting List

#### Hydraulic Oil Condition

- Oil milky or dirty.
  - Water in oil (milky).
  - Filter failure (dirty).
  - Metal particles (mechanical failure).
  - Oil discolored or has burned odor.
  - See *Oil Overheating*.

- System Inoperative
  - Power Take-Off (PTO) not engaged.
    - Engage PTO.
  - No oil in system.
    - Fill tank to proper level. Check system for leaks.
  - Oil viscosity too high.
    - Refer to Lubrication Chapter for proper viscosity.
  - Suction line plugged.
    - Drain oil and clean suction line. Locate source of contamination.
  - Ball valve closed.
    - Make sure this valve is fully open.
  - Restriction in system.
    - Oil lines could be dirty or have inner walls that are collapsing and cutting off the oil supply. Clean or replace lines.
  - Air leaks in pump suction line.
    - Repair or replace suction line.
  - Dirt in pump.
    - Clean and repair pump. If necessary, drain and flush hydraulic system. Locate source of contamination.
  - Badly worn pump.
    - Repair or replace pump.
  - Badly worn components.
    - Examine and test valves, motors, and cylinders for external and internal leaks. If wear is abnormal, locate the cause.
  - Oil leak in pressure lines.
    - Tighten fittings or replace defective lines.
  - Relief valves improperly adjusted or defective.
    - Test relief valves to make sure they are opening at specified pressures. Refer to Hydraulic Schematic.
    - Examine seals for damage that could cause leaks. Clean relief valves and check for broken springs and other possible causes.
  - Pump rotating in wrong direction. *Applies to knockdown units only.*
    - Reverse to prevent damage.
- Important** *Pump rotation must be matched with PTO and transmission.*
- Operating system under excessive load.
    - Check Capacity Chart for load limits.
  - Hoses attached improperly.
    - Attach correctly and tighten securely.
  - Broken PTO.
    - Replace defective parts.
  - Pump not operating.
    - Check for broken pump shaft.

### System Operates Erratically

- Air in system.
  - Examine suction line for leaks. Make sure oil level is correct (leaks on pressure side of system could account for oil loss).
- Cold oil.
  - Viscosity of oil may be too high at start-up. Allow oil to warm before operating controls.
- Components sticking or binding.
  - Check for dirt or gummy deposits. If dirt is caused by contamination, locate the source. Check for worn parts.
- Pump damaged.
  - Check for broken or worn parts. Determine cause of pump damage.
- Dirt in relief valves.
  - Clean relief valves.
- Restriction in suction line.
  - Suction line could be dirty or have inner walls that are collapsing and cutting off the oil supply. Clean or replace suction line.



## System Operates Slowly

- Cold oil.
  - Allow oil to warm before operating controls.
- Oil viscosity too high.
  - Refer to Lubrication Chapter for proper viscosity.
- Insufficient drive speed.
  - Make sure PTO is matched to transmission. Troubleshoot engine.
- Low oil supply.
  - Check tank and add oil if necessary. Check system for leaks that could cause loss of oil.
- Air in system.
  - Check suction line for leaks.
- Badly worn pump.
  - Repair or replace pump. Check for problems causing pump wear such as misalignment or contaminated oil.
- Restriction in suction line.
  - Suction line could be dirty or have inner walls that are collapsing and cutting off the oil supply. Clean or replace suction line.
- Ball valve closed.
  - Make sure this valve is fully open.
- Relief valves not properly set or leaking.
  - Test relief valves to make sure they are opening at specified pressures. Examine valves for damaged seats that could leak.
- Badly worn components.
  - Examine and test valves, motors, and cylinders for external and internal leaks. If wear is abnormal, locate the cause.
- Valves plugged.
  - Clean dirt from components. Clean orifices. Find source of dirt and correct.
- Oil leak in pressure lines.
  - Tighten fittings or replace defective lines. Examine mating surfaces of fittings for irregularities.

## Oil Overheating

- Operator holds control levers in power position too long, causing relief valve to open.
  - Return control levers to NEUTRAL position when not in use.
- Using incorrect oil.
  - Drain and refill system with proper oil. See Lubrication Chapter.
- Low oil level.
  - Fill tank to proper level. Look for leaks.
- Dirty oil.
  - Drain and refill with clean oil. Look for source of contamination.
- Engine running too fast.
  - Troubleshoot engine.
- Incorrect relief valve pressures.
  - Check and reset pressures; clean or replace relief valve.
- Internal oil leakage.
  - Examine and test valves, cylinders, and motors for internal leaks. If wear is abnormal, locate the cause.
- Restriction in pump suction line.
  - Clean or replace suction line.
  - Dented, obstructed or undersized oil lines.
  - Remove obstructions or replace defective oil lines.
- Control valve stuck in partially open position.
  - Free spool so it returns to NEUTRAL position.
- Heat not radiating properly.
  - Clean dirt and debris from oil cooler, hydraulic tank, oil lines and all other components.
  - Make sure oil cooler fans are operating properly. The oil cooler fans should turn on when the oil temperature rises above 120°F. Make sure oil is circulating through oil cooler.

### **Oil Foaming**

- Low oil level.
  - Fill tank to proper level. Look for leaks.
- Water in oil.
  - Drain and replace oil.
  - Wrong kind of oil being used. Drain and refill system with proper oil. See Lubrication Chapter.
- Air leak in suction line.
  - Tighten or replace suction line.
- Kink or dent in oil lines (restricts oil flow).
  - Replace oil lines.
- Worn seal around pump shaft.
  - Clean sealing area and replace seal. Check oil for contamination or pump for misalignment.

### **Pump Makes Noise**

- Low oil level.
  - Fill tank to proper level. Check system for leaks.
- Oil viscosity too high.
  - Drain and refill system with proper oil. See Lubrication Chapter.
- Pump speed too fast.
  - Operate pump at recommended speed.
- Suction line plugged or pinched.
  - Clean or replace suction line.
- Ball valve closed.
  - Make sure this valve is fully open.
- Sludge and dirt in pump.
  - Disassemble and inspect pump and lines. Clean hydraulic system. Determine cause of dirt.
- Tank breather plugged.
  - Replace breather.
- Air in oil.
  - Tighten or replace suction line. Check system for leaks. Replace pump shaft seal.
- Worn or scored pump bearings or shafts.
  - Replace worn parts or complete pump if parts are badly worn or scored. Determine cause of scoring.
- Broken or damaged pump parts.
  - Repair pump. Look for cause of damage like contamination or too much pressure.
- Sticking or binding parts.
  - Repair binding parts. Clean parts and change oil if necessary.

### **Pump Leaks Oil**

- Damaged seal around drive shaft.
  - Replace seal. Trouble may be caused by contaminated oil. Check oil for abrasives and clean entire hydraulic system. Locate source of contamination. Check the pump drive shaft; misalignment could cause the seal to wear. If shaft is not aligned, check the pump for other damage.
- Loose or broken pump parts.
  - Make sure all bolts and fittings are tight. Check gaskets and seals. Examine pump casting for cracks. If pump is cracked, look for a cause like too much pressure or hoses that are attached incorrectly.

### **Motor Leaks Oil**

- Damaged seal around drive shaft.
  - Replace seal. Trouble may be caused by contaminated oil. Check oil for abrasives and clean entire hydraulic system. Locate source of contamination. Check the motor drive shaft; misalignment could cause the seal to wear. If shaft is not aligned, check the motor for other damage.
- Loose or broken motor parts.
  - Make sure all bolts and fittings are tight. Check gaskets and seals.
  - Examine motor casting for cracks. If motor is cracked, look for a cause like too much pressure or hoses that are attached incorrectly.
- Back pressure too high.
  - Check if return filter is bypassing; if so, replace element.

- Check for and remove any obstruction in return line.

### Valve Sticks or Works Hard

- Tie bolts too tight on valve stacks.
  - Use manufacturer's recommendation to adjust tie bolt torque.
- Valve broken or scored internally.
  - Repair broken or scored parts. Locate source of contamination that caused scoring.

### Valve Leaks Oil (External)

- Tie bolts too loose on valve stacks.
  - Use manufacturer's recommendation to adjust tie bolt torque.
- Worn or damaged O-rings.
  - Replace O-rings (especially between valve stacks). If contamination has caused O-rings to wear, clean system and look for source of contamination.
- Broken valve parts.
  - If valve is cracked, look for a cause such as too much pressure or hoses that are attached incorrectly.

### Cylinder Leaks Oil (External)

- Damaged cylinder barrel.
  - Replace cylinder barrel. Correct cause of barrel damage.
- Rod seal leaking.
  - Replace seal. If contamination has caused seal to wear, look for source. Wear may be caused by external as well as internal contaminants. Check piston rod for scratches or misalignment.
- Loose parts.
  - Tighten parts until leakage has stopped.
- Piston rod damaged.
  - Check rod for nicks or scratches that could cause seal damage or allow oil leakage. Replace defective rod.

### Cylinder Drifts or Will Not Hold Load

**Important** See *Cylinder Leaks Oil (External)*.

- Excessively worn or damaged piston seals.
  - Disassemble cylinder and replace faulty parts.
- Counterbalance valve or check valve stuck open.
  - Replace valve.

### Cylinder Will Not Extend or Not Retract

**Important** See *System Inoperative*.

- Counterbalance valve or check valve stuck closed.
  - Replace valve.

### Boom Cannot Be Extended or Lowered

- LMI function lockout.
  - See LMI Operating Instructions.

### Swing Inoperative or Erratic

**Important** See *System Inoperative or System Operates Erratically*.

- Swing parking brake switch.
  - Brake not releasing.
  - Check for a collapsed, restricted, or leaking brake release hose. Clean or replace the hose.

*Note* The brake should fully release at 260 psi.

- Improper backlash between the swing pinion and the slewing ring gear.
  - Adjust the backlash between the gears.
- Damaged slewing ring bearing.
  - Replace the slewing ring.

### **Swing Brake Does Not Hold**

- Brake return springs broken or brake discs worn or damaged.
  - Disassemble the brake and replace the faulty parts.

### **Winch Will Not Lower Load or Lowers Load Erratically**

**Important** See *System Inoperative* or *System Operates Erratically*.

- Brake not releasing.
  - Check for a collapsed, restricted, or leaking pilot line to the brake. Clean or replace the hose.

*Note* The winch brake should fully release at 350 psi to 450 psi.

- Counterbalance valve not opening.
  - Check for a collapsed, restricted, or leaking pilot line to the counterbalance valve. Clean or replace the hose.

### **Winch Will Not Hold Load in Neutral**

- Excessive back pressure acting on the brake causing brake to release partially.
  - Back pressure must not exceed 150 psi. Inspect the return lines between the control valve and tank for restrictions.
- Brake return springs broken or brake discs worn or damaged.
  - Disassemble the winch and replace the faulty brake parts.
- Clutch slipping.
  - Improper oil being used in winch can cause the clutch to slip. Drain the winch and refill with proper oil, see Lubrication Chapter.
  - The clutch may be damaged or worn. Disassemble the winch and replace the clutch.

### **Winch Will Not Raise Load**

**Important** See *System Inoperative*.

- Load too heavy.
  - Refer to the Capacity Chart for load limits and applicable reeving diagram.
- LMI function lockout.
  - See LMI operating instructions.

### **Boom Chatters When Extending or Retracting Boom**

- Boom sections not lubricated.
  - Lubricate the boom sections as instructed in the Lubrication Chapter.
- Slider pads worn or improperly adjusted.
  - Check the slider pads for wear and proper adjustment.

### **Boom Does Not Sequence Properly**

- Crowd rope system improperly adjusted.
  - Adjust the crowd ropes.