

# Manitowoc 2250

## MAX-ER<sup>®</sup> 2000 Operator Manual



Grove

Manitowoc

National Crane

Potain







# OPERATOR MANUAL

This manual has been prepared for and is considered part of -

## 2250 MAX-ER<sup>®</sup> 2000 Attachment

Crane Model Number

**2253000**

Crane Serial Number

This Manual is divided into the following sections:


<b>SECTION 1</b>	<b>INTRODUCTION</b>
<b>SECTION 2</b>	<b>SAFETY INFORMATION</b>
<b>SECTION 3</b>	<b>OPERATING CONTROLS AND PROCEDURES</b>
<b>SECTION 4</b>	<b>SET-UP AND INSTALLATION</b>
<b>SECTION 5</b>	<b>LUBRICATION</b>
<b>SECTION 6</b>	<b>MAINTENANCE CHECKLIST</b>

### NOTICE

The serial number of the crane and applicable attachments (i.e. luffing jib, MAX-ER) is the only method your Manitowoc dealer or Manitowoc Crane Care has of providing you with correct parts and service information.

The serial number is located on a crane identification plate attached to the operator's cab and each attachment. Refer to the Nameplate and Decal Assembly Drawing in Section 2 of this manual for the exact location of the crane identification plate.

***Always furnish serial number of crane and its attachments*** when ordering parts or discussing service problems with your Manitowoc dealer or Manitowoc Crane Care.

	<b>⚠ WARNING</b>
	<p><b>To prevent death or serious injury:</b></p> <ul style="list-style-type: none"><li>• Avoid unsafe operation and maintenance. Crane and attachments must be operated and maintained by trained and experienced personnel. Manitowoc is not responsible for qualifying these personnel.</li><li>• Do not operate or work on crane or attachments without first reading and understanding instructions contained in Operator Information Manual and Service Manual supplied with crane and applicable attachments.</li><li>• Store Operator Information Manual and Service Manual in operator's cab.</li></ul> <p>If Operator Information Manual or Service Manual is missing from cab, contact your Manitowoc dealer for a new one.</p>



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# SECTION 1 INTRODUCTION

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# SECTION 1 INTRODUCTION

## CRANE DATA

See the end of this section for crane data specific to your crane:

- Basic Specifications.
- EC Declaration (if applicable).

## CRANE/ATTACHMENT IDENTIFICATION

An identification label is attached to the outside of the operator's cab (see Figure 1-1) and to the attachments (i.e. luffing jib and MAX-ER) available for this crane.

The crane or attachment model, application, and serial number are provided on the label.

For the exact location of the identification labels on your crane and attachments, see the Nameplates and Decals Drawing in Section 2 of this manual.

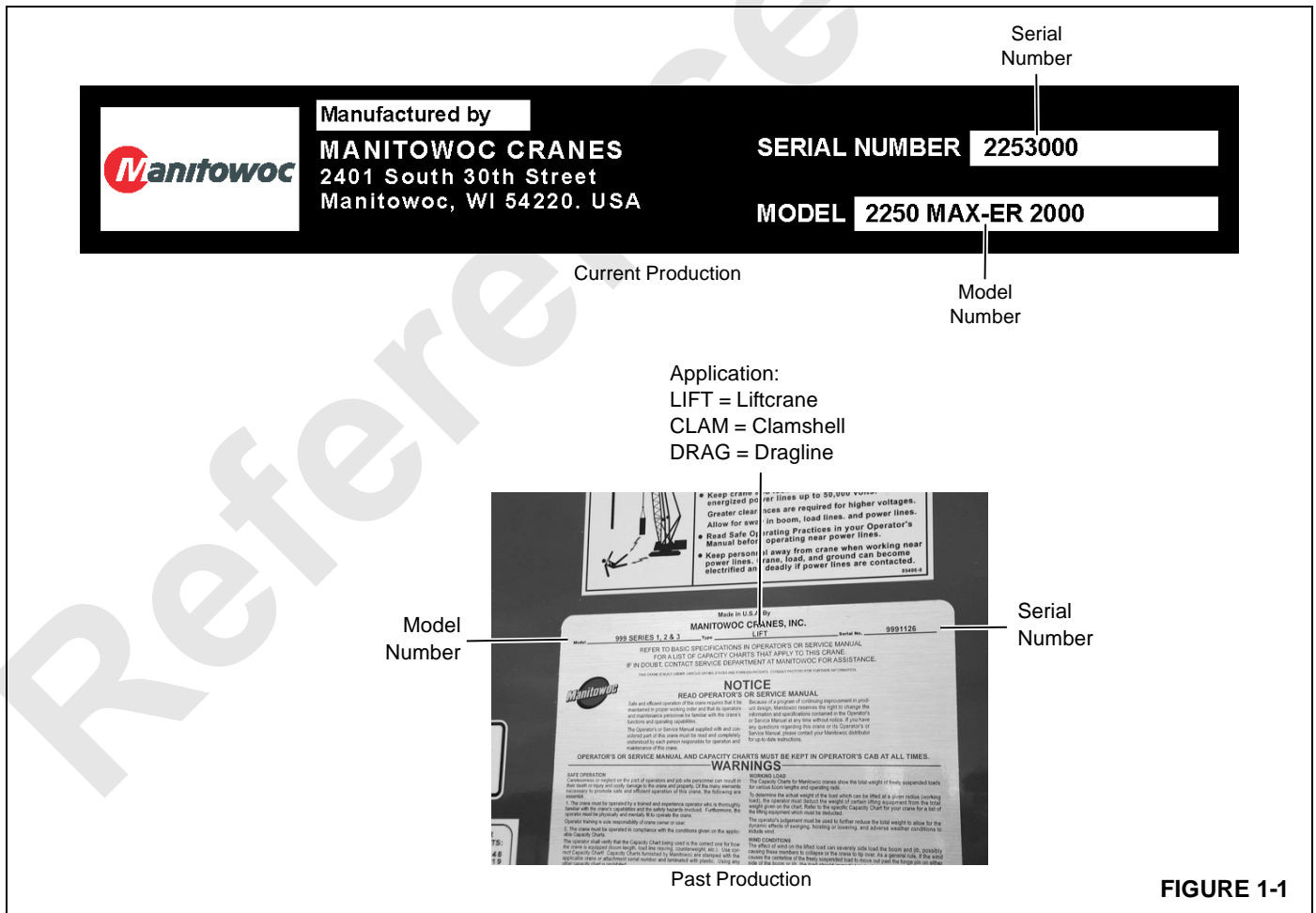
## CRANE ORIENTATION

The terms RIGHT, LEFT, FRONT, REAR used in this manual see operator's right, left, front, and rear sides when seated in the operator's cab looking forward.

- The boom is on the front of the upperworks.
- The crawler drive shafts are at the rear of the crawlers and carbody.

## IDENTIFICATION OF MAX-ER COMPONENTS

See Figure 1-2 for identification of the MAX-ER components. See Section 1 in the Crane Operator's Manual for identification of the crane components.



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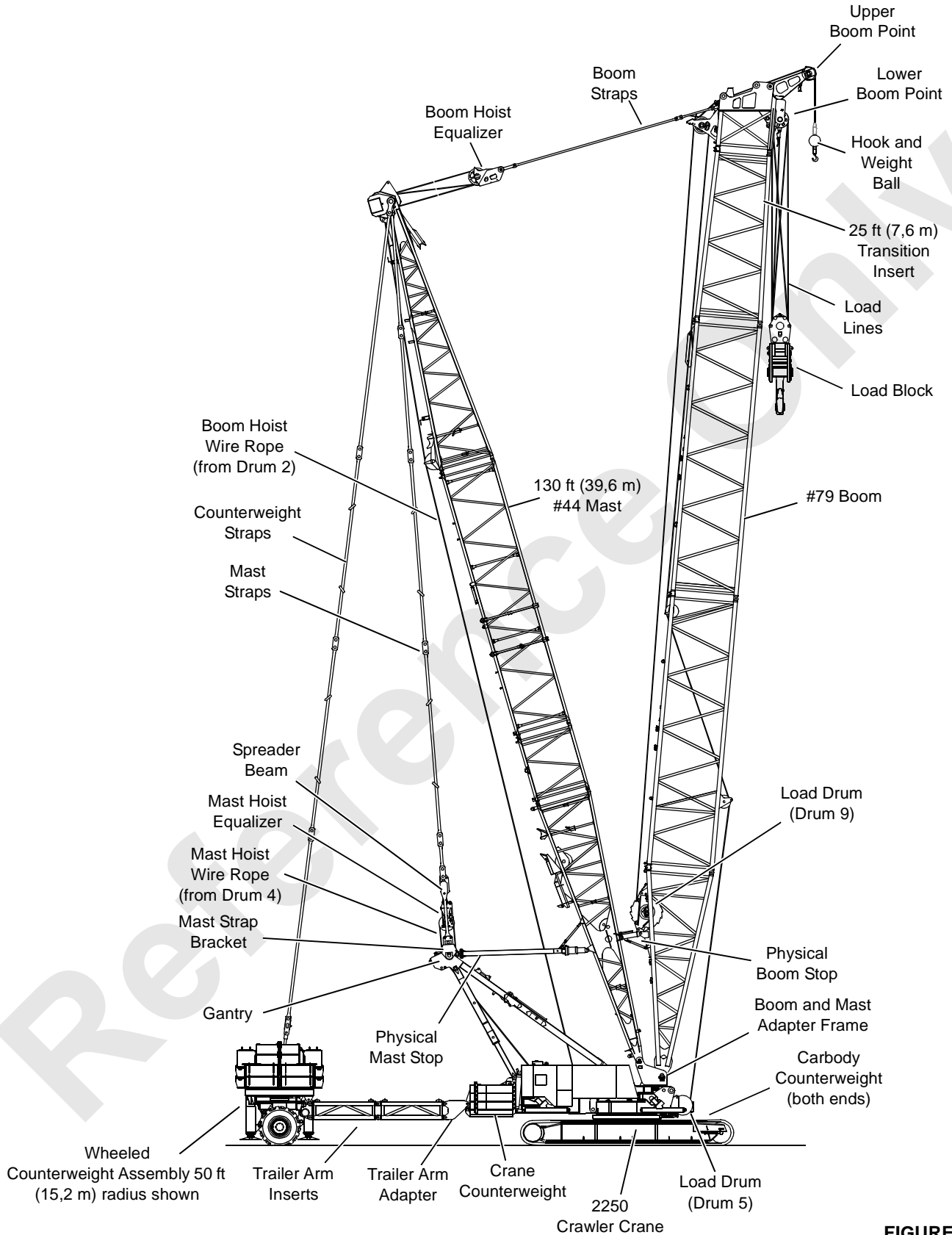
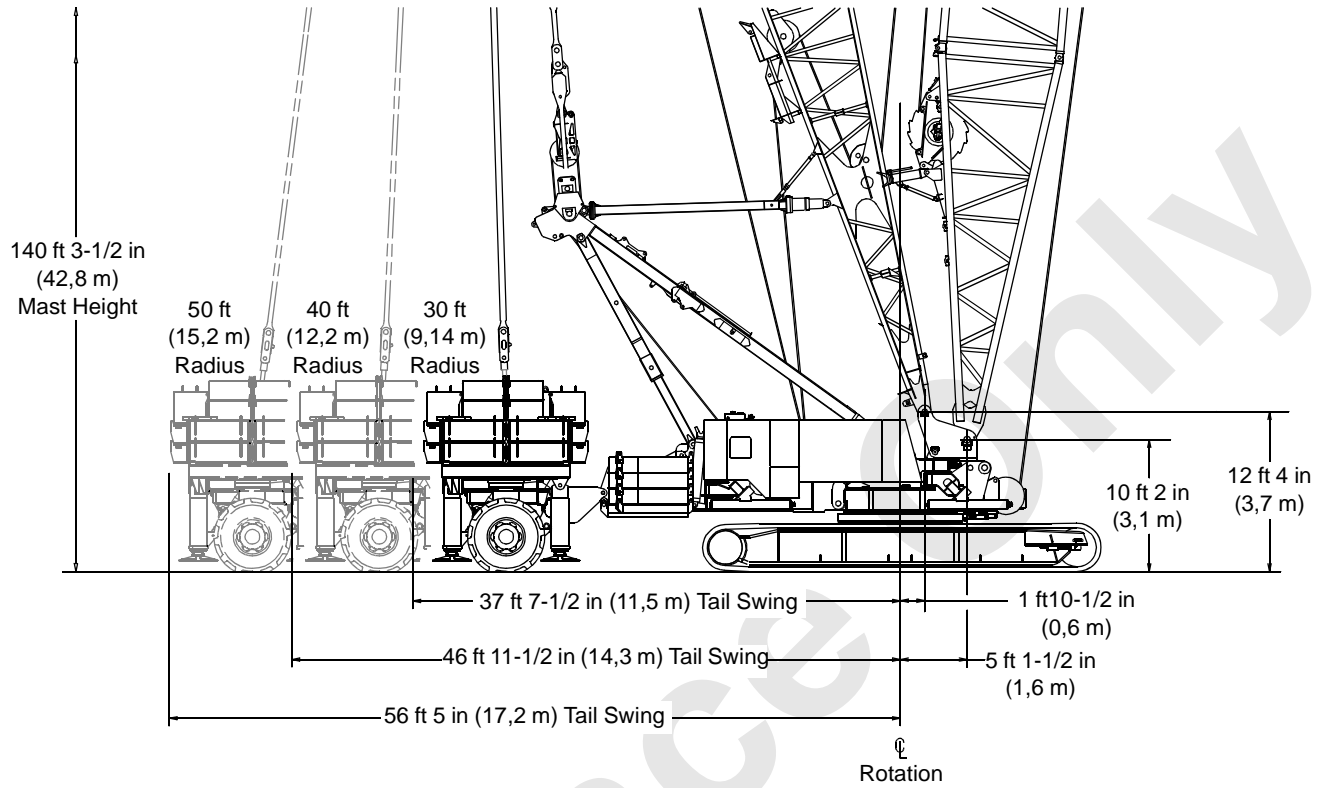


FIGURE 1-2

### OUTLINE DIMENSIONS



## WEIGHTS OF COMPONENTS

**NOTE:** Weights may fluctuate  $\pm 3\%$  due to manufacturing tolerances

Description	Weight	
	Pounds	Kilograms
<b>LIFTCRANE:</b>		
Upperworks and lowerworks complete, 2 swing drives, counterweight, gantry, backhitch, MAX-ER equipped with 462,000 lb (209 560 kg) wheeled counterweight, 130 ft (39,6 m) No. 44 Mast, fully rigged 120 ft (42,7m) Boom No. 79 [including upper boom point, 500 USt (453 t) block and 15 USt (14 t) hook], boom stops, and load lines	1,103,575	500 573
<b>COUNTERWEIGHT - CRANE:</b>		
Tray	38,775	17 588
Lifting frame (each) 2 required	140	63
Center counterweight	37,000	16 782
Lower side counterweight (6 required) (each)	15,500	7 030
Upper power pin with cylinder (each)	30	13
Lower power pin with cylinder (each)	20	9
Total crane counterweight	169,200	76 747
<b>COUNTERWEIGHT - WHEELED:</b>		
Side counterweight box (each) 4 required	20,000	9 071
Side counterweight box (each) 8 required	19,500	8 845
Center top counterweight box (each) 4 required	15,000	6 803
Center middle counterweight box (each) 2 required	21,250	9 638
Center bottom counterweight box (each) 2 required	21,250	9 638
Wheeled counterweight trailer assembly with strap cylinders	77,420	35 117
Front trailer insert	2,565	1 163
Rear trailer insert	2,565	1 163
Adapter arm	2,800	1 270
Total wheeled counterweight	462,000	209 559
<b>COUNTERWEIGHT - CARBODY:</b>		
Carbody center counterweight (each) 2 required	30,000	13 607
<b>MAST ASSEMBLY - 130 ft (39,6m):</b>		
40 ft (12,2 m) butt	10,215	4 633
40 ft (12,2 m) top with sheaves in point, links and straps	15,810	7 171
10 ft (3,0 m) insert	1,890	857
40 ft (12,2 m) insert	6,115	2 773
16 ft 10-1/4 in (5,1 m) backhitch strap (each)	355	161
17 ft 0-1/8 in (5,1 m) backhitch strap (each)	355	161
26 ft 10-5/8 in (8,2 m) backhitch strap (each)	575	260
3 ft 9-1/8 in (1,1 m) backhitch strap (each)	115	52
1 ft 1 in (0,3 m) backhitch link set (each) with pins and collars	100	45
Backhitch spreader bar	1,625	737
Backhitch link (each) attached to equalizer	55	24
Equalizer with pins	1,925	873
Mast and boom adaptor	4,305	1 952
Mast stop	2,230	1 011



Description	Weight	
	Pounds	Kilograms
34 ft 5-3/4 in (10,5 m) counterweight strap (each)	740	335
26 ft 10-5/8 in (8,2 m) counterweight strap (each)	575	260
26 ft 6 in (8,1 m) counterweight strap (each)	525	238
1 ft 1 in (0,3 m) counterweight link set (each) with pins and collars	100	45
2 ft (0,6 m) counterweight link set (each) with pins and collars	195	88
<b>NO. 79 BOOM:</b>		
30 ft (9,1 m) butt	12,165	5 517
5 ft (1,5 m) top with lower point and wire rope guide	15,595	7 073
25 ft (7,6 m) transition insert	7,340	3 329
20 ft (6,1 m) insert	6,725	3 050
40 ft (12,2 m) insert	11,145	5 055
40 ft (12,2 m) insert with equalizer platform	11,365	5 155
1 ft 0 in (0,3 m) link (each) boom top	65	29
4 ft 10-1/2 in (1,5 m) basic strap (with connector links) (each)	115	52
25 ft (7,6 m) basic strap (with connector links) (each)	350	158
20 ft (6,1 m) strap (with connector links) (each)	290	131
40 ft (12,2 m) strap (with connector links) (each)	525	238
Links (attached to equalizer) 2 with pins	75	34
Equalizer	2,160	979
Equalizer fork with pins	635	288
Equalizer weight box with jaw and hook	3,015	1 367
Upper boom point (single sheave)	725	328
Lower wire rope guide [on 40 ft (12,2 m) insert]	410	185
Upper wire rope guide [on 40 ft (12,2 m) insert]	410	185
Drum No. 9 (bare)	8,750	3 968
Boom stop (each tube)	305	138
Boom stop strut (each) with pins	30	13
<b>NO. 79-44 BOOM (Additional Components):</b>		
30 ft (9,1 m) top with lower point and wire rope guide	12,830	5 819
20 ft (6,1 m) insert - No. 44	3,215	1 458
40 ft (12,2 m) insert - No. 44	5,420	2 458
15 ft (4,6 m) transition insert - No. 79-44	4,830	2 190
Upper boom point (single sheave)	1,300	589
Wire rope guide (on transition insert)	765	346
31 ft 1-3/16 in (9,5 m) basic strap (each)	425	192
11 ft 10-3/4 in (3,6 m) strap (with connector links) (each)	325	147
20 ft 0 in (6,1 m) strap (with connector links) (each)	295	133
40 ft 0 in (12,2 m) strap (with connector links) (each)	540	244
Intermediate suspension sheave assembly (each)	80	36
57 ft 1 in (17,4 m) intermediate suspension pendant (each)	100	45
50 ft 2 in (15,3 m) intermediate suspension pendant (each)	90	40
Intermediate suspension shackle (each)	20	9
Boom suspension link	175	79
Intermediate suspension links (2 with pins)	40	18

Description	Weight	
	Pounds	Kilograms
<b>NO. 44 FIXED JIB:</b>		
40 ft (12,2 m) butt	8,605	3 903
30 ft (9,1 m) top with lower point and wire rope guide	12,040	5 461
10 ft (3,0 m) insert - No. 44	1,890	857
20 ft (6,1 m) insert - No. 44	3,215	1 458
40 ft (12,2 m) insert - No. 44	5,420	2 458
31 ft 1-3/16 in (9,5 m) basic strap (each)	400	181
20 ft 0 in (6,1m) strap (with connector links) (each)	295	133
40 ft 0 in (12,2 m) strap (with connector links) (each)	540	244
Adjustable strap (each) with pins	1,565	709
50 ft 0 in (15,2 m) jib strut with guide sheave, luffing sheaves and links	13,285	6 025
47 ft 0 in (14,3 m) main strut with luffing sheaves and links	9,425	4 275
Luffing wire rope guide	1,070	485
38 ft 2 in (11,6 m) backstay basic strap (with connector links) (each)	410	185
20 ft 0 in (6,1 m) backstay strap (with connector links) (each)	295	133
40 ft 0 in (12,2 m) backstay strap (with connector links) (each)	540	244
8 ft 1-51/64 in (2,5 m) backstay strap (attached to boom butt) (each)	150	68
Luffing jib stop assembly	1,850	839
Upper point (single sheave) with rollers	1,220	553
Strap (each) main strut to jib strut	290	131
Strap support (each) on jib strut	35	15
Link (each) with pins	115	52
Sheave and sheave support (attached to straps)	30	13
<b>No. 132 JIB:</b>		
20 ft 0 in (6,1 m) butt	1,020	462
20 ft 0 in (6,1 m) top (with jib point sheaves)	1,885	855
20 ft 0 in (6,1 m) insert	800	362
40 ft 0 in (12,2 m) basic pendant (each)	175	79
19 ft 2 in (5,8 m) pendant (each)	115	52
Jib stop pendant and link (each)	35	15
20 ft 0 in (6,1 m) strut with sheave and links	1,360	616
65 ft 7 in (20,0 m) backstay pendant (each)	240	108
26 ft 8 in (8,1 m) backstay pendant (each)	140	63
7 ft 4 in (2,2 m) backstay pendant (each)	80	36
3 ft 8 in (1,1 m) backstay link (each)	65	29
Backstay link (each)	35	15
Backstay support (each)	315	142
<b>BLOCK OPTIONS:</b>		
500 USt (454 t) load block with swivel hook	16,500	7 484
100 USt (91 t) load block with weight plates	9,800	4 445
60 USt (55 t) load block with weight plates	4,425	2 007
30 USt (27 t) load block with weight plates	3,500	1 587
15 USt (14 t) swivel hook with weight plates	1,900	861

Description	Weight	
	Pounds	Kilograms
<b>WIRE ROPE:</b>		
Boom Hoist - 2,600 ft (792 m) of 1-1/8 in (28,6 mm) wire rope - 2.58 lb per ft (3,84 kg/m)	6,710	3 043
Load Lines		
1-1/8 in (28,6 mm) wire rope - 2.58 lb per ft (3,84 kg/m)		
4,400 ft (1 341 m) No. 79 Boom	11,350	5 148
4,200 ft (1 280 m) No. 79-44 Boom	10,835	4 914
3,500 ft (1 067 m) No. 44 Fixed Jib	9,030	4 095
Alternate Load Lines		
1-1/8 in (28,6 mm) wire rope - 2.70 lb per ft (4,02 kg/m)		
4,400 ft (1 341 m) No. 79 Boom	11,880	5 388
4,200 ft (1 280 m) No. 79-44 Boom	11,340	5 143
3,500 ft (1 067 m) No. 44 Fixed Jib	9,450	4 286
1 in (25,4 mm) wire rope - 2.03 lb per ft (3,02 kg/m)		
4,400 ft (1 341 m) No. 44 Fixed Jib - maximum capacity	8,930	4 050
1,450 ft (442 m) No. 44 Fixed Jib - full hoisting range	2,945	1 335
Whip Lines		
1 in (25,4 mm) wire rope - 2.03 lb per ft (3,02 kg/m)		
1,150 ft (351 m) No. 79 Boom	2,335	1 059
1,825 ft (556 m) No. 79-44 Boom	3,705	1 680
1-1/8 in (28,6 mm) wire rope - 2.70 lb per ft (4,02 kg/m)		
1,325 ft (404 m) No. 44 Fixed Jib	3,580	1 623

**ENGLISH AND METRIC CONVERSIONS****Inverse Conversion****Direct Conversion**

MULTIPLY ( x ) known value by conversion factor to obtain equivalent value in desired units. For example, 12 ft is converted to meters (m), as follows:

$$12 \text{ ft} \times 0.3048 = 3,6576 \text{ m}$$

DIVIDE ( ÷ ) known value by conversion factor to obtain equivalent value in desired units. For example, 3,6576 m is converted to feet, as follows:

$$3,6576 \text{ m} \div 0.3048 = 12$$

To Convert	Symbol	Application	To	Symbol	Multiply By
<b>AREA</b>					
Square Inch	in <sup>2</sup>	Filter Area Clutch Contact	Square Centimeter	cm <sup>2</sup>	6.4516
Square Foot	ft <sup>2</sup>	Ground Contact	Square Meter	m <sup>2</sup>	0.0929
<b>FORCE</b>					
Pound Force	lb	Pedal Effort	KiloNewton	kN N	0.00445 4.4482
Pound Force	lb	Line Pull	KiloNewton	kN	0.00445
Pound Force Per Inch	lb/in.	Spring Force	Newton per millimeter	Nmm	0.1751
Pound Force Per Foot	lb/ft		Newton per meter	Nm	14.5939
<b>LENGTH</b>					
Inch	in.	Adjustments	Millimeter	mm	25.4000
Foot	ft	Outline Dimensions	Meter	m	0.3048
Mile	miles	Travel Distance	Kilometer	km	1.6093
<b>POWER</b>					
Horsepower	hp	Engine	Kilowatt	kW	0.7457
<b>PRESSURE</b>					
Pound/Sq. In.	psi	Hydraulic & Air	Bar		0.0689
<b>TEMPERATURE</b>					
Degrees Fahrenheit	°F	Oil, Air, Etc.	Degrees Centigrade	°C	°F - 32 ÷ 1.8
Degrees Centigrade	°C		Degrees Fahrenheit	°F	°C x 1.8 + 32
<b>TORQUE</b>					
Inch Pound	in lb	Bolt Torque	Newton Meter	Nm	0.1129
Foot Pound	ft lb		Newton Meter	Nm	1.3558
<b>VELOCITY</b>					
Miles Per Hour	mph	Vehicle Speed	Kilometers Per Hour	km/h	1.6093
Miles Per Hour	mph	Wind Speed	Meters Per Second	m/s	0.4470
Feet Per Minute	fpm	Line Speed	Meters Per Minute	m/min	0.3048
<b>VOLUME</b>					
Cubic Yard	yd <sup>3</sup>	Bucket Capacity	Cubic Meter	m <sup>3</sup>	0.7646
Cubic Foot	ft <sup>3</sup>		Cubic Meter	m <sup>3</sup>	0.0283
Cubic Inch	in <sup>3</sup>	Pump Displacement	Cubic Centimeter	cm <sup>3</sup>	16.3871

To Convert	Symbol	Application	To	Symbol	Multiply By
<b>VOLUME (LIQUID)</b>					
Ounce	oz	Fluid Capacities	Milliliter	mL	29.5735
Pint	pt		Liter	L	0.4732
Quart	qt		Liter	L	0.9464
Gallon	gal		Liter	L	3.7854
Gallon Per Minute	gpm	Pump Flow	Liters Per Minute	L/min	3.7854
<b>WEIGHT</b>					
Pound	lb	Unit/Component	Kilogram	kg	0.4536
US Ton (2000 lb)	USt	Load Ratings	Metric USt	t	0.9072
US Ton (2000 lb)	USt		Kilogram	kg	907.1847

**CHANGE OF OWNERSHIP REGISTRATION**

A new owner of a Manitowoc crane should register the crane with Manitowoc Crane Care so we can contact you if the need arises. To register your crane:

1. Go to [www.manitowoccranes.com/en/services/crane-care/service-and-tech-support/Change-of-Ownership-Form](http://www.manitowoccranes.com/en/services/crane-care/service-and-tech-support/Change-of-Ownership-Form)
2. Complete the form.

**MANITOWOC DEALER**

For questions about this manual, the MLC165 crane, or the MLC165 luffing jib, contact a Manitowoc dealer. Before calling, find the model and serial number of the crane or attachment. This information is located on the identification plate on the crane cab or attachment.

To locate the Manitowoc dealer nearest to you:

1. Go to [www.manitowoccranes.com/en/our-company/dealers](http://www.manitowoccranes.com/en/our-company/dealers)
2. Follow the on-screen prompts to locate your Manitowoc dealer.

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Reference Only

## SECTION 2

### SAFETY INFORMATION

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## SECTION 2 SAFETY INFORMATION

### DIESEL ENGINE EXHAUST



#### WARNING

##### California Proposition 65

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

Battery posts, terminals, and related accessories contain chemical lead and lead compounds, chemicals known to the State of California to cause cancer, birth defects, and other reproductive harm. Wash hands after handling.

##### California Spark Arrestor

Operation of this equipment may create sparks that can start fires around dry vegetation. A spark arrestor may be required. The owner/operator should contact local fire agencies for laws or regulations relating to fire prevention requirements.

### NAMEPLATES AND DECALS

See drawings at the end of this section.

### CONTINUOUS IMPROVEMENT

Due to continuing product innovation, the information in this manual is subject to change without notice. If in doubt about any procedure, contact your Manitowoc dealer.

### SAFETY MESSAGES

#### General

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

To alert personnel to hazardous operating practices and maintenance procedures, safety messages are used throughout the manual. Each safety message contains a

safety alert symbol and a signal word to identify the hazard's degree of seriousness.

#### Safety Alert Symbol



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. **Obey all safety messages that follow this symbol to avoid possible death or injury.**

#### Signal Words



#### DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.



#### WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.



#### CAUTION

Used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

#### CAUTION

Without the safety alert symbol, identifies potential hazards that could result in property damage.

**NOTE:** Highlights operation or maintenance procedures.

#### Safety Symbols

Safety symbols used in the decals on this crane are identified in Figure 2-1.

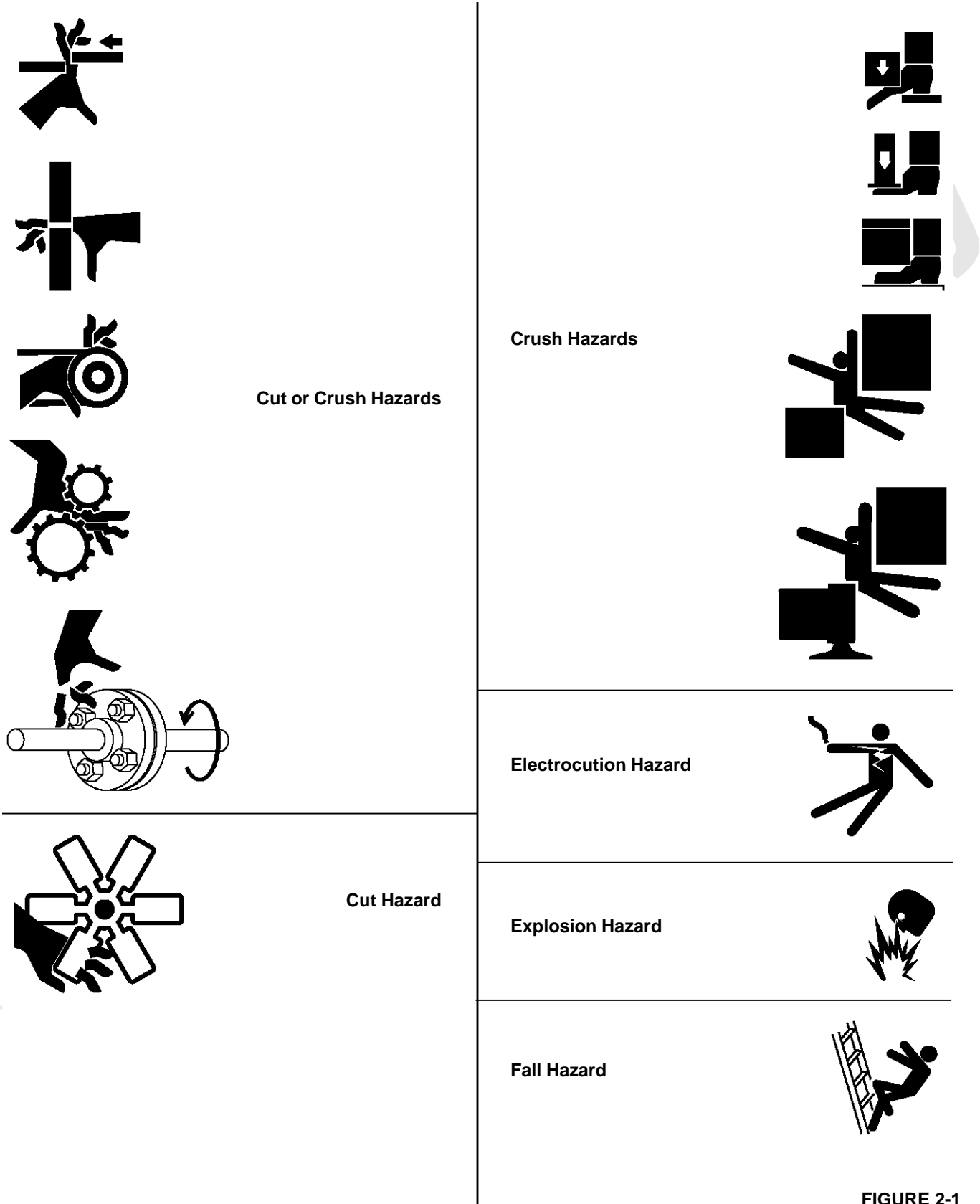
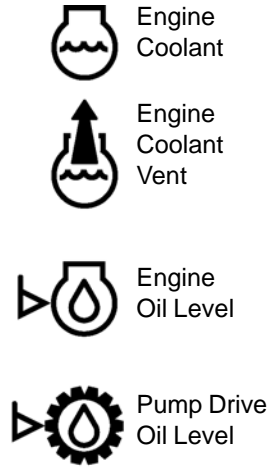


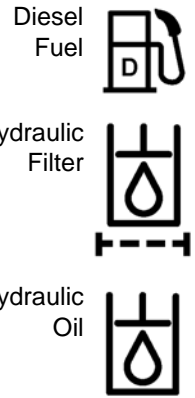
FIGURE 2-1



Fall Hazards



Fluid Symbols



Falling Boom Hazards  
(Crush Hazard)

Flying Object Hazards



Overhead Obstruction Hazard



Falling Load Hazards  
(Crush Hazard)

Power Line Hazard  
(Electrocution)

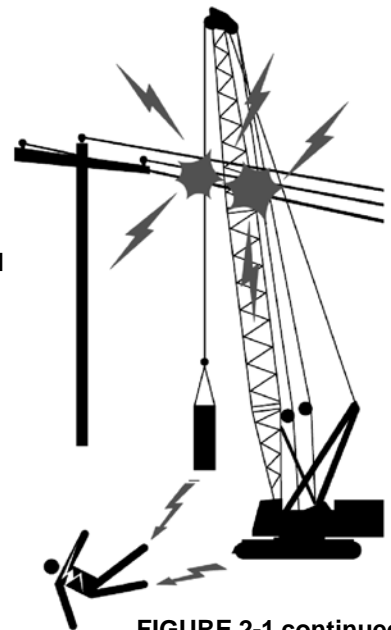


FIGURE 2-1 continued



Fire Extinguisher


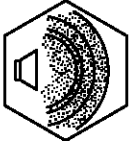
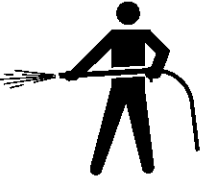

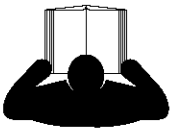


 <p>Personal Fall Protection</p>	<p>Sound Power Level</p> 
 <p>Pressure Cleaning</p>	<p>Read Manual</p>  
 <p>Pressure Release Hazard</p>	<p>Tire Pressure (if applicable)</p> 

FIGURE 2-1 continued

## SAFETY AND INFORMATION SIGNS

### Maintaining Signs

The crane owner/user shall make sure that all safety and information signs are legible and installed at the proper locations on the crane. If a sign has been defaced or removed, it must be replaced immediately. See the Nameplate and Decal Drawing at the end of this section for the installation locations of signs.

### Ordering Signs

Order replacement safety and information signs from your Manitowoc dealer.

When ordering a sign, give the crane model number, the crane serial number, and the name and part number of the sign.

## CRANE ACCESS POINTS



### WARNING

#### Crushing Injury Hazard!

Rotating bed can swing into and crush personnel climbing on or off crane.

Moving crawlers can crush personnel climbing on or off crane.

To prevent death or serious injury:

- Barricade all accessible areas to crane so personnel cannot be struck or crushed when upperworks is swung.
- Do not climb on or off crane while upperworks is being swung or crane is being traveled.
- Signal operator for permission to climb on or off crane.
- Operator: do not swing or travel while personnel are climbing on or off crane. Stop swing and travel motions. Apply swing brake and turn on travel park.
- Automatic alarms will sound to alert personnel when the crane is swung or traveled.

**NOTE:** If the swing and travel alarms are not operating properly, they must be repaired as soon as possible. Until they are repaired, the operator must alert personnel to crane movement using the horn on the control console.

Take necessary precautions to prevent slipping and /or falling off the crane or attachment during assembly, disassembly, maintenance, or other work. **Falling from any height could result in serious injury or death.**

Manitowoc has provided stairways, ladders, and platforms at the locations shown in Figure 2-2.

The owner/user must provide workers with approved ladders or aerial work platforms to access those areas of the crane, mast and boom that cannot be reached from the ground or from steps, ladders, catwalks, and platforms provided by Manitowoc.

*Adhere to local, state, and federal regulations for handling personnel and for personnel fall protection.*

- Access points must be kept clear to prevent personal injury and unsafe operation of crane. The operator must store his/her clothing and other personal belongings so they do not interfere with controls in operator's cab or with operation of crane.

- Do not allow ground personnel to store their personal belongings (clothing, lunch boxes, water coolers, and the like) on the crane.

This practice will prevent ground personnel from being crushed or electrocuted when they attempt to access personal belongings stored on the crane.

- Tools, oil cans, spare parts, and other necessary equipment must be stored in tool boxes or other appropriate locations. Do not allow these items to lie around loose in operators cab or on steps, ladders, catwalks, and platforms.
- To reduce the risk of slipping, non-skid material (sand in paint) has been applied to painted walkways and platforms. However, walkways and platforms can be slippery when wet and when oil or grease is spilled on them. **Keep walkways and platforms clean and dry to prevent slipping on them.** When non-skid material wears out, reapply it.
- Wear shoes with a highly slip-resistant sole material. Clean any mud or debris from shoes before entering the crane cab or climbing onto the crane. A shoe that is not clean might slip off a control pedal during operation.
- Do not make modifications or additions to the crane's access system that have not been evaluated and approved by Manitowoc.
- Do not use top of mast, boom or jib as walkways. (unless they have optional catwalks).

**NOTE:** Optional walkways (catwalks) are available for the boom and luffing jib sections, but only for those countries that authorize their use.

Two ladders, stored in the boom butt, are available for boom assembly and disassembly if the #44 Boom was purchased. See Boom Ladder Assembly in Section 4 of this manual for instructions.

## GETTING ON OR OFF CRANE

Personnel getting on and off the crane shall do so only at the steps provided and only **while crane is parked.**

Never climb onto or off a moving crane. **Climb onto and off crane only when it is parked and only with operator's permission.**

When personnel use ladders to get on or off the crane or attachment, their hands shall be free of any objects. Objects which cannot be carried in pockets or tool belts shall be lifted into place with a hand line or hoist.

Always maintain three points of contact when climbing ladders: two feet and one hand or two hands and one foot.

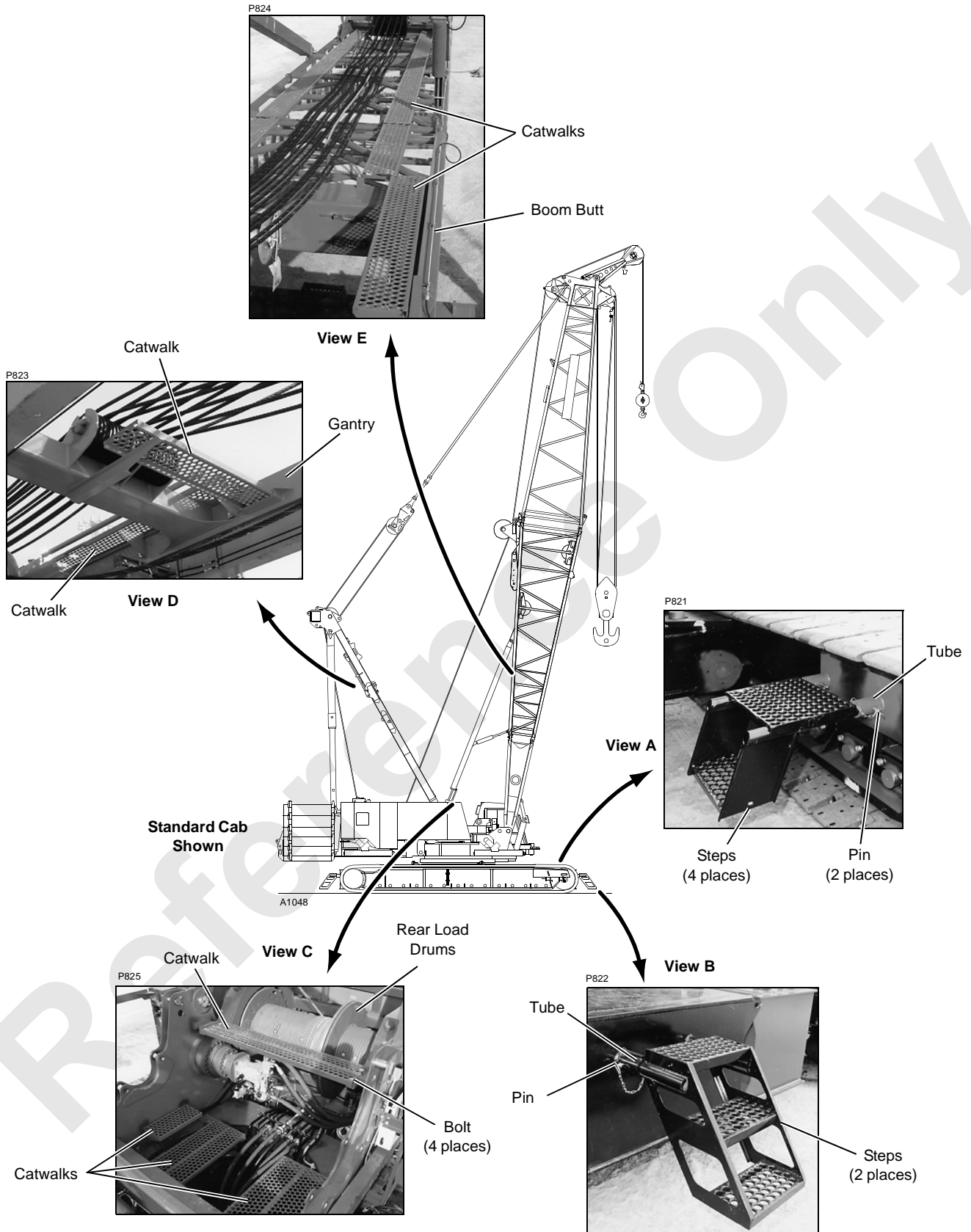
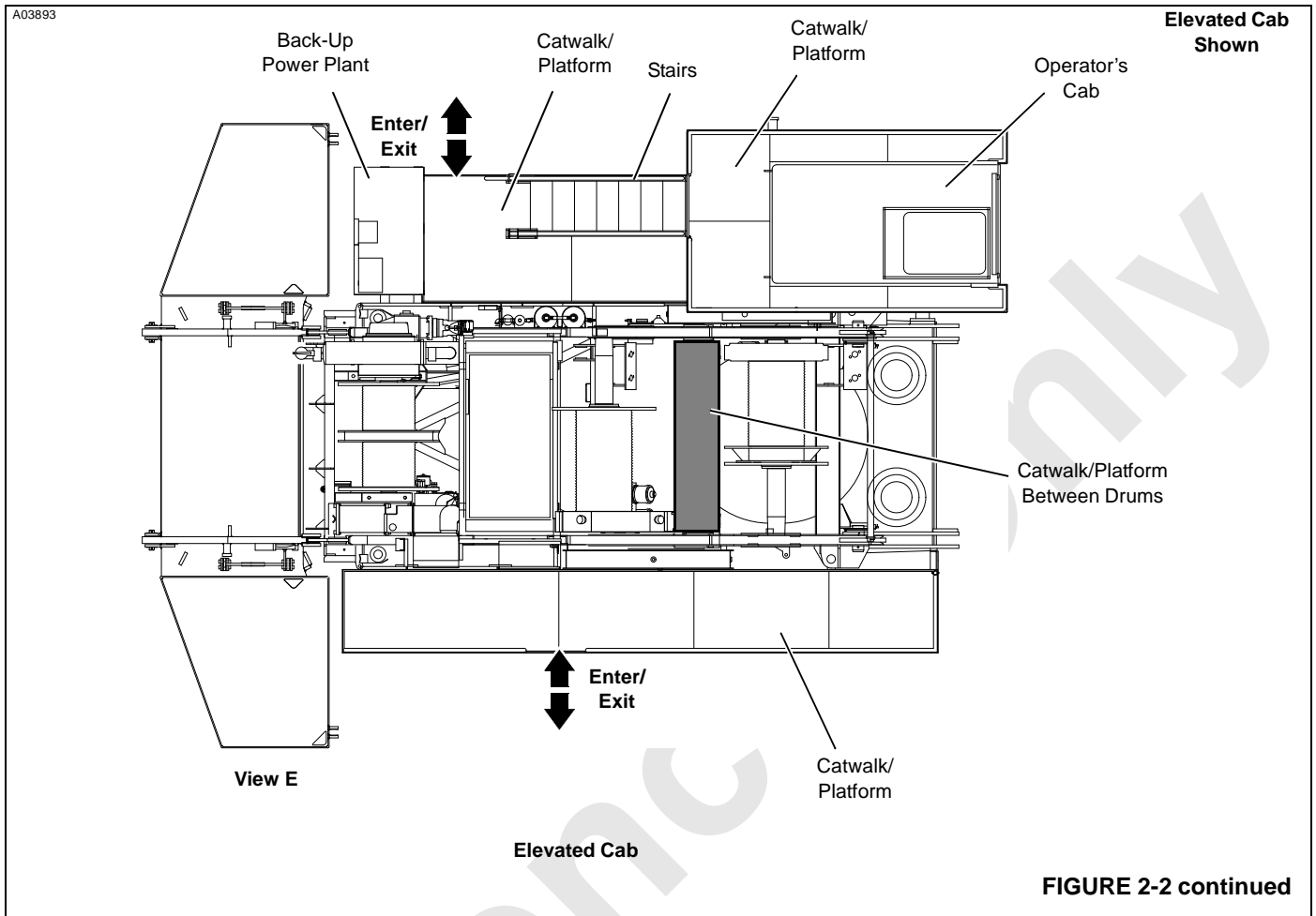


FIGURE 2-2



## OPERATOR'S MANUAL/CAPACITY CHART STORAGE

Manitowoc provides the following manuals and other important literature with your crane and attachment (Luffing Jib, etc.):

- Operator's Manual (Serial Numbered)  
*Contains safety information, crane specifications, assembly/erection procedures, operating instructions, lubrication and maintenance checks.*
- Parts Manual (Serial Numbered)  
*Contains illustrations and part numbers of replaceable parts.*
- Capacity Chart Manual (Serial Numbered)  
*Contains lifting capacities and related information (wire rope specifications, drum and lagging information, etc.)*
- Maintenance Checks and Lube Guide  
*Contains lists of maintenance checks and lube services and their prescribed intervals.*
- Rated Capacity Indicator/ Limiter Operation  
*Contains rated capacity indicator and/or rated capacity limiter operation, limits, and calibration procedures.*
- Service Manual (Serial Numbered)  
*Contains theory of operation, maintenance procedures, crane and wire rope inspection procedures, troubleshooting information, and shop procedures.*

The manuals which must be retained in the operator's cab (Operator's Manual, Capacity Charts, Maintenance Checks and Lube Guide, and RCL Operation) are supplied in an OPERATOR INFORMATION binder. A separate binder is provided for the crane and each applicable attachment.

The Operator's Manuals and Capacity Charts are stamped with the serial number of the crane or attachment. The serial number on the manuals and capacity charts must match the serial number of the crane and attachment in use. **Using any other manual or Capacity Chart is prohibited.**

- The crane model and serial number is located on the Crane Identification Plate on the crane cab.
- The model and serial number of the attachment (other than standard boom) is located on the Crane Identification Plate on the attachment.

If the serial numbers of your manuals and Capacity Charts do not match the serial numbers of the crane or attachment, contact your Manitowoc dealer for the proper manuals or Capacity Charts.

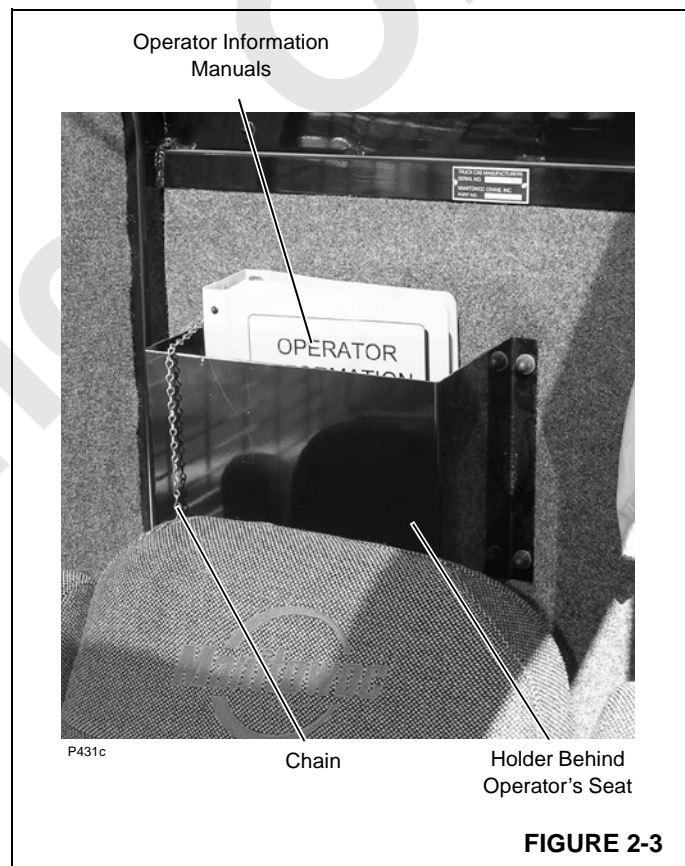
**Do not operate crane or attachment if proper Capacity Chart is not in cab.**

### Storing Manuals

Store the Operator Information Manuals for the crane and each applicable attachment in the holder in the Operator's cab (Figure 2-3).

Chain the manual to the link provided.

Keep all other manuals provided with the crane in the crane owner's/user's office so they are readily available when needed.



**FIGURE 2-3**



## SAFE OPERATING PRACTICES

### General

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

The safety information in this publication is intended only as a guide to assist qualified operators, supervisors and planners, rigging personnel, and job site personnel in safe operation. Manitowoc cannot foresee all hazards that will arise in the field; therefore, **safety remains responsibility of crane operators and owner.**

Local, state, and other governmental agencies may require stricter operating practices. When a conflict in practices exists, follow the strictest practice.

### Read Operator's Manual

Safe and efficient assembly, disassembly, and operation of this crane requires that it be maintained in proper working order and that its operators and maintenance personnel be familiar with the crane's functions and capabilities.

The Operator's Manual supplied with and considered part of your crane must be read and completely understood by each person responsible for assembly, disassembly, operation, and maintenance of the crane.

The Operator's Manual must be read to personnel who can not read or understand English or other language into which the manual is translated.

Because of a program of continuing improvement in product design, Manitowoc reserves the right to change the information and specifications contained in the Operator's Manual at any time without notice. If you have any questions regarding the crane or its Operator's Manual, please contact your Manitowoc dealer.

### Operator Qualifications

The crane shall be operated only by the following **qualified** personnel:

1. Designated operators.
2. Trainees under direct supervision of a designated operator.
3. Supervisors, inspectors, and maintenance or test personnel when necessary in performance of their duties. Operation of the crane by these personnel shall be limited to the crane functions needed to perform the inspection or to verify the crane's performance after maintenance procedures.

**No personnel shall be allowed to climb onto the crane or enter the crane cab unless performance of their duties requires them to do so, and then only with knowledge of operator or other qualified person.**

**Qualified person** is defined as one who by reason of training and experience is thoroughly familiar with crane operations and the hazards involved. Such a person shall meet the operator qualifications specified in Occupational Safety and Health Administration (OSHA) Regulations (United States Federal Law), in ASME B30.5 American National Standard, or in any other applicable federal, state, or local laws.

**Operator training and qualification is crane owner's responsibility.**

**NOTE:** The regulations and standards mentioned above and later in this section can be obtained from:

**US DOL/OSHA** Rules and Regulations are available by mail from the Superintendent of Documents, PO Box 371954, Pittsburgh, PA, 15250-7954 or by:

- Phone 202-512-1899
- Fax 202-512-2250
- Online at [www.osha.gov](http://www.osha.gov).

**ASME** (formerly ANSI) B30 Series American National Standards are available by mail from the ASME, 22 Law Drive, Fairfield, New Jersey, 0700-2900 or by:

- Phone US & Canada 800-843-2763
- Phone Mexico 95-800-843-2763
- Phone Universal 973-882-1167
- Fax 973-882-1717 or 973-882-5155
- E-mail [infocentral@asme.org](mailto:infocentral@asme.org).

### Operator Conduct

1. The operator shall not engage in any practice which diverts his/her attention while operating the crane.
2. The operator shall not operate the crane when he/she is physically or mentally unfit.
3. The operator shall be responsible for all operations under his/her direct control. When safety of an operation is in doubt, the operator shall stop the crane's functions in a controlled manner. Lift operations shall resume only after safety concerns have been addressed or the continuation of crane operations is directed by the lift supervisor.
4. The operator shall be thoroughly familiar with operation of crane and its proper care. If adjustments or repairs are

necessary or if there are known defects that impair safe operation, the crane shall not be operated until unsafe conditions have been corrected.

5. If there is a warning sign at the start controls, the operator shall not start the engine until the warning sign has been removed by the person who installed it.
6. Before starting the engine, the operator shall make sure that:
  - a. All daily inspection and maintenance services have been performed.
  - b. All controls are in off the position and all brakes and locking devices are applied or engaged.
  - c. All personnel are clear of the crane. Deploy a swing radius barrier.



### WARNING

Safety devices and operational aids such as rated capacity indicator or limiter, boom and jib angle indicator or limiter, anti-two-block device, level indicator, swing limiter, proximity device, etc., may be installed on your crane. Such devices are to be used only as **AIDS TO ASSIST OPERATOR**; their presence on crane in no way substitutes for or lessens requirement that operator knowledge, experience, and judgment are required to ensure safe operation of crane.

**Crane shall not be loaded beyond applicable static or dynamic ratings given in Capacity Chart for crane.**

- See Size of Load later in this section.
- For a description of each safety device and operational aid, see Safety Devices and Operational Aids in this section and Section 3 of this manual.

7. The operator shall test all controls, limits, and communication systems at the start of each shift. Any defects found shall be corrected before operation is begun.
8. The operator shall not start crane movement if the load or designated signal person is not within his/her range of vision or communication.
9. The operator shall understand and respond to signals from the person directing the lift or from the designated signal person. When a signal person or crane follower is not required, the operator is responsible for the lift. **Operator shall obey a stop signal at all times, no matter who gives it.**
10. The operator shall verify that the Capacity Chart being used is the correct one for the cranes configuration (boom length, load line reeving, counterweight, etc.).

11. The operator shall verify that:

- a. All attachments are properly assembled and attached to the crane according to the rigging drawings called for in the Capacity Chart.
- b. The counterweight — to include applicable auxiliary counterweight — is in place and of proper weight. **Maximum required counterweight shall not be exceeded.**



### WARNING

#### Moving Load/Tipping Crane Hazard!

Changing weather conditions including but not limited to: wind, ice or snow accumulation, precipitation, flooding, lightning, etc. should be considered when determining the location and configuration of a crane when it will be left unattended.

- c. The operator shall perform the following operations before leaving the operator's cab for any reason:
  - a. Park crane and position upperworks so crane does not interfere with operation of other equipment.
  - b. Apply travel and swing brakes or locking devices.
  - c. Land any attached load.
  - d. Lower the boom onto blocking at ground level or onto a boom rest if possible.

If the boom cannot be lowered, as determined by a qualified designated person, it must be securely fastened from movement by wind or other outside forces (see Wind Conditions in Capacity Chart Manual).

**NOTE:** The designated person must be familiar with the job site limitations, the crane configuration, and the expected weather conditions.

- e. Move all controls to off.
- f. Apply all drum brakes and pawls.
- g. Disengage the master clutch, if equipped.
- h. Stop the engine.

**NOTE:** Also read Unattended Crane instructions in Section 3 of the Crane Operator's Manual.

12. The operator shall perform the following operations if power or a control function fails during operation:
  - a. Land all suspended loads, if possible, under brake or power control.
  - b. Apply all brakes and locking devices.
  - c. Move all controls to off.

13. If the crane will be operated at night, the operator shall make sure that there is sufficient lighting for safe operation. The load and landing area shall be illuminated.

14. The operator shall not operate the crane during periods of bad weather if his/her ability to see the load or the signal person is impaired by darkness, fog, rain, snow, and the like.

Do not operate the crane with a snow or ice covered boom. The extra weight may cause overload, tipping, or structural damage.

Never operate the crane during an electrical thunderstorm.

When a local weather storm warning exists (including electrical thunderstorm), stop operation and secure the crane. See step c under Operator Conduct topic.

**NOTE:** DO NOT depend on grounding. Grounding of a crane affords little or no protection from electrical hazards. The effectiveness of grounding is limited by the size of the conductor (wire) used, condition of the ground, the magnitude of voltage and current present, and numerous other factors.

15. Wind can cause the crane to tip or the boom and other attachments to collapse. The operator or qualified person directing the lift shall compensate for the effect of wind on the load and boom by reducing ratings, reducing operating speeds, or a combination of both.

Unless otherwise specified in the Capacity Chart, or in Operator's Manual, stop operation under the following wind conditions:

- a. If the wind causes the load to swing forward past the allowable operating radius or sideways past either boom hinge pin, land the load and apply the drum brakes.
- b. If the wind exceeds 35 mph, land all loads and apply the drum brakes, lower the boom onto blocking at ground level or otherwise restrain it, and apply the swing and travel brakes and/or locks.

**NOTE:** "**Land load**" means to set it down on a firm uniformly supporting surface.

16. Booms, jibs, or masts which are being assembled or disassembled on the ground (with or without support of boom rigging) shall be securely blocked to prevent the boom, jib, or mast sections from dropping.

**Workers shall not go under boom, jib, or mast sections when removing connecting pins or bolts.**

17. Each outrigger shall be visible to the operator or the signal person during extension and retraction.

## Handling Load

### Size of Load

1. The crane shall not be loaded beyond the applicable static or dynamic ratings given in the Capacity Chart for the crane configuration.

**NOTE:** Capacity charts for Manitowoc cranes show the total weight of freely suspended loads for various boom and jib lengths and operating radii.

**"Freely suspended load"** is a load that is hanging free with no direct external force applied except by the crane's load-line reeving.

To determine the actual weight of the load which can be lifted at a given radius (working load), the operator must deduct the weight of certain lifting equipment from the total weight given in the chart. See the specific Capacity Chart for your crane for a list of lifting equipment which must be deducted.

The operator's judgment must be used to further reduce total the load to allow for the dynamic effects of swinging, hoisting, or lowering, and adverse weather conditions to include wind.

2. The operator or other designated person directing the lift shall verify that the weight of load is within the static or dynamic rating for the radius at which the load will be lifted.

**Verified weights and measured radii shall take priority over RCI/RCL readings.**

### Attaching Load

1. Attach the hook to the load with slings, or other suitable rigging. Each hook shall have a latch that is in proper working order. **Hook latches shall not be wired open.**
  - a. Inspect each hook and latch before using.
  - b. Never use a hook or latch that is distorted or bent.
  - c. Make sure spring will force the latch against the tip of the hook.
  - d. Make sure the hook supports the load. The latch must never support the load. Latches are only intended to retain loose slings under slack conditions.
2. Only use slings and other rigging that are in safe operating condition and have a rating equal to or greater than the load to be lifted.
3. Do not wrap the load line around the load.
4. Use suitable protection between slings and any sharp edges on the load. When synthetic slings are used, the synthetic sling manufacturer's instructions, limitations, specifications, and recommendations must be followed.

5. Secure unused legs of a multi-leg sling before handling a load with one leg of sling.

### Lifting/Moving Load

1. Before lifting or moving a load, the operator or qualified person directing the lift shall make the following checks:

- a. Crane has a firm, uniformly supporting foundation under all crawlers. Unless otherwise specified in the Capacity Chart, the foundation shall be *level to within 1% — 1ft (0,3 m) rise or fall in 100 ft (30,5 m) distance.*

When such a surface is not available, it shall be provided with timbers, cribbing, or other structural members to distribute the load such that the allowable bearing capacity of the underlying member is not exceeded.

*For ground bearing data go to:  
www.manitowoccranes.com/site/EN/  
groundbearingpressure.aspx.*

- b. The load is secured and properly balanced in the slings or the lifting device before lifting the load more than 3 to 6 in (76 to 152 mm).
- c. The lift and swing paths are clear of personnel and obstructions.
- d. The load is free to be lifted.
- e. The load line is not kinked or otherwise damaged.
- f. Multiple part load lines are not twisted around each other in such a manner that the lines will not separate when the load is lifted.
- g. The hook is brought over the load in a manner that will minimize twisting or swinging.
- h. The load line and the boom hoist rope are properly spooled on the drums and seated in the sheaves.
- i. The load drum brakes are in proper working order.

The operator shall test the load drum brakes each time a load approaching the rated load is handled. Lift the load 3 to 6 in (76 to 152 mm) and fully apply the brakes — *load must not lower through applied brakes.*

- j. Unused load drums are parked (working and parking brakes applied; if equipped, drum pawls engaged).
- k. All personnel are clear of the swing radius of the crane's counterweight.

2. While lifting or moving the load, the operator shall take the following precautions:

- a. Accelerate and decelerate the load smoothly to avoid excessive stress on the crane boom and machinery.
- b. Avoid sudden starts and stops while swinging. Keep the swing speed under control to prevent the load from swinging out beyond the radius at which the load can be handled and to minimize the pendulum action of the load.
- c. Sound the signal horn before swinging and intermittently while swinging, especially when approaching personnel.

If equipped, the automatic swing alarm will sound when the crane is swung.

- d. Use taglines or other restraints to control the load when necessary.
- e. Do not exceed any swing limitations (areas of operation) given in the Capacity Chart.
- f. Do not allow the load, the boom, or any other part of the crane to contact obstructions.
- g. Do not use the crane to drag a load.
- h. Do not hoist, lower, or swing the load while personnel are on the load or the hook. See Personnel Handling in this section.
- i. Avoid carrying the load over personnel. Loads which are suspended shall be blocked or cribbed before personnel are allowed to work under or between them.
- j. Before lifting a load which requires the use of outriggers (or anytime outriggers are used), fully extend the outrigger beams and jacks so the truck tires do not bear any load.

Securely fasten the outrigger jack pads or floats to jacks and set them on a flat, firm surface that will support the load placed on the pads or floats. Do not set the jack pads or floats in holes, on rocky ground, or on extremely soft ground.

When dictated by ground conditions, install wood blocking or steel plates under the jack pads or floats to properly distribute the loading on the supporting surface.

Wood blocking or steel plates used under the jack pads or floats shall be:

- Free of defects.
- Strong enough to prevent crushing, bending, or shear failure.
- Of sufficient thickness, width, and length to completely support the jack pad or float, transmit the load to the supporting surface, and

prevent shifting, toppling, or excessive settlement under load.

- k.** Fully retract and lock the jacks and the outrigger beams so they cannot extend when not in use.
- l.** Operate with extreme caution when using two or more cranes to lift the same load.

One designated person shall be responsible for operation when two or more cranes are used to lift same load. The designated person shall analyze the lift and instruct all personnel involved in proper rigging and positioning of the load and all movements to be made. Decisions such as the necessity to reduce crane ratings, load position, boom position, ground support, and speed of movements shall be in accordance with the designated person's decision.

- m.** Do not lower the load or the boom to a point where less than three full wraps of wire rope are remaining on the respective drum (or as otherwise indicated in local, state, or federal regulations).
  - n.** Engage the boom hoist pawl when operating with the boom at a fixed radius.
  - o.** Engage the luffing hoist pawl when operating with the luffing jib at a fixed radius.
- 3.** While traveling, the operator shall take the following precautions:
- a.** Sound the signal horn before traveling and intermittently while traveling, especially when approaching personnel.

If equipped, the automatic travel alarm will sound when the crane is traveled.

- b.** Carry the boom in-line with the lowerworks and facing the direction of travel.
  - c.** Do not position the boom so high that it could bounce over backwards whether traveling with or without load.
  - d.** Secure the rotating bed against rotation except:
    - When operating with a MAX-ER® attachment.
    - When it is necessary to negotiate a turn, and then only when the operator is seated at controls or the boom is supported on a dolly.
  - e.** Lash or otherwise restrain unused hooks so they cannot swing freely.
- 4.** Before traveling with a load, the operator shall take the following additional precautions:
- a.** A designated person shall be responsible for operation. Decisions such as the necessity to reduce crane ratings, load position, boom position, ground support, and speed of movements shall be in accordance with the designated person's decision.
  - b.** Maintain specified tire pressures (truck cranes).
  - c.** Avoid sudden starts and stops. Use taglines or other restraints to control the position of the load.

## Multiple Load Line Operation



### WARNING

#### Avoid Over Load and Side Load Damage to Crane

Manitowoc highly recommends that you contact your Manitowoc dealer for lift planning assistance and approval.

Multiple load line operation is becoming common practice for applications like panel tilt-up, pile tilt-up, pile driving, rolling fabricated sections, etc. The multiple lines may be on a common shaft (each with different parts of line) or on multiple shafts (lower boom point and upper point, boom point and fixed jib point, etc).

Manitowoc authorizes multiple load line operation for those applications requiring it, provided the following steps are performed:

1. The qualified lift planner and the crane operator shall read and become thoroughly familiar with the appropriate Capacity Charts and Wire Rope Specification Charts.
2. The lift planner and the crane operator shall make sure the total load does not exceed the rated capacity given in the Capacity Chart and Wire Rope Specification Chart for given boom point or jib point, whichever is less.

EXAMPLE: If one load line is lifting from the jib point, the proper jib chart applies.

3. The crane shall be thoroughly inspected by a qualified person prior to setup.
4. The crane shall be thoroughly inspected for load line interference caused by routing and reeving of multiple load lines. If interference is found, it shall be eliminated.
5. For cranes produced before 2003, Rated Capacity Indicators/Limiters were not required by ASME B30.5 for non-personnel lifting.

To aid the operator in staying within the crane's Capacity Chart with the total applied load, Manitowoc recommends that its cranes be equipped with Rated Capacity Indicators/Limiters to monitor the load on each load line.

**Operator is still responsible for knowing load and radius whether or not crane is equipped with load indicator(s).**

6. Manitowoc recommends that each load line be equipped with an anti two-block device.

7. Manitowoc's Capacity Charts are based on freely suspended loads. To prevent side load damage to the boom, the jib, and the sheaves:

- The load lines must hang as close to vertical as possible to minimize side and forward loads.

The distance between the load points and the hook points must be a minimum of three times the horizontal distance between the hook point on the load being lifted.

- The load must remain centered on the boom and jib point shafts unless special lift approval is granted by Manitowoc.
- The load lines should be located over the load's center of gravity as it is supported on a trailer, a barge, or the ground.

8. The crane operator must be familiar with the operational characteristic of the crane as it relates to multiple drum operation (simultaneous operation, same or opposite direction, or individual operation).
9. When using tandem drums, the maximum operating layers may be limited depending on whether the crane was initially designed for tandem drum operation or not.
10. Load shift when lifting with two hooks may be more unpredictable than typical one hook lifting.

### Holding Load

When a load is suspended, the operator shall take the following precautions:

1. Not leave his/her position at the controls.
2. Not allow personnel to stand or pass under the load.
3. Move all controls to off, apply all drum brakes, engage the boom hoist pawl, and apply the swing and travel brakes or locks.

### SIGNALS

1. Continuous communication shall be maintained between the operator and the signal person during all crane movements. If communication is disrupted, **operator shall stop all crane movements.**
2. Signals to the operator shall be in accordance with the standard signals shown in Section 3, unless communications equipment (telephone, radio, etc.) is used.
3. All signals shall be easily understood by the operator at all times. The operator shall not respond to any signal which is not clearly understood.
4. For operations not covered in the standard signals, or for special situations or emergencies, 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 shall not conflict with or have potential to be confused with the standard signals.

5. When it is necessary to give instructions to the operator (other than those established by the signal system), all crane motions shall be stopped.
6. The signal person shall:
  - a. Be tested by a designated person and show that he or she has a basic understanding of crane operations and limitations, to include boom deflection.
  - b. Be thoroughly familiar with the standard hand signals and voice signals if used.
  - c. Be positioned in clear view of the operator. The signal person's position should give him or her a clear view of the load, the crane, and the operating area.
  - d. Direct the load so it does not pass over personnel.
  - e. Keep unnecessary personnel out of the crane's operating area.
7. When moving the crane, the following audible signals shall be used:
  - a. STOP - one short audible signal.
  - b. GO AHEAD - two short audible signals.
  - c. BACK UP - three short audible signals.

## SAFETY DEVICES



### WARNING

Do not operate crane unless all safety devices listed in this section are in proper working order.

- If a safety device stops working properly during operation, the operator must safely stop operation.
- If any safety device listed in this section is not in proper working order, the safety device must be taken out of service and crane operation must not resume until the safety device is again working properly.
- Alternative measures are not permitted to be used for a faulty safety device.
- Always tag-out any faulty safety device and place a warning tag in the cab stating that the crane is out of service and must not be used.

Manitowoc provides the following safety devices on its cranes.

1. Horn activated by a switch on the control console in the operator's cab.  
If the horn is not working properly, it must be tagged-out or removed, if possible.
2. Crane level indicator: either electronic (viewable in crane's electronic display) or mechanical (viewable from operator's cab seat). If the crane level indicator is not working properly, it must be tagged-out or removed, if possible.
3. Cranes operating on a barge require: a trim indicator, a swing brake, and a wind direction indicator if the wind is a factor (supplied by crane owner or user).
4. Boom stops, both physical and automatic.  
If a boom stop is damaged or not working properly, it must be tagged-out or removed if possible.
5. Jib stops, both physical and automatic (for fixed jib and luffing jib).  
If a jib stop is damaged or not working properly, it must be tagged-out or removed, if possible.
6. Pedal locks for all foot-operated brakes (if applicable).  
If a pedal lock is damaged or not working properly, it must be tagged-out or removed if possible.
7. An integral holding device or check valve on each jacking cylinder.

## OPERATIONAL AIDS



### WARNING

Do not operate crane unless all applicable operational aids listed in this section are in proper working order, except:

- Where an operational aid is being repaired.
- The crane user implements a specified temporary alternative measure.

If an operational aid stops working properly during operation, the operator must safely stop operation until the temporary alternative measures are implemented or the device is again working properly.

Manitowoc provides the following operational aids on its cranes, either as standard equipment or optional equipment. The operational aids are designated as Category 1 or Category 2:

## Category 1 Operational Aids

If a Category 1 operational aid is not working properly, it must be repaired no later than 7 calendar days after the deficiency occurs.

Exception: If the crane user documents that he/she has ordered the necessary parts within 7 calendar days of the occurrence of the deficiency, the repair must be completed within 7 calendar days of receiving the parts.

### 1. Boom or Luffing Jib Angle Limiter (automatic boom or jib stop)

*Temporary alternative measures if inoperative or malfunctioning:*

The qualified person directing the lift shall make sure the maximum boom or jib angle/radius specified in the Capacity Chart for the load being handled is not exceeded. One or more of the following methods must be used:

- a. Measure radius using a tape measure.
- b. Measure the boom angle with a protractor-level on the centerline of boom.
- c. Clearly mark the boom or luffing hoist cable (so it can easily be seen by the operator) at a point that gives the operator sufficient time to stop the boom or jib within the minimum allowable radius.

In addition, install mirrors or remote video cameras and displays if necessary for the operator to see the mark.

- d. Clearly mark the boom or luffing hoist cable (so it can easily be seen by a designated signal person) at a point that gives the signal person sufficient time to signal the operator and have the operator stop the boom or jib within the minimum allowable radius.

### 2. Anti-Two-Block Device

*Temporary alternative measures if inoperative or malfunctioning:*

The qualified person directing the lift shall establish procedures to furnish equivalent protection. One or more of the following methods must be used:

- a. Assign a signal person to signal the operator to stop hoisting when the load is a safe distance from the boom or jib point.
- b. Clearly mark the hoist cable (so it can easily be seen by the operator) at a point that will give the operator sufficient time to stop the load a safe distance from the boom or jib point.

**NOTE:** The temporary alternative measures for the anti-two-block device do not apply when lifting personnel in load line supported baskets. ***Personnel shall not be lifted in load line supported baskets when anti-two-block devices are not functioning properly.***

## Category 2 Operational Aids

If a Category 2 operational aid is not working properly, it must be repaired no later than 30 calendar days after the deficiency occurs. Exception: If the employer documents that it has ordered the necessary parts within 7 calendar days of the occurrence of the deficiency, and the part is not received in time to complete the repair in 30 calendar days, the repair must be completed within 7 calendar days of receiving the parts.

### 1. Rated Capacity Indicator/Limiter

*Temporary alternative measures if inoperative or malfunctioning:*

The qualified person directing the lift shall establish procedures for determining load weights and shall make sure that the weight of the load does not exceed the crane's rating at the radius where the load is handled.

The weight of the load must be provided to the operator before the lift is made.

### 2. Boom Angle or Radius Indicator

*Temporary alternative measures if inoperative or malfunctioning:*

- a. Refer to the pendulum boom angle indicator on the boom butt (viewable from operator's cab).
- b. Measure the boom angle with a protractor-level on the centerline of boom.
- c. Measure radius using a tape measure.

### 3. Jib Angle or Radius Indicator

*Temporary alternative measures if inoperative or malfunctioning. Use either or both:*

- a. First, make sure you know the boom angle (see item 2 above).
- b. Then, measure radius using a tape measure.

### 4. Drum Rotation Indicator

*Temporary alternative measures if inoperative or malfunctioning:*

Mark the drum to indicate its rotation.

If the operator cannot see the drum, add mirrors or remote video cameras and displays so the operator can see the mark.



## 5. OPTIONAL Swing Limiter or Proximity Device

*Temporary alternative measures if inoperative or malfunctioning:*

The qualified person directing the lift shall establish procedures to furnish equivalent protection (for example, assign an additional signal person to observe the distance between the boom or load and job site obstructions to include power lines or to limit the swing sector specified in the Capacity Chart).

## 6. OPTIONAL Drum Spooling Limiter (maximum or minimum bail limit)

*Temporary alternative measures if inoperative or malfunctioning:*

The qualified person directing the lift, the operator, or a designated signal person shall watch the drum and signal the operator to stop it before it is over spooled (rope does not jump off drum) or before there are less than 3 full wraps of wire rope on the load drum or boom hoist.

## 7. OPTIONAL Closed-Circuit Television (CCTV)

*Temporary alternative measures if inoperative or malfunctioning:*

A designated signal person shall watch the load, the drums, and the counterweight and provide necessary hand or voice signals to the crane operator.

## ASSEMBLING, DISASSEMBLING, OR OPERATING CRANE NEAR ELECTRIC POWER AND TRANSMISSION LINES

### Electrocution Hazard

Thoroughly read, understand, and abide by all applicable federal, state, and local regulations regarding operation of cranes near electric power lines or equipment.

***United States federal law prohibits the use of cranes closer than 20 ft (6 m) to power sources up to 350 kV and greater distances for higher voltages unless the line's voltage is known [29CFR1910.180 and 29CFR1926.1400].***

***To avoid death or serious injury, Manitowoc recommends that all parts of crane, boom, and load be kept at least 20 ft (6 m) away from all electrical power lines and equipment less than 350 kV.***

**NOTE:** For detailed guidelines on operating near power lines, refer to the current edition of OSHA 29CFR1926.1400 and ASME B30.5 American National Standard.



### **WARNING** **Electrocution Hazard!**

Manitowoc cranes are not equipped with all features required to operate within OSHA 29CFR1926.1408, Table A clearances when the power lines are energized.

1. Keep all personnel and their personal belongings (clothing, water coolers, lunch boxes, etc.) away from the crane if it is being operated near electrical power lines or equipment.

2. Before operating the crane in the vicinity of electrical power lines or equipment, notify the power utility company. Obtain positive and absolute assurance that the power has been turned off.

The crane is NOT INSULATED. Always consider all parts of the load and the crane as conductors, including the wire rope, pendants or straps, and taglines.

Most overhead power lines ARE NOT insulated. Treat all overhead power lines as being energized unless you have reliable information to the contrary from the utility company or owner.

The rules in this section must be followed at all times, even if the electrical power lines or equipment have been de-energized.

3. Crane operation is dangerous when close to an energized electrical power source. Exercise extreme caution and prudent judgement. Operate slowly and cautiously when in the vicinity of power lines.

4. If the load, wire rope, boom, or any portion of the crane contacts or comes too close to an electrical power source, everyone in, on, and around the crane can be seriously injured or killed.

The safest way to avoid electrocution is to stay away from electrical power lines and electrical power sources.

5. The operator is responsible for alerting all personnel to the dangers associated with electrical power lines and equipment. The crane is not insulated. Do not allow unnecessary personnel in the vicinity of the crane while operating. Permit no one to lean against or touch the crane. Permit no one, including riggers and load handlers, to hold the load, load lines, taglines, or rigging gear.

6. Even if the crane operator is not affected by an electrical contact, others in the area may become seriously injured or killed.

7. It is not always necessary to contact a power line or power source to become electrocuted. Electricity, depending on magnitude, can arc or jump to any part of

the load, load line, or crane boom if it comes too close to an electrical power source. Low voltages can also be dangerous.

## Set-Up and Operation

1. During crane use, assume that every line is energized ("hot" or "live") and take necessary precautions.
  2. Position the crane such that the load, boom, or any part of the crane and its attachments cannot be moved to within 20 ft (6 m) of electrical power lines or equipment. This includes the crane boom and all attachments. Overhead lines tend to blow in the wind, so allow for movement of the overhead lines when determining a safe operating distance.
  3. Erect a suitable barricade to physically restrain the crane, all attachments, and the load from entering into an unsafe distance from electrical power lines or equipment.
  4. Plan ahead and always plan a safe route before traveling under power lines. A wooden clearance frame should be constructed to ensure sufficient clearance is maintained between crane and power lines.
  5. Appoint a reliable and qualified signal person, equipped with a loud signal whistle or horn and voice communication equipment, to warn the operator when any part of the crane or load moves near a power source. This person should have no other duties while the crane is working.
  6. Taglines should always be made of non-conductive materials. Any tagline that is wet or dirty can conduct electricity.
  7. DO NOT store materials under power lines or close to electrical power sources.
  8. When operating near transmitter/communication towers where an electrical charge can be induced into the crane or load:
    - The transmitter shall be deenergized OR,
    - Tests shall be made to determine if an electrical charge will be induced into the crane or load.
    - The crane must be provided an electrical ground.
    - If taglines are used, they must be non-conductive.
    - Every precaution must be taken to dissipate induced voltages. Consult with a qualified RF (radio frequency) Consultant. Also refer to local, state, and federal codes and regulations.
- stops does not ensure that electrical contact will not occur. Even if codes or regulations require the use of such devices, failure to follow the rules in this section may result in serious injury or death.
2. Be aware that such devices have limitations and you should follow the rules and precautions outlined in this section at all times even if the crane is equipped with these devices.
  3. Insulating links installed into the load line afford limited protection from electrocution hazards. Links are limited in their lifting abilities, insulating properties, and other properties that affect their performance. Moisture, dust, dirt, oils, and other contaminants can cause a link to conduct electricity. Due to their capacity ratings, some links are not effective for large cranes and/or high voltages/currents.
  4. The only protection that may be afforded by an insulated link is below the link (electrically downstream), provided the link has been kept clean, free of contamination, has not been scratched or damaged, and is periodically tested (just before use) for its dielectric integrity.
  5. Boom cages and boom guards afford limited protection from electrocution hazards. They are designed to cover only the boom nose and a small portion of the boom. Performance of boom cages and boom guards is limited by their physical size, insulating characteristics, and operating environment (e.g. dust, dirt, moisture, etc.). The insulating characteristics of these devices can be compromised if not kept clean, free of contamination, and undamaged.
  6. Proximity sensing and warning devices are available in different types. Some use boom point (localized) sensors and others use full boom length sensors. No warning may be given for components, cables, loads, and other attachments located outside of the sensing area. Reliance is placed upon the operator in selecting and properly setting the sensitivity of these devices.
  7. Never rely solely on a device to protect you and your fellow workers from danger.
 

Some variables you must know and understand are:

    - Proximity devices are advertised to detect the existence of electricity and not its distance, quantity, or magnitude.
    - Some proximity devices may detect only alternating current (AC) and not direct current (DC).
    - Some proximity devices detect radio frequency (RF) energy and others do not.
    - Most proximity devices simply provide a signal (audible, visual, or both) for the operator and this signal must not be ignored.

## Electrocution Hazard Devices

1. The use of insulated links, insulated boom cages/guards, proximity warning devices, or mechanical limit

- Sometimes the sensing portion of the proximity devices becomes confused by complex or differing arrays of power lines and power sources.
8. DO NOT depend on grounding. Grounding of a crane affords little or no protection from electrical hazards. The effectiveness of grounding is limited by the size of the (wire) conductor used, the condition of the ground, the magnitude of the voltage and current present, and numerous other factors.

## Electrical Contact

If the crane comes in contact with an energized power source, the operator must:

1. Stay in the crane cab. DON'T PANIC.
2. Immediately warn PERSONNEL in the vicinity to STAY AWAY.
3. Attempt to move the crane away from the contacted power source using the crane's controls which are likely to remain functional.
4. Stay in the crane until the power company has been contacted and the power source has been de-energized. NO ONE must attempt to come close to the crane or load until the power has been turned off.

Only as a last resort should an operator attempt to leave the crane upon contacting a power source. If it is absolutely necessary to leave the cab, JUMP COMPLETELY CLEAR OF CRANE. DO NOT STEP OFF. Hop away with both feet together. DO NOT walk or run.

5. Following any contact with an energized electrical source, your Manitowoc dealer must be immediately advised of the incident and consulted on necessary inspections and repairs.

If the dealer is not immediately available, contact Manitowoc Crane Care at the factory. The crane must not be returned to service until it is thoroughly inspected for any evidence of damage and all damaged parts are repaired or replaced as authorized by Manitowoc or your Manitowoc dealer.

## REFUELING

1. When using a portable container to refuel the crane, the container shall be a safety-type can equipped with an automatic closing cap and a flame arrester.
2. The engine shall be **stopped** before refueling crane.
3. Smoking and open flames shall be prohibited in refueling area.

## FIRE EXTINGUISHERS

1. A portable fire extinguisher with a minimum rating of 10 BC shall be installed in operator's or machinery cab of crane.
2. The operator and all maintenance personnel shall be thoroughly familiar with the location, use, and care of the fire extinguisher(s) provided.

## ACCIDENTS

If this crane becomes involved in a property damage and/or personal injury accident, immediately contact Manitowoc Crane Care or the Product Safety and Reliability Manager at the following address:

### Manitowoc Cranes

2401 So. 30th St.  
Manitowoc, WI 54220

Phone: 1-888-499-7278 or  
920-683-6390

Provide a complete description of the accident, including the crane model and serial number.

## SAFE MAINTENANCE PRACTICES



### WARNING

Importance of safe maintenance cannot be over emphasized. Carelessness and neglect on part of maintenance personnel can result in their death or injury and costly damage to the crane or property.

Safety information in this publication is intended only as a guide to assist qualified maintenance personnel in safe maintenance. Manitowoc cannot foresee all hazards that will arise in field; therefore, ***safety remains responsibility of maintenance personnel and crane owner.***

## Maintenance Instructions

To ensure safe and proper operation of Manitowoc cranes, they must be maintained according to the instructions contained in this manual and in the Service Manual provided with the crane.

Crane maintenance and repair must be performed by qualified personnel. These personnel must ***read Operator's Manual and Service Manual before attempting any maintenance procedure.*** If there is any question regarding maintenance procedures or specifications, contact your Manitowoc dealer for assistance.

***Qualified person*** is defined as one who by reason of training and experience is thoroughly familiar with the

crane's operation and required maintenance as well as the hazards involved in performing these tasks.

**Training and qualification of maintenance and repair personnel are crane owner's responsibility.**

### Safe Maintenance Practices

1. Perform the following steps (as applicable) before starting a maintenance procedure:
  - a. Park the crane where it will not interfere with other equipment or operations.
  - b. Lower all loads to the ground or otherwise secure them against movement.
  - c. Lower the boom onto blocking at ground level, if possible, or otherwise secure the boom against dropping.
  - d. Move all controls to off and secure all functions against movement by applying or engaging all brakes, pawls, or other locking devices.
  - e. Stop the engine and render the starting means inoperative.
  - f. Place a warning sign at the start controls alerting other personnel that crane is being serviced and the engine must not be started. **Do not remove sign until it is safe to return crane to service.**
2. Do not attempt to maintain or repair any part of crane while engine is running, unless absolutely necessary. Wait for engine and machinery to cool before servicing them.

If engine must be run, perform following steps to prevent injury:

- Keep your clothing and all parts of your body away from moving parts.
- Use extreme caution when working around machinery. It can be extremely hot.
- **Maintain constant verbal communication between person at controls and person performing maintenance or repair procedure.**



### WARNING

#### Burn and Inhalation Hazards!

Temperature of exhaust and exhaust components for Tier 4 engines can be higher than other engines.

To prevent death or serious injury:

- Avoid physical contact with exhaust gases and exhaust system components.
- Keep all flammable materials away from the exhaust system to prevent fire.
- If necessary to service crane while engine is running, inhibit (turn off) DPF regeneration using switch in cab to prevent higher exhaust temperatures.

3. Wear clothing that is relatively tight and belted.
4. Wear appropriate eye protection and approved hard hat.
5. Never climb onto or off a moving crane. **Climb onto and off crane only when it is parked and only with operator's permission.**

Use *both hands* and handrails, steps and ladders provided to climb onto and off the crane.

Lift tools and other equipment which cannot be carried in pockets or tool belts onto and off the crane with hand lines or hoists.

6. The boom and gantry are not intended as ladders. Do not attempt to climb lattice work of the boom or gantry to get to maintenance points. If the boom or gantry is not equipped with an approved ladder, lower them before performing maintenance or repair procedures.
7. Do not remove cylinders until the working unit has been securely restrained against movement.
8. Pinch points are impossible to eliminate; watch for them closely.
9. Pressurized air, coolant, and hydraulic oil can cause serious injury. Make sure all air, coolant, and hydraulic lines, fittings, and components are tight and serviceable.

**Do not use your hands to check for air, coolant or hydraulic oil leaks:**

- Use a soap and water solution to check for air leaks (apply to fittings and lines and watch for bubbles).
  - Use a piece of cardboard or wood to check for coolant and hydraulic oil leaks.
10. Relieve pressure before disconnecting air, coolant, and hydraulic lines and fittings.
  11. Do not remove the radiator cap while the coolant is hot or under pressure. Stop the engine, wait until the

pressure drops and the coolant cools, then slowly remove the cap.

12. Avoid battery explosion: do not smoke while performing battery maintenance or short across battery terminals to check its charge.
13. Read the safety information in the battery manufacturer's instructions before attempting to charge a battery.
14. Avoid battery acid contact with skin and eyes. If contact occurs, flush the area with water and immediately consult a doctor.
15. Stop the engine before refueling crane.
16. Do not smoke or allow open flames in refueling area.
17. Use a safety-type can with an automatic closing cap and flame arrestor for refueling.
18. Hydraulic oil can also be flammable. Do not smoke or allow open flames in the area when filling hydraulic tanks.
19. Never handle wire rope with bare hands. Always wear heavy-duty gloves to prevent being cut by broken wires.
20. Use extreme care when handling coiled pendants. Stored energy can cause the coiled pendants to uncoil quickly with considerable force.
21. When inflating tires, use a tire cage, a clip-on inflator, and an extension hose which permits standing well away from the tire.
22. Only use cleaning solvents which are non-volatile and non-flammable.
23. Do not attempt to lift heavy components by hand. Use a hoist, jacks, or blocking to lift components.
24. Use care while welding or burning on the crane. Cover all hoses and components with non-flammable shields or blankets to prevent a fire or other damage.
25. To prevent damage to crane parts (bearings, cylinders, swivels, slewing ring, computers, etc.), perform the following steps **before welding on crane**:
  - Disconnect all cables from batteries.
  - Disconnect output cables at engine junction box.
  - Attach the ground cable from the welder directly to the part being welded and as close to the weld as possible.

Do not weld on the engine or engine mounted parts (per engine manufacturer).
26. Disconnect and lock the power supply switch before attempting to service high voltage electrical components and before entering tight areas (such as carbody openings) containing high voltage components.

27. When assembling and disassembling booms, jibs, or masts on the ground (with or without support of boom rigging pendants or straps), securely block each section to provide adequate support and alignment.

***Do not go under boom, jib, or mast sections while connecting bolts or pins are being removed.***

28. Unless authorized in writing by Manitowoc, do not alter the crane in any way that affects the crane's performance (to include welding, cutting, or burning of structural members or changing pressures and flows of air/hydraulic components). Doing so will invalidate all warranties and Capacity Charts and make the crane owner/user liable for any resultant accidents.
29. **Keep crane clean.** Accumulations of dirt, grease, oil, rags, paper, and other waste will not only interfere with safe operation and maintenance but also create a fire hazard.
30. Store tools, oil cans, spare parts, and other necessary equipment in tool boxes. Do not allow these items to lie around loose in the operator's cab or on walkways and stairs.
31. Do not store flammable materials on the crane.
32. Do not return the crane to service at completion of maintenance or repair procedures until all guards and covers have been reinstalled, trapped air has been bled from hydraulic systems, safety devices have been reactivated, and all maintenance equipment has been removed.
33. Perform a function check to ensure proper operation at the completion of maintenance or repair.

## ENVIRONMENTAL PROTECTION

***Dispose of waste properly!*** Improperly disposing of waste can threaten the environment.

Potentially harmful waste used in Manitowoc cranes includes — but is not limited to — oil, fuel, grease, coolant, air conditioning refrigerant, filters, batteries, and cloths which have come into contact with these environmentally harmful substances.

Handle and dispose of waste according to local, state, and federal environmental regulations.

When filling and draining crane components: do not pour waste fluids onto the ground, down any drain, or into any source of water.

- Always drain waste fluids into leak proof containers that are clearly marked with what they contain.
- Always fill or add fluids with a funnel or a filling pump.
- Immediately wipe up any spills.

## BOOM DISASSEMBLY SAFETY



### DANGER!

#### Collapsing Boom Hazard!

Prevent death or serious injury when disassembling boom sections — read and adhere to following instructions.

**NOTE:** The term “*Boom*” used in the following instructions applies to all lattice attachments (boom, fixed jib, luffing jib, mast, etc.).

Safe handling of lattice booms during disassembly is a primary concern for preventing serious or fatal injuries. A boom can collapse during disassembly if workers fail to observe safe working practices.

Accidents during boom disassembly usually result from one of three primary causes:

- Workers are not familiar with equipment or are not properly trained.
- Disassembly area is not suitable.
- Safe procedures are overlooked because not enough time is allocated for the task.



FIGURE 2-4

### General

Safety decals (Figure 2-4) are placed near the connectors on the boom sections as shown on the Boom Disassembly Decal Drawing at the end of this section.

Workers involved with boom disassembly must be trained and experienced in the operation and disassembly of construction cranes. The workers must read and thoroughly understand the assembly and disassembly instructions in the Boom Assembly Drawing, and in the assembly and disassembly instructions in Section 4 of this manual before beginning disassembly. Anyone who has a question should ask for an explanation. **One worker who does not fully understand or fails to follow correct procedures can be killed or seriously injured or endanger other workers.**



### WARNING

#### Falling Boom Hazard!

Crane can tip or boom can collapse if excess boom is cantilevered. Never cantilever more boom than specified in Boom Assembly Drawing.

### Location

Select a suitable location for boom disassembly. It must be firm, level, and be free of obstructions. It should have enough open space to accommodate the crane, the length of boom, and – if required – movement of an assist crane or other equipment. If possible, secure the area to keep unauthorized personnel and vehicles away.

### Pin Removal



### DANGER

#### Collapsing Boom Hazard!

Boom can collapse or jerk when pins are removed. To avoid death or serious injury:

- Do not remove bottom connecting pins from any boom section when boom is supported by straps as shown in Figure 2-5, View A.
- Do not remove strap connecting pins until straps are fully lowered into supports as shown in Figure 2-5, View C.
- Do not remove bottom connecting pins from any boom section when boom point is resting on ground and boom butt is not supported by handling cylinder as shown in Figure 2-5, View B.
- Never work or stand inside boom unless it is lowered and securely blocked as shown in Figure 2-5, View C.
- Do not stand or walk on top of boom unless it has walkways.

When removing pins from boom sections, stand clear of pins being removed. Even though the boom is resting on blocking, individual pin connections may still be under load. Pins can be ejected forcefully if the boom has any pressure on it or if the boom is not supported properly.

### Disassembly Precaution

Always block boom sections so they are securely supported and cannot shift or move suddenly when pins are removed. If there is any doubt about a boom disassembly procedure, **block tightly under boom sections before removing any pin.**

A1301

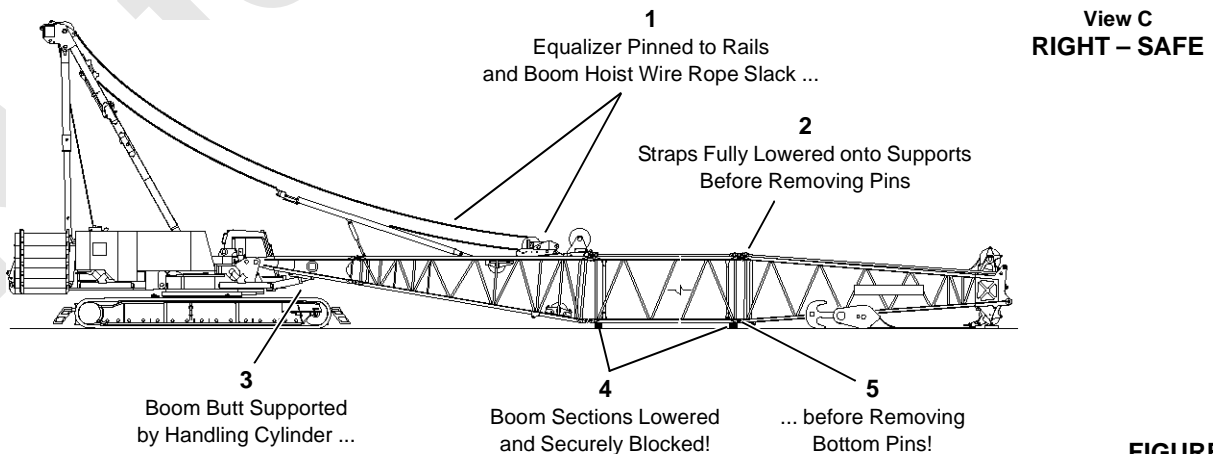
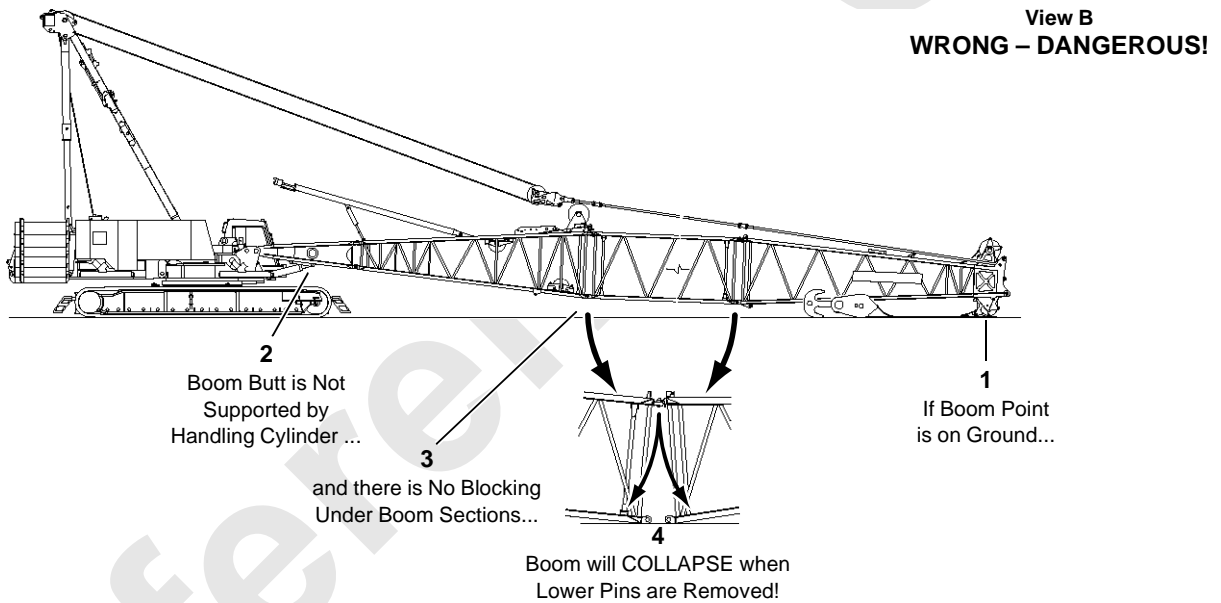
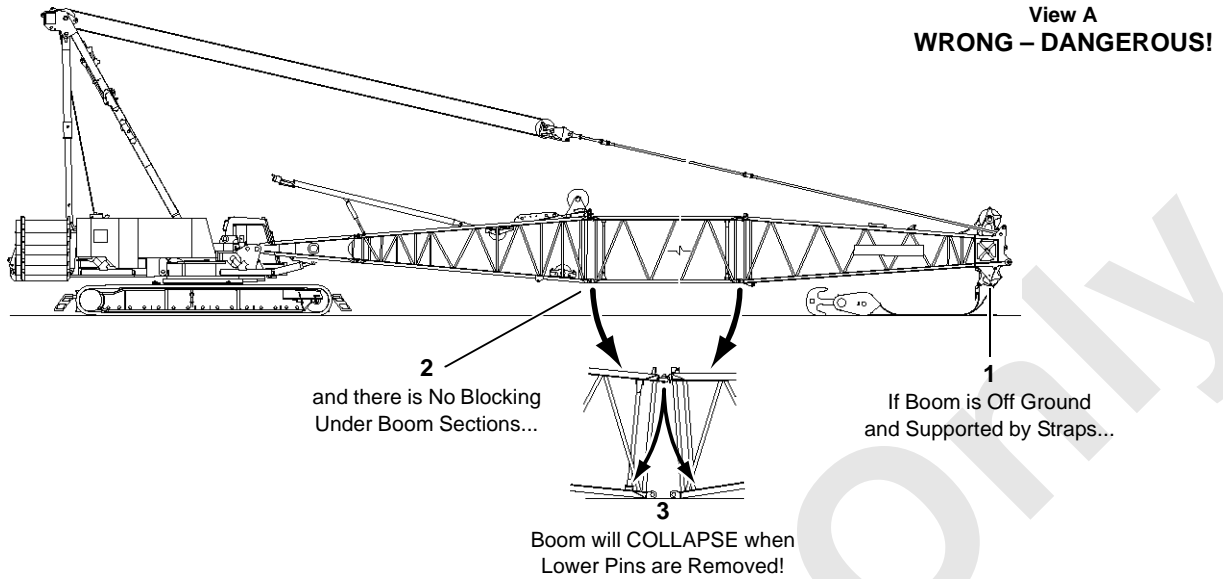


FIGURE 2-5

## PERSONNEL HANDLING POLICY

In 1998, the American Society of Mechanical Engineers issued a new American National Standard entitled, Personnel Lifting Systems, ASME B30.23-1998. This standard provides, ***“lifting and lowering of personnel using ASME B30 Standard hoisting equipment shall be undertaken only in circumstances when it is not possible to accomplish the task by less hazardous means. Unless all of the applicable requirements of this volume are met, the lifting or lowering of personnel using ASME B30 Standard equipment is prohibited.”***

The ASME Standards recognize that mobile and locomotive cranes are primarily designed and intended for handling materials and not personnel. The ASME Standards have a retrofit statement that applies to existing cranes after the standards go into effect. It is not the intent of the standards to require retrofitting of existing equipment. If an item is being modified, the performance requirement shall be reviewed relative to the current standard.

This new standard is consistent with the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) regulations for Construction that state, in 29CFR1926.1431(a): ***The use of a crane or derrick to hoist employees on a personnel platform is prohibited, except when the erection, use, and dismantling of conventional means of reaching the work site, such as a personnel hoist, ladder, stairway, aerial lift, elevating work platform or scaffold, would be more hazardous or is not possible because of structural design or work site conditions.***

Use of a Manitowoc crane to handle personnel is acceptable provided:

- The crane user shall comply with the manufacturer's specifications and limitations for lifting accessories (hooks, slings, personnel platforms, etc.).
- The requirements of the applicable national, state and local regulations and safety codes are met.
- A determination has been made that use of a crane to handle personnel is the least hazardous means to perform the work.
- The crane operator shall be qualified to operate the specific type of hoisting equipment used in the personnel lift.
- The crane operator must remain in the crane cab at all times when personnel are off the ground.
- The crane operator and occupants have been instructed in the recognized hazards of personnel platform lifts.
- The crane is in proper working order.
- Load and boom hoist drum brakes, swing brakes, and locking devices such as pawls and dogs shall be

engaged when the occupied personnel platform is in a stationary position.

- The crane must be equipped with a boom angle indicator that is visible to the crane operator.
- The crane must be equipped with boom hoist limiting device.
- If the luffing jib is used for hoisting personnel, the crane must be equipped with a luffing jib angle indicator that is visible to the crane operator.
- If the luffing jib is used for hoisting personnel, the crane must be equipped with a luffing hoist limiting device.
- The crane is equipped with a positive acting device which prevents contact between the load block or overhaul ball and the boom tip (anti-two block device).

For friction cranes, this implies the addition of spring applied brakes activated by the anti-two block device. The load line hoist drum shall have a system or device on the power train, other than the load hoist brake, which regulates the lowering rate of speed of the hoist mechanism (controlled load lowering).

### ***Free fall of the hoist line is prohibited.***

- The crane's Operator's Manual is in the crane's cab, readily accessible to the Operator.
  - The crane's load Capacity Chart is affixed inside the crane cab, readily accessible to the operator. The total weight of the loaded personnel platform and related rigging shall not exceed 50 percent of the rated capacity for the radius and configuration of the crane.
  - The crane is uniformly level within one percent of level grade and located on a firm footing. Some Capacity Charts require more stringent levelness criteria.
- Cranes with outriggers or stabilizers shall have them all extended and locked. All outriggers or stabilizers must be extended equally in accordance with the Capacity Charts and operating procedures.
- Handling personnel from a platform suspended by wire rope from a luffing jib is acceptable, but only when it is not possible to accomplish the task using a less hazardous means. The crane user and operator shall take into account hazards that may be present when using a luffing jib.
  - Direct attachment of a personnel platform to a luffing jib is prohibited.
  - The platform meets the requirements as prescribed by applicable standards and regulations.
  - Applicable personal protection equipment is provided (i.e., personal fall-protection system, etc.)



- For wire rope suspended platforms, the crane is equipped with a hook latch that can be closed and locked, eliminating the throat opening.
- The platform is properly attached and secure.
- Personnel platforms must not be used in winds exceeding 20 mph (9 m/s) at the hoisted platform height or in electric storms, snow, ice, sleet, or other adverse weather conditions which could affect the safety of personnel.
- Hoisting personnel within 20 ft (6 m) of a power line that is up to 350 kV or within 50 ft (15 m) of a power line that is over 350 kV is PROHIBITED, except for work covered in OSHA 29CFR1926 subpart V.

For operation outside the United States, the requirements of the applicable national, state and local regulations and safety codes must be met. This may include, in addition to the above:

- Automatic brakes such that when the equipment operating controls are released, the motions are brought to rest.
- A holding device (such as a load hold check valve) shall be provided in the hydraulic or pneumatic systems to

prevent uncontrolled movement of the hoisting equipment in the case of a system failure.

Manitowoc offers upgrade packages for friction controlled models to install anti-two block, dead man control, and automatic hoist system control requirements to satisfy other codes and standards.

Manitowoc recommends that cranes be properly maintained, regularly inspected, and repaired as necessary. All safety signs must be in place and legible. We also urge Manitowoc crane owners to upgrade their cranes with rated capacity indicator/limiter systems for all lifting operations.

If you have any questions about this subject or other product safety matters relating to the operation and use of a Manitowoc crane, please contact Manitowoc Crane Care or the Product Safety and Reliability Manager at the following address:

**Manitowoc Cranes**

2401 So. 30th St.  
Manitowoc, WI 54220

Phone: 1-888-499-7278 or  
920-683-6390

## PEDESTAL/BARGE MOUNTED CRANES



### WARNING

#### Overload Hazard!

A pedestal mounted crane will not tip to indicate to operator that crane's capacity has been exceeded. When capacity of a pedestal mounted crane is exceeded, hook rollers or other structural components may break, before load lines fail, causing crane to separate from pedestal.

For this reason, great care must be taken to operate a pedestal mounted crane within its rated capacity.

Careful planning is required before a crane can be operated on a barge. Crane user shall verify that barge is capable of limiting crane list and/or dynamics to maximum allowable specified in Capacity Charts. If specified crane list and/or dynamic conditions are exceeded, crane's capacity may be exceeded; hook rollers or other structural components may break, causing crane to separate from pedestal.



### WARNING

Crane owner/user must verify that method used to fasten or restrain crane to foundation, barge, ship or floating platform is strong enough, under all operating conditions, to prevent crane from breaking off foundation or moving on barge.

Manitowoc does not permit use of a truck crane on a barge, ship or floating platform.

### Pedestal Mounted Crane

Also see ASME publication B30.8-2004, Floating Cranes and Derricks.

### Definition

A pedestal mounted crane is a crane which is securely fastened to a foundation, barge, ship, or floating platform so the crane is restrained from tipping.

### Examples

1. Crane rotating bed mounted on a turret (pedestal) which is securely fastened to the foundation (Figure 2-6).

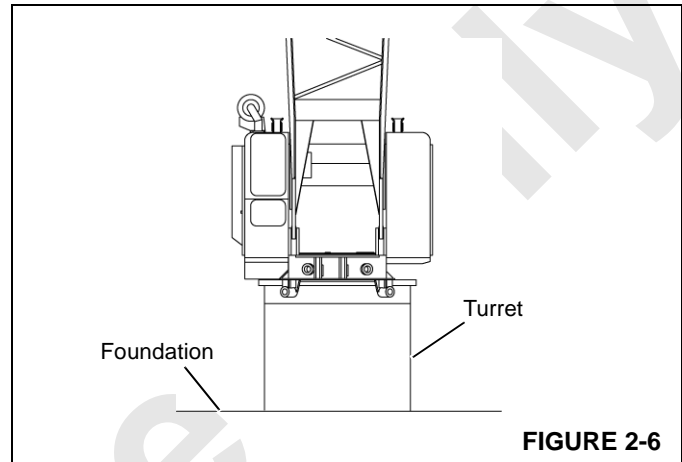


FIGURE 2-6

2. Crane rotating bed mounted on a carbody (crawlers removed) which is securely fastened to the foundation (Figure 2-7).

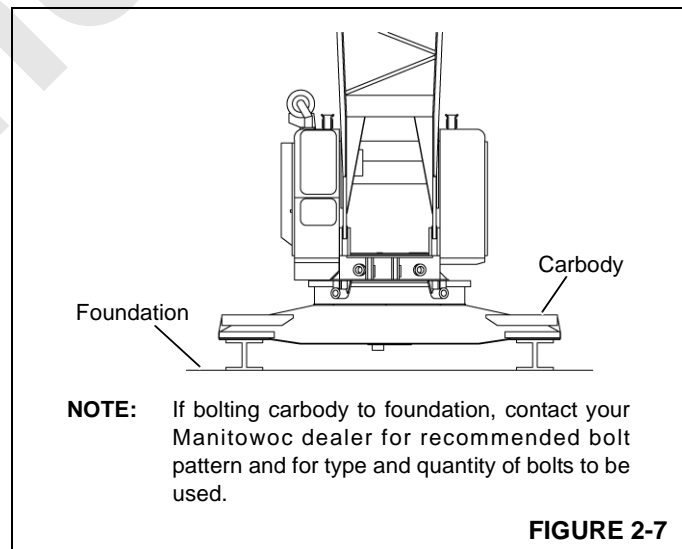


FIGURE 2-7

## Barge Mounted Crane

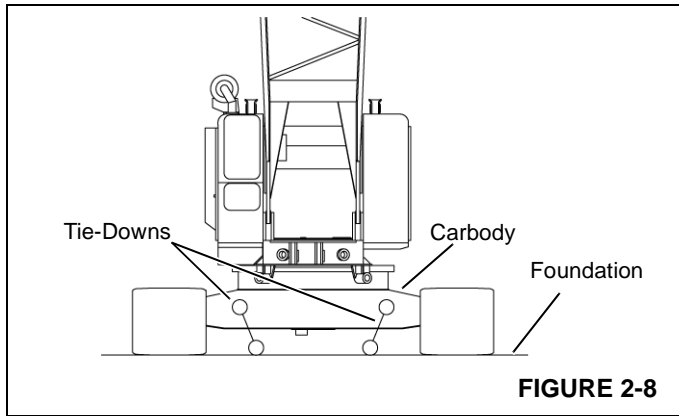
### Definition

A barge mounted crane is a crane that is anchored or restrained in a work area of the barge, ship, or floating platform and is subjected to tipping forces.

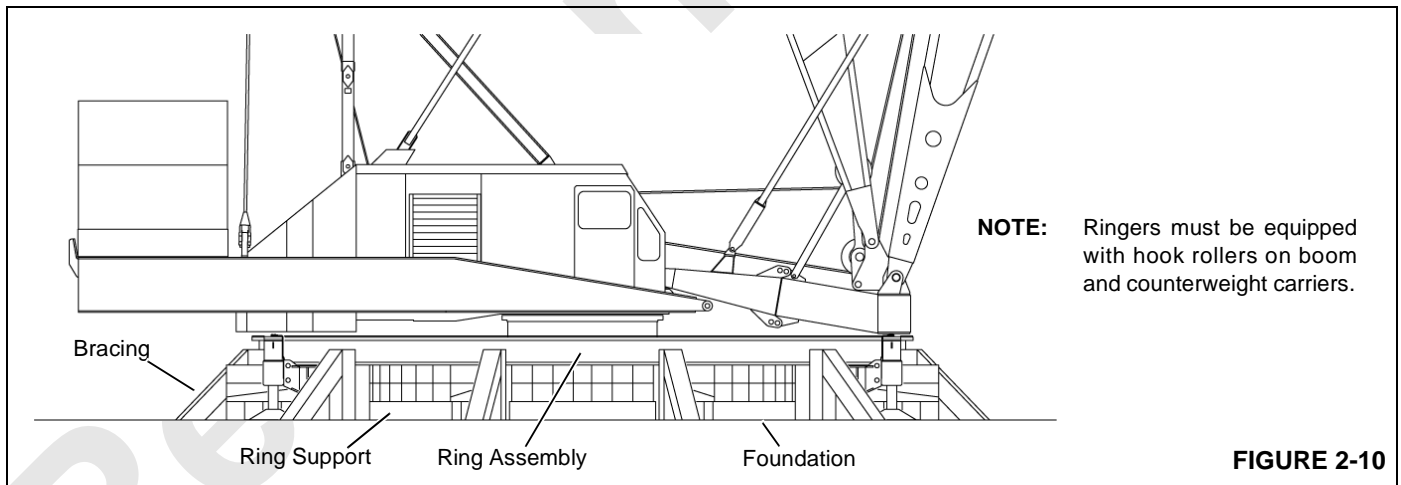
### Examples

**NOTE:** The foundation is the deck of the barge, ship, or floating platform.

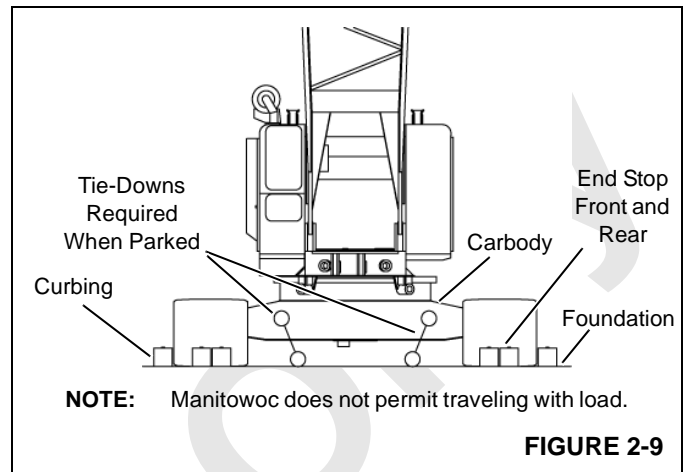
1. Crawler-mounted crane with carbody anchored with tie-downs to the foundation (Figure 2-8).



2. Crawler-mounted crane working on a timbered area of the barge, ship, or floating platform with the crawlers



restrained by curbing and end stops (Figure 2-9). When not working, the crane carbody is anchored with tie-downs to the foundation. **Traveling with load is not permitted.**



3. RINGER® (crawler mounted, carbody mounted) supported on blocking, screw jacks, or steel pedestals which are braced and fastened to the foundation in such a manner as to prevent movement (Figure 2-10).
4. RINGER (platform mounted) which has the ring braced and fastened directly to the foundation in such a manner as to prevent movement.

AXIS		TRANSITIONAL		ROTATIONAL	
SYMBOL	NAME	STATIC	DYNAMIC	STATIC	DYNAMIC
X	Longitudinal		Surge	Heel List	Roll
Y	Vertical		Heave		Yaw
Z	Lateral		Sway	Trim	Pitch

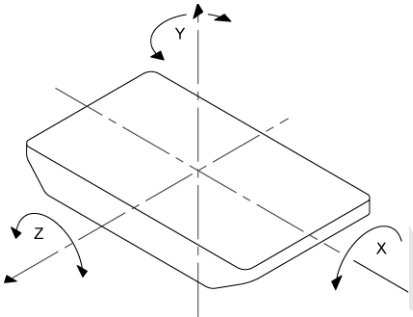


FIGURE 2-11

## Capacity Charts

Manitowoc provides two types of Capacity Charts for a crane mounted on a barge or other supporting structure under static conditions.

1. A Capacity Chart based on tipping when the crane is anchored only to prevent shifting.
2. A Capacity Chart based on structural competence when crane is securely fastened for use as a pedestal mounted crane.

**NOTE:** Unless otherwise specified in a machine list Capacity Chart, a 0 degree machine list Capacity Chart rating applies to machine list **not to exceed 1/2 degree**. All other machine list ratings – 1°, 2°, and 3° – must NOT be exceeded.

## Shock Loading

### Definition

Shock loads to the crane can be experienced when the barge is subjected to up and down movement of wave action (referred to as DYNAMICS). Figure 2-11 illustrates the dynamic conditions of the barge which influence crane capacity.

## CAUTION

### Structural Damage Hazard!

If crane boom or structure is shock loaded during operation, or there is any indication of shock loading, all structural components of crane shall be inspected to detect cracks and other damage. Nondestructive test equipment, such as magnetic particle or ultrasonic procedures, is recommended for this inspection.

**NOTE:** Manitowoc does not recommend crane operation under dynamic conditions.

## Operation On Barge

### General

Machine list and/or dynamics will be experienced when a crane is operated on a barge, ship, or floating platform. Both of these conditions reduce the crane's capacity and each must be taken into account for safe operation on a barge, ship, or floating platform.



## WARNING

### Tipping Crane Hazard!

Tie-downs which only prevent crane from shifting as in barge, ship or floating platform mounting, may not provide adequate support when using a Capacity Chart for pedestal mounting. Before operating a crane on a barge, ship or floating platform, crane user shall verify that correct Capacity Chart is being used — pedestal mounted, barge mounted, 0°, 1°, 2° or 3° list or dynamic Capacity Chart.

Failing to use correct Capacity Chart can result in an accident.

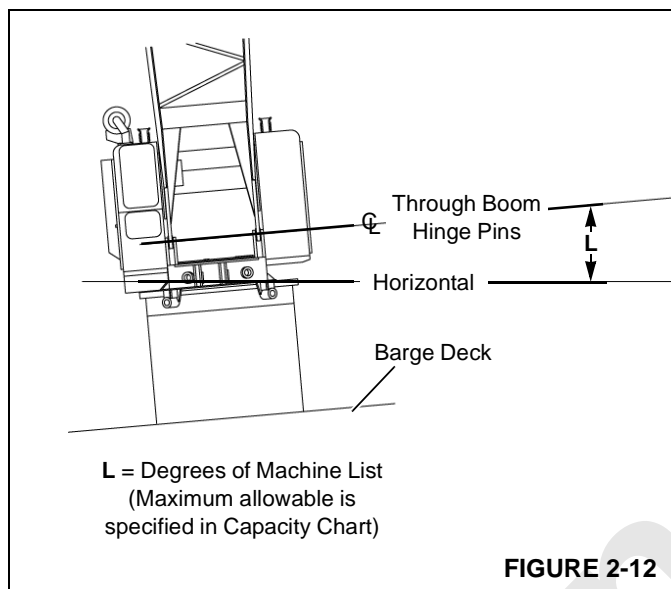
### Definitions

1. *Machine List*, as defined by Manitowoc, is the crane's out-of-level condition — from side-to-side — as measured by the angle between horizontal and a line drawn through the centerline of the crane's boom hinge pins (Figure 2-12). This out-of-level condition creates side load and affects the crane's lifting capacity.
2. *Barge List* (also referred to as heel or trim) causes swing out of the load and may produce side load. When Manitowoc provides a Capacity Chart showing capacities for a 2 degree machine list for example, we are referring to the maximum allowable lifting capacity for the crane when experiencing an out-of-level condition (side-to-side) of 2 degrees as measured by

angle between horizontal and a line drawn through centerline of the crane's boom hinge pins.

Unless otherwise specified in the Capacity Chart, barge list (heel or trim) must not exceed the machine list degrees given in the Capacity Chart.

3. *Barge List and Machine List are not same.* As the crane rotates on a barge, barge list (as defined above) will change. The worst machine list condition generally occurs when the crane swings over the corner of the barge, producing maximum side load.



### Crane Inspection

To aid in preventing harmful and damaging failure as previously indicated, regular inspection for signs of

overloading in the following load bearing components is required. Correct each defect found before placing the crane into service.

- Boom
- Counterweight
- Backhitch
- Rotating Bed
- Wire Rope
- Pendants and Straps
- Hook and House Rollers

When equipped with hook rollers, it is recommended that each hook roller assembly be inspected daily for any sign of overloading, to include:

- Deformation of roller path.
- Proper hook roller adjustment.
- Deformation or cracks in hook roller hanger.
- Bent hook roller shaft.
- Damaged bearings.

### Transporting Crane on Barge

If it is necessary to transport the crane on a barge, ship, or floating platform when dynamic conditions will be experienced, the boom shall be lowered onto a cradle (or other support) and the crane's boom, rotating bed, and lowerworks shall be secured against movement. If the crane is equipped with a mast, the mast shall be securely tied down with guylines. Failing to take these steps can result in shock load or side load damage to the boom and mast.

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## SECTION 3

### OPERATING CONTROLS AND PROCEDURES

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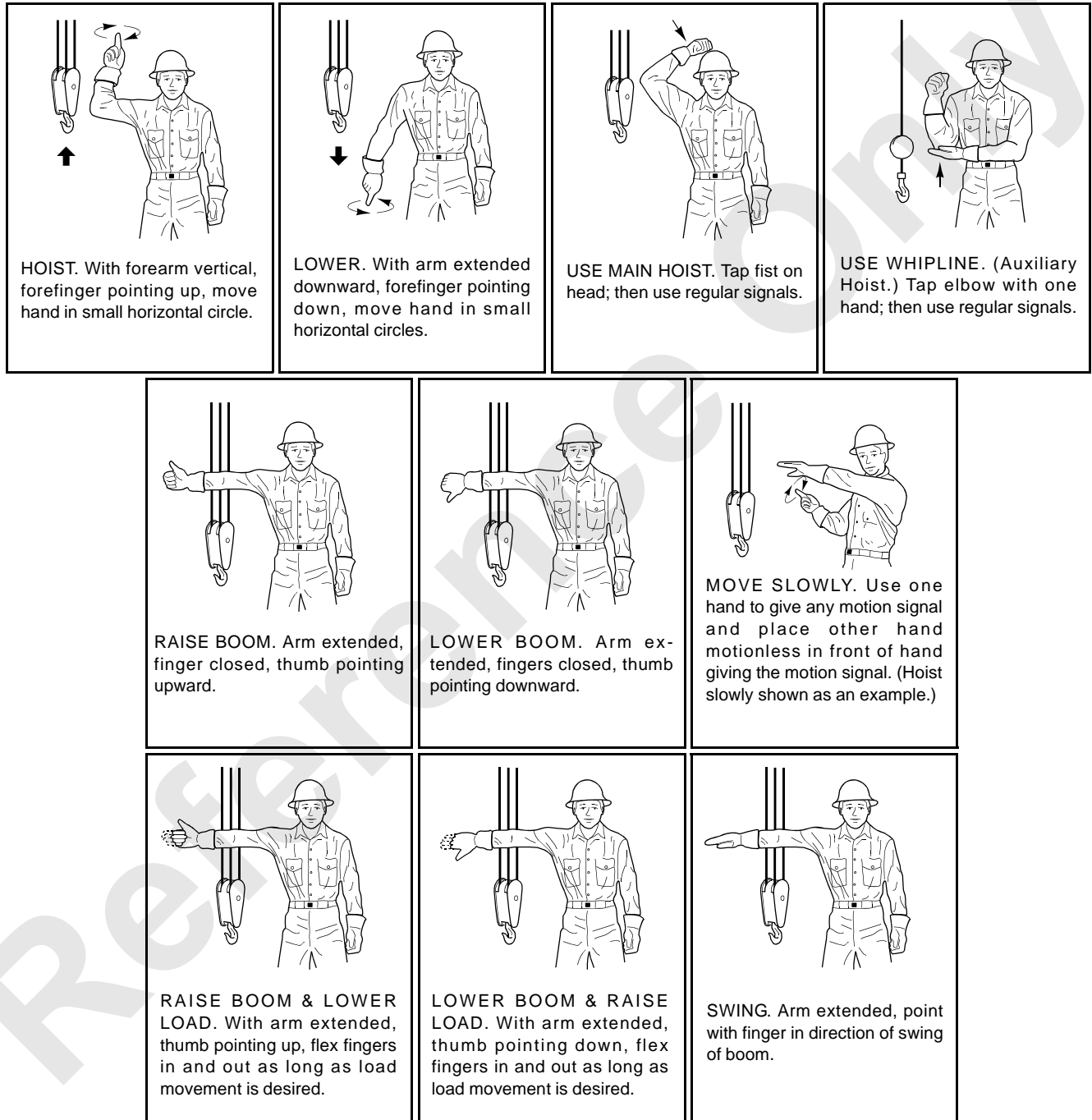
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## SECTION 3 OPERATING CONTROLS AND PROCEDURES

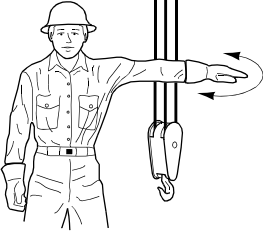
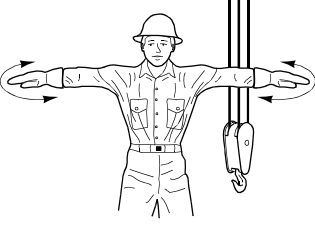
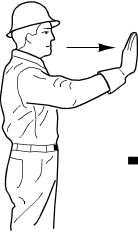

### STANDARD HAND SIGNALS FOR CONTROLLING CRANE OPERATIONS

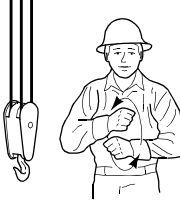
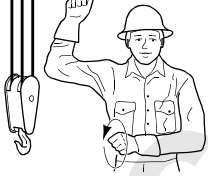


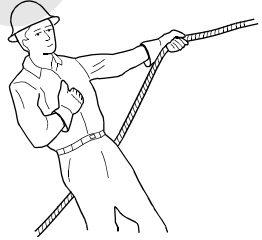
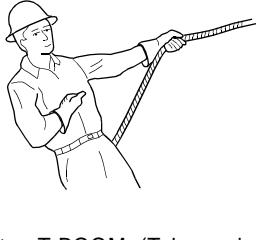
The following standard hand signals comply with ASME B30.5 - 2007



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**FIGURE 3-1**

 <p><b>STOP.</b> Arm extended, palm down, move arm back and forth horizontally.</p>	 <p><b>EMERGENCY STOP.</b> Both arms extended, palms down, move arms back and forth horizontally.</p>	 <p><b>TRAVEL.</b> Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.</p>	 <p><b>DOG EVERYTHING.</b> Clasp hand in front of body.</p>
--	--	--	--

 <p><b>TRAVEL. (Both Tracks.)</b> 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. (One Track.)</b> 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. (Telescoping Booms.)</b> Both fists in front of body with thumbs pointing outward.</p>
 <p><b>RETRACT BOOM. (Telescoping Boom.)</b> Both fists in front of body with thumbs pointing toward each other.</p>	 <p><b>EXTEND BOOM. (Telescoping Boom.)</b> One Hand Signal. One fist in front of chest with thumb pointing outward and heel of fist tapping chest.</p>	 <p><b>retract BOOM. (Telescoping Boom.)</b> One hand signal. One fist in front of chest, thumb pointing outward and heel of fist tapping chest.</p>

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FIGURE 3-1 continued

## GENERAL INSTRUCTIONS

The instructions in this section supplement the operating control instructions in your Crane Operator's Manual. This section also contains operating precautions.

This section has two purposes:

- To familiarize **qualified operators** with the location and operation of specific controls used for MAX-ER operation.
- To alert operators to important safety information.

If the MAX-ER is equipped with a luffing jib, see the Operation Guide in the Luffing Jib Operator's Manual for identification and operation of the luffing jib controls and additional operating precautions.



### WARNING

#### Prevent Death or Serious Injury to Personnel!

MAX-ER attachment must be installed and operated by experienced personnel trained in erection and operation of construction cranes. These personnel shall read, understand, and comply with instructions in this manual, in Crane Operator's Manual, and in MAX-ER Capacity Charts.



### WARNING

#### Tipping Hazard!

Tipping can occur if too little counterweight is installed. Structural damage can occur if too much counterweight is installed.

Do not operate crane with MAX-ER until proper counterweight is installed.

## COUNTERWEIGHT

See Figure 3-3, View E in this section and the MAX-ER Capacity Charts for counterweight identification and requirements.

See the Crane Operator's Manual and section 4 of this manual for counterweight installation and removal instructions.

## PRINCIPLES OF OPERATION

When the MAX-ER mode is on:

- The load sensing pin in the gantry backhitch (left side) measures backhitch loading created by the lifted load.
- The load sensing pin sends a proportional voltage to the programmable controller.
- The programmable controller activates the crane's electric and hydraulic systems to automatically extend and retract the counterweight cylinders (raise and lower wheeled counterweight assembly) in response to changes in backhitch tension as indicated in Table 3-1.

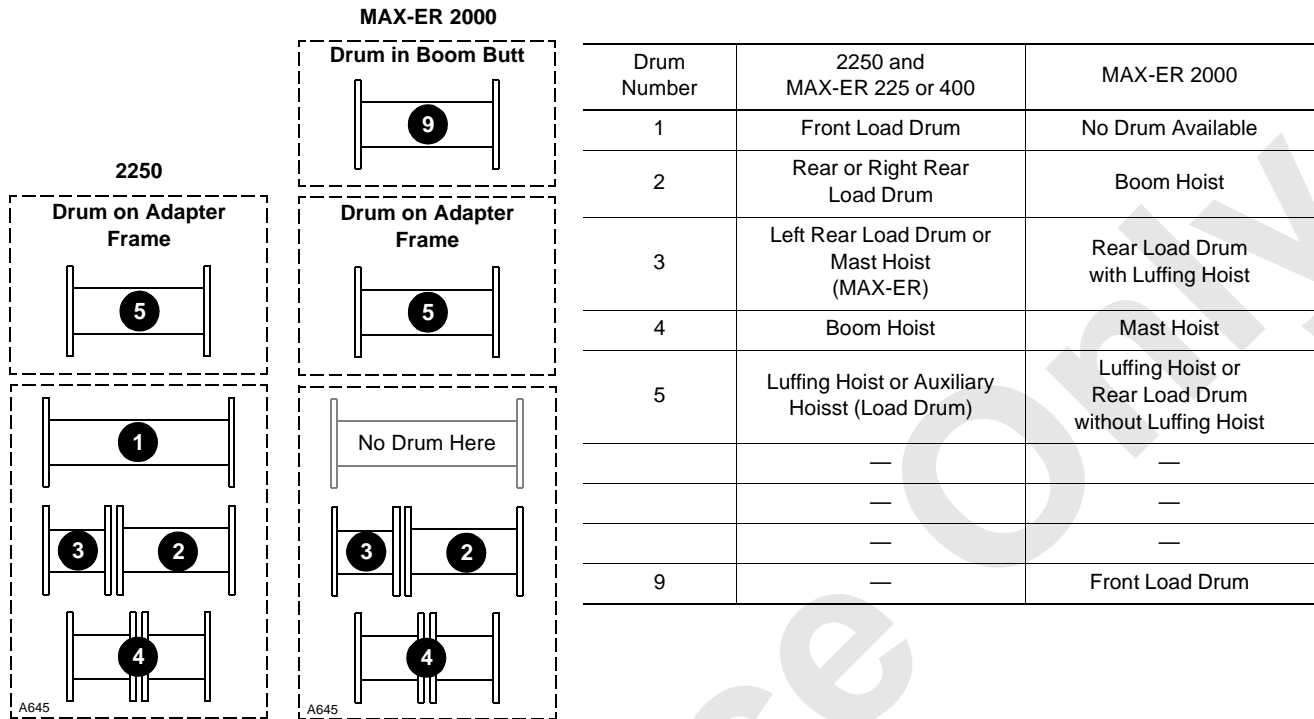
**Table 3-1 Counterweight Cylinder Operation**

Backhitch Load U.S. Tons	Counterweight Cylinders	Trailer
30	Retract	Raise
28	Stop Raising <sup>1</sup>	
< 4	Extend	Lower
6	Stop Lowering	

<sup>1</sup> Cylinders stop retracting when limit switch at left cylinder is contacted.

If tray gets more than ±4° out of level, automatic cylinder control shuts-off. Re-level tray manually with remote controls (MAX-ER mode off.)

### DRUM IDENTIFICATION



- NOTE 1:** Only one drum (left or right) can be operated at a time. Desired drum must be selected with drum selector.
- NOTE 2:** Only one drum (boom or luffing) can be operated at a time. To operate boom hoist, select standard mode. To operate luffing hoist select Drum 5 (Luff Hoist). Drum not in use must be parked before other drum can be used.
- NOTE 3:** If auxiliary hoist is powered by boom hoist circuit, only one drum (boom or auxiliary) can be operated at a time. Drum not in use must be parked before other drum can be used.  
 If auxiliary hoist is powered by travel circuit, auxiliary drum and travel cannot be operated at same time. Function not in use must be parked before other function can be used.  
 Auxiliary drum is always controlled by Handle C. All other drums that could be controlled by Handle C are parked and inoperable.  
 Drum 5 (Aux Hoist) mode is not available for Clamshell Attachment.

**! WARNING**

**Falling Boom and Jib Hazard!**

Do not use Drum 5 (Aux Hoist) to operate luffing hoist when equipped with MAX-ER 2000 Attachment. Luffing jib limits are turned off in this mode.

Boom and luffing jib could be pulled over backwards.

To operate luffing jib on a MAX-ER 2000, always select Drum 5 (Luff Hoist).

- NOTE 4:** Tandem Drum mode is not available for MAX-ER or Clamshell Attachments.
- NOTE 5:** With MAX-ER mode on, only one drum (boom or left rear) can be operated at a time.  
 Use Standard or Setup mode to raise and lower MAX-ER 2000 mast with Drum 4. See MAX-ER Assembly and Disassembly Guide Procedures in this section.

FIGURE 3-2

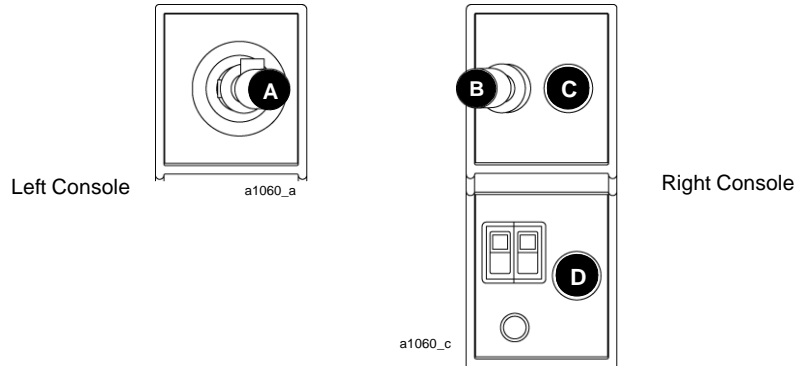


FIGURE 3-2 continued

**HANDLE-TO-DRUM IDENTIFICATION**

Mode/Drum Options	HANDLE A Controls	HANDLE B Controls	HANDLE C Controls	HANDLE D Controls
<b>Standard or Setup Mode</b>				
Split Rear Drums (2-Drum Crane)	4 - Boom Hoist	2 - Right Rear	3 - Left Rear	
Front and Rear Drums (2-Drum Crane)	4 - Boom Hoist	1 - Front	2 - Rear	
Front and Rear Drums (3-Drum Crane)	4 - Boom Hoist	1 - Front	2 - Right Rear or 3 - Left Rear (NOTE 1)	
<b>Drum 5 (Luff Jib) Mode - Standard Crane (NOTE 2)</b>				
	4 - Boom Hoist or 5 - Luffing Hoist	Same as Standard Mode		
<b>Drum 5 (Luff Jib) Mode - MAX-ER 2000 (NOTE 2)</b>				
	4 - Boom Hoist or 5 - Luffing Hoist	9 - Boom Butt Drum	3 - Left Rear	
<b>Drum 5 (Aux Hst) Mode - Standard Crane (NOTE 3)</b>				
	4 - Boom Hoist	Same as Standard Mode		5 - Auxiliary
<b>Drum 5 (Aux Hst) Mode - MAX-ER 2000 (NOTE 3)</b>				
	2 - Boom Hoist	9- Boom Butt	5 - Auxiliary	
<b>Tandem Drum Mode (NOTE 4)</b>				
Split Rear Drums (2-Drum Crane)	4 - Boom Hoist	2 - Right Rear and 3 - Left Rear		
Front and Rear Drums (2-Drum Crane)	4 - Boom Hoist	1 - Front and 2 - Rear		
Front and Rear Drums (3-Drum Crane)	4 - Boom Hoist	1 - Front and 2 - Right Rear		
<b>Clamshell Mode</b>				
Split Rear Drums (2-Drum Crane)	4 - Boom Hoist	2- Right Rear	2 - Right Rear and 3 - Left Rear	
Front and Rear Drums (2-Drum Crane)	4 - Boom Hoist	1- Front	1- Front and 2 - Rear	
Front and Rear Drums (3-Drum Crane)	4 - Boom Hoist	1- Front	1- Front and 2 - Right Rear	
<b>MAX-ER Mode (M*) (MAX-ER 2000) (NOTE 5)</b>				
	2 - Boom Hoist	9 - Boom Butt	3 - Left Rear	

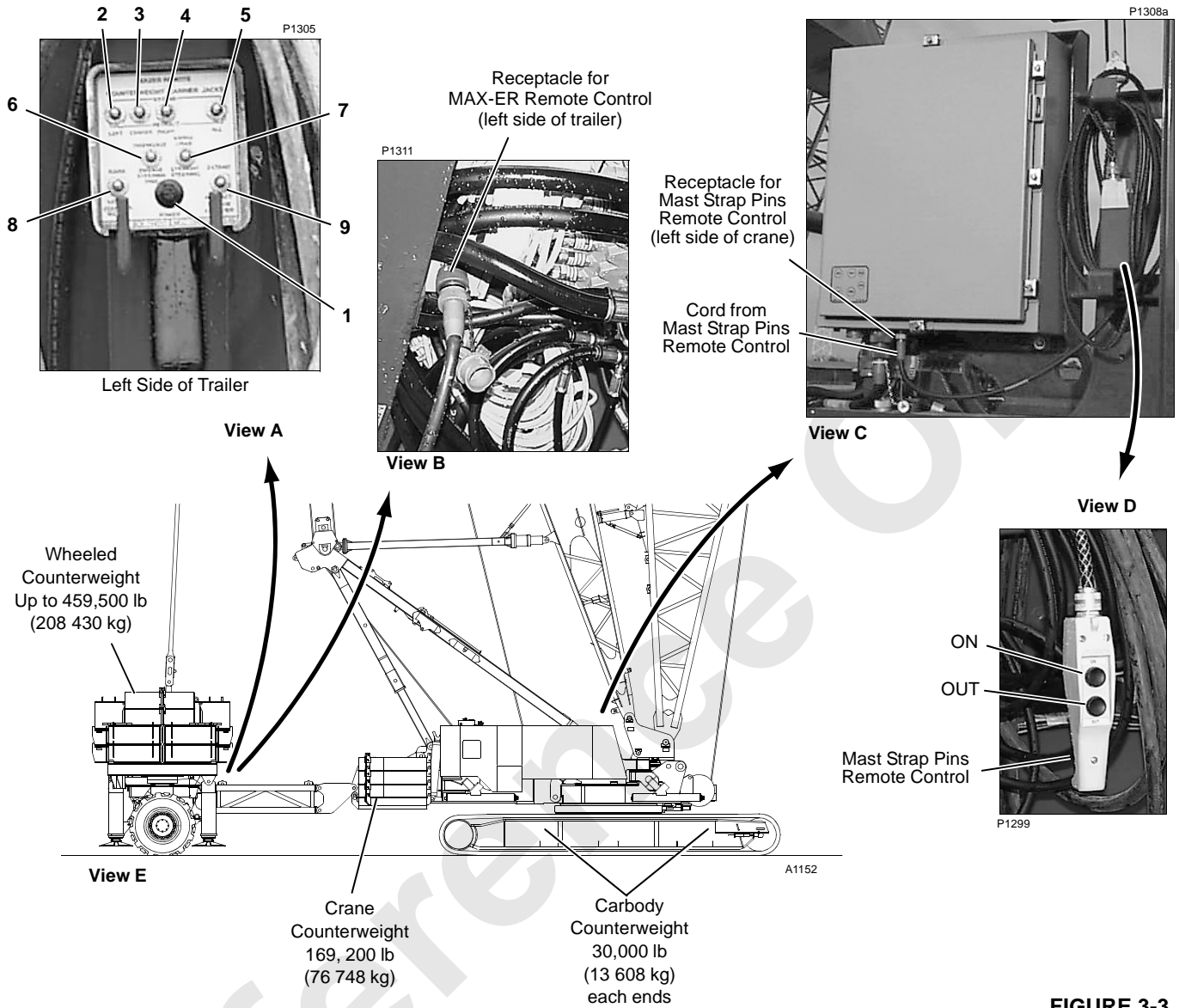


FIGURE 3-3


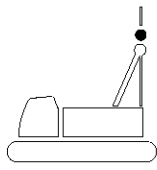




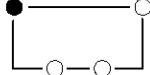

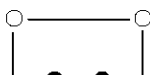

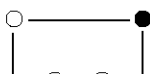

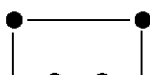


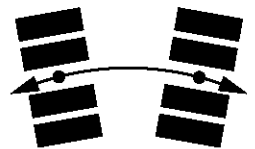
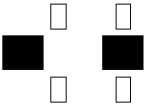
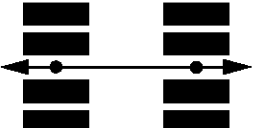
Remote Control		Mast Strap Pins	
Extend Jack Raise Counterweight Carrier		Raise Counterweight (Extend Cylinder)	
Retract Jack Lower Counterweight Carrier		Lower Counterweight (Retract Cylinder)	
Left Jack		Lower Tongue (Retract Cylinder)	
Center Jacks		Raise Tongue (Extend Cylinder)	
Right Jack		Power	
All Jacks		Straight	
Steering		Swing	
Disengage Pins and Engage Pins		Crab (Shipping)	

FIGURE 3-4

## MAX-ER OPERATING CONTROLS

### Crane Mode Selector – Crane Software Version 5005 and Lower

The crane mode selector is located in the operator's cab. See Section 3 in your Crane Operator's Manual for operation of the crane mode selector.

See Figure 3-2 in this section for drum and control handle identification.

For MAX-ER operation, the MAX-ER mode must be selected and confirmed in addition to the desired main mode — Standard, Drum 5 [Luff Jib], Drum 5 [Aux Hst].

Once selected and confirmed, the modes appear on the digital display as shown in Figure 3-4. The \*M on the right end of the screen indicates that the MAX-ER mode is on.

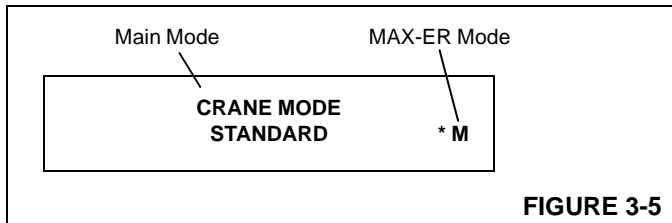


FIGURE 3-5

The crane functions operate as follows in MAX-ER mode:

- Boom Hoist can be operated at any time independently of Drum 9 and Travel.
- Only one function – Drum 9 or Travel – can be operated at a time. Travel has priority.

A simultaneous mode is available (Figure 3-5). The crane functions operate as follows in SIMULTANEOUS MAX-ER mode:

- Boom Hoist, Drum 9, and Travel can be operated at same time.
- Boom Hoist and Drum 9 can only be operated at half speed (maximum).
- Travel can be operated up to full speed.
- All other crane functions can be operated up to full speed.

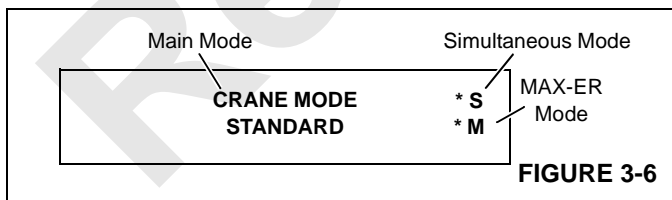


FIGURE 3-6

**NOTE:** MAX-ER mode must be on to operate Drum 9, even when you operate with the wheeled counterweight removed – 0 lb (0 kg) wheeled counterweight.

### Crane Mode Selector – Crane Software Version 5007 and Higher

The crane mode selector is located in the operator's cab. See Section 3 in your Crane Operator's Manual for operation of the crane mode selector.

See Figure 3-2 in this section for drum and control handle identification.

For MAX-ER operation, the MAX-ER mode must be selected and confirmed in addition to the desired main mode — Standard, Drum 5 [Luff Jib], Drum 5 [Aux Hst].

Additionally, the trailer control system must be turned on or off.

**To TURN ON MAX-ER Mode, proceed as follows:**

1. Turn crane mode key clockwise repeatedly until desired main mode appears on display (Standard, Drum 5 [Luff Jib], Drum 5 [Auxiliary Hoist]) as shown in Figure 3-6.
2. Then turn key counterclockwise and release to confirm selected main mode.

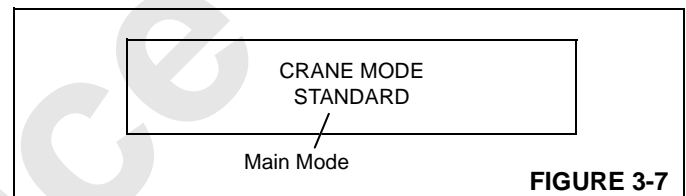


FIGURE 3-7

3. Turn crane mode key clockwise repeatedly until MAX-ER OFF appears on display as shown in Figure 3-7.

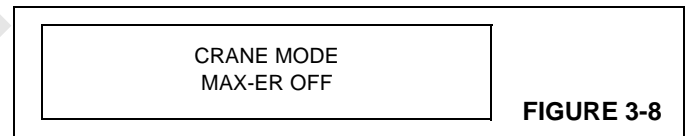


FIGURE 3-8

4. Then turn key counterclockwise and release to TURN ON and confirm MAX-ER On mode. Screen shown in Figure 3-8 appears.

TRAILER CTL ON is default setting. This is mode that must be used when MAX-ER trailer is attached to rear of crane.

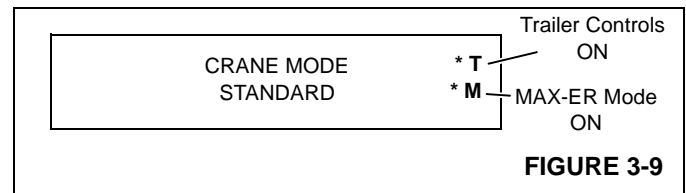


FIGURE 3-9

5. If **MAX-ER trailer is attached**, you are now ready to operate.
6. If **MAX-ER counterweight trailer is not attached (or is removed)**, turn key clockwise (select) until TRAILER CTL ON appears on display as shown in Figure 3-9.



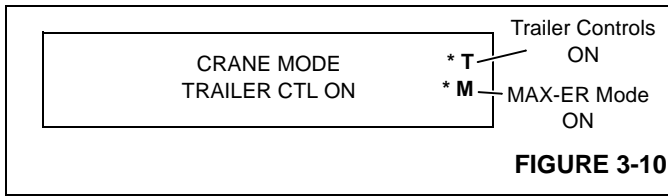


FIGURE 3-10

- Then turn key counterclockwise and release to confirm TRAILER CTL OFF mode. Screen shown in Figure 3-10 appears.

This is mode that must be used when MAX-ER trailer is not attached to rear of crane. In this mode, strap cylinder response to changing load conditions is disabled and MAX-ER related system faults are turned off.

**You must use 0 Lb Wheeled Counterweight column of MAX-ER Capacity Charts when operating in this mode.**

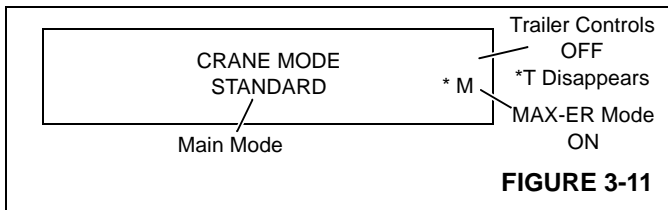


FIGURE 3-11

- If MAX-ER counterweight trailer is reattached, turn key clockwise (select) until TRAILER CTL OFF appears on display as shown in Figure 3-11.

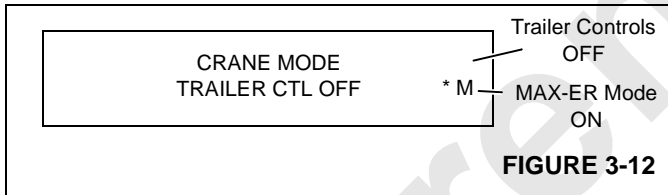


FIGURE 3-12

- Then turn key counterclockwise and release to confirm TRAILER CTL ON mode. Screen shown in Figure 3-12 appears. **This is mode that must be used when MAX-ER trailer is attached to rear of crane.**

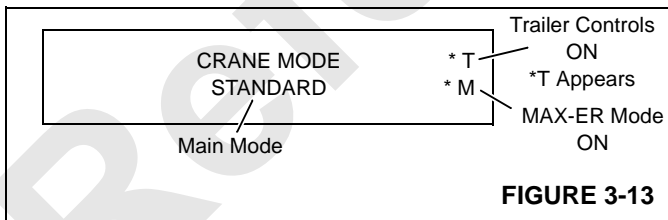


FIGURE 3-13

**NOTE:** The TRAILER CTL can be turned OFF (steps 6 and 7) or turned ON (steps 8 and 9), as desired, as long as the MAX-ER Mode is on.

**To TURN OFF MAX-ER Mode proceed as follows:**

- Turn crane mode key clockwise repeatedly until MAX-ER ON appears on display as shown in Figure 3-13.

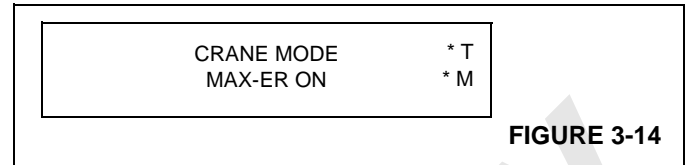


FIGURE 3-14

- Then turn key counterclockwise and release to TURN OFF and confirm MAX-ER Off mode. Screen shown in Figure 3-14 appears.

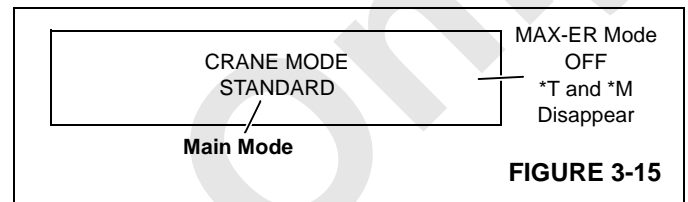


FIGURE 3-15

**The crane functions operate as follows in MAX-ER mode:**

- Boom Hoist can be operated at any time independently of Drum 9 and Travel.
- Only one function – Drum 9 or Travel – can be operated at a time. Travel has priority.

A simultaneous mode is available (Figure 3-15). The crane functions operate as follows in SIMULTANEOUS MAX-ER mode:

- Boom Hoist, Drum 9, and Travel can be operated at same time.
- Boom Hoist and Drum 9 can only be operated at half speed (maximum).
- Travel can be operated up to full speed.
- All other crane functions can be operated up to full speed.

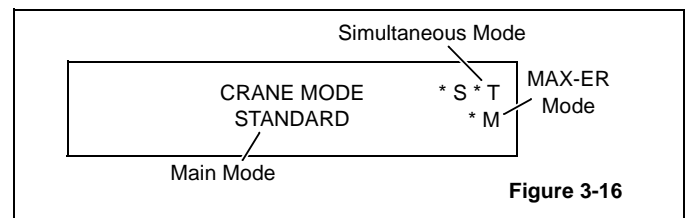


Figure 3-16

**NOTE:** The MAX-ER mode must be on to operate Drum 9, even when you operate with the wheeled counterweight removed – 0 lb (0 kg) wheeled counterweight.

## Symbol Identification

The symbols shown in Figure 3-4 are used to identify controls on current production remote controls.

## MAX-ER Remote Controls

See Figure 3-3, View A for identification of following controls.

Connect cord from MAX-ER remote control to receptacle on left side of counterweight trailer (Figure 3-3, View B).

All MAX-ER remote switches, except Counterweight Raise/Lower switch, can be operated in any crane mode with the MAX-ER mode either on or off.

### 1. Power Switch

Button held DOWN to TURN ON power to the remote control.

RELEASE button to TURN OFF power to the remote control.



## DANGER Tipping Hazard!

Trailer can tip:

- Extend and retract jacking cylinders slowly and carefully to keep trailer as level as possible.
- Jacks must be extended or wheels must be in 90° standalone position (parallel to front of trailer) to support trailer when it is disconnected from crane.
- Make sure trailer pins are in proper position when operating jacks and performing other installation/removal procedures. See Figure 3-20 for correct pin positions.
- Read and understand Trailer Jacking Procedure before operating MAX-ER Remote Control.

### 2. Left Counterweight Trailer Jack Control

### 3. Center Counterweight Trailer Jack Control

### 4. Right Counterweight Trailer Jack Control

Toggle UP to EXTEND jacking cylinder (RAISE counterweight).

RELEASE toggle to STOP (lock) jacking cylinder in last position.

Toggle DOWN to RETRACT jacking cylinder (LOWER counterweight).

### 5. All Jacking Cylinders Control

Toggle UP to EXTEND all jacking cylinders at same time.

RELEASE toggle to STOP (lock) jacking cylinders in last position.

Toggle DOWN to RETRACT all jacking cylinders at same time.

### 6. Steering Pins Control

Toggle UP to DISENGAGE steering pins.

Toggle DOWN to ENGAGE steering pins.

### 7. Steering Control

Toggle UP to rotate wheel assembly to SWING/CRAB position.

RELEASE toggle to STOP wheel assembly rotation.

Toggle DOWN to rotate wheel assembly to STRAIGHT STEERING position.

### 8. Counterweight Control

This switch is provided only for assembly or disassembly. It allows counterweight straps to be slackened during counterweight installation and removal. **This switch cannot be operated when MAX-ER mode is on.**

Toggle UP to RAISE MAX-ER counterweight (retract strap cylinders).

RELEASE toggle to STOP (lock) counterweight in last position.

Toggle DOWN to LOWER MAX-ER counterweight (extend strap cylinders).



## DANGER Tipping Hazard!

Counterweight control is used to manually extend and retract counterweight cylinders only during MAX-ER assembly and disassembly. Any other use of this control is neither intended nor approved.

Read MAX-ER Assembly Guide in Section 4 before using counterweight control. Improper use of control can cause crane to tip backwards or mast to collapse.

### 9. Tongue Cylinder Control

This switch is provided for tongue alignment during assembly.

Toggle UP to RAISE tongue (extend cylinder).

RELEASE toggle or button to STOP (lock) tongue in last position.

Toggle DOWN to LOWER tongue (retract cylinder).

## Mast Strap Pins Remote Control

See Figure 3-3, View D for identification of following control.

Connect cord from mast strap pins remote control to receptacle on MAX-ER controller (Figure 3-3, View C). **Crane Set Up mode must be on to operate this control.**

To Retract Mast Strap Pins: Press and **hold** ON button while pressing OUT button. Air pressure will retract pins.

**To Extend Mast Strap Pins:** RELEASE ON and OUT buttons. Spring pressure will EXTEND pins.

## Digital Display

The digital display is located in the operator's cab.

Scroll to CTWT BHITCH position of digital display as shown in Figure 3-16 to monitor MAX-ER operating conditions.

1. CTWT — indicates position, UP or DOWN, of wheeled counterweight assembly.
2. BHITCH — indicates backhitch loading in U.S. tons.

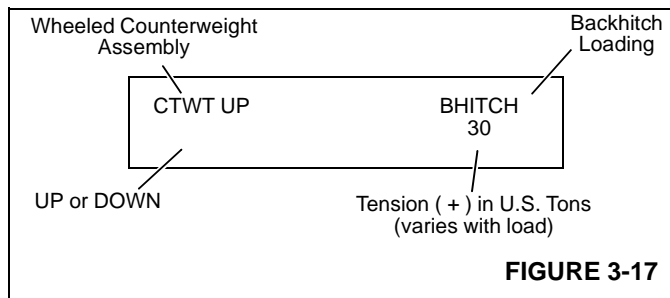


FIGURE 3-17

## System Fault Alert

The system fault beeper and red light in the operator's cab come on to warn the operator to two faults:

- LOAD PIN - all MAX-ER Units
- MAX-ER SYSTEM - MAX-ER's with Crane Software Version 5007 and Higher

A LOAD PIN fault occurs due to faulty voltage output from the pin (at or near 0 volts or at or near 10 volts).

The fault appears as shown in Figure 3-17 when the operator scrolls to the system faults group of the digital display.

The cause of the fault could be a blown fuse or a loose electric cord at the pin. Check those areas first before replacing the load sensing pin. If a fuse or loose cord is not the cause of the fault, replace the load sensing pin. **Contact Crane Care Customer Service at factory for procedure.**

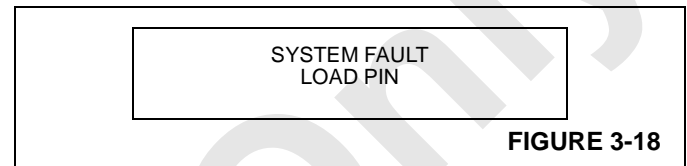


FIGURE 3-18

If a load sensing pin fault occurs, the counterweight will remain in its last position. All other crane functions will remain operable.

A MAX-ER SYSTEM fault occurs if a transducer is out of the 0.6 to 9 voltage range, differential pressure between the strap cylinders is 1,200 psi (83 bar), or the counterweight tray is 3° or more out of level.

The fault appears as shown in Figure 3-18 when the operator scrolls to the system faults group of the digital display.

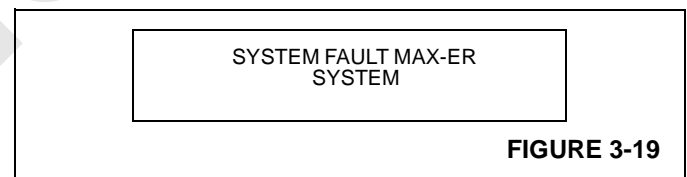


FIGURE 3-19

## TIRE INFLATION

Check tire inflation weekly. Inflate tires equally to:

- Michelin 116 -120 psi (8,0 - 8,3 bar).
- Yokohama 138 -148 psi (9,5 - 10,2 bar).
- Goodyear 142 - 146 psi (9,8 - 10,1 bar)

**NOTE:** The crane's air system does not provide adequate pressure for inflating the tires. An outside air supply is required.

Inspect the tires for damage weekly. Contact a qualified tire dealer for tire and rim servicing.

## WHEEL NUT TORQUE

Check wheel nut torque monthly. Lubricate studs with Never-Seez. Torque wheel nuts to 1,400 ft-lb (1 900 Nm).

## MAX-ER DIAGNOSTICS

See Diagnostic Display Instructions in Section 3 of the Crane Operator's Manual for assistance in troubleshooting MAX-ER 2000 problems.

## OPERATING PRECAUTIONS



### WARNING

Observe following precautions to prevent tipping or structural failure of attachment.

1. Read and comply with instructions in this section and in MAX-ER 2000 Capacity Charts before operating crane.  
If equipped with a luffing jib, also read instructions in Luffing Jib Operator's Manual and in Luffing Jib Capacity Charts.
2. Make sure proper counterweight is installed.
3. **Read and comply with instructions in MAX-ER Capacity Chart.** Do not operate beyond limits given. Automatic operation of wheeled counterweight assembly does not provide overload protection.
4. For Crane Software Version 5007 and higher, if trailer is removed, **use 0 Lb Wheeled Counterweight column of applicable MAX-ER Capacity Chart.**
5. Make sure you use correct set of Capacity Charts for required operating radius: 30 ft (9,1 m), 40 ft (12,2 m) or 50 ft (15,2 m) radius.
6. To prevent structural damage when tires are on foundation, do not travel or swing crane until wheel assemblies have been rotated and pinned in proper position.
7. Make sure crawlers are blocked, if required per Capacity Chart, before raising and lowering boom to and from ground level (see instructions in MAX-ER Capacity Chart Manual).
8. Make sure load pin is calibrated and operating properly; otherwise, wheeled counterweight assembly will not rise off ground when required (see Sensor Adjustments in Section 6 of this manual).
9. Make sure left counterweight cylinder limit switch is adjusted and operating properly; otherwise, wheeled counterweight assembly will not rise off ground proper amount when required (see Sensor Adjustments in MAX-ER 2000 Operator's Manual).
10. Make sure all operating limits — block-up, boom and jib stops, boom and jib angle indicators, and Rated Capacity Indicator/Limiter (RCL) — are installed and operating properly. See Section 6 of this manual for adjustment procedures. See separate Rated Capacity Indicator/Limiter Manual for operation and calibration of the RCL.
11. Select and confirm desired main mode — Standard, Drum 5 [Luff Jib], Drum 5 [Aux Hst] — and MAX-ER mode for operation with wheeled counterweight assembly installed. **Wheeled counterweight assembly will not rise and lower automatically if MAX-ER mode is not selected.**  
Wheeled counterweight assembly remains in its last position — up or down — if MAX-ER mode or engine is turned off during operation.
12. Operate only with crane on a firm uniformly supporting surface.  
**With load**, crane must be level to within 1 percent (0.5°) of grade.  
**Without load**, see Maximum Allowable Travel Specifications Chart.  
Make sure foundation under crane and under wheeled counterweight assembly is at same level, plus or minus 12 in (305 mm). **Mast can buckle if counterweight is lowered too far below grade.**
13. Do not operate, to include raising boom and luffing jib from ground level, if wind exceeds allowable limits given in Capacity Charts provided with crane and luffing jib. Contact your local weather station for wind velocity.
14. Be aware of increased tail swing with wheeled counterweight assembly installed. Assembly can strike objects or personnel in area of travel and swing paths.

15. Warn all personnel to stand well clear of crane. Wheeled counterweight assembly rises and lowers automatically without warning — it can strike or land on personnel.

Provide a signal person for all crane operations.

Have signal person watch wheels while swinging and traveling. Do not allow tires to strike or roll over obstructions.

16. Depending on lifted load, clearance under tires when they are off ground should be 6 – 12 in (152 – 305 mm).
17. Check and level wheeled counterweight assembly independently of crane.
18. Observe following precautions for counterweight trailer jacking cylinders:
- Make sure foundation is strong enough to support load placed on counterweight trailer jack pads. Steel or timber mats must be used to distribute loading as required.
  - Maximum load on each counterweight trailer jack is 281,000 lb (127 462 kg).
  - Area of each jack pad is 731 in<sup>2</sup> (4 716 cm<sup>2</sup>).
  - Prior to operating jacking cylinders when wheeled counterweight assembly is connected to crane, make sure all pins are in proper position (see Table 3-3 and Figure 3-21 on page 3-17). **Structural damage is possible if pins are in wrong position.**
  - Prior to operating jacking cylinders when wheeled counterweight assembly is disconnected from crane, make sure all pins are in proper position (see Table 3-3 and Figure 3-21 on page 3-17). **Wheeled counterweight assembly will fall over if this step is not performed.**

## OPERATING THE MAX-ER

### Handling Loads

- Select and confirm desired main mode — Standard, Drum 5 [Luff Jib], Drum 5 [Aux Hst] — and MAX-ER mode.
- For Crane Software Version 2007 and higher, select and confirm counterweight trailer control – either ON if trailer is attached or OFF if trailer is removed.

If trailer is removed, **you must use 0 Lb Wheeled Counterweight column of applicable MAX-ER Capacity Chart.**

- Scroll to CTWT BHITCH position of digital display to observe counterweight position.
- The counterweight cylinders will automatically lift the counterweight assembly off the ground and set it back down when required depending on load (governed by boom angle, boom length, lifted load).
- When the wheeled counterweight assembly is off the ground, the crane can be swung and traveled in the normal manner to position the crane and load.

When the wheeled counterweight assembly is on the ground, the wheels must be properly positioned before swinging or traveling the crane.

- Block crawlers if required before lowering boom to ground (see MAX-ER Capacity Chart for requirements).



### WARNING

#### Crushing Injury Hazard!

If wheeled counterweight assembly is off ground, it will lower to ground as weight of boom is lowered onto blocking.

**Rigging personnel beware!** Once counterweight lands, boom lowering speed may increase suddenly for a short distance. Keep clear of boom until it has been stopped and is at rest.

A1153

**All Views from Top Looking Down**  
Trailer Frame and other Details Removed for Clarity

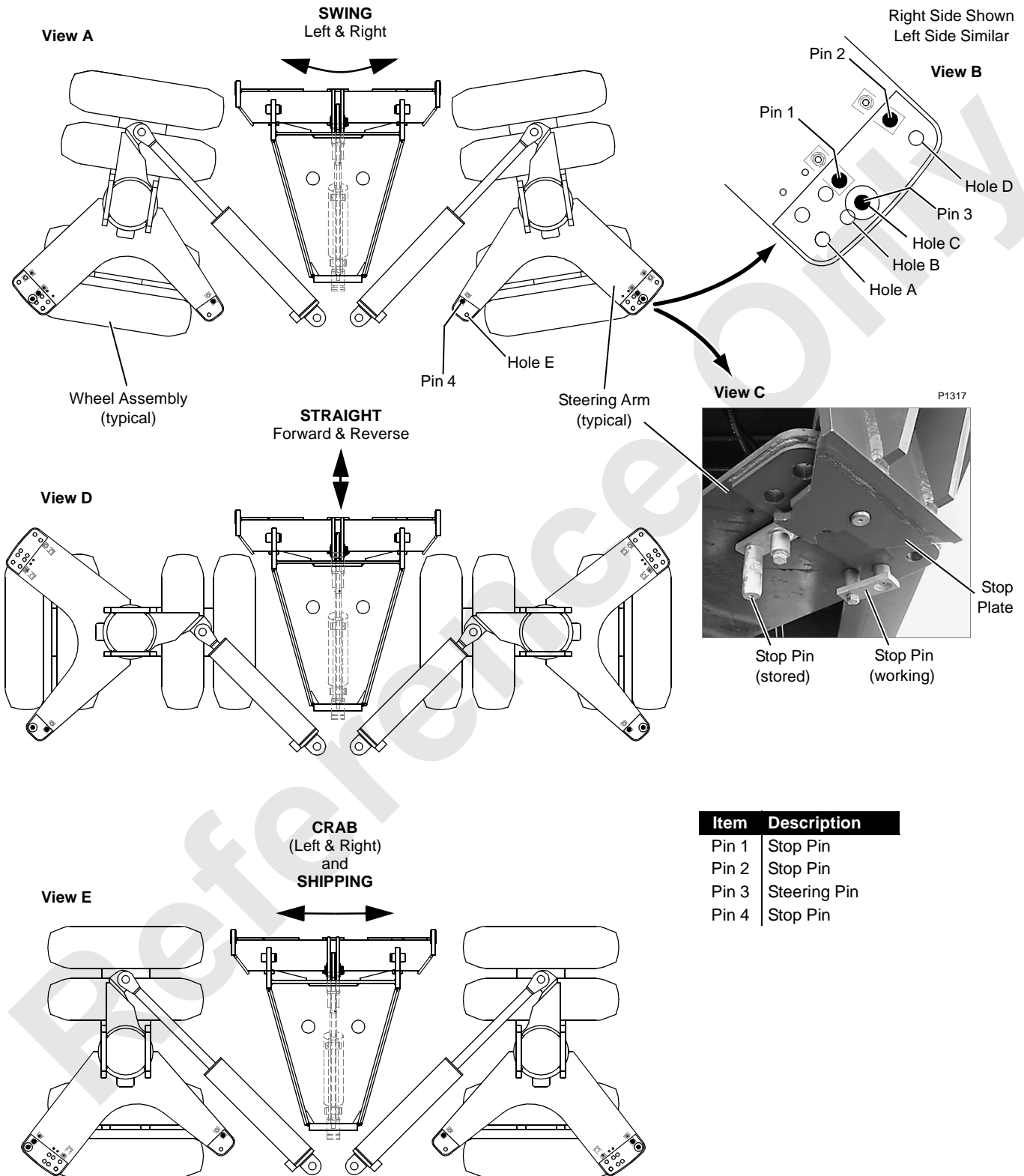


FIGURE 3-20

## Traveling and Swinging

The following travel and swing instructions apply only when the MAX-ER wheels are on the ground.

The wheels are positioned using the MAX-ER remote control switches to release the steering pins, to move the steering arms and to engage the steering pins. The steering arms and pins must be properly positioned depending on swing radius and type of travel or swing.

### CAUTION

#### Machinery Damage!

Counterweight trailer must be supported on jacks before changing wheel position:

- Check that strut and drawbar pins are in proper positions (see Figure 3-20). Hydraulic cylinders and other wheeled counterweight assembly components may be damaged.
- Extend jacks to bear most of counterweight trailer load (until bulge is out of tires). Failure to do so may cause tires to separate from rims as wheels are positioned.

### Stop Pin Positions

See Figure 3-19, Views B and C. Letters identifying pin holes in Table 3-2 refer to inner holes on steering arm.

**Table 3-2 Stop Pin Inner Hole Positions**

Stop Pin	Swing			Straight	Crab
	30 ft (9,1 m)	40 ft (12,2 m)	50 ft (15,2 m)		
1	Inner Hole A	Inner Hole B	Inner Hole C	Keep Installed	Store
2	Keep Installed				
4	Keep Installed				

### Straight Travel /Turns

See Figure 3-19 for following procedure.

### CAUTION

#### Machinery Damage!

To prevent damage to arm between counterweight assembly and crane or to swing drives:

- Do not counter-rotate crawlers without first disengaging swing lock and releasing swing brake.
- Do not attempt turns traveling in reverse.

1. Swing upperworks and wheeled counterweight assembly in-line with crawlers (perform Swinging steps).
2. Raise counterweight with jacking cylinders until bulge is out of tires.
3. Disengage steering pins (Pins 3, View B).
4. Set stop pins (see Table 3-2).
5. Rotate wheel assemblies until Pin 4 hits stop plate (straight position) (View D).
6. Engage steering pins (Pins 3) in outer Holes E. **Some movement back toward swing position may be required to align holes.**
7. Retract jacking cylinders.
8. Disengage swing lock and release swing brake.

### CAUTION

#### Swing Drive Damage!

Do not attempt to travel straight or make turns while swing lock is engaged or swing brake is applied. Damage to swing drives will result.

9. Proceed to travel forward or in reverse.
  - Turns while traveling straight are permitted in forward direction only. Watch tires closely during turn. If tire scraping is excessive, reduce radius of turn.

### Crab Travel

**NOTE:** On current production cranes without a swing lock, crab travel is not allowed.

See Figure 3-19 for following procedure.

1. Pin wheels in straight position (perform Straight Travel steps).
2. Disengage swing lock and release swing brake.
3. Counter-rotate crawlers 90° to crane upperworks. **Crane upperworks must be 90° to crawlers to prevent damage to swing drives.**

### CAUTION

#### Machinery Damage!

To prevent damage to arm between counterweight assembly and crane or to swing drives:

- Do not counter-rotate crawlers without first disengaging swing lock and releasing swing brake.
4. Raise counterweight with jacking cylinders until bulge is out of tires.
  5. Disengage steering pins (Pins 3, View B).

6. Set stop pins (see Table 3-2).
7. Rotate wheels to until Pin 2 hits stop plate (crab position) (View E).
8. Engage steering pins (Pin 3) in outer Holes A (View B). **Some movement back toward straight position may be required to align holes.**
9. Retract jacking cylinders.
10. Engage swing lock and apply swing brake.
11. Proceed to travel to right or left.

Watch bulge in tires. If side-load is excessive, crane upperworks is not 90° to crawlers.

### Swinging

See Figure 3-19 for following procedure.

1. Raise counterweight with jacking cylinders until bulge is out of tires.
2. Disengage steering pins (Pins 3, View B).
3. Set stop pins for desired radius (see Table 3-2).
4. Rotate wheels until Pin 1 hits stop plate (View C).
5. Engage steering pins (Pins 3) in outer Holes A, B, or C (View B). **Some movement back toward swing position may be required to align holes.**
6. Retract jacking cylinders.
7. Disengage swing lock and release swing brake.
8. Proceed to swing right or left.

### Operating Counterweight Trailer Jacks

The counterweight trailer jacking system is used for the following operations:

- To support trailer during shipping, assembly, and disassembly.
- To raise and lower trailer for steering and swing operations.
- To raise and lower the trailer for tire servicing.

The axle wedges (Figure 3-20, View B) stabilize the trailer when it is disconnected from the crane.



### DANGER Tipping Hazard!

To prevent trailer from tipping:

- Support trailer in either of following positions before disconnecting it from crane:
  - Jacks extended to level trailer and wedges installed.
  - Wheels rotated to CRAB position, wedges installed, and tires blocked so trailer cannot roll on its own.
- Install pins in proper position prior to jacking or performing other procedures. See Figure 3-20 and Table 3-3 for correct pin and wedge positions.
- Make sure jacking surface supports weight of trailer and counterweight and provides necessary traction to prevent jacks from sliding under load.
- Operate jacks slowly and smoothly so trailer remains as level as possible while jacking.



**Table 3-3** Pinning Arrangements

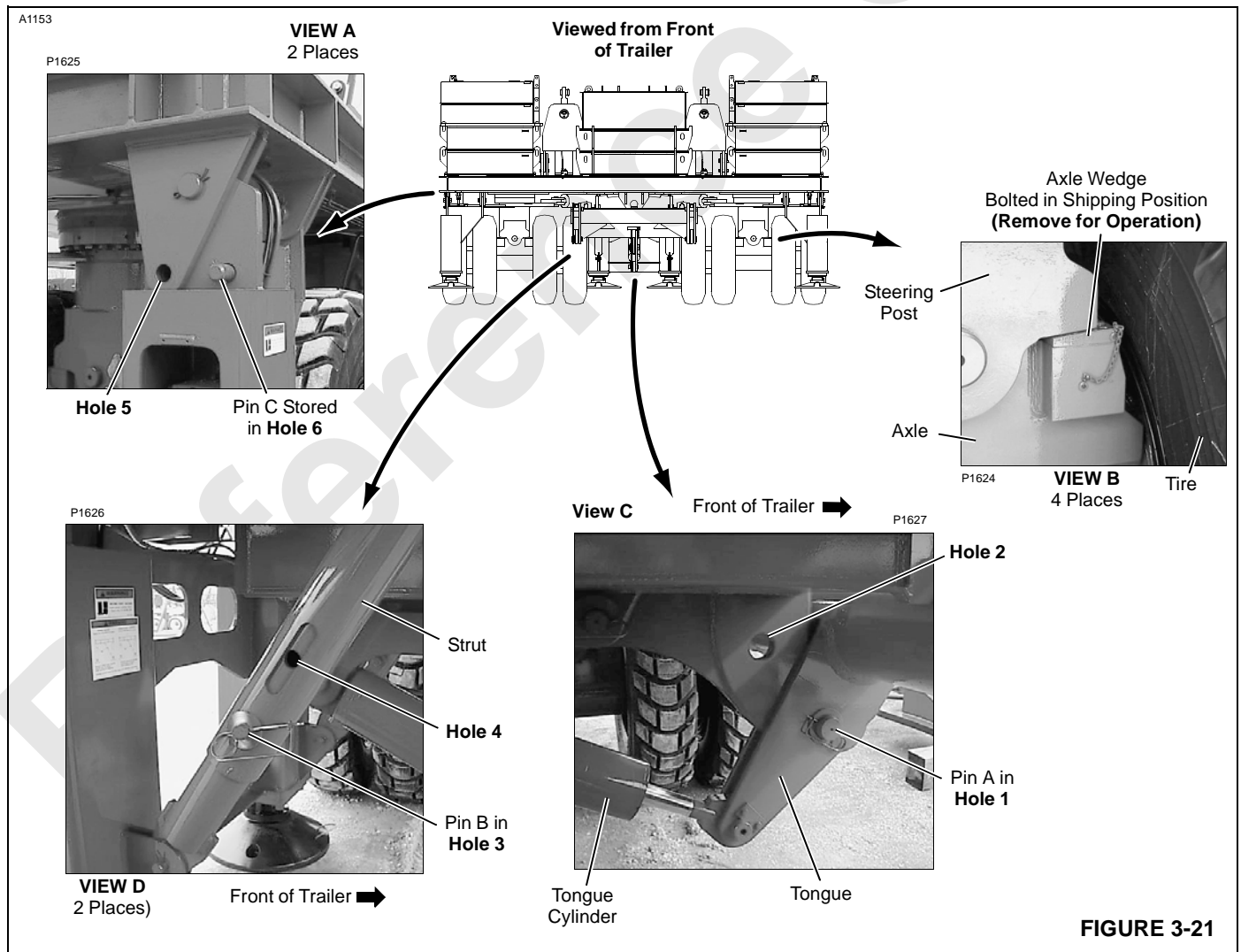
Function	Tongue		Rear Jack Struts		Front Jacks		Axle Wedges
	Hole 1	Hole 2	Hole 3	Hole 4	Hole 5	Hole 6	
<b>Trailer NOT ATTACHED to Crane</b>							
Shipping (CRAB Position)	Pin A	No Pin	Pin B	No Pin	Pin C	No Pin	Shipping
Raising and Lowering Adapter Arm	No Pin	Pin A	Pin B	No Pin	Pin C	No Pin	Shipping
Raising/lowering Trailer with Jacks	Pin A	No Pin	Pin B	No Pin	Pin C	No Pin	Shipping
<b>Trailer ATTACHED to Crane</b>							
Operating - Jacks Retracted	Pin A	No Pin	Pin B in Either Hole		No Pin	Pin C	Operating
Leveling Trailer	Pin A	No Pin	Pin B in Either Hole		No Pin	Pin C	Operating
Raising/lowering Trailer with Jacks	Pin A	No Pin	No Pin	Pin B	No Pin	Pin C	Operating

**NOTE 1:** Read MAX-ER Assembly Guide in Section 4 of this manual before attempting to install or remove wheeled counterweight trailer.

**NOTE 2:** Hole 1 in tongue (View C) is slotted to allow tongue to be pivoted during assembly and levelling.

**NOTE 3:** Raising or lowering trailer slightly with jacks may be necessary when removing pins from holes.

3



## LEAVING CRANE UNATTENDED

When crane is left unattended, it shall be parked as instructed in Section 3 of the Crane Operator's Manual. The following additional steps shall be taken if the boom cannot be lowered to ground.



### WARNING

#### Tipping Crane Hazard!

Do not leave crane unattended with wheeled counterweight assembly off ground. Counterweight will lower if pressure in counterweight cylinders bleeds off over extended period of time. Crane may tip forward when counterweight lowers.

1. Position boom at mid-point of boom angle range given in Capacity Chart.

If wheeled counterweight assembly did not lower to ground when step 1 was performed, boom up until counterweight is on ground.

2. Turn on boom hoist park and secure boom against movement by wind or other outside forces.

## WIND CONDITIONS

Wind adversely affects lifting capacity and stability as shown in Figure 3-22. The result could be loss of control over the load and crane, even if the load is within the crane's capacity.



### WARNING

#### Tipping Crane Hazard!

Judgment and experience of qualified operators, job planners, and supervisors must be used to compensate for affect of wind on lifted load and boom by reducing ratings or operating speeds, or a combination of both.

Failing to observe this precaution can cause crane to tip or boom and/or jib to collapse. Death or serious injury to personnel can result.

Wind speed (to include wind gusts) must be monitored by job planners and supervisors.

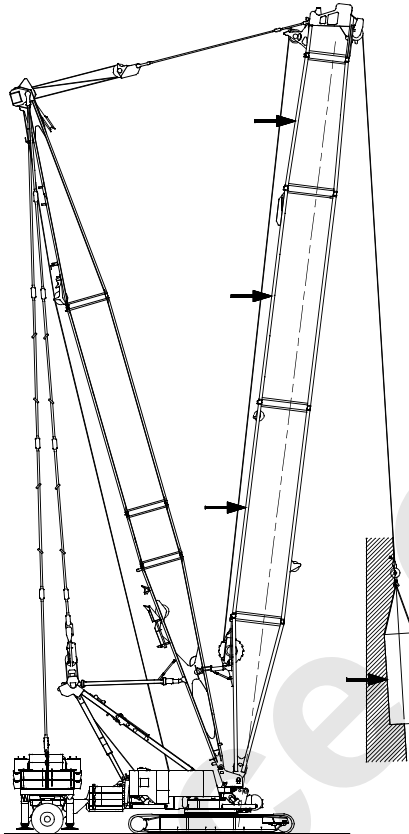
The wind speed at boom or jib point can be greater than wind speed at ground level. Also be aware that the larger the sail area of the load, the greater the wind's affect on the load.

As a general rule, ratings and operating speeds must be reduced when:

***Wind causes load to swing forward past allowable operating radius or sideways past either boom hinge pin.***

For wind conditions specific to this crane, see Wind Conditions Chart at end of this section or, if applicable, see wind conditions in Capacity Charts provided with crane and attachments.

Forward stability is affected by wind on the rear of the boom. Wind applies a force to the boom and load that adds to the crane's overturning moment. This action has the same effect as adding load to the hook.



The wind's affect on the rear of the load increases load radius. This condition can result in an overload hazard, possibly causing the crane to tip or the boom to collapse.

To avoid this hazard, reduce operating speeds and load (see Tables for recommended capacity reductions).

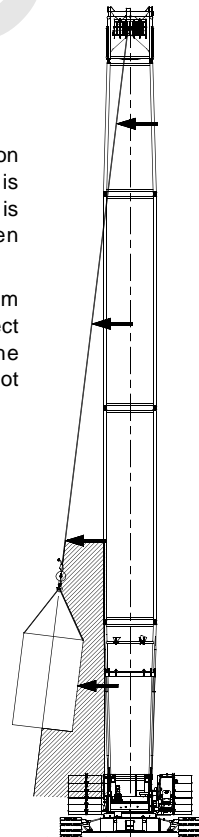
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Backward stability is affected by wind on the front of the boom. This condition is especially dangerous when the boom is at or near the maximum angle when operating without load.

Wind forces on the front of the boom reduce the normal forward tipping effect of the boom. The crane can tip or the boom can collapse if this condition is not avoided.

The boom can buckle and collapse if the load contacts the boom.



Boom strength is affected the most when the wind acts on the side of the boom.

The wind's affect on the side of the load can cause the load to swing out past the boom hinge pin. This condition can result in excessive side load forces on the boom, possibly causing the crane to tip or the boom to collapse.

To avoid this hazard, reduce operating speeds and load (see Tables for recommended capacity reductions).

FIGURE 3-22

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## SECTION 4

### SET-UP AND INSTALLATION

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## SECTION 4

### SET-UP AND INSTALLATION



#### WARNING

##### Avoid Death or Serious injury!

Read and understand instructions in this section before attempting to install or remove attachment.

##### Moving Parts/Pinch Points!

Avoid death or crushing injury during crane assembly and disassembly:

- Assembly personnel – take every precaution to prevent injury when working near moving parts.
- Maintain communication between operator and assemblers to avoid accidents.

#### KEEP UNAUTHORIZED PERSONNEL WELL CLEAR OF CRANE.

##### Falling Load Hazard!

To prevent lifting equipment from failing and load from dropping, crane owner/user shall verify following prior to each lift:

- All lifting equipment (shackles, hooks, slings, blocks) has been properly maintained and is safe for use.
- All lifting equipment has a capacity equal to or greater than load to be lifted.

### MAX-ER 2000 COMPONENTS

The MAX-ER 2000 has a wheeled counterweight assembly which supplements the crane's counterweight. Added counterweight increases the crane's capacity while maintaining its ability to travel and swing with and without load (see Section 3 for swing and travel instructions).

The attachment consists of the following components (Figure 4-1):

**Wheeled Counterweight Assembly** suspended from mast by straps and hydraulic cylinders. An extender arm (stinger) connects the wheeled counterweight assembly to the rear of the crane. The wheels can be turned to permit crane travel and swing without a load.

**Counterweight Straps and Cylinders** which suspend the wheeled counterweight assembly from the mast. The cylinder automatically raises and lowers the counterweight in response to changes in load (weight of lifted load and boom angle).

**Load Sensing Pin** which monitors loading (tension) and sends corresponding electric signals to the crane's programmable controller.

**Programmable Controller** which operates the attachment's electric and hydraulic systems to automatically raise and lower the wheeled counterweight assembly in response to signals from the load sensing pin and the boom hoist control handle.

**Limit Switch** which limits how high the wheeled counterweight assembly is raised.

### INSTALLATION AND REMOVAL NOTES

This section contains installation and removal instructions for only for the MAX-ER attachment:

- Mast and backhitch assemblies.
- Wheeled counterweight assembly.
- Boom and fixed jib assemblies.

Crane assembly and disassembly instructions are located in the Crane Operator's Manual. MAX-ER Luffing Jib installation and removal instructions are located in the MAX-ER Luffing Jib Operator's Manual.

The MAX-ER attachment shall be installed, operated, and removed by experienced personnel trained in the erection and operation of construction cranes.

**ASSEMBLY PERSONNEL/OPERATOR'S** — *read and become thoroughly familiar with instructions in this manual and in the Operator's Manuals supplied with crane and MAX-ER attachment before attempting to install, operate, or remove attachment.*

**Contact Crane Care Customer Service at factory for a detailed explanation of any procedure you do not fully understand.**

The installation/removal area must be free of ground and overhead obstructions, firm, uniformly supporting, and level to within 1 ft (0,3 m) in 100 ft (30,1 m). The area selected must be large enough to accommodate the crane with wheeled counterweight assembly and selected boom length in addition to movement of an assist crane.

**Contact Crane Care Customer Service at factory for ground bearing information.**

### RIGGING DRAWINGS

See the end of this section for applicable MAX-ER 2000 mast, boom, and fixed jib rigging drawings.

### ACCESSING PARTS

Some parts of the crane and MAX-ER attachment cannot be reached from the ground. Take necessary precautions to

prevent falling off the crane and attachment during assembly and disassembly.

**Owner/user shall provide approved ladders or personnel hoists so workers can safely access those areas of crane and attachment that cannot be reached from ground. Adhere to all local, state and federal regulations for handling personnel.**

**ASSIST CRANE REQUIREMENTS**

An assist crane is required to install and remove parts. See MAX-ER Weights in Section 1 of this manual to determine the weight of the heaviest individual part to be lifted.

If desired, the MAX-ER mast can be used as a boom to assemble and install the MAX-ER boom and wheeled counterweight assembly.

If the mast will be used as a boom, see Mast Capacities for Self- Assembly and Disassembly in this section for:

- 2250 Requirements.
- Operating Conditions.
- Lifting Capacities.

**MAST CONNECTORS**

The mast sections have FACT™ connectors:

- The top connectors are joined by fixed vertical pins that hook into holes in the adjacent section.
- The bottom connectors are joined by removable horizontal pins.

**IDENTIFYING BOOM/MAST COMPONENTS**

Boom and mast sections are marked for proper identification as shown in Figure 4-1, View A.

Boom straps and links are marked for proper identification as shown in Figure 4-1, View B.

**HANDLING COMPONENTS**

Handle boom and jib components with care to avoid damaging lacings and chords. Current production #44 and #79 inserts are equipped with lifting lugs (in top chords) designed to provide a balanced load and to prevent damage during lifting.

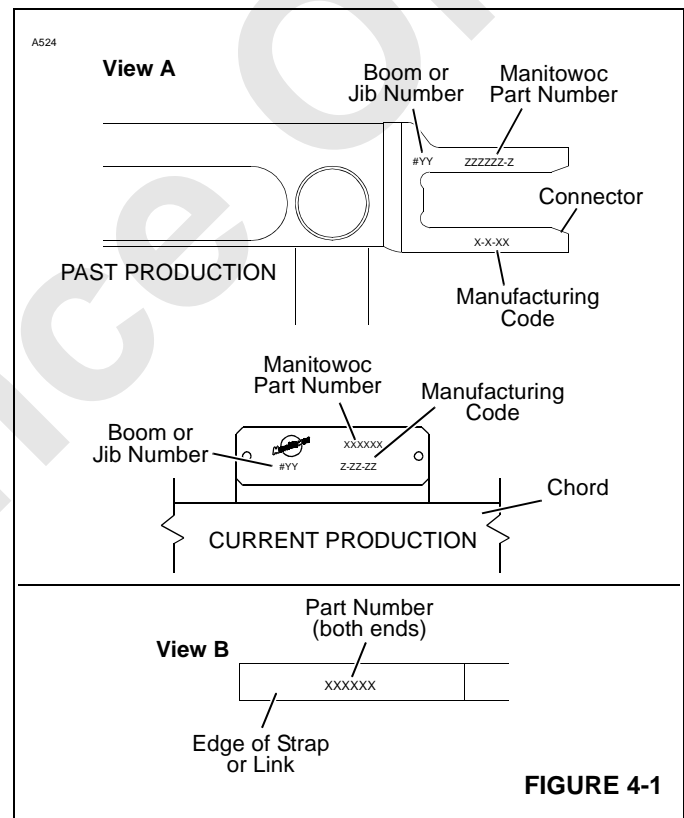
The terms RIGHT, LEFT, FRONT, REAR used in this section refer to the operator's right, left, front, and rear sides when seated in the operator's cab looking forward with the crawler motors to the rear.

**! WARNING**  
**Falling Load!**

Lifting lugs may break when lifting two or more inserts with lifting lugs on one insert,  
Lift only one insert at a time.

When lifting lugs are not provided:

- Lift against chords only, never against lacings.
- Use nylon lifting slings. If wire rope or chain slings are used, install protective covering (such as sections of rubber tire) between slings and chords.



**FIGURE 4-1**

**COUNTERWEIGHT REQUIREMENT**

MAX-ER operation with the wheeled counterweight assembly requires the following counterweight:

**Crane** — 169,200 lb (76 748 kg). See Crane Operator's Manual for crane counterweight installation procedure.

**Carbody** — 60,000 lb (27 216 kg). See instructions later in this section for carbody counterweight installation procedure.

**Wheeled** — up to 462,000 lb (209 563 kg) depending on crane capacity chart.

**NOTE:** See MAX-ER 2000 Capacity Charts for capacity limitations and counterweight requirements for operation with mast only (wheeled counterweight removed).



### WARNING

#### Tipping Hazard!

Install proper counterweight before operating crane.

## BLOCKED CRAWLERS

To prevent crane from tipping, some boom lengths must be raised and lowered over the front of blocked crawlers. See the MAX-ER Capacity Charts and Luffing Jib Raising Procedure in Capacity Chart Manual for blocked crawler requirements.

## RETAINING CONNECTING PINS

All connecting pins are retained with keeper plates, snap pins, or cotter pins. **Do not operate crane until all keeper plates, snap pins, and cotter pins are installed. Spread all cotter pins.**

## REMOVABLE LACINGS

The 20 ft (6,1 m) and 40 ft (12,2 m) #44 inserts are equipped with removable diagonal lacings. This design feature allows the lacings to be removed so that jib sections (fixed or luffing) can be stored inside the boom inserts during shipment.

User supplied blocking can be placed across the bottom chords for supporting the jib sections during shipment. **It is user's responsibility to securely fasten blocking and jib sections so sections cannot move during shipment.**



### WARNING

#### Falling Boom and Mast!

To prevent collapse of boom and mast, install removable diagonal lacings before lifting load.

Prior to using the inserts, all blocking must be removed and the removable diagonal lacings must be reinstalled as follows:

1. Thoroughly clean all dirt from mating surfaces between lacings and supports on inserts.
2. Reinstall proper number of removable lacings in each insert with bolts and stop nuts as shown in Figure 4-2.
3. Securely tighten nuts.

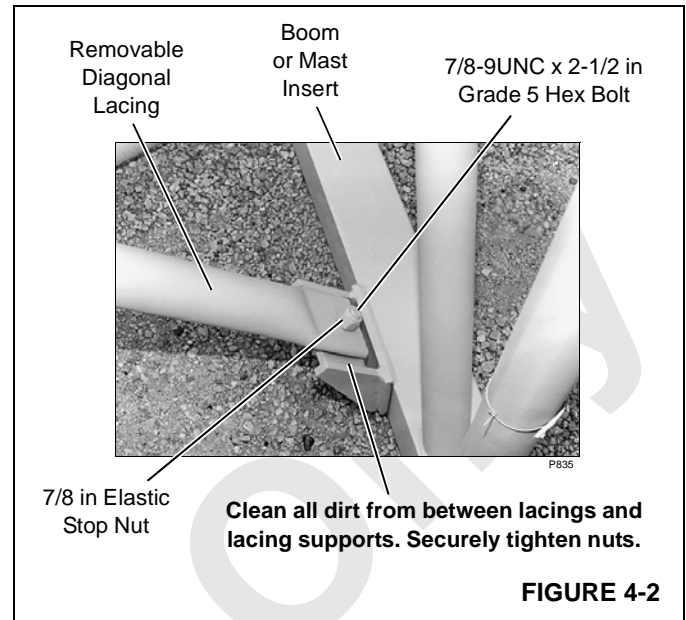


FIGURE 4-2

## MAX-ER ASSEMBLY PROCEDURE

### Prepare Crane

The 2250 crane to which the MAX-ER attachment will be assembled must be specially prepared and modified. Contact Crane Care Customer Service at factory to determine if your crane is properly prepared and modified.

Perform the following steps if your crane is equipped with an existing front-end attachment (boom or boom-luffing jib).

1. Position crane in selected assembly area and block crawlers if necessary.
2. Lower existing attachment onto blocking at ground level.
3. Remove load block and/or weighted hooks.
4. Store load lines on drums.
5. Disconnect block-up limit cord from crane at cable reel on boom butt. Connect electric cord to shorting plug on left side of upperworks adapter (see Block-Up Limit Control in Section 6 of this manual).

**NOTE:** If this step is not performed, operating limit alert will come on to indicate a block-up fault when engine is started. Also, load drums will not operate in up direction and boom hoist will not operate in down direction.

6. Unplug electric cord from block-up limit cable reel at junction box on boom top and wind cord onto reel.
7. Pin equalizer to rails on boom butt and disconnect boom straps from equalizer (see Boom Rigging Procedure in Crane Operator's Manual).

8. Disconnect boom butt from remainder of boom and travel crane to rear approximately 20 ft (6,1 m). **Leave boom butt connected to crane.**
9. If necessary, install or remove crane counterweights with gantry or an assist crane. See Crane Operator's Manual for instructions.

Counterweight Required for MAX-ER 2000	Counterweight Installed (Before Prep)	Action
Upper 169,200 lb (76 748 kg)	Series 1	None
	Series 2 Series 3	Remove 20,000 lb (9 072 kg) side boxes.
	Series 1	Install
Carbody 30,000 lb (13 608 kg) each end	Series 2	None
	Series 3	Remove all 15,000 lb (6 084 kg) boxes.

**NOTE:** Unused crane counterweight can be installed on wheeled counterweight assembly.

**NOTE:** Minimum counterweight requirement for raising and lowering mast is 169,200 lb (76 748 kg) Series 1 upper counterweight and 60,000 lb (27 216 kg) Series 2 carbody counterweight.

10. Lower gantry (see Gantry Raising and Lowering in Crane Operator's Manual).
11. Remove boom angle sending unit from right leg of boom butt. Store sending unit on front of crane until MAX-ER boom is installed.

**NOTE:** Do not disconnect electric cord from sending unit. Otherwise, system fault alert will come on to indicate a boom angle sender fault when engine is started.

12. Remove block-up limit cable reel from boom butt and store until MAX-ER boom is installed.
13. Disconnect all air and hydraulic lines from boom butt.
14. Remove boom butt from crane.
15. If necessary, reeve mast hoist equalizer. (Reeving is same as boom hoist reeving on standard 2250 liftcrane.)
16. If necessary, install appropriate laggings on load drums. See Drum and Lagging Chart and Drum Spacer/Lagging Installation in Crane Operator's Manual.
17. If necessary, install 2,600 ft (792,5 m) wire rope on boom hoist drum as specified on Mast Rigging Assembly drawing.
18. If necessary, install load pin on left side of gantry.

Reference Only

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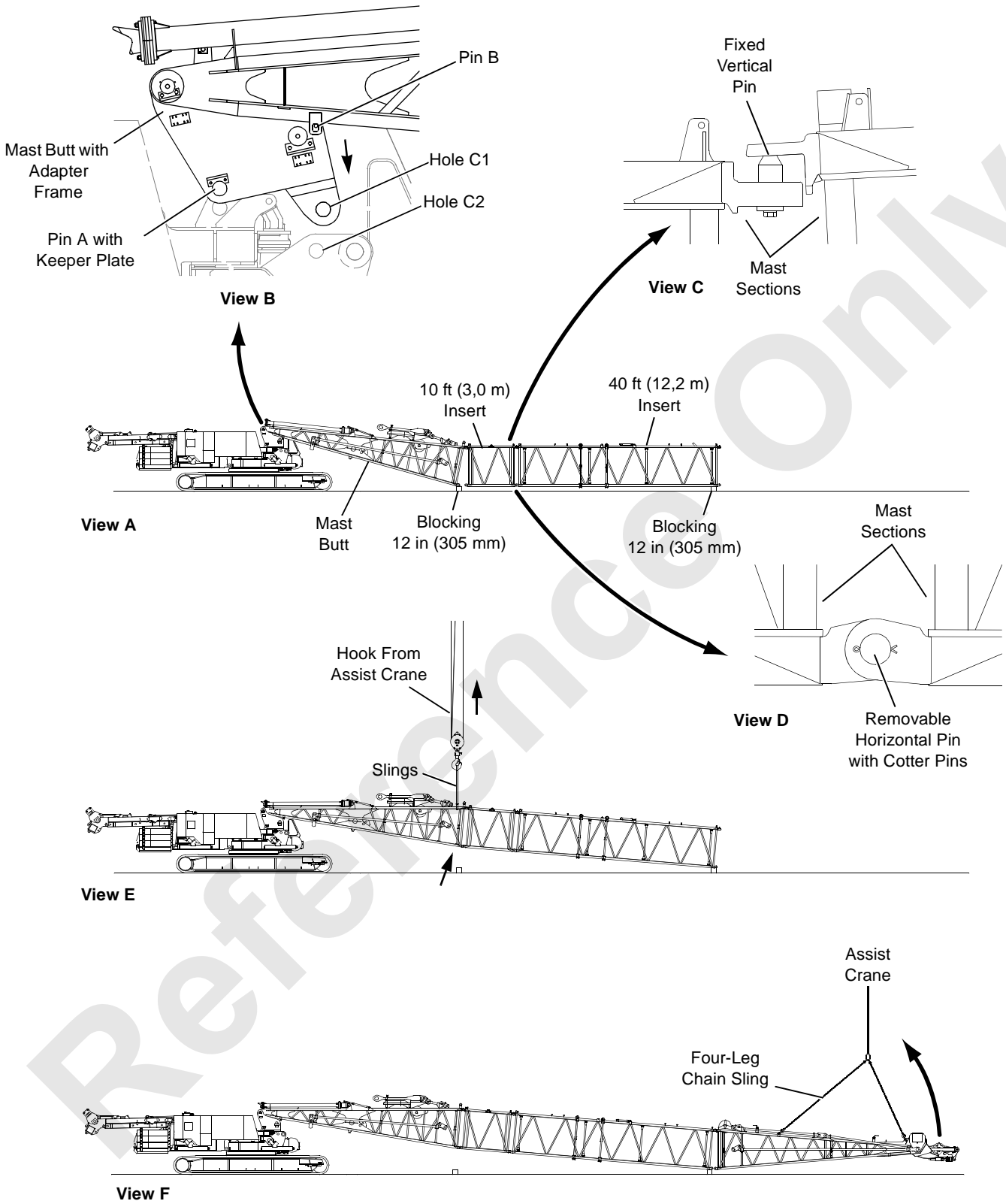


FIGURE 4-3

## Install MAX-ER Attachment

### Install Mast

See Figure 4-3 for following procedure.

1. If not already done, remove all shipping timbers from bottom chords of mast sections and install removable diagonal lacings (see Removable Lacings topic for instructions).



### WARNING

#### Tipping Crane Hazard!

Install carbody counterweights before installing mast. Crane will tip if upperworks is swung over side of crawlers with mast raised and carbody counterweights removed.



### WARNING

#### Collapsing Mast Hazard!

Always stand outside of mast sections when installing connecting pins. Do not stand on, inside, or under mast sections during assembly.



### WARNING

#### Mast Movement Hazard!

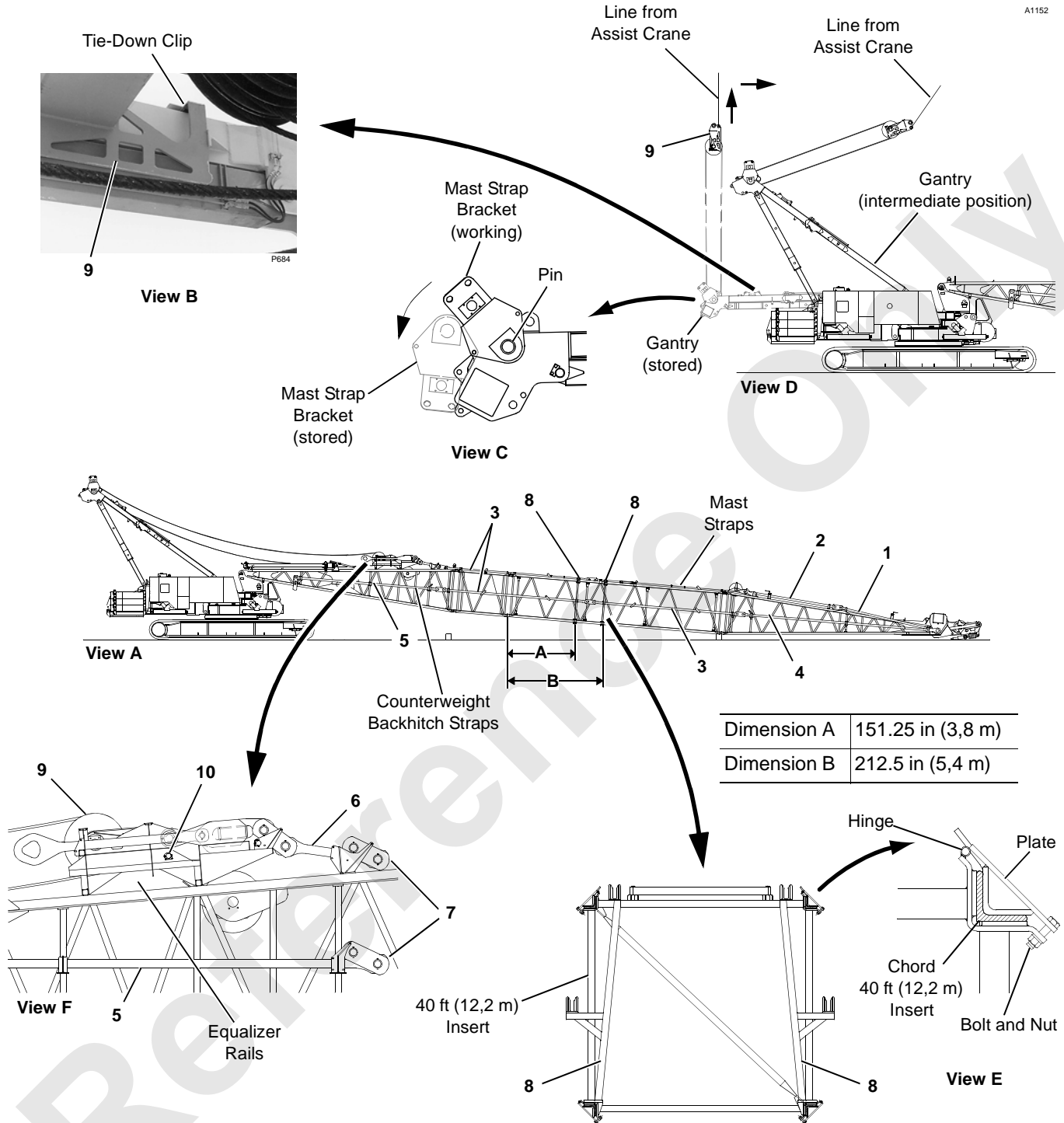
Weight of equalizer on mast top can lift mast inserts from mast butt. Pin mast inserts to butt before installing mast top.

2. Install mast butt and mast adapter frame as follows
  - a. Lift mast butt and mast adapter frame (View B) into position at front of crane and align adapter frame connecting holes with connecting holes in rotating bed.
  - b. Pin adapter frame to rotating bed (Pin A, View B). Install washers as pins are installed to limit adapter frame side play to 1/8 in (3,2 mm).
  - c. Retain pins with keeper plates provided.
  - d. Lower top end of mast butt to rotate adapter frame to align holes C1 and C2. Pin adapter frame to rotating bed.
  - e. Remove Pin B to release adapter frame from shipping position. It may be necessary to lift mast butt slightly to release pressure on pin.
3. Install mast inserts:
  - a. Lift 10 ft (3,0 m) insert into position and engage top connector holes in insert with fixed vertical pins in mast butt (View C).
  - b. Lower insert onto blocking 12 in (305 mm) high (View A).
  - c. Lift 40 ft (12,2 m) insert into position and engage top connector holes with fixed vertical pins in 10 ft (3,0 m) insert (View C).
  - d. Lower insert until bottom connector holes between inserts are in line and install removable pins (View D).
  - e. Block under top end of insert. **Blocking must be at least 12 in (305 mm) high to allow for installation of mast top.**
4. Pin inserts to butt:
  - a. Attach nylon lifting slings to chords at top end of mast butt (View E).
  - b. Hook assist crane to slings. **Crane must have sufficient capacity to lift 40,000 lb (18 144 kg) – 1/2 the weight of assembled mast.**
  - c. Lift butt and assembled mast inserts until bottom connector holes between butt and inserts are aligned.
  - d. Install removable horizontal pins to connect insert to butt (View D).
5. Install mast top as follows:
  - a. Keeping weight of equalizer in mind, hook chain sling to lifting lugs on mast top (View F).
  - b. Lift mast top into position and engage top connector holes with fixed vertical pins in 40 ft (12,2 m) insert (View C).
  - c. Lower mast top until bottom connector holes between top and insert are in line and install removable pins (View D).

### Reeve Boom Hoist Equalizer

Route wire rope from boom hoist drum (Drum 2) through sheaves in boom hoist equalizer and mast top as shown in reeving diagram on MAX-ER Mast Rigging Assembly drawing. The rigging drawing also includes wire rope specifications.

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Item	Description	Item	Description
1	16 ft 10-1/4 in (5,1 m) Strap	6	3 ft 9-1/8 in (1,15 m) Strap
2	17 ft 0-1/8 in (5,8 m) Strap	7	Strap Connecting Links (typical)
3	26 ft 10-5/8 in (8,2 m) Strap	8	Strap Rest Assembly
4	34 ft 7-3/4 in (10,6 m) Strap	9	Mast Hoist Equalizer
5	26 ft 6 in (8,1 m) Strap	10	Equalizer Stop Pin

FIGURE 4-4



### Install Straps

See Figure 4-4 for following procedure.

1. Remove and set to side straps shipped on 10 ft (3,1 m) and 40 ft (12,2 m) inserts.

**NOTE:** Straps stored on mast top are equipped with lifting lugs.

Lugs on straps (right-hand and left-hand) must face inside of mast.

2. Install strap rests assemblies (8, View E) on 40 ft (12,2 m) insert at dimensions shown in View A (2 places each side).
3. Remove strap storage bars from mast top (four places).
4. Lift straps (3) stored on mast top and lay into side mast rests on 10 ft and 40 ft inserts (four places) (View A).
5. Securely attach taglines (fiber rope) approximately 75 ft (23 m) long to links at lower end of both counterweight straps (5).

### Raise Gantry

See Figure 4-4 for following procedure.

1. Rotate mast strap brackets on gantry from stored position to working position and pin to gantry (View C).
2. Hook slings from assist crane to connecting holes in end of mast hoist equalizer.
3. Start 2250 engine. Select set-up mode and confirm.

4. Slowly pay out 2250 mast hoist wire rope (Drum 4) and carefully lift equalizer clear of tie-down clips on gantry (View B) (must guide equalizer forward slightly).
5. Continue until equalizer is pulled about 1 ft (0,3 m) out of clips. Equalizer must remain clear of gantry guide rollers.
6. Haul in assist crane load line to lift equalizer off gantry. Pay out 2250 mast hoist wire rope at same time.
7. Maintain equal haul in and pay out speeds so equalizer rises smoothly to approximately 20 – 25 ft (6 – 7,6 m) (View D). Park mast hoist (drum 4).
8. Slowly haul in assist crane load line to raise gantry.  
Pins will engage automatically when gantry is in intermediate position (View D).

### Place Mast Hoist Equalizer on Mast Butt

See Figure 4-4 for following procedure.

1. Travel and swing assist crane as needed to pull equalizer toward mast butt. Pay out 2250 mast hoist wire rope at same time (View D).
2. Maintain equal haul in and pay out speeds so equalizer moves smoothly toward mast butt.
3. Pay out load line to lower equalizer onto rails on mast butt (View F). Haul in 2250 mast hoist wire rope as needed.

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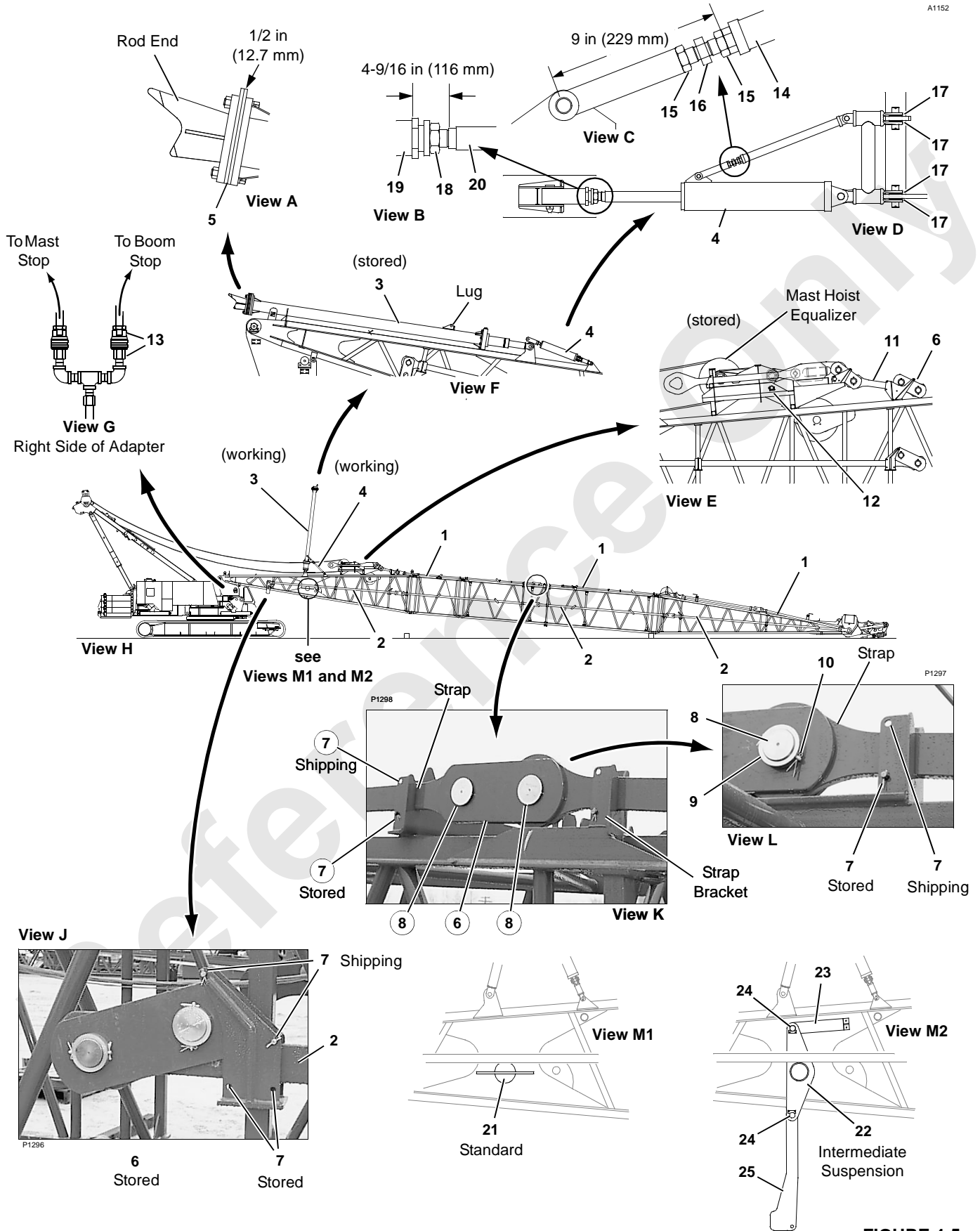


FIGURE 4-5

**Connect Mast Straps**

See Figure 4-5 for following procedure.

Mast straps and links are stored on the mast top and butt for shipping.

1. Connect straps (1, View H) at top end of each mast insert as follows:
  - a. Remove storage pins (7, Views K and L).
  - b. Store pins in storage holes (7, Views K and L).
  - c. Remove retaining pins (10), collars (9) and connecting pins (8) from end of each strap (View L).
  - d. Rotate links (6) to working position.
  - e. Install pins and collars to pin links to adjacent strap (View L).
2. Connect equalizer to front holes in equalizer rails with stop pins (12, View E). **Stop pins must be installed to prevent equalizer from accidentally sliding back on rails during link assembly.**
3. Connect straps (1) to mast hoist equalizer straps (11, View E) as follows:
  - a. Remove and store storage pins (7).
  - b. Remove retaining pins (10), collars (9), and connecting pins (8) from equalizer strap (11).
  - c. Rotate links (6, View E) forward and pin to mast strap (1) using retaining pins, collars, and connecting pins.

- d. Unpin equalizer from rails. Store stop pins (12) in lugs on rails.

**Connect Counterweight Straps**

1. Remove and store pins (7) holding straps (2) and links (6) in strap rests on side of insert (Figure 4-4, View J).
2. Remove retaining pins, collars, and connecting pins from links.
3. Rotate links and pin to strap using retaining pins, collars, and connecting pins.

**Raise Physical Mast Stop**

See Figure 4-5 for following procedure.

1. If not installed, add four shims (17) to each side of strut (14) mounting lugs (View D).
2. Add shims (5, View A) so distance between rod end and mast stop tube is approximately 1/2 in (13 mm).
3. Adjust length of air cylinder strut (14, View C) and rod end (19, View B) to dimensions given. Securely tighten jam nuts.

**NOTE:** Steps 2 and 3 are preliminary adjustments to ensure that the mast stop rod ends properly engage the gantry pins (Figure 4-8, View D).

4. Using an assist crane, raise mast stop (3) to working position (View H) and pin air cylinder (4) to lugs on mast stop.
5. Repeat steps 1-4 for other mast stop.
6. Connect air line from tee on right side of rotating bed to air line on mast butt (View G).

When engine is started, air cylinders rods will extend and push mast stops to working position.

**CAUTION**

**Structural Damage!**

Do not lift mast with mast hoist when equalizer is pinned to rails and straps are pinned to strap supports.



**Component Identification for Figure 4-5**

Item	Description	Item	Description
1	Mast Strap	14	Strut
2	Counterweight Strap	15	Jam Nut
3	Physical Mast Stop	16	Threaded Rod
4	Air Cylinder	17	1/16 in (1,6 mm) shim
5	Shims (various thickness)	18	Jam Nut
6	Strap Connecting Links	19	Rod End
7	Strap Storage Pin	20	Cylinder Rod
8	Connecting Pin	21	Mast Stop
9	Collar	22	Mast Stop
10	Retaining Pin with Cotter Pins	23	Bracket
11	3 ft 9-1/8 in (1,2 m) Strap	24	Pin with Keeper
12	Equalizer Stop Pin	25	Suspension Link
13	Nipple with Dust Cap		

**Install Intermediate Suspension Links**

See Figure 4-5 for following procedure.

---

**CAUTION****Boom Damage!**

Install intermediate suspension, if required, before raising or lowering boom.

---

Perform following steps only for #79-44 boom lengths that require intermediate suspension. Intermediate suspension is required for boom lengths of 320 ft (98 m) – 400 ft (122 m).

1. Unpin and remove standard mast stop (21, View M1) from both sides of mast butt (store for future use).
2. Install and pin intermediate suspension mast stop (22, View M2) to both sides of mast butt.
3. Pin both mast stops (22) to brackets (23).
4. Pin suspension links (25, View M2) to mast stops (22). **Pendant pin holes in end of links must face mast top.**

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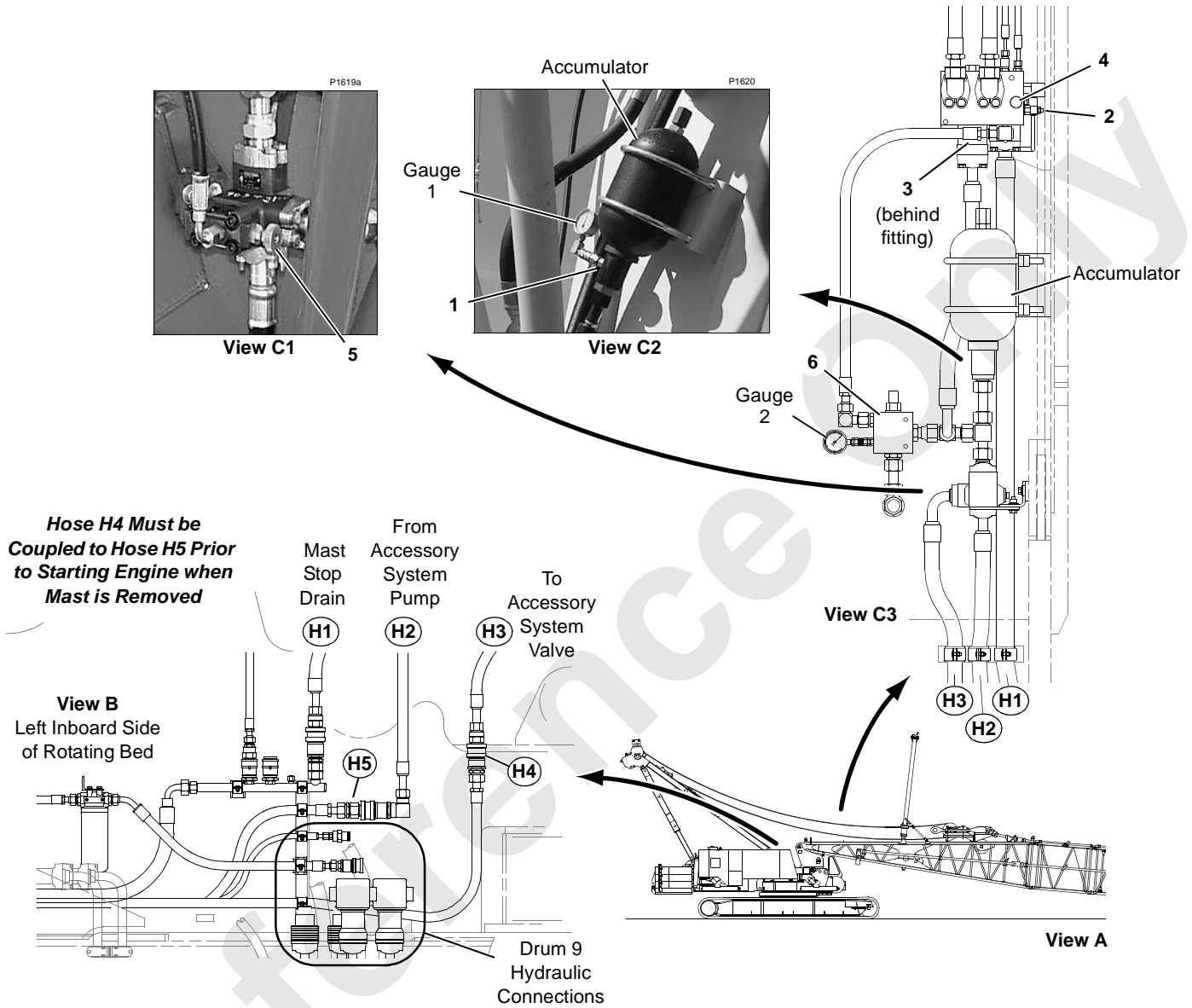
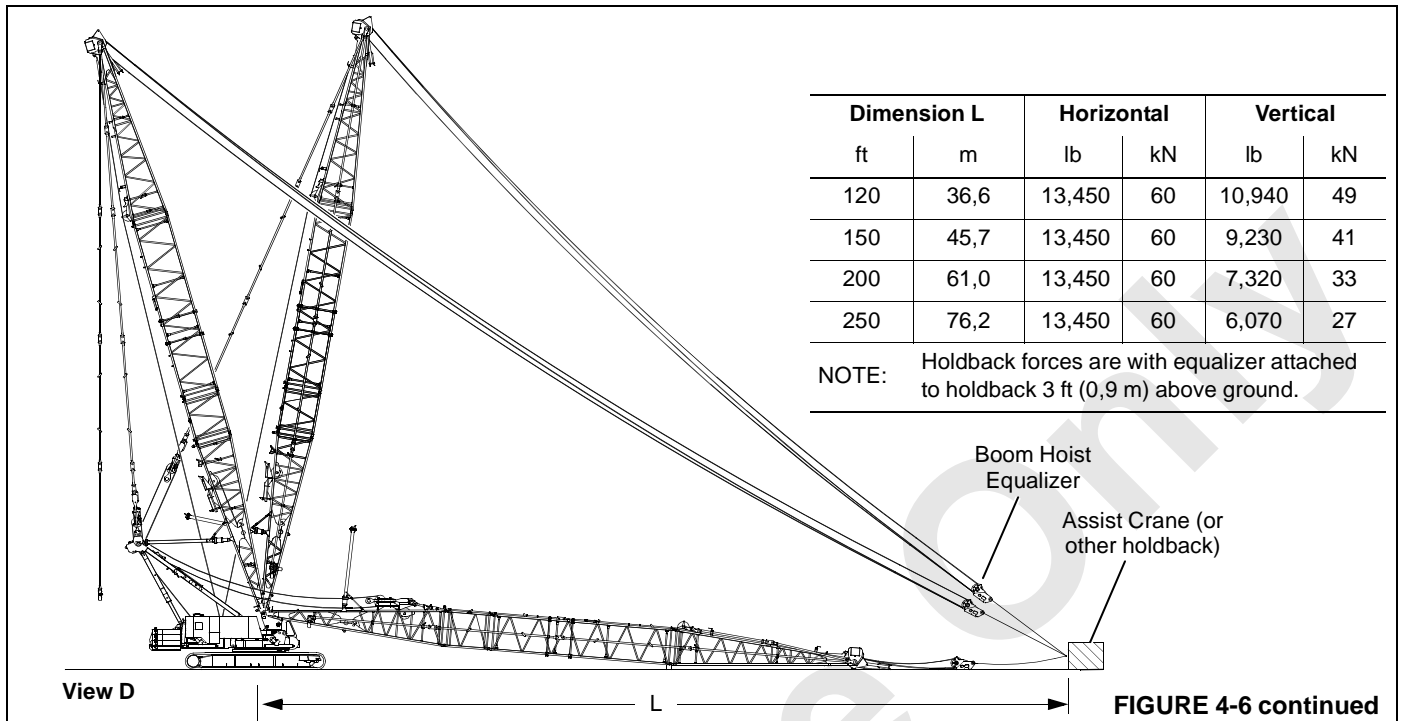


FIGURE 4-6



## Raise Mast

### General

A holdback is required to raise the mast. One of two methods can be used:

- Assist crane to which the boom hoist equalizer is securely attached (Figure 4-6, View D). The assist crane must be capable of providing horizontal and vertical holdback forces listed in the table in Figure 4-6.

**Assist crane can tip if it is too small or improperly positioned.**

- Fully rigged boom 120 ft (36,6 m) minimum.

If desired, the MAX-ER mast can be used as a boom to assemble and install the MAX-ER boom. If the mast will be used as a boom, see Mast Capacities for Self-Assembly and Disassembly for instructions.

The following procedure contains steps for raising the mast using the boom as a holdback. The same procedure applies if an assist crane is used as the holdback with the following exceptions:

- Securely attach boom hoist equalizer to proper size assist crane.
- Park assist crane approximately 15 ft (4,6 m) from equalizer.
- Install boom after mast is fully raised.

### CAUTION

#### Wire Rope/Sheave Damage!

Do not allow boom hoist equalizer to drag across ground while raising mast with assist crane as holdback. Keep equalizer level.

The SETUP mode must be selected and confirmed (MAX-ER mode turned off) in order to raise the mast. In this mode, the 80° mast stop limit is automatically bypassed. The following controls are used to raise the mast:

- Drum 2 (boom hoist).
- Drum 4 (mast hoist).
- Drum 2 and Drum 4 park and pawl switches.

A qualified operator is required to raise the mast. The operator must be experienced with the 2250 liftcrane MAX-ER 2000 attachment and thoroughly familiar with their operation. See the Operating Controls in the Crane Operator's Manual for identification and operation of the controls.

A qualified signal person is required to give signals to the operator.

#### Connect Hydraulic Hoses

See Figure 4-6 for following procedure.

1. Make sure accumulator is stamped for 2,000 psi (138 bar) pre-charge.

## 2. Stop engine.



### WARNING

#### High Pressure Oil Hazard!

If equipped, plug (1, View C2) is pressurized when hoses on rotating bed (View B) are connected and engine is running. **Before removing plug**, stop engine and open (counter-clockwise) valve knob (4, View C3) to relieve pressure.

3. On past production units only, remove plug (1, View C2) from port in bottom of accumulator and install gauge (1). Install gauge (2) at quick-coupler in valve (6, View C3).
4. At initial installation of mast, loosen lock nut at valve (2, View C3) and turn screw fully in (clockwise).
5. Then turn screw out (counter-clockwise) two full turns. Securely tighten lock nut.
6. Connect hydraulic hoses (View B), as follows:
  - a. Loosen locking knob and fully close (clockwise) valve knob (4, View C3). **Make sure locking knob doesn't limit full closure of valve knob.** This step should have been done when mast was removed.
  - b. **Connect drain hose (H1, View B and C3) first.** Then connect hoses (H2 and H3).

If you can't connect hoses (H2 and H3), open (counter-clockwise) valve knob (4, View C3) to vent pressure.

7. Fully close (clockwise) valve knob (4, View C3). **Make sure locking knob doesn't prevent full closure of valve knob.**
8. Make sure valve (3, View C3) is fully open — **line on valve stem in line with piping.**
9. Start engine. Mast stop cylinders should extend.
10. Check accumulator cut-in and cut-out pressure settings, as follows:

Pressure settings can vary  $\pm 50$  psi (3.4 bar).

- a. Crack open valve knob (4, View C3) so accumulator circuit cycles (will continue cycling until valve knob is closed).
- b. Observe gauge (1) on accumulator. Pressure should bleed down to approximately 2,400 psi (165 bar) [cut-in] and charge back up to 2,900 psi (200 bar) [cut-out].  
If proper pressure is not obtained, loosen lock nut and turn system pressure knob (5, View C1) IN to INCREASE pressure or OUT to DECREASE pressure until gauge reads 2,900 psi (200 bar).
- c. Check gauge (2, View C3). Pressure should be 2,200 psi (152 bar).
- d. Fully close (clockwise) valve knob (4). **Make sure locking knob doesn't prevent full closure of valve knob.** Then tighten locking knob.

**NOTE:** Mast valves should not require further adjustment. If you don't get proper pressures, contact Manitowoc Crane Care Customer Service for corrective action.



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Circled Numbers in Illustrations Correspond to Numbered Steps in Raise Mast Procedure.

40° - 75°  
MAST CAN BE USED AS A BOOM  
(See Mast Capacities for Self-Assembly and Disassembly.)

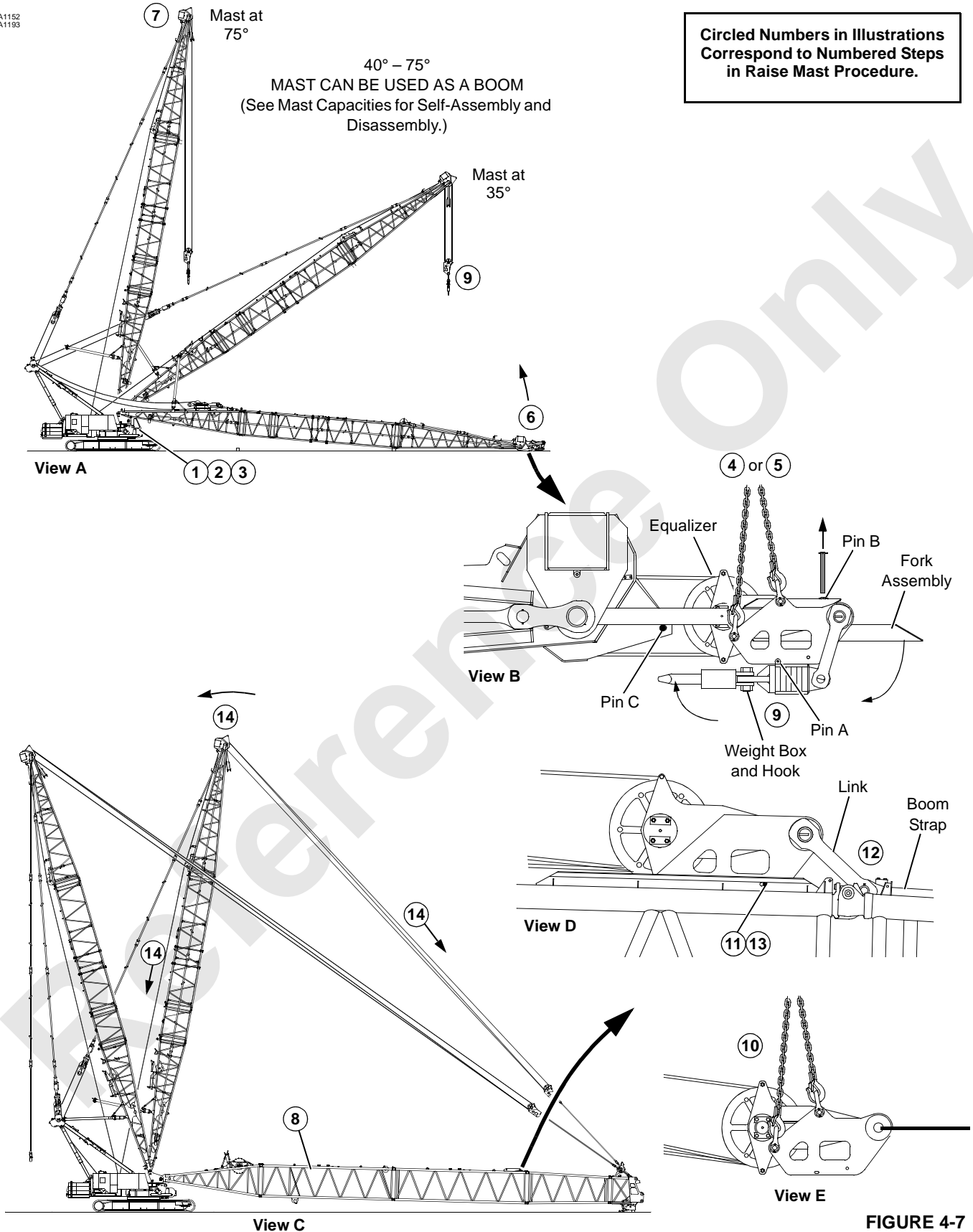


FIGURE 4-7

**Raise Mast**

See Figures 4-7 and 4-8 for following procedure.

Numbered steps in the procedure correspond to item numbers in both figures.

1. Provide a qualified person to coordinate mast raising and to provide necessary signals to crane operators.
2. Start 2250 engine. Select and confirm SETUP mode. **Turn MAX-ER mode off.**
3. Make sure working brake for Drum 2 is released.

**CAUTION****Wire Rope Damage!**

If boom hoist equalizer tips, wire rope may be damaged. Support boom hoist equalizer properly during preparation for mast raising.

4. Prepare boom hoist equalizer – if equipped with optional weight box and hook – (View B).

**NOTE:** If not equipped with weight box and hook, go to step 5.

- a. With outside assist supporting weight box and hook, remove and store pin A.
- b. Lower weight box and hook to ground.
- c. Disconnect assist crane.
- d. With outside assist supporting equalizer, remove and store pins B and C.
- e. Lower equalizer and fork assembly to ground.
- f. Disconnect outside assist.

**Equalizer will slide off forks when mast is raised.**

5. Prepare boom hoist equalizer – no weight box and hook:

- a. Attach chain slings from assist crane to equalizer so equalizer will be level when removed from forks.
- b. With assist crane supporting equalizer, remove and store pins B (View B).
- c. Pull equalizer off forks.

**Pay out boom hoist wire rope while pulling equalizer off forks.**

- d. With assist crane supporting fork assembly, remove and store Pins C (View B). Then lower forks to ground.

**Pins C must be removed for operation.**

- e. Connect equalizer to assist crane carbody to stabilize equalizer while raising mast (View E).

6. Slowly mast up (hoist with Drum 4). Pay out boom hoist wire rope (boom down with Drum 2) as needed.

7. Stop raising mast when it is at 70 – 75° (View A).

If MAX-ER mast will be used as a boom, see Mast Capacities for Self-Assembly and Disassembly for instructions. If not, turn off and park Drum 2 during boom installation.

**When using mast as a boom, operate crane in STANDARD mode to enable automatic mast stop (set at 80°). MAX-ER mode must be off.**

8. Install desired length of boom (View C). See Boom Rigging in this section for instructions.

**Minimum boom length required for mast raising holdback is 120 ft (36,6 m).**

9. If equipped with weight box and hook, lower boom hoist equalizer and hook to ground (pay out Drum 2). Remove weight box and hook and set to side.

10. Using four-point connection to keep equalizer level (View E), lift boom hoist equalizer into position on rails with assist crane.

Haul in or pay out wire rope from Drum 2 as needed.

11. Attach equalizer to holes in equalizer rails with stop pins (View D). **Stop pins must be installed to prevent equalizer from accidentally sliding back on rails during link assembly.**

12. Attach links from equalizer to boom straps. See Boom Rigging in this section for instructions.

**CAUTION****Structural Damage!**

Do not raise mast when equalizer is pinned to rails and straps are pinned to strap supports.

13. Remove stop pins securing equalizer to rails (View D).

Make sure boom straps are not pinned to strap supports.

14. Slowly begin masting up (Drum 4) while booming down (Drum 2) (View C).

Operator must carefully match rate of speed at which mast hoist wire rope is hauled in (Drum 4) with rate of speed at which boom hoist wire rope is paid out (Drum 2). Boom hoist wire rope must remain slack until mast is raised to vertical.

**CAUTION****Mast Damage!**

Keep boom hoist wire rope slack as mast is raised toward vertical. Tension in boom hoist wire rope can damage to mast or gantry and possibly cause mast to buckle.

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Circled Numbers in Illustrations Correspond to Numbered Steps in Raise Mast Procedure.

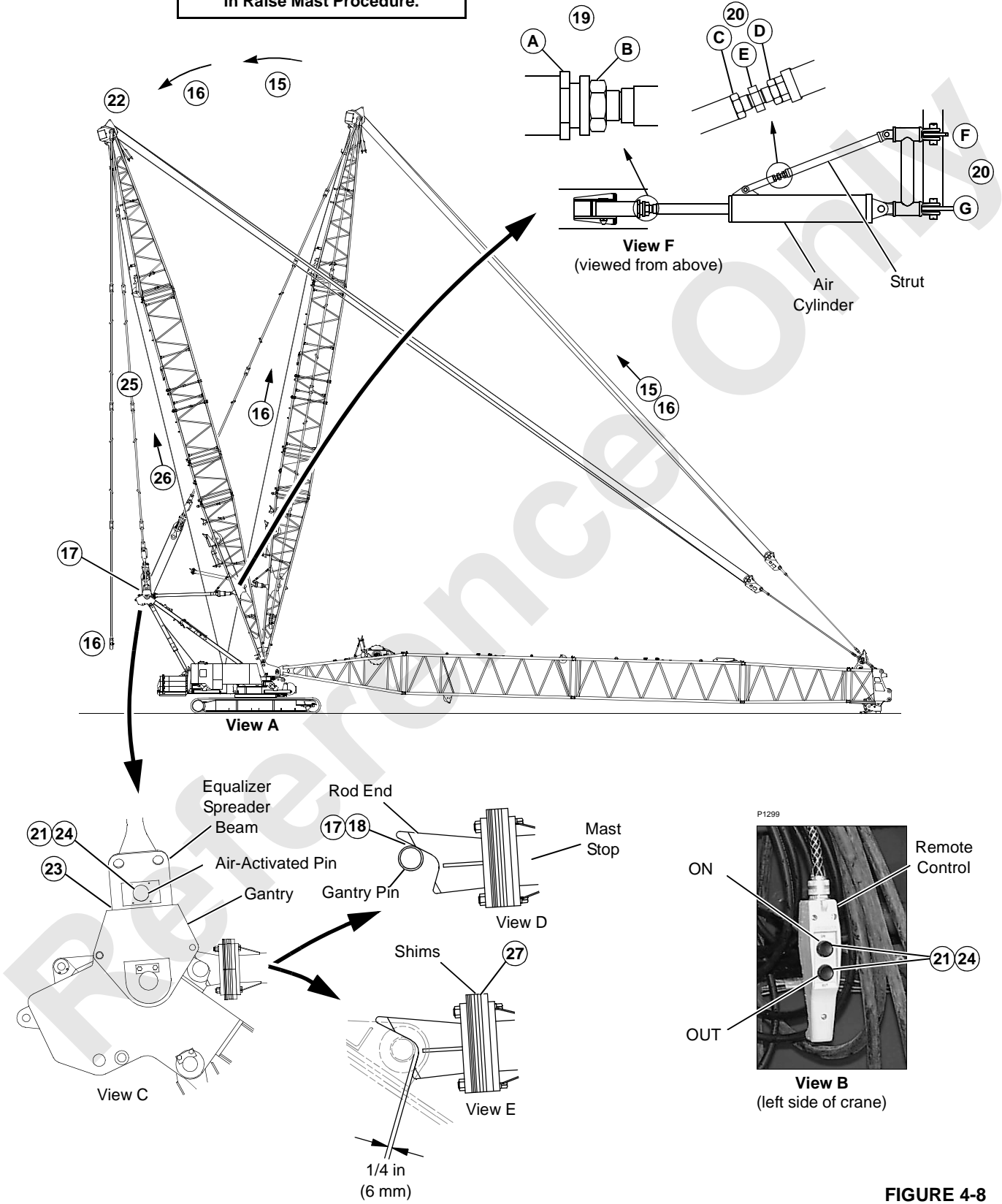


FIGURE 4-8

See Figure 4-8 for remainder of procedure.

15. As mast nears vertical, gradually tighten boom hoist wire rope (Drum 2) so mast moves smoothly past vertical to the rear (View A).
16. As mast moves past vertical:
  - a. Lower mast by slowly paying out boom hoist wire rope (Drum 2). Keep mast wire rope slack (Drum 4).
  - b. Have ground personnel use taglines to guide counterweight straps around gantry as mast is lowered.
17. Continue to lower mast to rear until just before mast stop rod ends are in position to engage gantry pins (View D).
18. Check horizontal and vertical alignment of mast stop saddles with gantry pins. Engagement should first take place first 1/3 – 1/2 down upper side of saddle with width of saddle resting on pin (View D).
19. If saddles do not align vertically:
  - a. Loosen jam nuts A and B (View F).
  - b. Adjust cylinder rod end so that saddle first contacts upper portion of pins 1/3 – 1/2 down upper side.
  - c. Tighten jam nuts A and B.
20. If saddles do not align horizontally:
  - a. Loosen jam nuts C and D (View F).
  - b. Turn threaded rod (E) in or out as needed.
  - c. Tighten jam nuts C and D.
- d. If saddle does not align properly with gantry pin after adjusting length of strut rod, adding, removing, or repositioning shims at pin points F and/or G will be necessary.
21. Using remote control on left side of 2250 (View B), press and hold ON and OUT buttons to activate air cylinders and retract mast strap pins.
22. Slowly lower mast to rear (View A).
23. As mast is being lowered to rear, guide legs of equalizer spreader beam into pockets in gantry top (View C).
24. Release ON and OUT buttons on remote control to engage pins connecting spreader beams to gantry (View C).
25. Slowly boom down until mast straps just start to slacken and stop.
26. Mast down (Drum 4) so mast hoist wire rope is slack and not under tension. Park Drum 4.
27. Shim mast stops as needed to achieve 1/4 in (6 mm) dimension between rod end and gantry pin on each side (View E).

---

 **WARNING**  
**Mast Collapse!**

Mast can collapse if mast hoist wire rope is tight. Allow adequate slack during machine operation.

---

Function	Tongue		Rear Jack Struts		Front Jacks		Axle Wedges
	Hole 1	Hole 2	Hole 3	Hole 4	Hole 5	Hole 6	
<b>Trailer NOT ATTACHED to Crane</b>							
Shipping (CRAB Position)	Pin A	No Pin	Pin B	No Pin	Pin C	No Pin	Shipping
Raising and Lowering Adapter Arm	No Pin	Pin A	Pin B	No Pin	Pin C	No Pin	Shipping
Raising/lowering Trailer with Jacks	Pin A	No Pin	Pin B	No Pin	Pin C	No Pin	Shipping
<b>Trailer ATTACHED to Crane</b>							
Operating - Jacks Retracted	Pin A	No Pin	Pin B in Either Hole		No Pin	Pin C	Operating
Leveling Trailer	Pin A	No Pin	Pin B in Either Hole		No Pin	Pin C	Operating
Raising/lowering Trailer with Jacks	Pin A	No Pin	No Pin	Pin B	No Pin	Pin C	Operating

Note 1: Read this section before attempting to install or remove wheeled counterweight trailer.  
 Note 2: Hole 1 in tongue (View A) is slotted to allow tongue to be pivoted during assembly and leveling.  
 Note 3: Raising or lowering trailer slightly with remote control may be necessary when removing pins from holes.

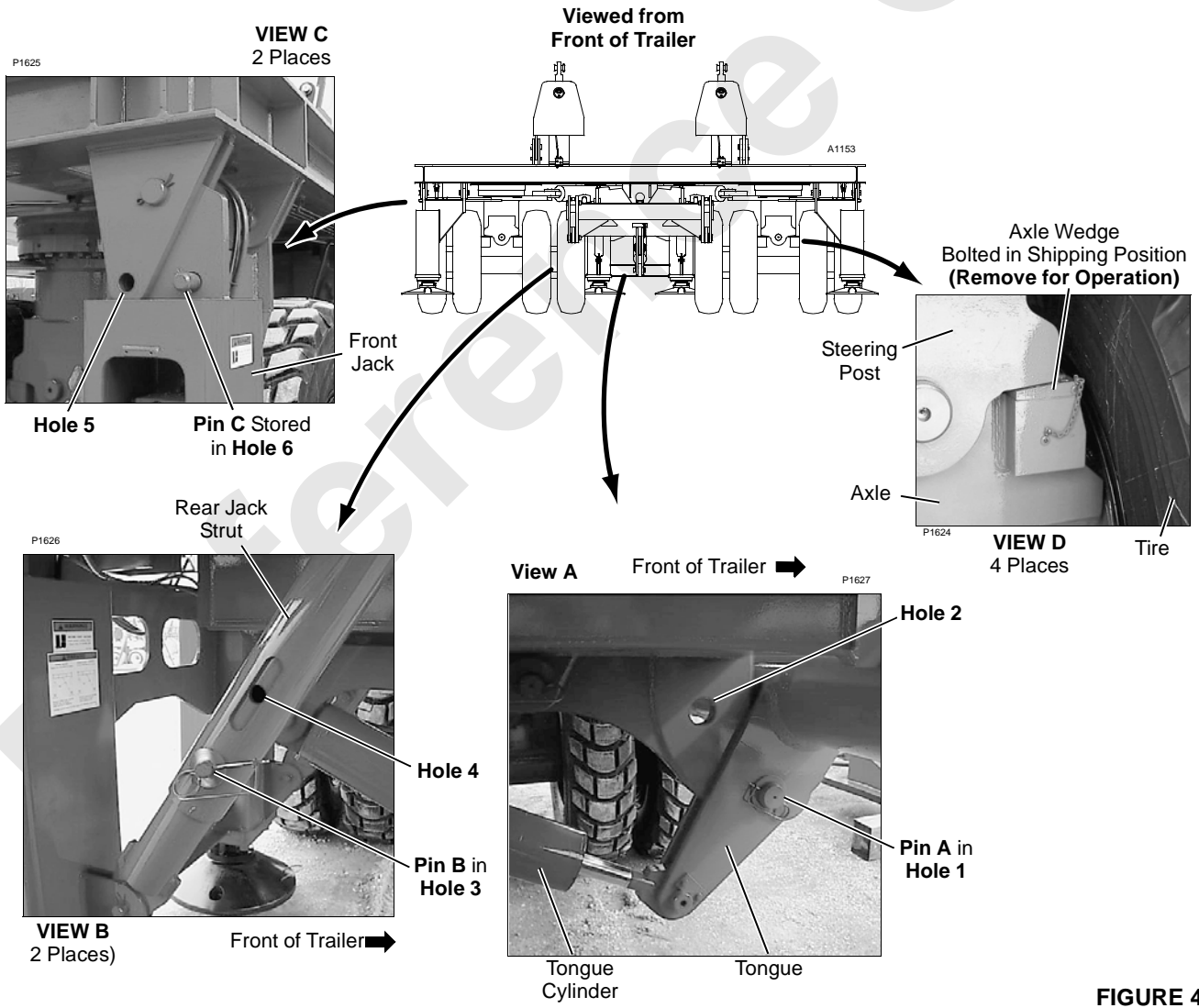


FIGURE 4-9

## Install Wheeled Counterweight Assembly

Before attaching wheeled counterweight assembly to 2250, review capacity charts to determine radius required for loads to be lifted including raising the boom.

If desired the 2250 with mast raise and boom installed can be used to assemble the wheeled counterweight assembly. **Operate within 0 lb (0 kg) counterweight column of MAX-ER Capacity Chart.** If the 2250 is not used, an assist crane is required. The weight of the trailer is approximately 83,000 lb (37 650 kg).

Trailer can tip or be structurally damaged if pins and axle wedges are not in correct position during installation and removal procedures. See Figure 4-9 for correct pin and wedge positions.



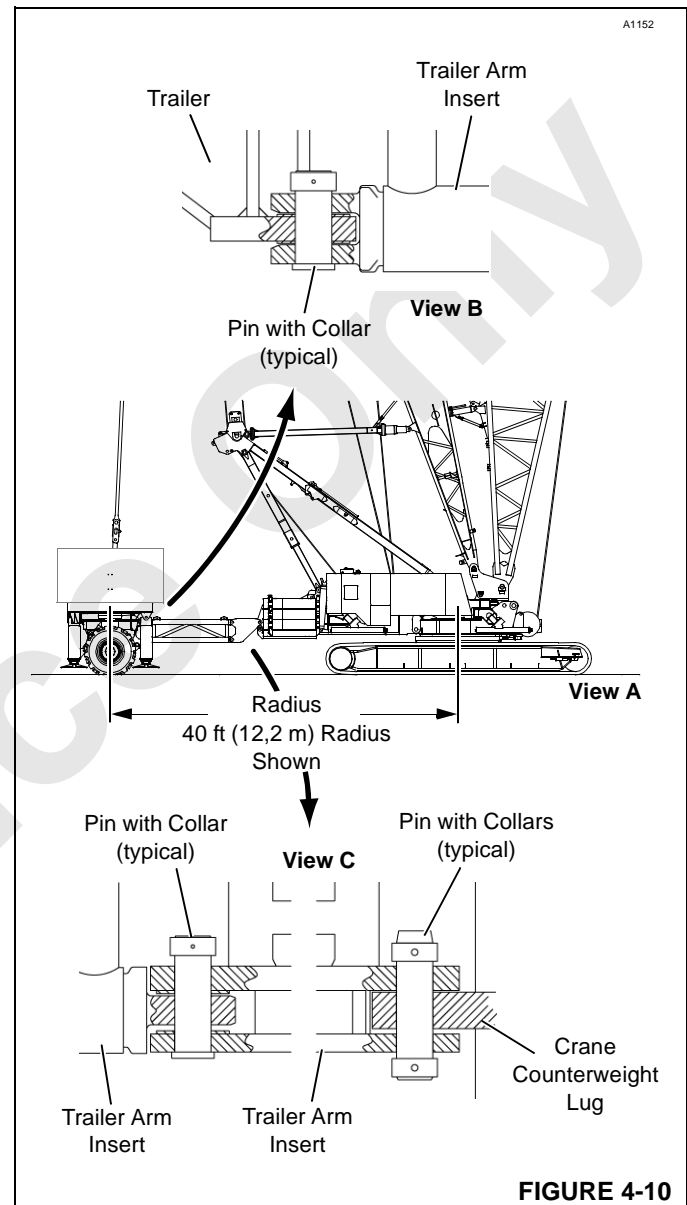
### DANGER

#### Trailer Tipping Hazard!

- Support trailer on a firm level uniformly supporting surface in either of following positions when it is disconnected from crane:
  - Extend jacks to level trailer and install wedges. **This position must be used if counterweights and arm inserts are installed.**
  - Rotate wheels to CRAB position, install wedges, and block tires so trailer cannot roll. **This is shipping position and can be used only on job site when counterweights are removed. If arms are installed, wheels must be blocked.**
- Install wedges whenever trailer is disconnected from crane — whether supported on jacks or on tires.
- Install pins in proper position prior to jacking or performing other procedures. See Figure 4-9 for correct pin and wedge positions.
- Make sure jacking surface supports weight of trailer and counterweight and provides necessary traction to prevent jacks from sliding under load.
- Operate jacks slowly and smoothly so trailer remains as level as possible while jacking.

1. Lift wheeled counterweight trailer from transport trailer and place on ground in assembly area.  
Four triangular shaped lifting holes are provided in top of counterweight bed.
2. Assemble trailer arm (Figure 4-10):
  - a. For 50 ft (15,2 m) radius, pin two 10 ft (3,0 m) inserts together and to adapter (View C).

- b. For 40 ft (12,2 m) radius, pin one 10 ft (3,0 m) insert to adapter.
- c. For 30 ft (9,1 m) radius, only the adapter is used.



- d. Lift assembled trailer arm inserts and adapter into position and pin to tongue on front trailer (View B).

**Pin heads must face out to prevent tire damage.**

**If trailer is standing on tires, support inserts on blocking so trailer cannot tip over.**

3. Position rear of 2250 so it is centered in line with trailer and holes in crane counterweight are aligned with connecting holes in adapter (Figure 4-10, View C).
4. Connect hydraulic hoses from trailer (Figure 4-11, View D) to quick connect couplers on crane (Figure 4-11, View C).

5. Connect electric power cord from trailer to receptacle on crane (Figure 4-11, View C).

**NOTE:** Remaining steps require use of trailer remote control. See Section 3 in this manual for instructions.

6. Extend jacks to support trailer.
7. Operate jacks and tongue cylinder as required to align connecting holes in trailer arm adapter with holes in counterweight (Figure 4-10, View C).

Make sure trailer pins are in proper position for **Trailer NOT ATTACHED to Crane (Figure 4-9)**.

8. Install pins to connect trailer arm adapter to crane.
9. Move trailer pins to proper positions for **Trailer ATTACHED to Crane (Figure 4-9)**.
10. Once adapter is connected to crane, move tongue pin (A, Figure 4-9) to hole (1) and extend/retract tongue cylinder to level trailer with relation to crane.
11. Extend jacks until tires are clear of ground or most of bulge is out of tires and rotate wheels to desired position.  
See Section 3 in this manual for instructions.
12. Remove axle wedges from shipping position (Figure 4-9, View D).
13. Retract jacks for operation.

**! WARNING**

**Trailer Tipping Hazard/Structural Damage!**

Make sure pins are in proper position when operating jacks. See Figure 4-9 for pin positions.

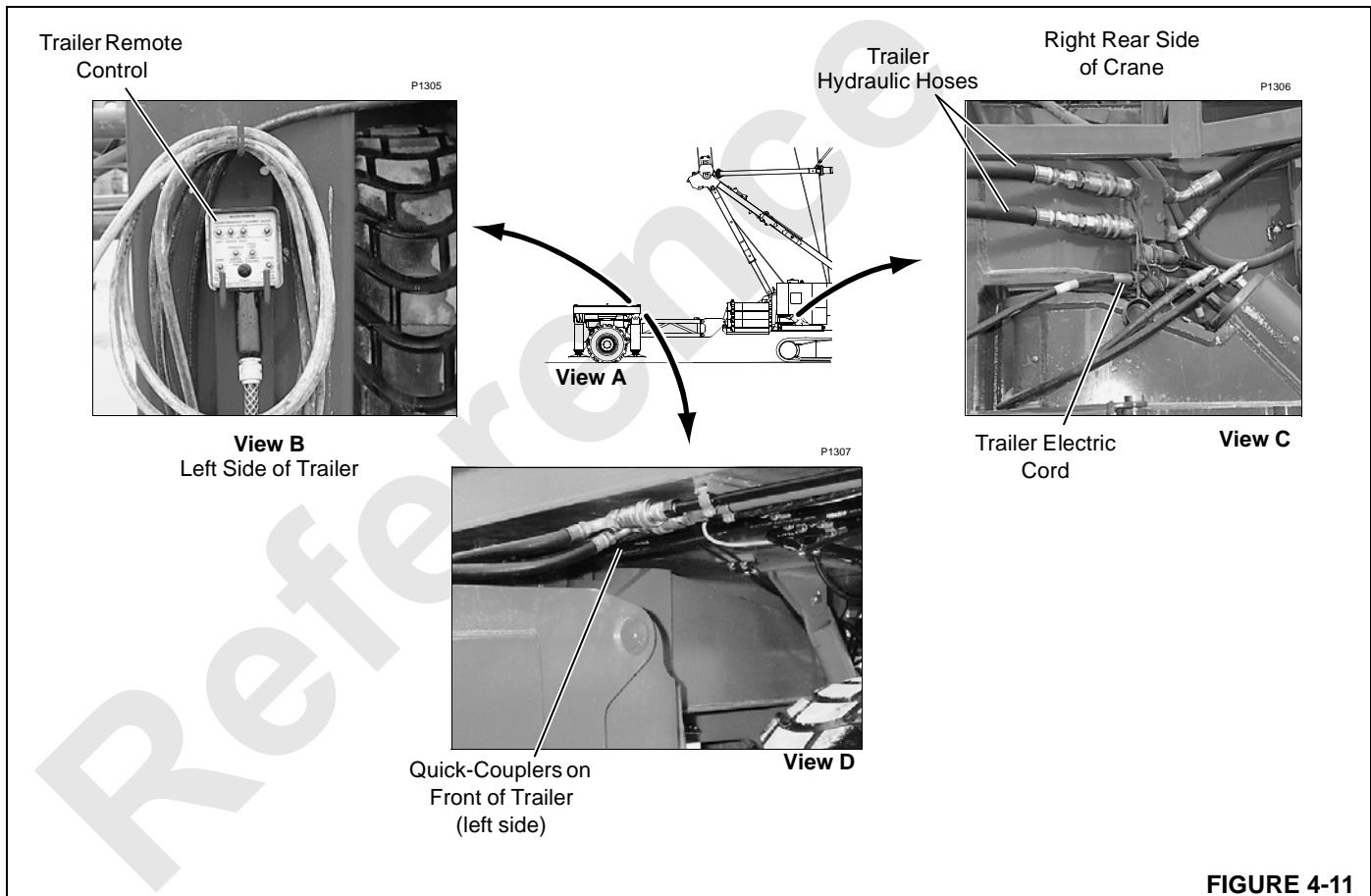


FIGURE 4-11



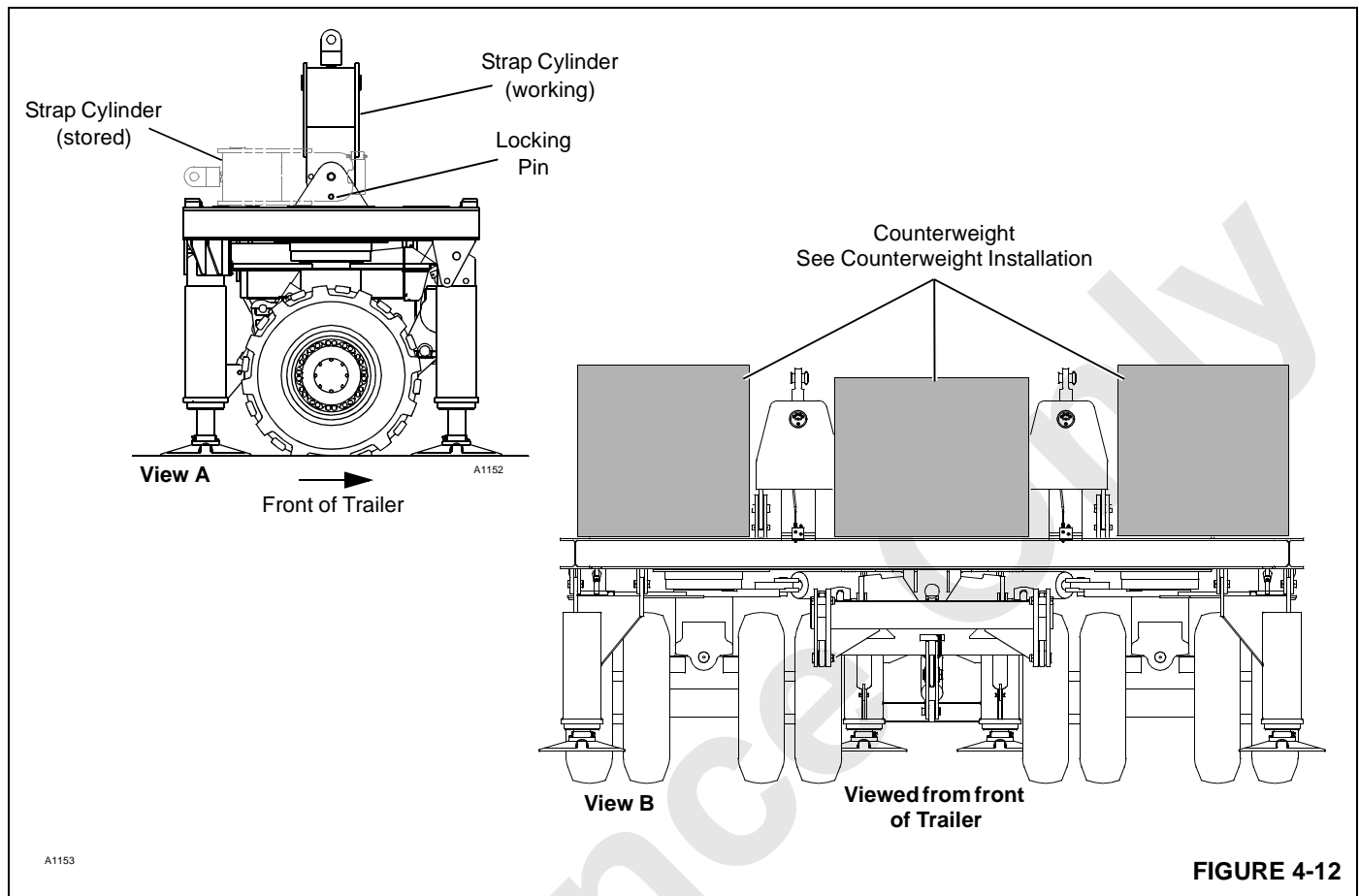


FIGURE 4-12

14. Raise each strap cylinder to working position (Figure 4-12, View A):
  - a. Hook assist crane to hole in cylinder rod end.
  - b. Lift cylinder assembly from horizontal stored position to vertical working position.
  - c. Insert locking pin to hold cylinder in position.
15. Adjust counterweight cylinder limit switch (each time attachment is assembled). See procedure in Section 6 of this manual.
16. Install counterweight. See Counterweight Installation in this section for instructions.
17. Connect counterweight straps to strap cylinders:
  - a. Start crane engine. Select STANDARD mode and confirm.
  - b. Using counterweight switch on trailer remote control, extend or retract strap cylinders to align cylinder rod ends with holes in counterweight strap links.
  - c. Pin counterweight strap links to strap cylinders.

**! WARNING**  
**Tipping Hazard!**

Alternate installation of counterweight boxes from front to rear and from side to side to prevent unbalanced loading of trailer.

Trailer must be level and supported on jacks with axle wedges installed if trailer is NOT ATTACHED to crane.

**! WARNING**  
**Collapsing Mast!**

Do not retract cylinders with remote control after straps are pinned to cylinders. Mast could be pulled over backwards or damaged structurally.

## Install Boom

See Boom Rigging in this section for boom installation instructions.

## Install Jib

See Jib Rigging in this section for jib installation instructions. If a luffing jib will be installed, see MAX-ER Luffing Jib Operator's Manual for luffing jib installation instructions.

## Install Load Line

See Load Block Reeving in this section for proper routing and reeving of load lines.

## Install Block-Up Limit Control

See Block-Up Limit Control in Section 6 of this manual for block-up limit control installation and adjustment instructions.

## ADJUSTMENTS

Adjust following components:

- Boom and jib and jib angle indicators.
- Automatic boom stop.
- Block up limit control limit switches.
- Counterweight cylinder limit switch adjustment (for controlling how high counterweight rises).

## MAX-ER OPERATION

See Section 3 in this manual for operating precautions and a description of the MAX-ER operating controls. The MAX-ER mode must be selected and confirmed.

**NOTE:** Axle wedges must be in operating position for crane operation (Figure 4-13).

## PRE-RAISING CHECKS

Perform following pre-raising checks and correct any defects before raising boom and jib.

- Crane is on firm, level surface.
- Crawlers are blocked if required per Capacity Chart.
- All connecting pins are installed and properly retained.
- Boom inserts and straps are installed in proper sequence.
- Intermediate suspension pendants are installed, if required.

- All insert and strap connecting pins are installed and properly retained.
- Jib inserts and pendants are installed in proper sequence.
- Proper crane counterweight and, if required, MAX-ER counterweight is installed
- Load lines are spooled tightly onto drums and engaged with proper sheaves. Load lines are securely anchored to sockets at boom points or at load block and weight ball.
- All blocking, tools, and other items are removed from boom and jib.
- Electronic boom angle indicator is properly installed and adjusted.
- Block-up limit control is properly installed and operational.
- Load moment indicator is properly installed and operational.
- Automatic boom stop is installed and properly adjusted (after boom and jib are raised).
- Crane and attachment are properly lubricated.
- Wind is within allowable limits for operation.

## MAX-ER DISASSEMBLY PROCEDURES

### Prepare Crane

Position crane in selected disassembly area. Area must have adequate space for boom length and accommodate movement of an assist crane.

### Lower Boom

1. If required for boom length in use, block crawler rollers on end of crane from which boom will be lowered.



### WARNING

#### Tipping Hazard!

Block crawlers, if required, before lowering boom to ground.

See Capacity Chart for blocked crawler requirements and for instructions.

2. Lower boom onto blocking at ground level. Continue to boom down until boom hoist equalizer comes to rest on equalizer rails and counterweight straps slacken.

## Remove MAX-ER Counterweight



### WARNING

#### Tipping Hazard!

Alternate removal of counterweight boxes from front to rear and from side to side to prevent unbalanced loading of trailer.

1. Disconnect counterweight straps from strap cylinders on trailer.  
To perform this step, select and confirm STANDARD mode. Then use counterweight switch on MAX-ER remote control to extend strap cylinders so connecting pins are loose.  
Fully retract strap cylinders when complete.
2. Remove counterweight boxes. See Counterweight Installation for identification of the boxes.
  - a. Remove center counterweight boxes.
  - b. Remove right and left side boxes and adapter plates.
3. Lower strap assist cylinders (Figure 4-12, View A):
  - a. Hook assist crane to hole in cylinder rod end.
  - b. Remove locking pin holding cylinder in position.
  - c. Lower cylinder assembly to horizontal stored position.

## Disconnect Trailer from Crane



### DANGER

#### Trailer Tipping Hazard!

- Support trailer on a firm level uniformly supporting surface in either of following positions when it is disconnected from crane:
    - Extend jacks to level trailer and install wedges. ***This position must be used if counterweights and arm inserts are installed.***
    - Rotate wheels to CRAB position, install wedges, and block tires so trailer cannot roll. ***This is shipping position and can be used only on job site when counterweights are removed. If arms are installed, wheels must be blocked.***
  - Install wedges whenever trailer is disconnected from crane — whether supported on jacks or on tires.
  - Install pins in proper position prior to jacking or performing other procedures. See Figure 4-9 for correct pin and wedge positions.
  - Make sure jacking surface supports weight of trailer and counterweight and provides necessary traction to prevent jacks from sliding under load.
  - Operate jacks slowly and smoothly so trailer remains as level as possible while jacking.
1. ***Make sure trailer pins are in proper position for Trailer ATTACHED to Crane (Figure 4-9).***
  2. If trailer is being shipped or will be stored on tires, proceed as follows:
    - a. Extend jacks until tires are clear of ground or most of bulge is out of tires.
    - b. Rotate wheels to CRAB position.  
See Operation Guide in Section 2 for instructions.
  3. If trailer will be supported on tires, ***block under trailer arm inserts so trailer cannot tip over.***
  4. If trailer will be supported on jacks, extend jacks until trailer is level and most of bulge is out of tires.



### WARNING

#### Trailer Tipping Hazard!

When trailer is supported on jacks, install front jack pins (C, Figure 4-9, View C) in holes (5) before removing pins connecting trailer arm adapter from crane.

5. Remove pins attaching trailer arm adapter to lugs on crane (Figure 4-10, View C).

Use jacks and tongue cylinder to raise or lower trailer arm as required to loosen pins.

6. Disconnect electric cord from trailer at receptacle on crane (Figure 4-11, View C). Install protective caps and coil cord on trailer for storage.
7. Disconnect hydraulic lines from trailer at quick connect couplers on crane (Figure 4-11). View C. Install protective caps and coil hoses on trailer for storage.
8. If trailer is being shipped, remove trailer arm inserts and adapter from trailer with assist crane.
9. Disassemble trailer arm as required.

**Lower Mast**

A holdback is required to lower the mast. One of two methods can be used:

- Assist crane to which the boom hoist equalizer is securely attached (Figure 4-6, View D). The assist crane must be capable of providing horizontal and vertical holdback forces listed in the following table.

***Assist crane can tip if it is too small or improperly positioned.***

Dimension L (Figure 4-6, View D)		Horizontal		Vertical	
ft	m	lb	kN	lb	kN
120	36,6	13,450	60	10,940	49
150	45,7	13,450	60	9,230	41
200	61,0	13,450	60	7,320	33
250	76,2	13,450	60	6,070	27

NOTE: Holdback forces are with equalizer attached to holdback 3 ft (0,9 m) above ground.

- Fully rigged boom 120 ft (36,6 m) minimum.  
  
If desired, the MAX-ER mast can be used as a boom to disassemble and remove the MAX-ER boom. If the mast will be used as a boom, see Mast Capacities for Self-Assembly and Disassembly for instructions.

The following procedure contains steps for lowering the mast using the boom as a holdback. The same procedure applies if an assist crane is used as the holdback with the following exceptions:

- Remove boom before mast is lowered.
- Securely attach boom hoist equalizer to proper size assist crane.
- Park assist crane at dimension L, Figure 4-6, View D.

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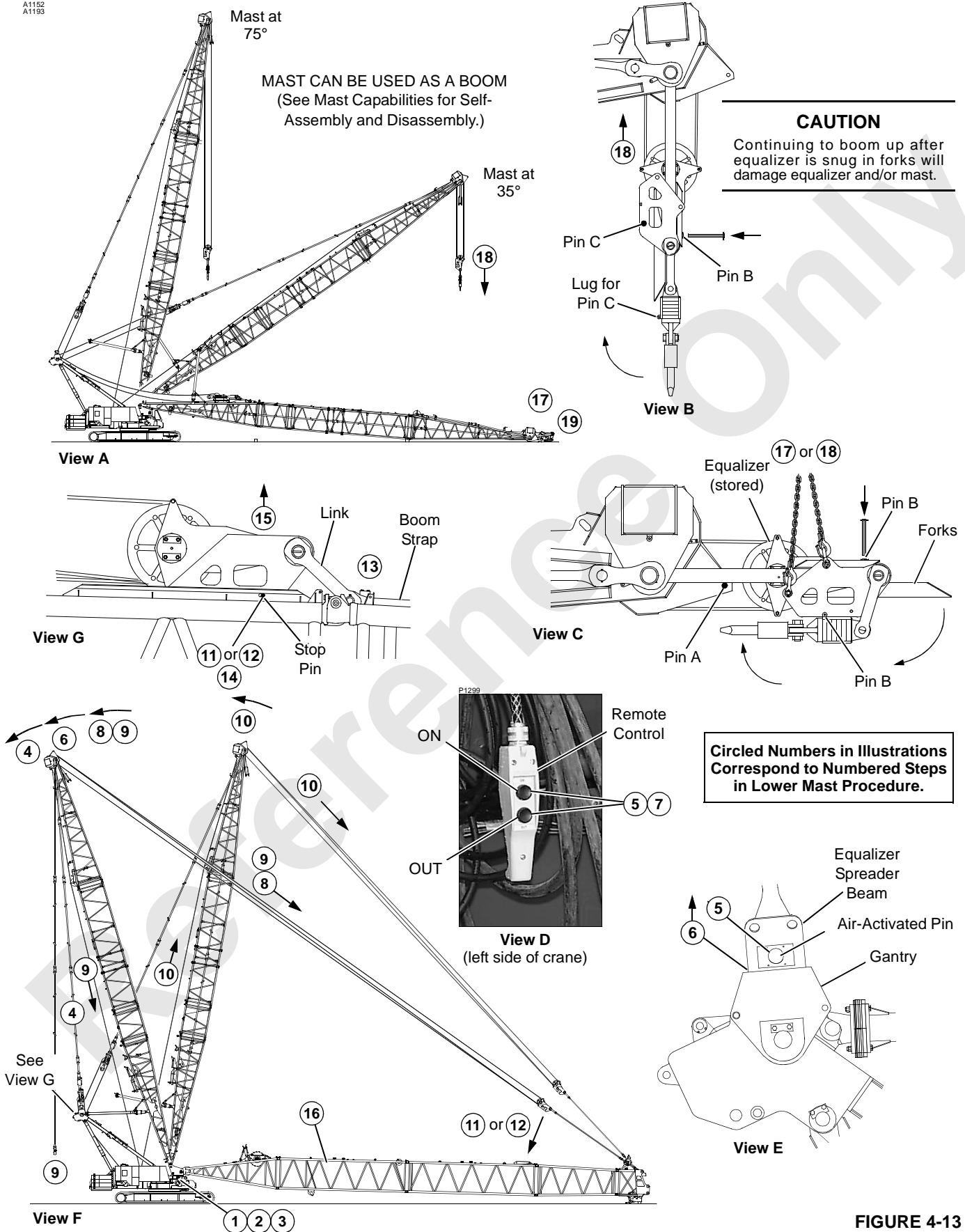


FIGURE 4-13

The SETUP mode must be selected in order to lower the mast. The following controls are used:

- Drum 2 (boom hoist).
- Drum 4 (mast hoist).
- Drum 2 and Drum 4 park and pawl switches.

A qualified operator is required to lower the mast. The operator must be experienced with the 2250 liftcrane with MAX-ER 2000 attachment and thoroughly familiar with their operation. See the Operating Controls in Section 3 of the Crane Operator's Manual for identification and operation of the controls.

A qualified signal person is required to give signals to the operator.

See Figure 4-13 for the following procedure.

Numbered steps in the procedure correspond to item numbers in the figure.

1. Provide a qualified person to coordinate mast lowering and to provide necessary signals to crane operators.
2. Start 2250 engine. Select SETUP mode and confirm. **MAX-ER mode must be off.**
3. Make sure working brake for Drum 2 is released.
4. If necessary, lower mast to rear so that mast straps are slack. *Mast straps should not be under pressure when removing mast strap pins.*
5. Using remote control on left side of 2250, press and hold ON and OUT buttons to activate air cylinders and retract mast strap pins (View D).
6. Slowly boom up until legs of equalizer spreader beam are out of pockets in gantry top, and stop (View E).
7. Release ON and OUT buttons on remote control.

### CAUTION

#### Mast Damage!

Keep boom hoist wire rope slack as mast is raised toward vertical. Tension in boom hoist wire rope can damage mast or gantry and possibly cause mast to buckle.

8. Continue to boom up (Drum 2) to raise mast toward vertical. Pay out mast hoist wire rope to keep rope slack (Drum 4).
9. As mast nears vertical, gradually tighten mast hoist wire rope and pay out boom hoist wire rope so mast moves smoothly forward past vertical.
10. As mast moves past vertical:

- a. Lower mast by slowly paying out mast hoist wire rope. Haul in boom hoist wire rope as needed to keep boom hoist equalizer off ground.
- b. Have ground personnel use taglines to guide counterweight straps around gantry as mast is lowered.

### ! WARNING

#### Moving Parts!

Equalizer can slide on rails when booms straps are disconnected. Pin equalizer to rails before removing boom straps.

11. Pin boom hoist equalizer to rails – **120 ft (36,6 m) or 140 ft (42,7 m) boom** (View G):
  - a. Mast down to position boom hoist equalizer above equalizer rails.
  - b. Boom down to lower equalizer.
  - c. Pin equalizer to rails with stop pins.
12. Pin boom hoist equalizer to rails – **160 ft (42,7 m) boom or longer** (View G):
  - a. Mast down to approximately 45°.
  - b. Boom down to lower equalizer approximately 3 ft (0,9 m) above top of boom.
  - c. Using four-point connection (as shown in View C) to keep equalizer level, boom down with assist crane, travel, and swing as needed to lower equalizer onto rails.  
Haul in or pay out boom hoist wire rope as needed.
  - d. Pin equalizer to rails with stop pins.
13. Disconnect boom straps from boom hoist equalizer links and store for shipping (View G).
14. Remove stop pins securing equalizer to rails (View G).
15. Using four-point connection, lift boom hoist equalizer off rails and set to side for boom disassembly with assist crane.

Turn off and park Drum 2.

**NOTE:** If MAX-ER mast will be used as a boom, see Mast Capacities for Self-Assembly and Disassembly for instructions. Weight block and hook must be pinned to equalizer.

When using mast as a boom, operate crane in STANDARD mode to enable automatic mast stop (set at 80°). MAX-ER mode must be off.

**16. Disassemble boom.**

If weight block and hook are installed, go to step 16. If not, go to step 17.

**17. Store equalizer (weight box and hook not installed) (View C):**

- a. Lower mast until forks are just above ground. **Do not allow forks to dig into ground.**
- b. Using outside assist, swing forks up and insert Pin A.
- c. Lower mast onto blocking on ground.
- d. Using four-point connection to keep equalizer level, slide equalizer onto forks.
- e. Insert Pin B to store equalizer on forks.
- f. Disconnect outside assist from equalizer.

**18. Store equalizer (weight block and hook installed) (View B):**

- a. Lower equalizer, weight block and hook until weight box and hook are just above ground. Observer should be in position to signal operator. **Ensure that equalizer is not pulled onto forks during this step.**
- b. Lower mast while hauling in boom hoist wire rope. **Do not allow equalizer to rest on ground.**
- c. Stop when top of equalizer is approximately 3 ft (0,9 m) from bottom of mast top.
- d. Slowly boom up to pull equalizer onto forks. Observer should be prepared to signal operator when equalizer is snug against forks.  
Stop when equalizer is snug against forks. **Continuing to boom up may result in mast or equalizer damage.**
- e. Insert Pin B to store equalizer on forks.

- f. Using outside assist, swing forks up and insert Pin A (View C).
- g. Using outside assist, swing weight box and hook up and pin to equalizer with Pin C (View C).

**19. Lower mast onto blocking on ground.****Disconnect Hydraulic Hoses**

See Figure 4-6 for following procedure.

1. **Stop engine and don't restart until after step 5.**
2. Loosen locking knob and crack open valve knob (4, View C3) to vent accumulator circuit.
3. Fully close (cw) valve knob (4). *Make sure locking knob doesn't prevent full closure of valve knob.* Then tighten locking knob.
4. Disconnect hoses (H1, H2, and H3) from rotating bed (View B) and store on mast. **Install dust caps.**
5. Connect hose (H4, View B) to hose (H5). **Accessory pump will be damaged if you don't perform this step before starting engine.**

**Lower Physical Mast Stop**

Reverse assembly steps to lower the physical mast stop (Figure 4-5).

**Remove Counterweight Straps**

Reverse assembly steps to remove counterweight straps and store on mast top (Figure 4-5).

**Remove Mast Straps**

Reverse assembly steps to remove mast straps and store on mast top. (Figure 4-5). *Do not remove mast hoist equalizer stop pin when removing mast straps.*

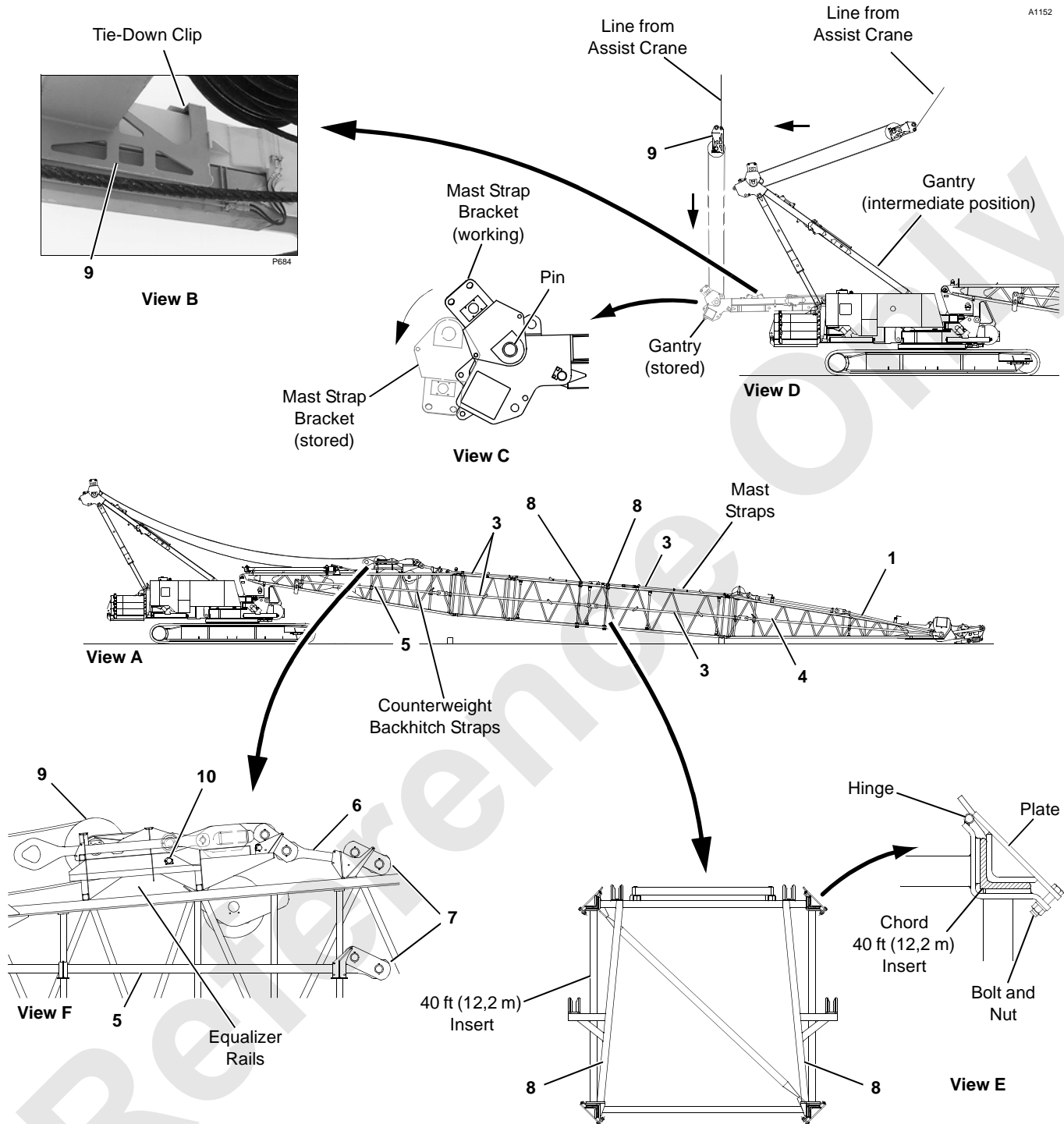
Install strap storage bars to secure mast and counterweight straps on mast top for shipping.



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Item	Description	Item	Description
1	16 ft 10-1/4 in (5,1 m) Strap	6	3 ft 9-1/8 in (1,15 m) Strap
2	17 ft 0-1/8 in (5,8 m) Strap	7	Strap Connecting Links (typical)
3	26 ft 10-5/8 in (8,2 m) Strap	8	Strap Rest Assembly
4	34 ft 7-3/4 in (10,6 m) Strap	9	Mast Hoist Equalizer
5	26 ft 6 in (8,1 m) Strap	10	Equalizer Stop Pin

FIGURE 4-14

## Lower Gantry and Store Mast Hoist Equalizer

See Figure 4-14 for following procedure.

1. Hook slings from assist crane to connecting holes in end of mast hoist equalizer.
2. Remove equalizer stop pin (10, View F).
3. Carefully lift equalizer clear of rails with assist crane.
4. Travel, boom up, and swing with assist crane so equalizer is suspended directly over gantry approximately 20 – 25 ft (6 – 7,6 m) (View D).

Haul in 2250 mast hoist wire rope at same time as needed.

Park mast hoist (drum 4).

5. Prepare gantry for lowering.  
See Gantry Raising/Lowering in Crane Operator's Manual.
6. Lower equalizer with assist crane until gantry is fully lowered (View D).
7. Lower equalizer so it lands on gantry equalizer rails. Haul in mast hoist line while lowering equalizer.
8. Continue to slowly haul in mast hoist line to slide equalizer under tie down clips (View B).
9. Disconnect sling from equalizer.
10. Slacken mast hoist wire rope so there is no tension between gantry sheaves and equalizer.
11. Remove pin and rotate mast strap brackets on gantry from working to stored position (View C).

## Remove Strap Rest Assemblies

Reverse assembly steps to remove strap assemblies (Figure 4-14, View E).

## Disassemble Mast

See Figure 4-14 for following procedure.

1. If not already done, lift boom hoist equalizer into position on forks at end of mast top, and install retaining pins (View F).
2. Hook chain sling to lifting lugs on mast top (View G).
3. Remove pins from bottom connector holes (View D).
4. Lift mast top to disengage from fixed vertical pin of upstream insert (View C).
5. Store mast top.

6. Repeat steps 2-5 for mast inserts to up to mast butt.
7. Remove mast butt and mast adapter frame as follows:
  - a. Hook chain sling to lifting lugs on mast butt.
  - b. Insert Pin B to secure mast butt to adapter frame for shipping (View B). It may be necessary to lift mast butt slightly to align holes.
  - c. Remove pin from Hole C2 (View B).
  - d. Remove keeper plate and unpin adapter frame from rotating bed (Pin A, View B).
  - e. Store mast butt.

## MAX-ER COUNTERWEIGHT INSTALLATION PROCEDURE

### General

The following installation procedures apply to the current production low profile counterweight boxes (Figure 4-15) and to the past production counterweight boxes (Figure 4-16).

Perform the following steps before installing MAX-ER counterweight:

- Review MAX-ER Capacity Charts to determine trailer radius and counterweight arrangement for your lifting requirements.
- Support trailer on jacks if it is not connected to crane.
- Install trailer pins and axle wedges in proper position for installation of counterweight.
- Raise and pin strap cylinders in operating position.

An assist crane with appropriate lifting slings, hooks, and shackles is required for installing the counterweight. The heaviest box to be lifted is 20,000 lb (9 072 kg).



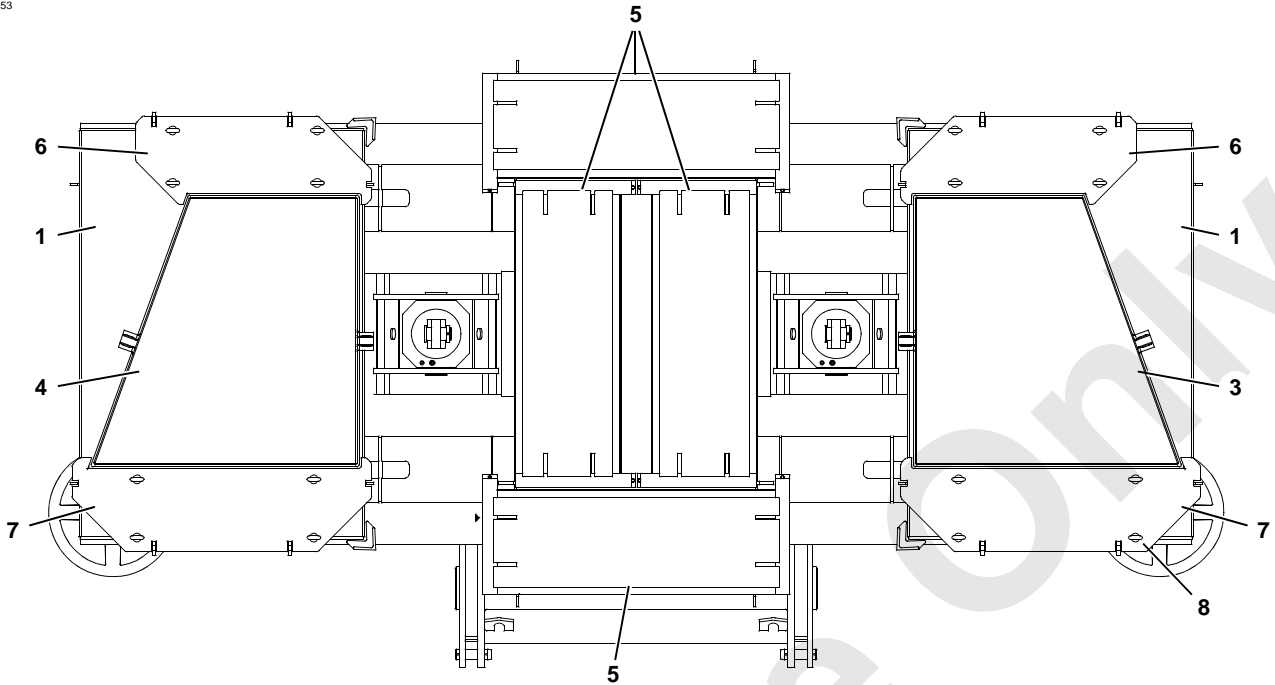
### WARNING

#### Tipping Hazard!

To prevent trailer from tipping, trailer must be level and supported on jacks with axle wedges installed if trailer is NOT ATTACHED to crane.

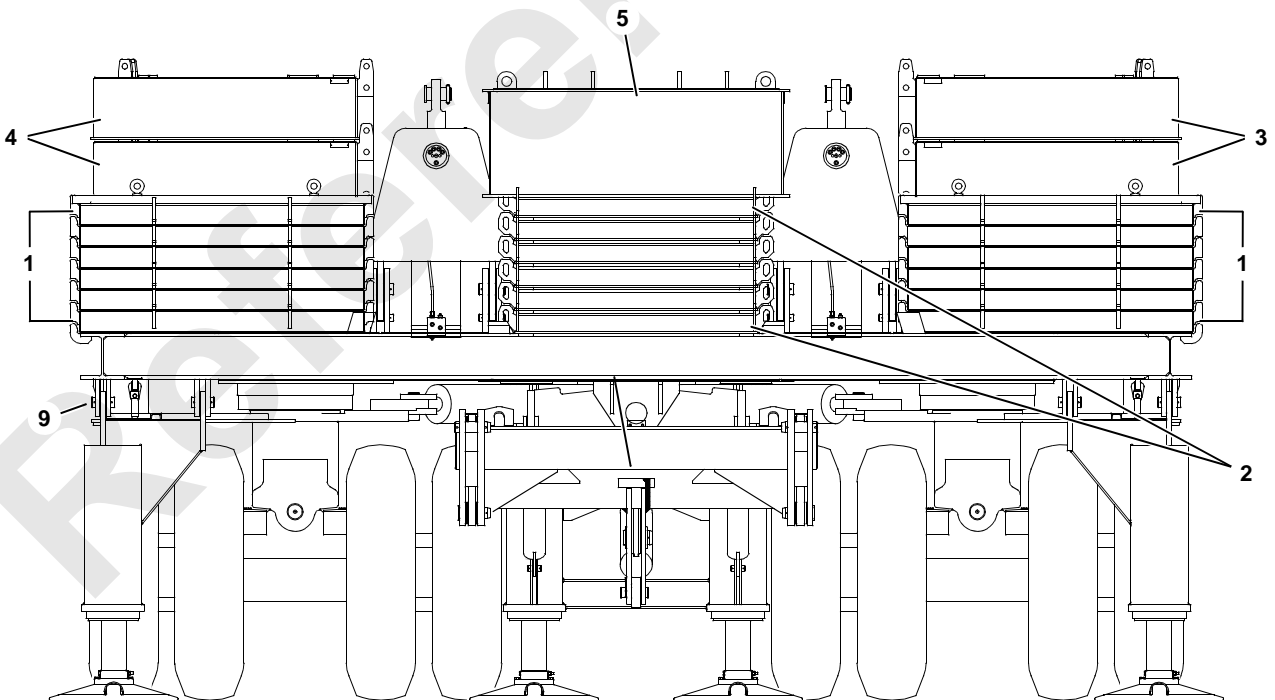
- Install trailer pins in proper position prior to jacking or performing other procedures. See instructions in this section for correct pin and wedge positions.
- Make sure jacking surface supports weight of trailer and counterweight and provides necessary traction to prevent jacks from sliding under load.

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*This illustration shows maximum counterweight arrangement. See Counterweight Arrangements chart in your MAX-ER Capacity Chart Manual for other counterweight arrangements.*

*See MAX-ER Capacity Charts to determine proper counterweight arrangement for your lifting requirements.*



**Viewed from front of Trailer**  
(trailer supported on jacks)

**FIGURE 4-15**

### Install Counterweight (current production)

See Figure 4-15 for following procedure.

**NOTE:** Trailer frame has lugs that center first counterweight box in each stack and prevent it from shifting.

Counterweight boxes (1 and 2) have lugs on sides and ends that keep the adjacent boxes from shifting.

1. Connect slings from assist crane to lifting lugs (4 places) and install center boxes (2). **To prevent lifting lugs from breaking, do not lift more than two boxes at a time.**
2. Connect slings from assist crane to lifting lugs (4 places) and install each center box (5). **To prevent lifting lugs**

**from breaking, do not lift more than one box at a time.**

3. Connect slings from assist crane to lifting lugs (4 places) and install side counterweight boxes (1) alternating from side to side until all side boxes are installed. **To prevent lifting lugs from breaking, do not lift more than two boxes at a time.**
4. Connect slings from assist crane to lifting eyes (4 places) and install front and rear adapter plates (6 and 7) on each side. Retain adapter plates (6 and 7) and boxes (1) with eye bolts (8).
5. Install left-hand boxes (3) and right-hand boxes (4). **To prevent lifting lugs from breaking, do not lift more than two boxes at a time.**

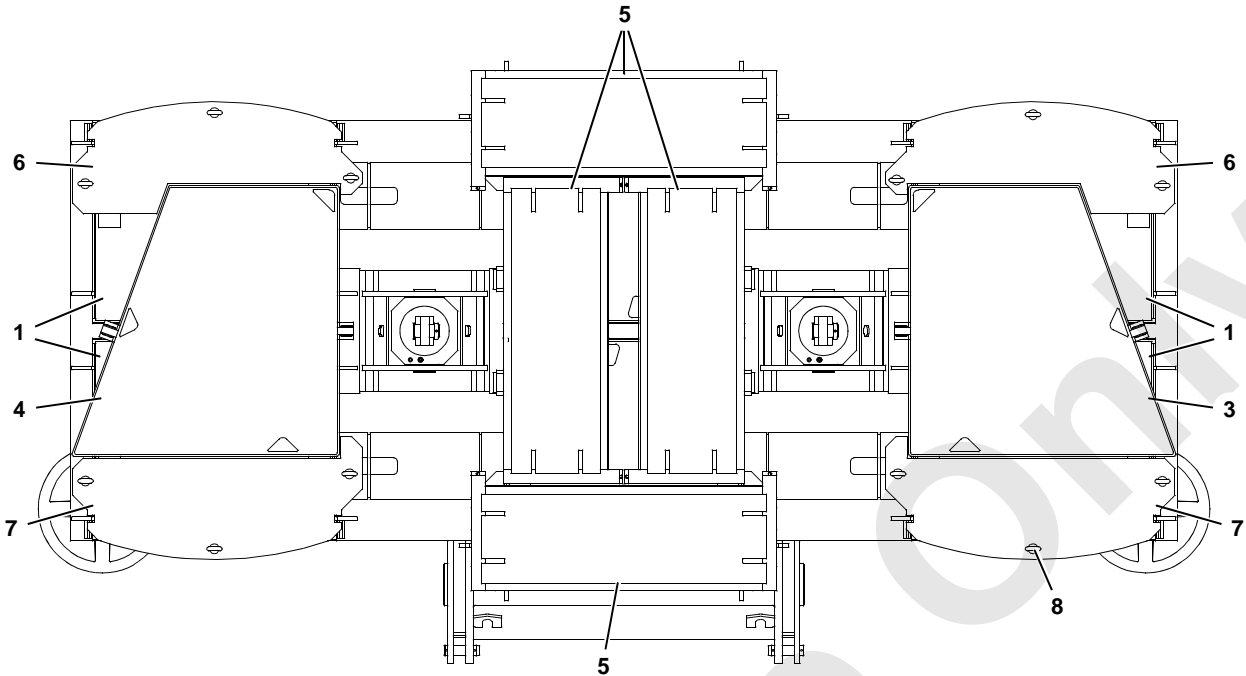
Position each box so tapered side faces side of trailer and narrow side faces rear of trailer.

Item No.	Quantity	Description	Weight (each) lb (kg)
1	12	Counterweight Box (side)	13,000 (5 900)
2	6	Counterweight Box (center)	14,200 (6 440)
3	2	Counterweight Box (left) *	20,000 (9 072)
4	2	Counterweight Box (right) *	20,000 (9 072)
5	4	Counterweight Box (center) **	15,000 (6 804)
6	2	Rear Counterweight Plate	1,000 (454)
7	2	Front Counterweight Plate	1,106 (502)
8	16	Eye Bolts	
9	1	Trailer	76,300 (34 610)
<b>Total Wheeled Counterweight</b>			<b>462,000 (209 563)</b>

\* 2250 Series 3 Crane Counterweight Boxes

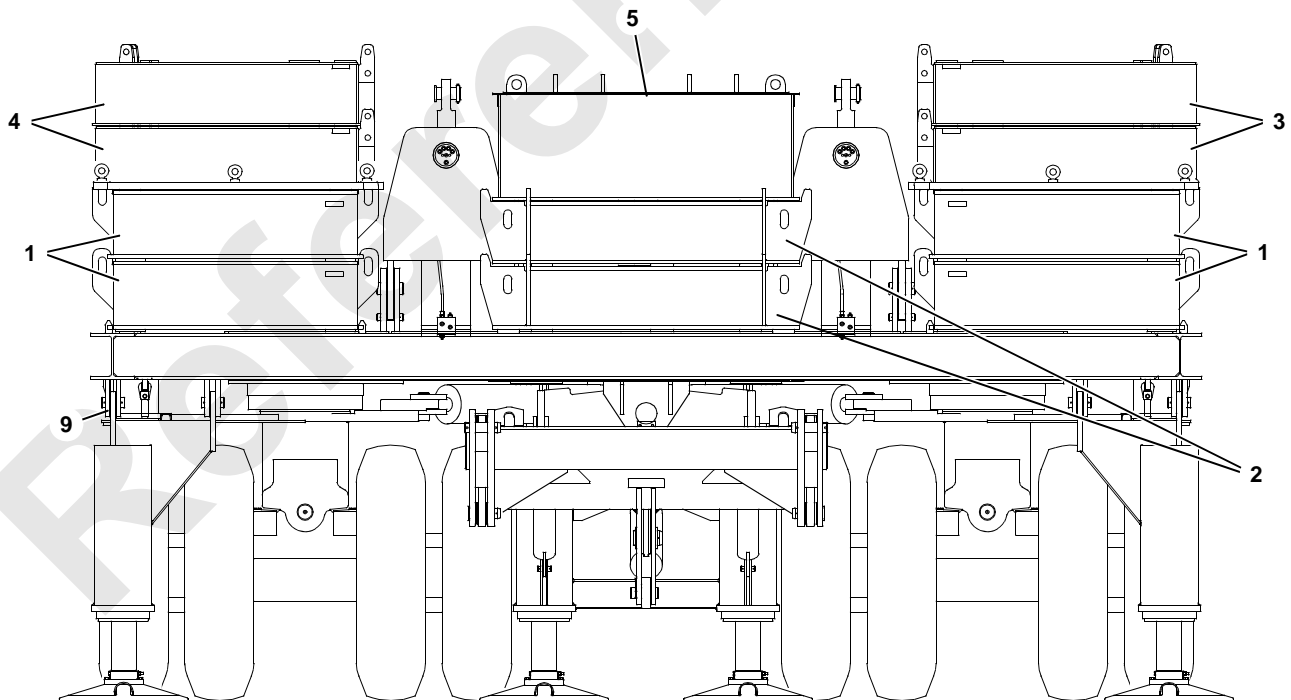
\*\* 2250 Series 3 Carbody Counterweight Boxes

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*This illustration shows maximum counterweight arrangement. See Counterweight Arrangements chart in your MAX-ER Capacity Chart Manual for other counterweight arrangements.*

*See MAX-ER Capacity Charts to determine proper counterweight arrangement for your lifting requirements.*



**Viewed from front of Trailer**  
(trailer supported on jacks)

**FIGURE 4-16**

### Install Counterweight (past production)

See Figure 4-16 for following procedure.

**NOTE:** Trailer frame has lugs that center first counterweight box in each stack and prevent it from shifting.

Counterweight boxes (1 and 2) have lugs on sides and ends that keep the adjacent boxes from shifting.

1. Connect slings from assist crane to lifting lugs (4 places) and install center boxes (2). **To prevent lifting lugs from breaking, do not lift more than one box at a time.**
2. Connect slings from assist crane to lifting lugs (4 places) and install each center box (5). **To prevent lifting lugs from breaking, do not lift more than one box at a time.**
3. Connect slings from assist crane to lifting lugs (4 places) and install side counterweight boxes (1) alternating from side to side until all side boxes are installed. **To prevent lifting lugs from breaking, do not lift more than two boxes at a time.**
4. Connect slings from assist crane to lifting eyes (4 places) and install front and rear adapter plates (6 and 7) on each side. Retain adapter plates (6 and 7) and boxes (1) with eye bolts (8).
5. Install left-hand boxes (3) and right-hand boxes (4). **To prevent lifting lugs from breaking, do not lift more than two boxes at a time.**

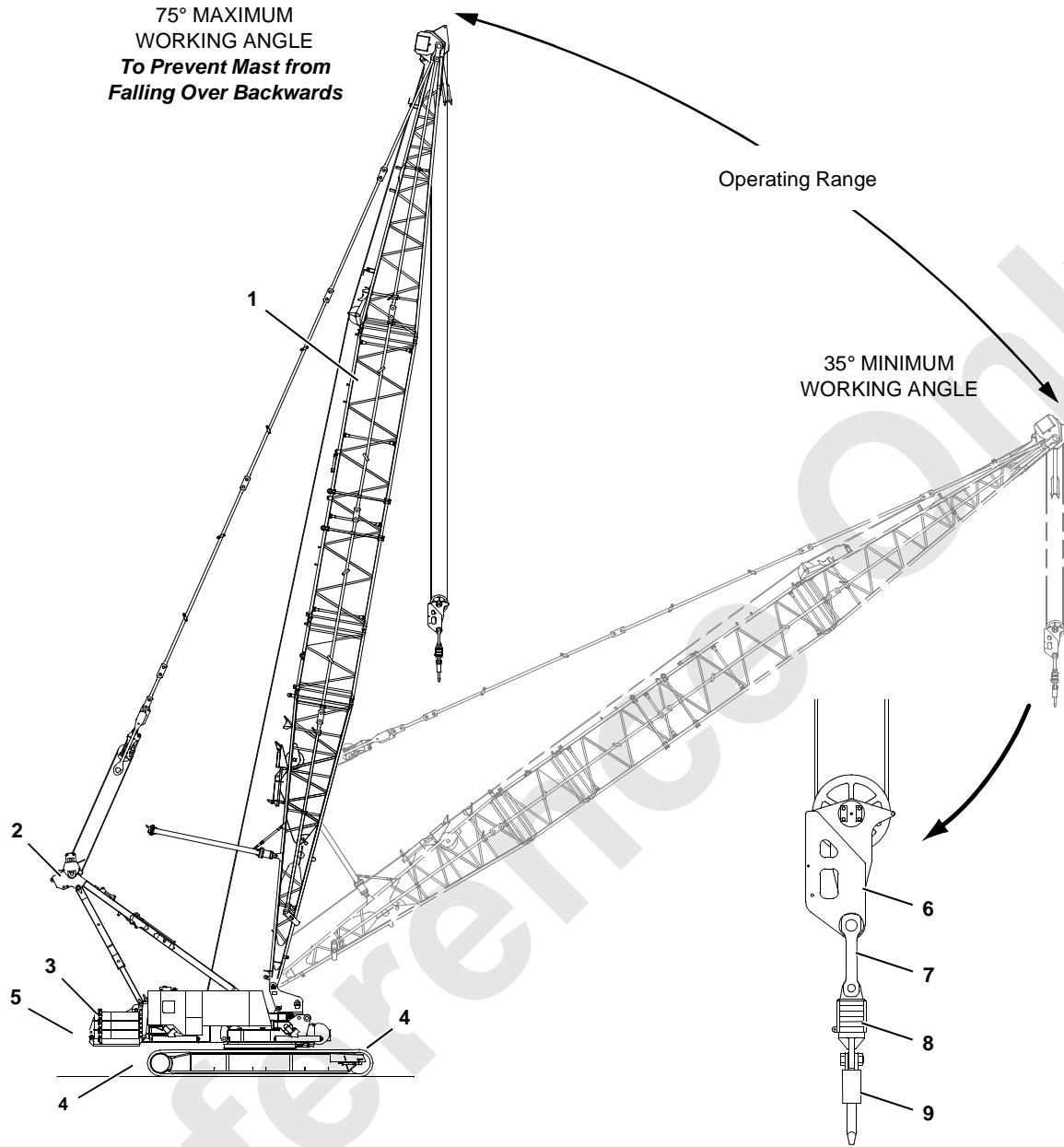
Position each box so tapered side faces side of trailer and narrow side faces rear of trailer.

Item No.	Quantity	Description	Weight (each) lb (kg)
1	8	Counterweight Box (side)	19,500 (8 845)
2	4	Counterweight Box (center)	21,250 (9 639)
3	2	Counterweight Box (left) *	20,000 (9 072)
4	2	Counterweight Box (right) *	20,000 (9 072)
5	4	Counterweight Box (center) **	15,000 (6 804)
6	2	Rear Counterweight Plate	987 (447)
7	2	Front Counterweight Plate	1,130 (513)
8		Eye Bolts	
9	1	Trailer	76,300 (34 610)
<b>Total Wheeled Counterweight</b>			<b>462,000 (209 563)</b>

\* 2250 Series 3 Crane Counterweight Boxes

\*\* 2250 Series 3 Carbody Counterweight Boxes

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**Table 4-1**  
Load Handling Capacities MAX-ER Mast

Item	Description
1	130 ft (39,6 m) #44 Mast
2	Gantry in Intermediate Position
3	169,200 lb (76 750 kg) Crane Counterweight
4	60,000 lb (27 220 kg) Carbody Counterweight
5	0 lb Wheeled Counterweight
6	Boom Hoist Equalizer
7	Links (remain with equalizer)
8	Weight Block
9	Hook

Mast Operating Radius ft (m)	Mast Operating Angle Degrees	Mast Capacity lb (kg)
36 – 65 (11,0 – 19,8)	74.8 – 61.0	99,000 (44 910)
66 – 105 (20,1 – 32,0)	60.4 – 37.5	37,000 (16 780)

FIGURE 4-17



## MAST CAPACITIES FOR SELF-ASSEMBLY AND DISASSEMBLY

### Crane Requirements

The 2250 must be rigged as follows (see Figure 4-17):

- 130 ft (39,6 m) #44 Mast
- 169,200 lb (76 750 kg) Crane Counterweight
- 60,000 lb (27 220 kg) Carbody Counterweight
- 0 lb Wheeled Counterweight
- 360° Rating

### Self-Assembly and Disassembly Capacities

Boom hoist equalizer #194343, weight box #194342, hook #674137, and 10-part boom hoist reeving are used as lift rigging as shown in Figure 4-17.

**Capacities and operating radii given in Table 4-1 in Figure 4-17 are for freely suspended loads and for self-assembly and disassembly only. Capacities are based on structural competence.**

The weight of all slings and load handling equipment beneath the hook is considered part of the mast load. The weight of the equalizer, boom hoist reeving, weight box, and hook are included in capacity determination.

**Do not lower mast beyond radii where combined weights are greater than rated capacity. Where no capacity is shown, operation is not intended or approved.**



### WARNING

#### Falling Mast Hazard!

Do not operate mast above 75°. Mast may fall over backwards.

Minimum mast operating angle is 35°.

### Operating Conditions

The crane must be operated on a firm, level, uniformly supporting surface with gantry in **intermediate position** as shown in Figure 4-17.

The automatic mast stop must be adjusted for 80° maximum angle as instructed in Section 6 of this manual.

The crane operator's judgment must be used to allow for the dynamic load effects of swinging, hoisting and lowering the load, traveling, wind and other adverse operating conditions, and the crane's physical condition.

**Crane must be operated in STANDARD mode (MAX-ER mode off) to enable automatic mast stop which is set at 80°.**

With STANDARD mode on, the following drums are used:

- DRUM 4 to raise and lower the mast with the boom hoist handle on the left console.
- DRUM 2 to raise and lower loads with the left drum handle on the right console.

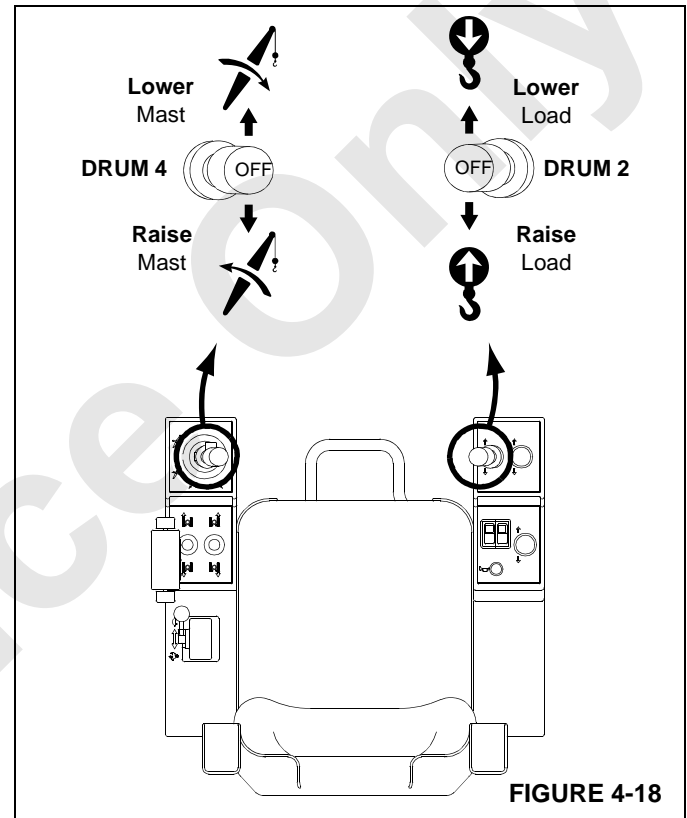


FIGURE 4-18

### Machine Travel

The crane must be traveled on a firm, level, uniformly supporting surface with the mast within the mast angle range given in Table 4-1. Travel may be limited depending upon ground conditions.

### Operating Radius

Operating radius is the horizontal distance from the crane's axis of rotation to the center of the vertical hoist line or equalizer. Mast angle is the angle between horizontal and the centerline of the mast butt and inserts, and is an indication of operating radius. In all cases, **operating radius shall govern capacity.**

## DISCONNECTING & CONNECTING WHEELED COUNTERWEIGHT TRAILER — WITH BOOM RAISED

### General

The topic contains instructions for disconnecting and connecting the wheeled counterweight trailer from the crane while the boom is raised to its operating position. ***These instructions apply only to those boom and jib lengths that can be operated with “0 Lb. Wheeled Counterweight.”***

Once the trailer is disconnected from the crane, the MAX-ER 2000 boom can be used to disassemble and assemble the trailer.

To operate with the trailer removed when equipped with boom/jib lengths that exceed the “0 Lb. Wheeled Counterweight” column of the capacity chart, contact Crane Care Customer Service at factory. Special calculations are required.

### Safety

All safety precautions given in the Assembly/Disassembly Guide apply to the procedures in this topic.

The trailer shall be disconnected and connected by experienced personnel trained in the erection and operation of construction cranes. It is expected that these personnel are thoroughly familiar with the MAX-ER attachment and its operation. Contact Crane Care Customer Service at factory for a detailed explanation of any procedure not fully understood.

The area in which the trailer is disconnected and connected must be firm, level, and free of ground and overhead obstructions. The area selected must be large enough to

accommodate the crane with wheeled counterweight assembly and selected boom length.



### WARNING TIPPING HAZARD!

Read instructions in this topic. Trailer will tip over if instructions in this topic are not followed.

Make sure trailer is level and securely support on jacks before disconnecting it from crane.



### WARNING Read Capacity Charts!

Crane must be rigged and operated according to instructions in capacity charts contained in Capacity Chart Manual provided with attachment.

Read capacity charts and instructions in Assembly/Disassembly Guide and this topic before removing, installing, and operating with trailer removed.

**Maximum weight lifted must not exceed capacity chart limitations for 0 Lb. Wheeled Counterweight.”  
Boom length shall not exceed:**

- #79 boom – 220 ft (67,1 m).
- #79-44 boom without jib – 220 ft (67,1 m).
- #79-44 boom with jib – 200 ft (61,0 m).

If raising or lowering boom, adhere to all instructions in capacity charts.

Failing to comply with instructions in capacity charts and this topic can result in tipping or structural failure of boom and jib.

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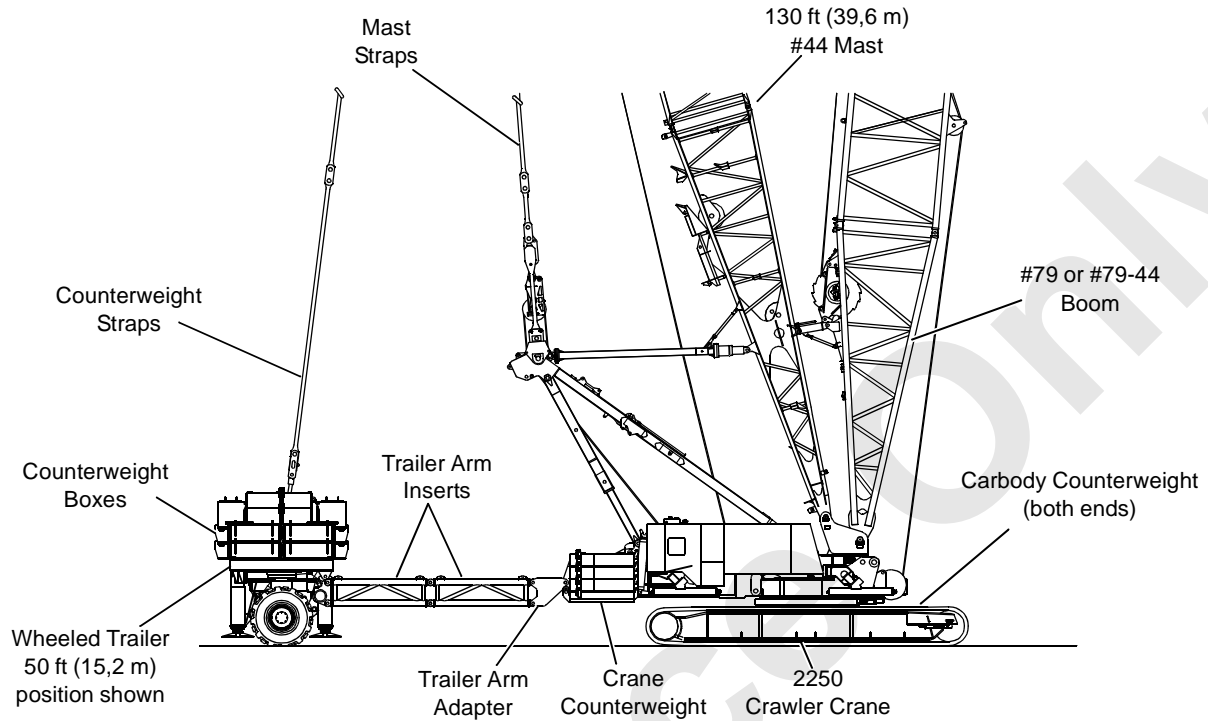


FIGURE 4-19

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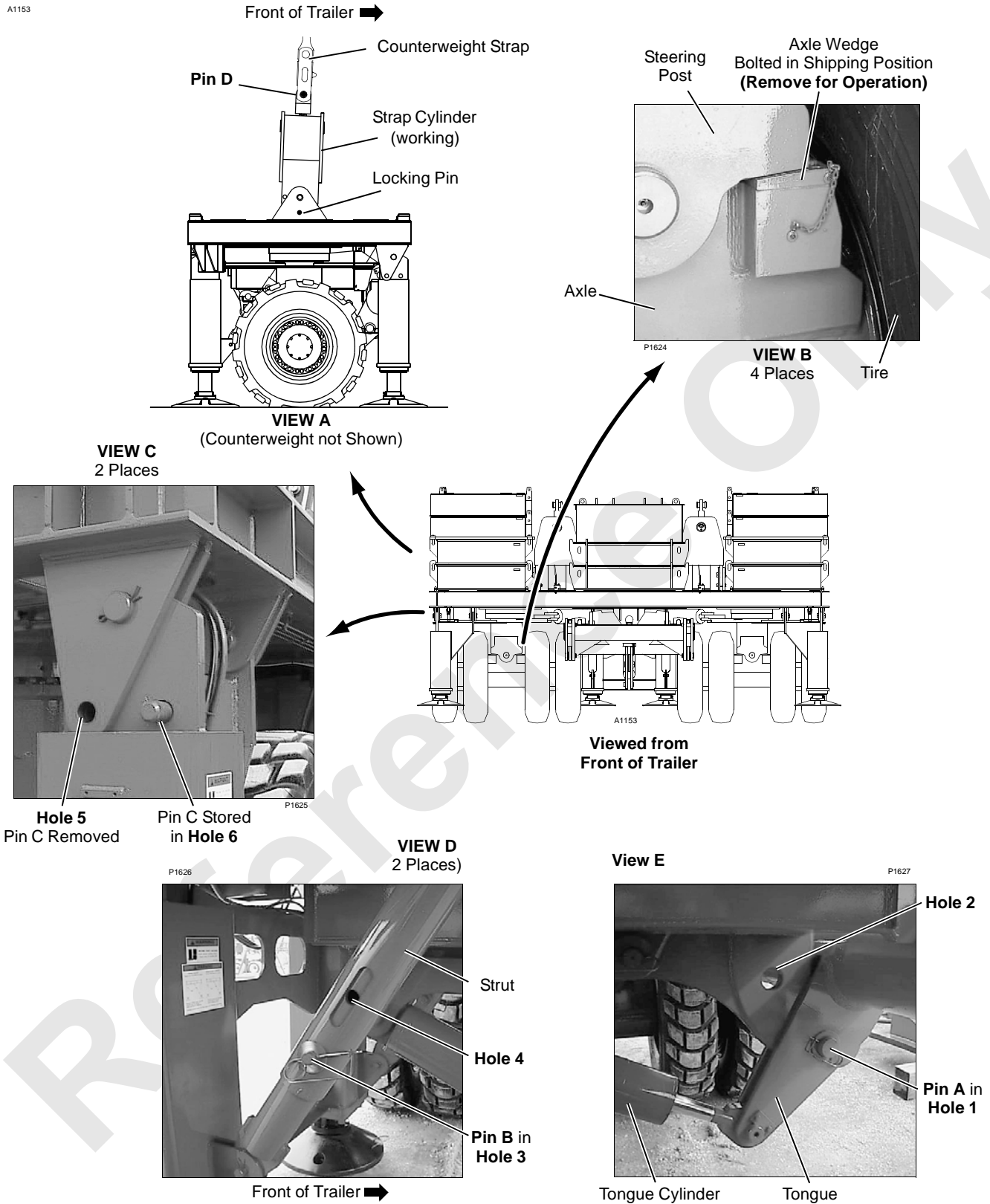


FIGURE 4-20

**NOTE:** To ensure proper operation of the crane's drums, the MAX-ER mode must be on. All of the functions on the MAX-ER remote control can be operated with the MAX-ER mode on, except for the strap cylinders. The MAX-ER mode must be turned off to operate the strap cylinders.

## Disconnecting Trailer from Crane — with Boom Raised

Before disconnecting the wheeled counterweight trailer, **review capacity charts** to determine allowable radius, load, and boom length for operation without wheeled counterweight.

**NOTE:** Counterweight may remain on trailer while trailer is disconnected from crane.

See Figure 4-20 for following steps.

1. Position boom at required operating angle for operation without wheeled counterweight.
2. Make sure trailer is on firm, level ground capable of supporting trailer when it is disconnected from crane.



### WARNING

#### Tipping Hazard!

Trailer will tip if pins are not installed in proper holes.

3. Install pins for raising and supporting trailer with jacks:
  - Pin A in Hole 1 (View E).
  - Pins B in Holes 4 (View D).
  - Pins C in Holes 6 (View C).
4. Using trailer remote control, extend jacks until tires are clear of ground or most of bulge is out of tires. **Make sure trailer is level.**

### CAUTION

#### Structural Damage!

When raising trailer with jacks, jack evenly to prevent overloading trailer bed and/or jacks.

5. Install axle wedges (four places between steering posts and axles) (View B).

6. If desired, rotate wheels to 90° stand-alone position (wheels parallel to front of trailer).
7. Remove Pins B from Holes 4 and install in Holes 3 (View D).
8. Remove Pins C from Holes 6 and install in Holes 5 (View C).
9. Disconnect counterweight straps from strap cylinders on trailer (View A):
  - a. Attach taglines to counterweight straps.
  - b. Turn off MAX-ER mode.
  - c. Using trailer remote control, extend strap cylinders as required to loosen strap Pins D.
  - d. While supporting straps with taglines, remove Pins D and slowly allow straps to swing toward crane.
  - e. Remove taglines.
  - f. Turn on MAX-ER mode.

10. Remove Pin A from Hole 1 and install in Hole 2 (View E).

See Figure 4-21 for following steps.

11. Remove pins attaching trailer arm adapter to lugs on crane (View A).

Loosen pin as needed by using tongue cylinder control on remote control to raise or lower extender arm.

12. Disconnect electrical cord from trailer at receptacle on crane (View B). Install dust caps.
13. Disconnect hydraulic hoses from trailer at quick connect couplers on crane (View B). Install dust caps.



### WARNING

#### Tipping Hazard!

Trailer will tip if crane swings while in contact with trailer arm adapter. Travel crane straight forward.

14. Travel crane forward until lugs on crane are clear of trailer arm adapters.

Crane can now be used to change extender arm length, disassemble counterweight trailer, or otherwise operated independently without wheeled counterweight. **Do not exceed capacity chart limitations for "0 Lb. Wheeled Counterweight."**

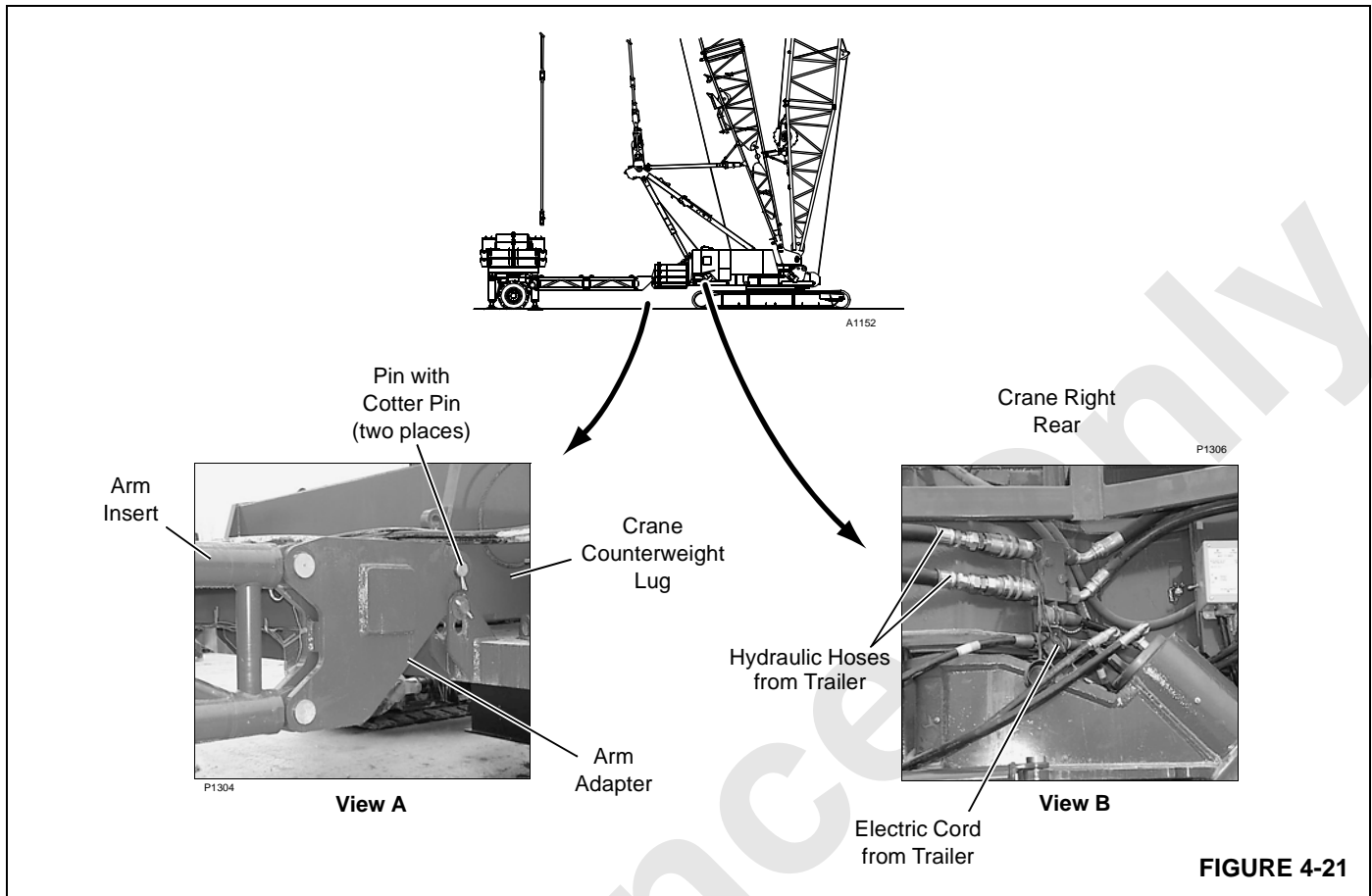


FIGURE 4-21

**Connecting Trailer to Crane — with Boom Raised**

**NOTE:** All of the functions on the MAX-ER remote control can be operated with the MAX-ER mode on, except for the strap cylinders. The MAX-ER mode must be turned off to operate the strap cylinders.

1. Assemble extender arm inserts to desired length, if necessary.

3. Connect hydraulic hoses from trailer to quick-connect couplings on crane (View B).
4. Connect electrical cord from trailer to receptacle on crane (View B).
5. Using remote control, extend or retract tongue cylinder as needed to align holes in trailer arm adapter with holes in counterweight lugs. Install pins (Figure 4-21, View A).

**! WARNING**  
**Tipping Hazard!**

Trailer will tip if crane swings while in contact with trailer arm adapters. Travel crane straight back.

See Figure 4-21 for following steps.

2. Align crane with trailer:
  - a. Position rear of crane in front of and in line with trailer.
  - b. Travel crane straight back to engage trailer arm adapter with counterweight lugs on crane (View A).

**! WARNING**  
**Tipping Hazard!**

Trailer will tip if pins are not installed in proper holes.

See Figure 4-20 for remaining steps.

6. Once trailer is attached move pins to following positions:
  - Pin A in Hole 1 (View E).
  - Pins B in Holes 4 (View D).
  - Pins C in Holes 6 (View C).
7. Rotate wheels to desired position.
8. Remove axle wedges from shipping position (View B).

9. Fully retract jacks.
10. Using tongue switch on remote control, adjust tongue so top of trailer and extender arm are parallel.
11. Connect counterweight straps to strap cylinders on trailer:
  - a. Attach taglines to counterweight straps.
  - b. Turn off MAX-ER mode.
  - c. Pull straps to cylinders with taglines and align connecting holes.
  - d. Using remote control, extend or retract strap cylinders to align holes in cylinder rod ends with holes in links of counterweight straps.
  - e. Pin counterweight straps to strap cylinders (Figure 4-20, View B).
  - f. Remove taglines.
  - g. Turn on MAX-ER mode.

---

**DANGER****Collapsing Mast!**

After straps are pinned to cylinders, do not retract cylinders. Mast can be pulled over backwards. Cylinders will automatically adjust strap tension when MAX-ER control mode is selected.

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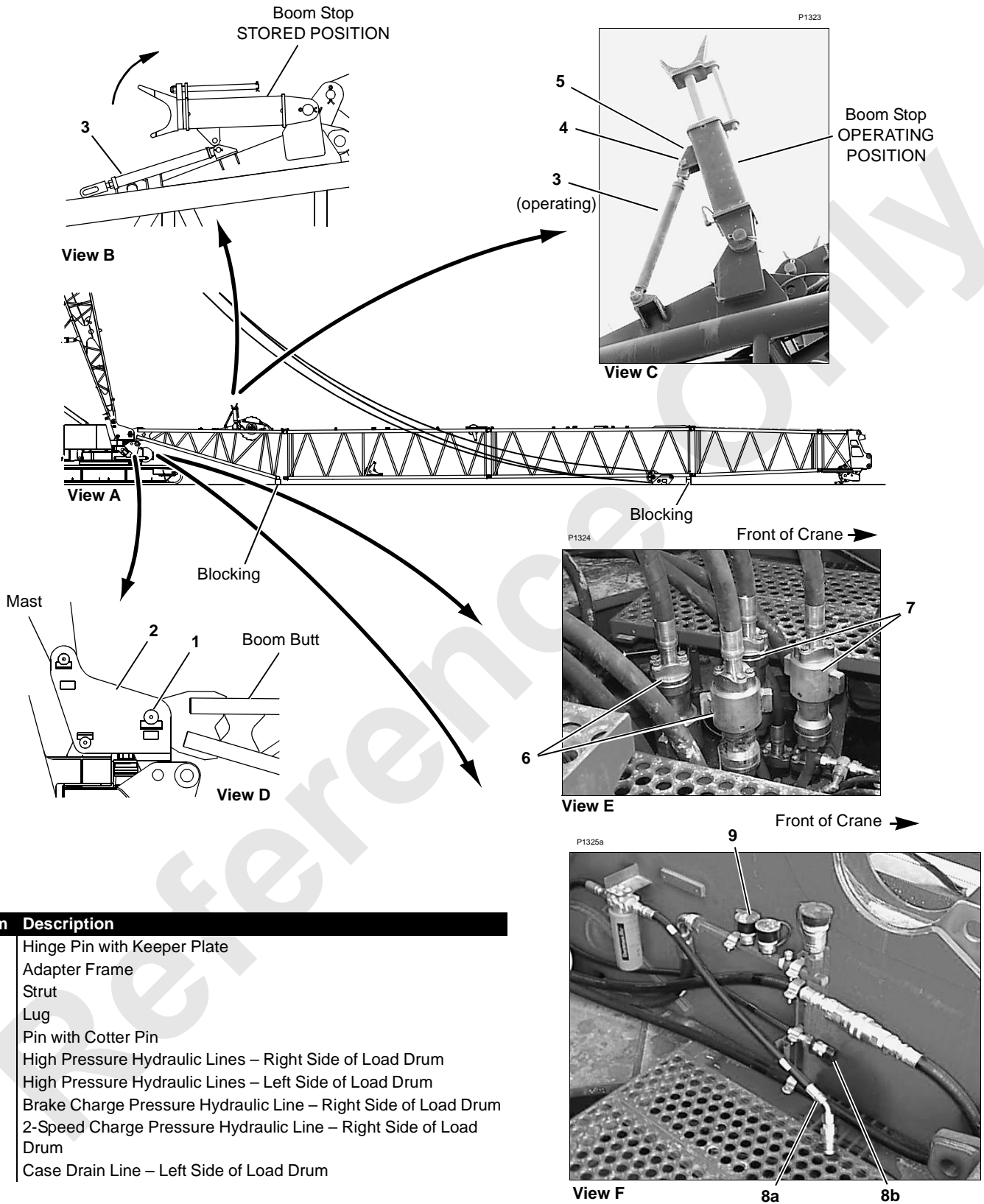


FIGURE 4-22



## BOOM INSTALLATION

### Boom Rigging Assembly Drawings

Boom components (top, inserts, straps) must be assembled in proper sequence according to this section and the Boom Rigging Assembly Drawings at the end of this section.

#### Install Boom Butt (all booms)

See Figure 4-22 for following procedure.

1. Attach 4-leg chain from assist crane to four lifting lugs on boom butt top chords.
2. If necessary, remove hinge pins and keeper plates (1, View D) on adapter frame and temporarily set to side.
3. Lift butt into position so connecting holes in butt line up with connecting holes in adapter frame (2, View D).
4. Add washers on each side to limit side play between butt and adapter frame to 1/8 in (3 mm)
5. Insert boom hinge pins (1, View D) and install keeper plates.
6. Lower butt onto blocking approximately 12 in (305 mm) high (View A).

#### Raise Physical Boom Stop (all booms)

See Figure 4-22 for following procedure.

Raise boom stop to operating position, as follows:

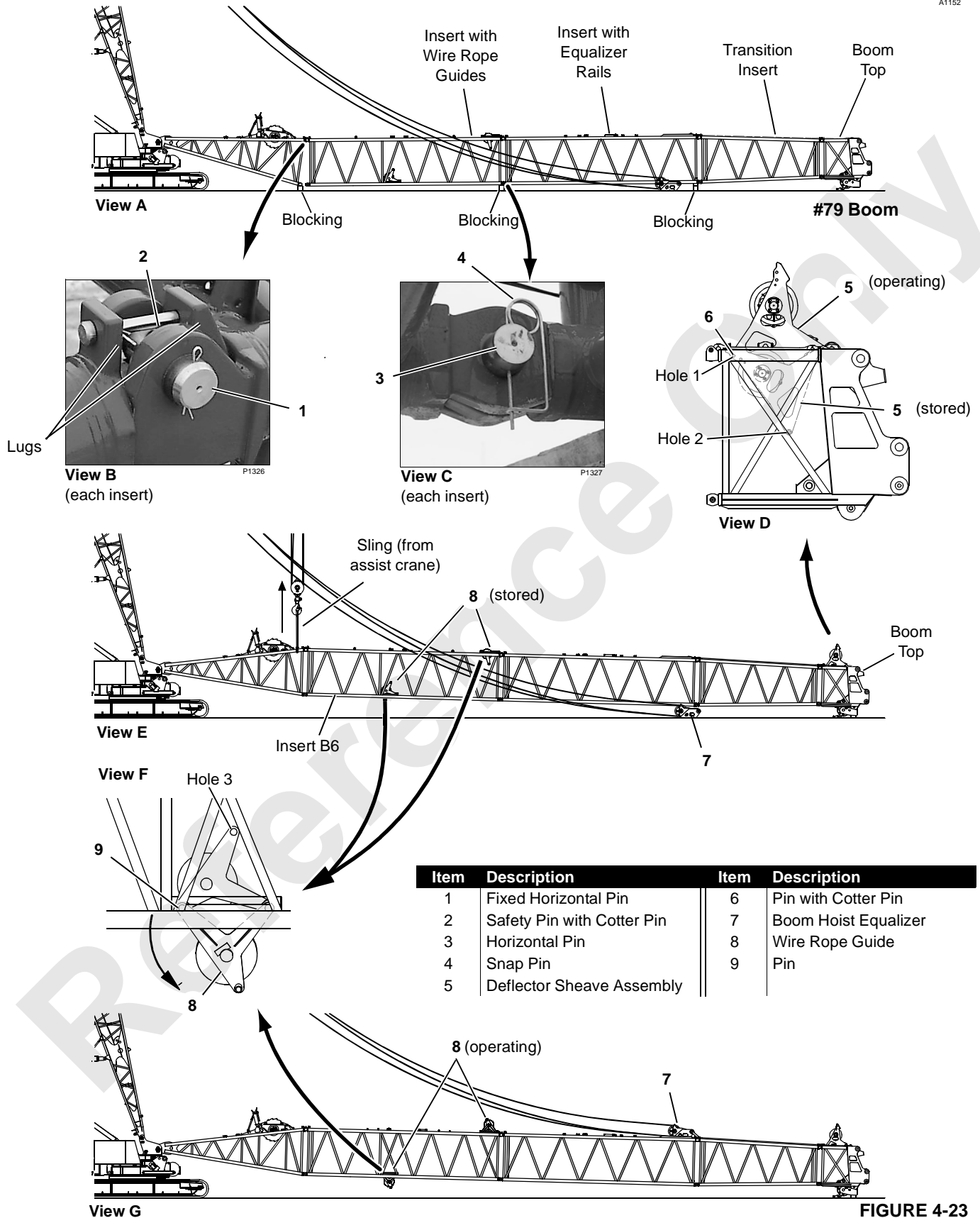
1. Attach a nylon sling from assist crane to boom stop in stored position (View B).
2. Raise boom stop to operating position (View C).
3. Raise strut (3, View B) from stored position to operating position (3, View C).
4. Pin strut (3) to lug (5, View C) with pin (4).
5. Disconnect sling.
6. For #79-44 boom, connect air lines from crane to boom stop.

#### Connect Hydraulic Lines (all booms)

The hydraulic lines from Drum 9 on the boom are coupled together to prevent dirt and water from entering the quick-couplers during shipment. The quick-couplers are arranged so the hoses can only be connected one way.

1. Connect high pressure hydraulic lines (6 and 7, View E) from Drum 9 to quick-couplers in center of rotating bed.
2. Connect charge pressure lines (8a and 8b, View F) from Drum 9 to quick couplers on left side of rotating bed.
3. Connect drain line from Drum 9 to quick coupler (9, View F) on left side of rotating bed.

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Item	Description	Item	Description
1	Fixed Horizontal Pin	6	Pin with Cotter Pin
2	Safety Pin with Cotter Pin	7	Boom Hoist Equalizer
3	Horizontal Pin	8	Wire Rope Guide
4	Snap Pin	9	Pin
5	Deflector Sheave Assembly		

FIGURE 4-23

## Assemble Boom Inserts — #79 Boom

See Figure 4-23 for following procedure.

**NOTE:** Boom sections must be assembled in proper sequence. See Figure Figure 4-29 and to the Boom Rigging Assembly drawing for assembly sequence.



### **WARNING** Crushing Injury Hazard!

Block under boom inserts before engaging connecting pins.

Never work under or inside boom inserts that are not securely blocked.

1. If jib will not be used, remove all jib backstay straps, links, and pins stored on boom sections.
2. Remove safety pin (2, View B) from both lugs at top of insert.
3. Lift insert into position in front of butt or adjacent insert.  
Lift with chain sling attached to four lifting lugs on insert.
4. Engage horizontal pins (1) into lugs at top of butt or insert (View B).
5. Lower insert until bottom connecting holes line up.
6. Insert both horizontal pins (3, View C).
7. Install safety pins (4, View C).
8. Block under top end of insert.
9. Remove chain slings.
10. Repeat steps 2 – 9 for remaining inserts.
11. Repeat steps 2 – 9 for boom top.

## Connect Boom to Boom Butt — #79 Boom

See Figure 4-23 for following procedure.

1. Attach nylon lifting slings to chords at top end of butt (View E).
2. Hook assist crane to slings. **Crane must have capacity to lift 1/2 the weight of assembled boom.**

3. Lift insert until bottom connecting holes line up.
4. Insert both horizontal pins (3, View C) and safety pins (4, View C).

## Raise Deflector Sheave Assembly — #79 Boom

The deflector sheave assembly may be shipped in the stored position in the boom top as shown in Figure 4-23, View D. If assembly is stored on transition insert:

1. Attach slings from assist crane to frame of sheave assembly (5).
2. Hoist just enough to loosen pins (6) holding assembly (5) in stored position (Hole 1).
3. Remove pins (6).
4. Raise assembly (5) to operating position.
5. Insert pins (6) in Hole 2 to support assembly in operating position.
6. Remove slings.

## Position Wire Rope Guides — #79 Boom

Two wire rope guides (8, View E) are shipped in the stored position on boom insert identified in Figure 4-23, View A)

**NOTE:** It is not necessary to raise the wire rope guides if the upper boom point is not installed.

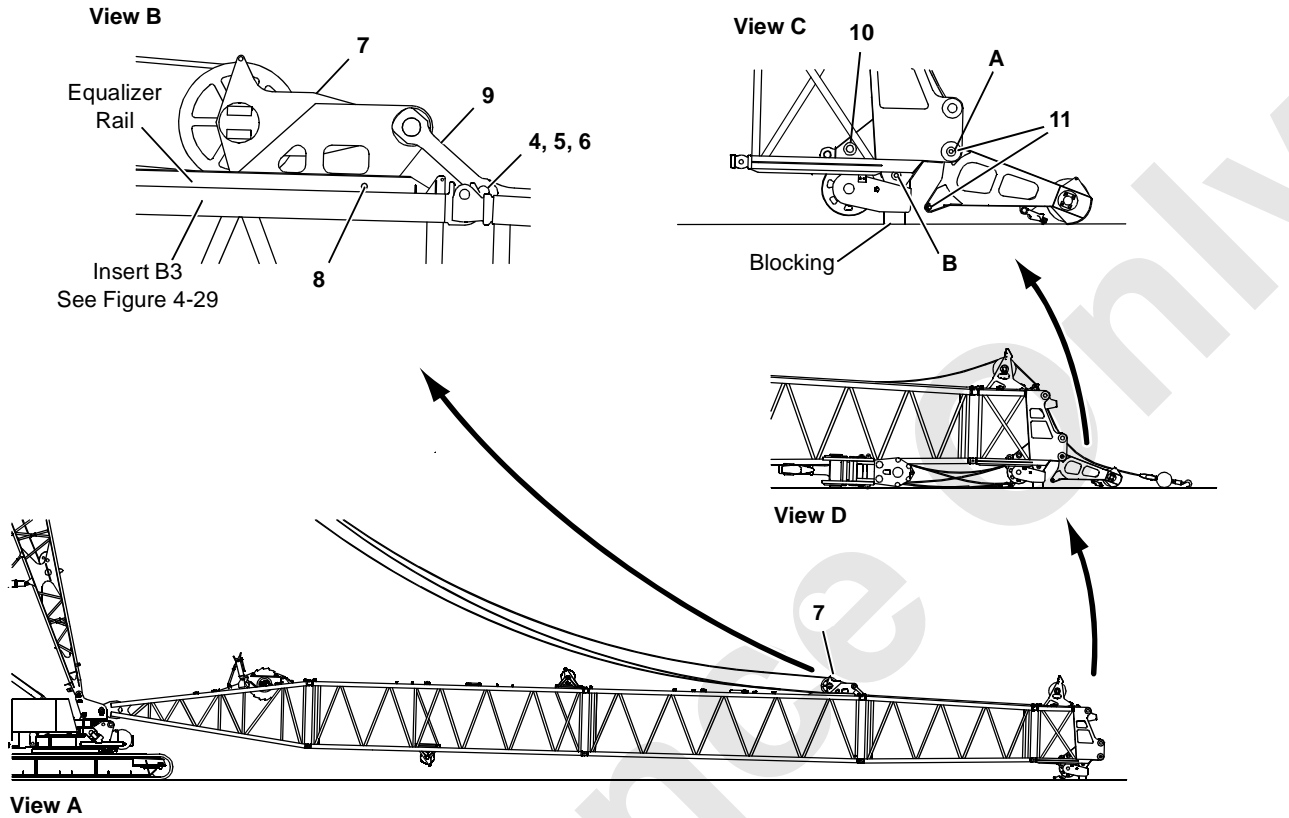
Boom insert B6 is not used for the 120 ft (36,6 m) basic boom.

1. Attach slings from assist crane to frame of wire rope guide (8, View F).
2. Hoist just enough to loosen pin (9, View F) holding wire rope guide (8) in stored position.
3. Remove pin (9).
4. Raise or lower wire rope guide (8) to operating position.
5. Insert pin (9) in Hole 3 (View F) to support wire rope guide in operating position.
6. Remove slings.

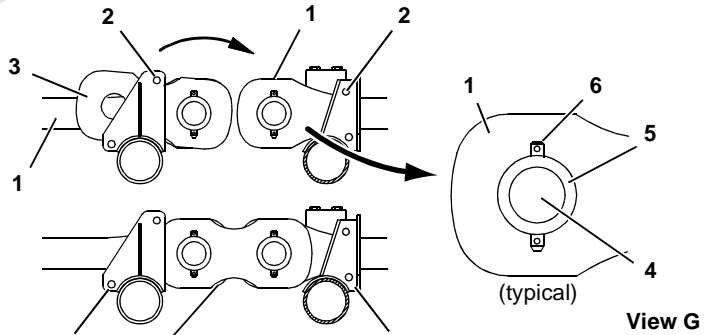
Repeat preceding steps for other wire rope guide.

#79 Boom

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**View E**  
SHIPPING POSITION  
(from inside of boom)



**View F**  
WORKING POSITION  
(from inside of boom)

Item	Description
1	Strap (typical)
2	Strap Storage Pin
3	Link (typical)
4	Connecting Pin
5	Collar (See Note 1)
6	Retaining Pin with Cotter Pins
7	Boom Hoist Equalizer
8	Stop Pin
9	Equalizer Strap Link
10	Pin
11	Pin with Snap Pin

**Note 1:** Collar must face inside of boom

FIGURE 4-24

## Connect Boom Straps — #79 Boom

See Figure 4-24 for following procedure.

Boom straps and links are shipped in the stored position on the boom inserts as shown in View E.

1. Connect straps (1, View E) at top end of each insert, as follows:
  - a. Remove storage pins (2, View E) from shipping position.
  - b. Store pins (2, View F).
  - c. Remove retaining pins (6, View G), collars (5), and connecting pins (5) from end of each strap.
  - d. Rotate links (3, View E) forward and pin to adjacent strap (View F) using connecting pins, collars, and retaining pins (4, 5, 6, View G).
2. Connect straps to boom hoist equalizer as follows:
  - a. Using assist crane, lift boom hoist equalizer into position on rails (View A).
  - b. Attach equalizer to holes in equalizer rails with stop pins (8, View B). **Stop pins must be installed to prevent equalizer from accidentally sliding back on rails during link assembly.**
  - c. Remove retaining pins, collars, and connecting pins (4,5,6, View B) from equalizer link (9).

- d. Rotate links forward and pin to strap on adjacent insert.

---

### CAUTION

Equalizer rails are provided only to support equalizer during assembly and disassembly.

Do not attempt to lift boom with boom hoist when equalizer is pinned to rails. Structural damage to insert or equalizer will occur.

---

- e. Unpin equalizer from rails.

## Install Upper Boom Point — #79 Boom

If required, install upper boom point.

See Figure 4-24, Views C and D for following procedure.

1. Using nylon lifting slings, lift upper boom point into position at front of boom top.
2. If necessary, remove pins (11) from bottom connecting holes in upper boom point.
3. Align connection holes (A) and inert pin (11).
4. Rest boom point on ground.
5. Remove slings.
6. Install lower connecting pin (2) in hole (B) when boom is raised.

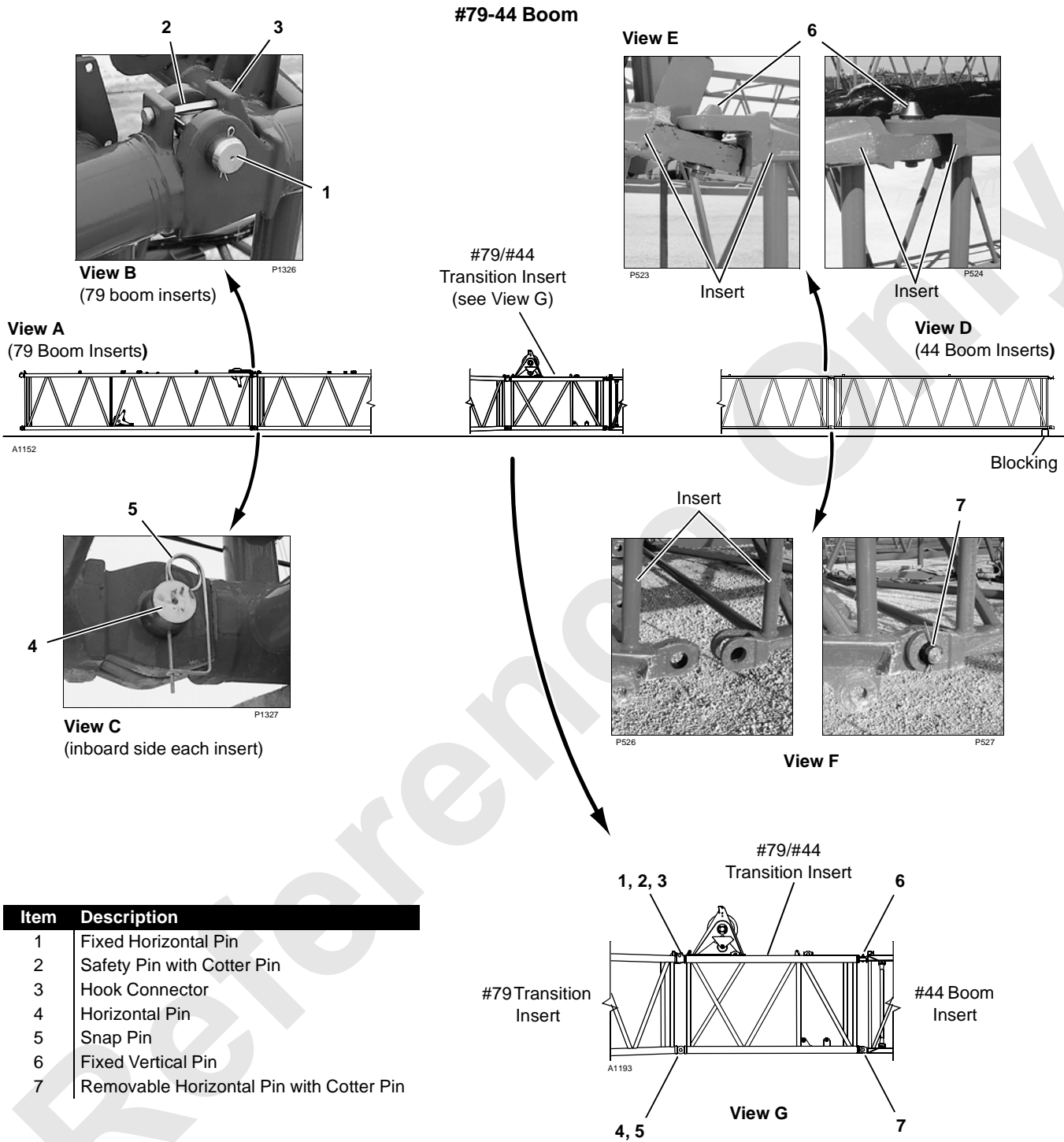


FIGURE 4-25

## Assemble Boom Inserts — #79-44 Boom

See Figure 4-25 for following procedure.

**NOTE:** Boom sections must be assembled in proper sequence. See Figure Figure 4-30 and to the Boom Rigging Assembly drawing for assembly sequence.

If jib will not be used, remove all jib backstay straps, links, and pins stored on boom sections.



### WARNING

#### Crushing Injury Hazard!

Block under boom inserts before engaging connecting pins.

Never work under or inside boom inserts that are not securely blocked.

### #79 Boom Inserts and Transition Inserts

1. Attach chain sling to four lifting lugs on first insert.
2. Lift first insert into position and place on blocking approximately 6 in (152 mm) high.
3. Remove safety pin (2, View B) from both lugs at top of insert.
4. Attach chain sling to four lifting lugs on next insert.
5. Lift position in front of adjacent insert.

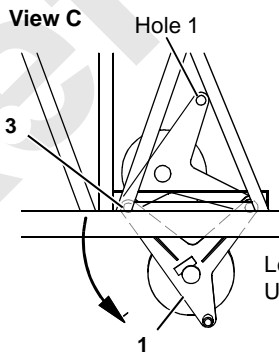
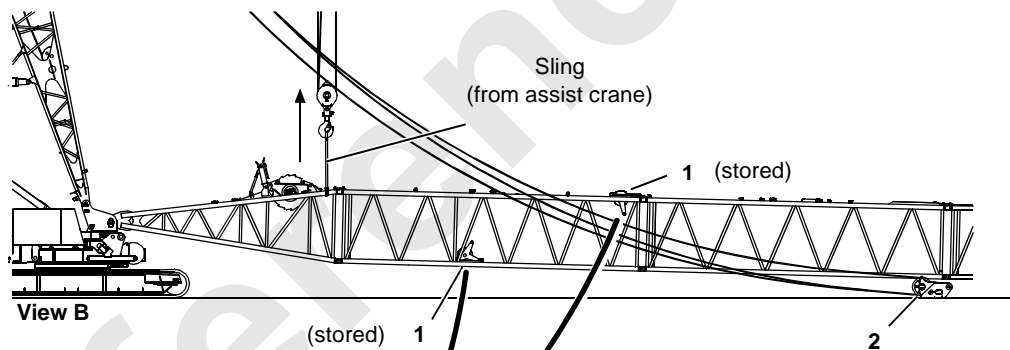
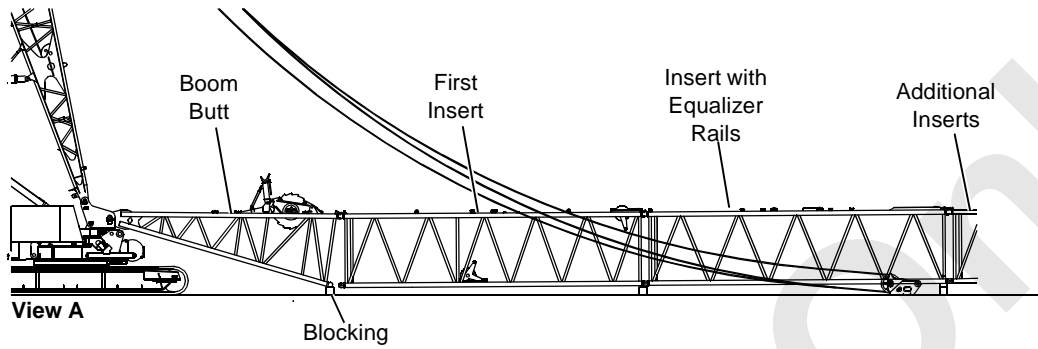
6. Engage horizontal pins (1) into hooked connector at top end of butt or insert (View B).
7. Lower insert until bottom connecting holes line up.
8. Insert both horizontal pins (4, View C).
9. Install safety pins (5, View C).
10. Block under top end of insert.
11. Remove chain slings.
12. Repeat steps 3 – 11 for remaining #79 boom inserts, #79 transition insert, and #79/#44 transition insert.

### #44 Boom Inserts

The #44 boom sections have FACT™ connectors — top connectors joined by fixed vertical pins that hook into holes in the adjacent insert (6, View E). The bottom connectors are joined by removable horizontal pins (7, View F).

1. Attach chain sling to four lifting lugs on appropriate #44 insert.
2. Lift insert into position and engage top connector holes with fixed vertical pins in transition insert (6, View E).
3. Lower insert until bottom connector holes are aligned and install removable horizontal pins (7, View F).
4. Block under bottom chords at top end of insert.
5. Repeat steps 1 – 4 until all #44 inserts and boom top have been installed.

#79-44 Boom



Lower Sheave Assembly Shown  
Upper Sheave Assembly Similar

Item	Description
1	Deflector Sheave
2	Boom Hoist Equalizer
3	Pin

FIGURE 4-26



## Connect Boom to Boom Butt — #79-44 Boom

See Figure 4-26 for following procedure.

1. If necessary, travel crane so that top connectors of butt and first insert are aligned and will engage when butt is lifted.
2. Attach nylon lifting slings to chords at top end of butt (View B).
3. Hook assist crane to slings. *Crane must have capacity to lift 1/2 the weight of assembled boom.*
4. Lift insert until bottom connecting holes line up.
5. Insert both horizontal pins and safety pins (Figure 4-22, View C).

## Position Wire Rope Guides — #79-44 Boom

See Figure 4-26 for following procedure.

Two wire rope guide assemblies (1, View B) may be shipped in the stored position on first boom insert.

**NOTE:** It is not necessary to raise the wire rope guides if the upper boom point is not installed.

1. Attach slings from assist crane to frame of sheave assembly.
2. Hoist just enough to loosen pins (3, View C) holding sheave assembly (1) in stored position.
3. Remove pins (3).
4. Depending on its location, raise or lower sheave assembly (1) to operating position.
5. Insert pins (3) in Hole 1 (View C) to support sheave assembly in operating position.
6. Remove slings.

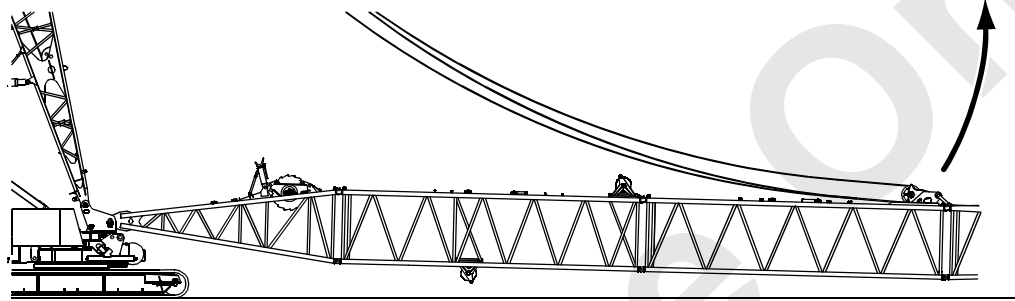
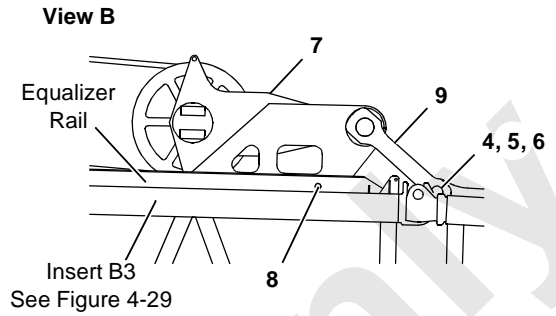
Repeat preceding steps for other deflector sheave assembly.

Item	Description	Item	Description
1	Strap (typical)	7	Boom Hoist Equalizer
2	Strap Storage Pin	8	Stop Pin
3	Link (typical)	9	Equalizer Strap Link
4	Connecting Pin	10	15 ft (4,6 m) Transition Insert
5	Collar (See Note 1)	11	Strap
6	Retaining Pin with Cotter Pins	12	Strap Storage Pin
		13	Pin

**Note 1:** Collar must face inside of boom

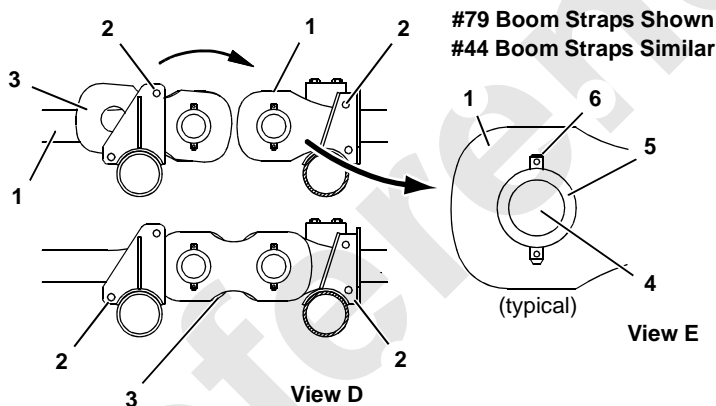
#79-44 Boom

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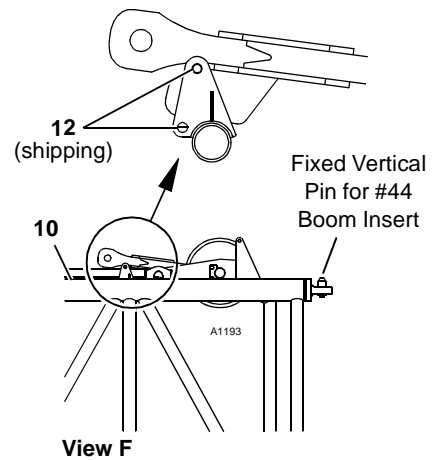
View A

View C  
SHIPPING POSITION  
(from inside of boom)

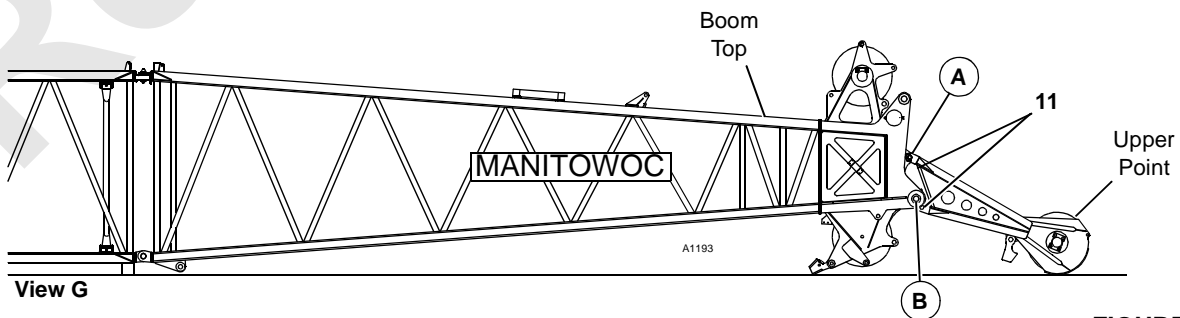


View D  
WORKING POSITION  
(from inside of boom)

View E



View F



View G

FIGURE 4-27

## Connect Boom Straps — #79-44 Boom

See Figure 4-27 for following procedure.

Boom straps and links are shipped in the stored position on #79 boom inserts.

1. Connect straps (1, View C) at top end of each insert, as follows:
  - a. Remove storage pins (2, View C) from shipping position.
  - b. Store pins (2, View D).
  - c. Remove retaining pins (6, View E), collars (5), and connecting pins (5) from end of each strap.
  - d. Rotate links (3, View C) forward and pin to adjacent strap (View F) using connecting pins, collars, and retaining pins (4, 5, 6, View E).
2. Connect straps to boom hoist equalizer as follows:
  - a. Using assist crane, lift boom hoist equalizer (7) into position on rails (View A).
  - b. Attach equalizer to holes in equalizer rails with stop pins (8, View B). **Stop pins must be installed to prevent equalizer from accidentally sliding back on rails during link assembly.**
  - c. Remove retaining pins, collars, and connecting pins (4, 5, 6, View B) from equalizer link (9).
  - d. Rotate equalizer links (9) forward and pin to strap on adjacent insert.

### CAUTION

Equalizer rails are provided only to support equalizer during assembly and disassembly.

Do not attempt to lift boom with boom hoist when equalizer is pinned to rails. Structural damage to insert or equalizer will occur.

3. Remove equalizer stop pins and store.

**NOTE:** See Figure 4-28, View A, for strap connections on booms 320 ft (98 m) – 400 ft (122 m) with intermediate suspension.

## Install Upper Boom Point — #79-44 Boom

If required, install upper boom point.

See Figure 4-27, View G for following procedure.

1. Using nylon lifting slings, lift upper boom point into position at front of boom top.
2. If necessary, remove pins (13) from upper connecting holes in upper boom point.
3. Align connection holes (A) and insert pin (13).
4. Rest boom point on ground.
5. Remove slings.
6. Install lower connecting pin (13) in hole (B) when boom is raised.

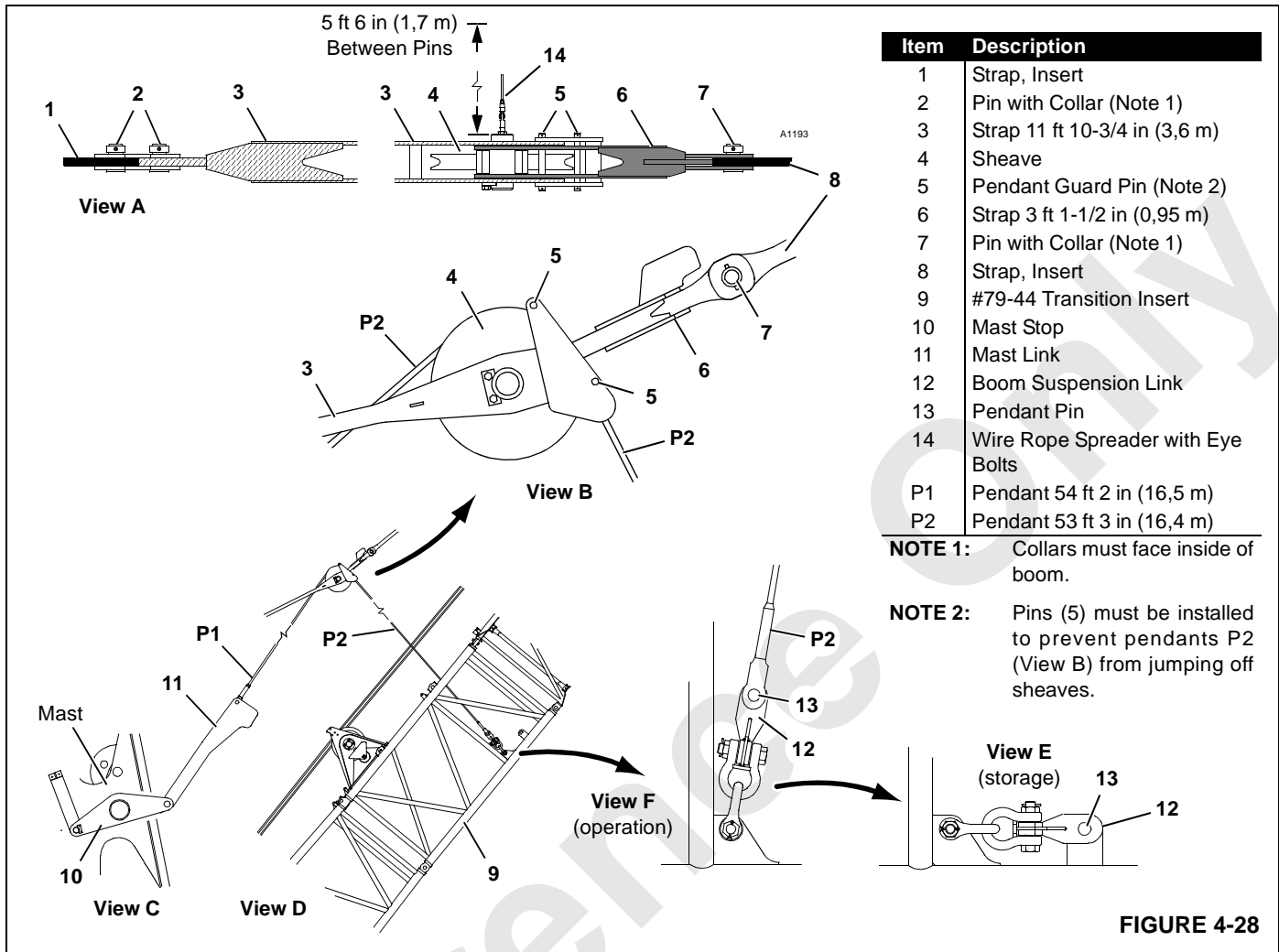


FIGURE 4-28

**Install Intermediate Suspension — #79-44 Boom**

See Figure 4-28 and #79-44 Boom Rigging Assembly Drawing for following procedure.

**CAUTION**  
**Avoid Boom Damage!**

Intermediate suspension is required for boom lengths of 320 ft (98 m) – 400 ft (122 m). Structural damage during boom raising/lowering can occur if it is not installed.

1. Connect straps as shown in Views A and B.
2. Pin two intermediate suspension pendants (P1, View C) (one each side) to mast links (11) on mast butt. Mast stops (10) and links (11) should be installed before mast is raised.

3. Connect six additional pendants (P1) (three each side) to pendants pinned to mast links.
4. Connect intermediate suspension pendants (P2) to pendants (P1).
5. Route pendants (P2) over sheaves (4, View B). Be sure to install guard pins (5).
6. Unpin suspension links (12, View E) from storage position.
7. Route pendants (P2) through transition insert (View D) and pin to suspension links (12, View F).
8. Install wire rope spreader (14, View A) between shafts of sheaves (4). Adjust spreader with eye bolts so distance between shafts is 5 ft 6 in (1,7 m).

**Load lines must be routed under wire rope spreader.**

**CAUTION****Avoid Pendant Damage!**

Watch intermediate suspension pendants as boom is raised/lowered. Do not allow pendants to get caught on adjacent parts.

**Finish Assembling Boom (all booms)**

Perform the following final assembly steps as outlined earlier in this section prior to raising boom and jib:

- Install jib.
- Install load lines.
- Install block-up limit control system.
- Make necessary adjustments.
- Perform pre-raising checks.

**BOOM REMOVAL**

Boom removal is the reverse of installation.

It is not necessary to remove the boom straps. The straps can be left on the inserts for shipping.

- The links at the front end of the inserts must be rotated rearward for storage (Figure 4-24, View E).
- The links at the equalizer (9, Figure 4-24, View B) are disconnected and stored with the equalizer.

- Install pins (2, Figure 4-24, View E) to secure the links and straps in stored position.

**CAUTION****Pendant Damage!**

Use extreme care when lowering #79-44 boom when equipped with intermediate suspension. Boom straps can land on and crush intermediate suspension pendants. To avoid this problem, push pendants to inner side of boom.

**WARNING****Crushing Injury Hazard!**

Boom sections can collapse when connecting pins are removed.

Block both ends of each boom insert before removing connecting pins.

Never work under or inside boom sections that are not securely blocked.

For #79-44 boom, do not disconnect boom hinge pins until lifting slings from assist crane are connected to boom butt. Boom butt may swing away from crane suddenly and rapidly.

A1149

#79 Boom

Item	Description	Length
B1	Butt	30 ft (9,1 m)
B2	Insert	20 ft (6,1 m)
B3	Insert with Equalizer Rails	40 ft (12,2 m)
B4	Transition Insert	25 ft (7,6 m)
B5	Top	5 ft (1,5 m)
B6	Insert with Wire Rope Guides	40 ft (12,2 m)
B7	Insert	40 ft (12,2 m)

NOTE 1  
*Inserts B2, B4, and B7 are shipped with straps and links stored on insert*  
**Inserts B6 and B7 on butt side of insert with equalizer rails (B3) must have straps and links removed, if equipped.**

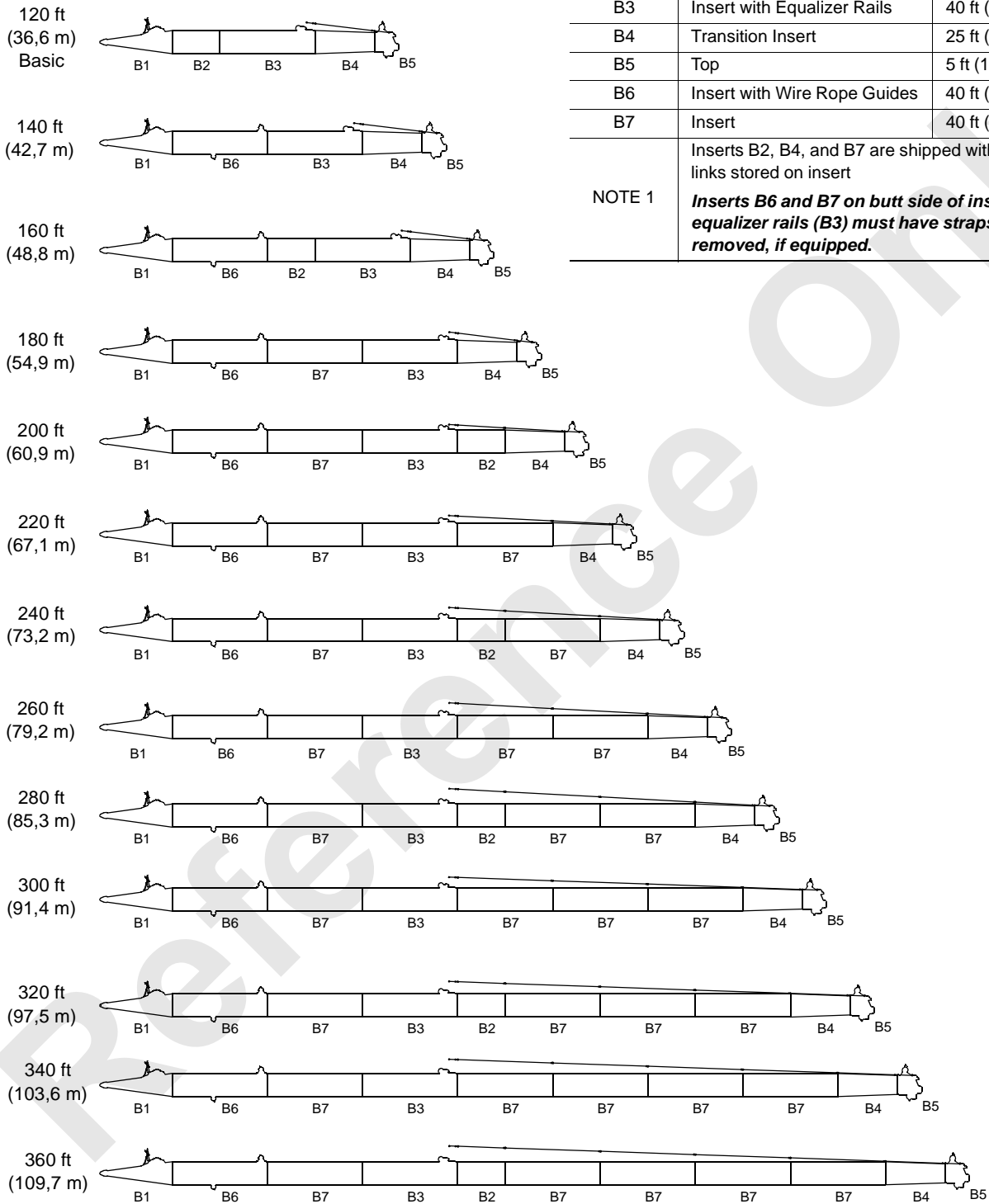


FIGURE 4-29

A1149

#79-44 Boom

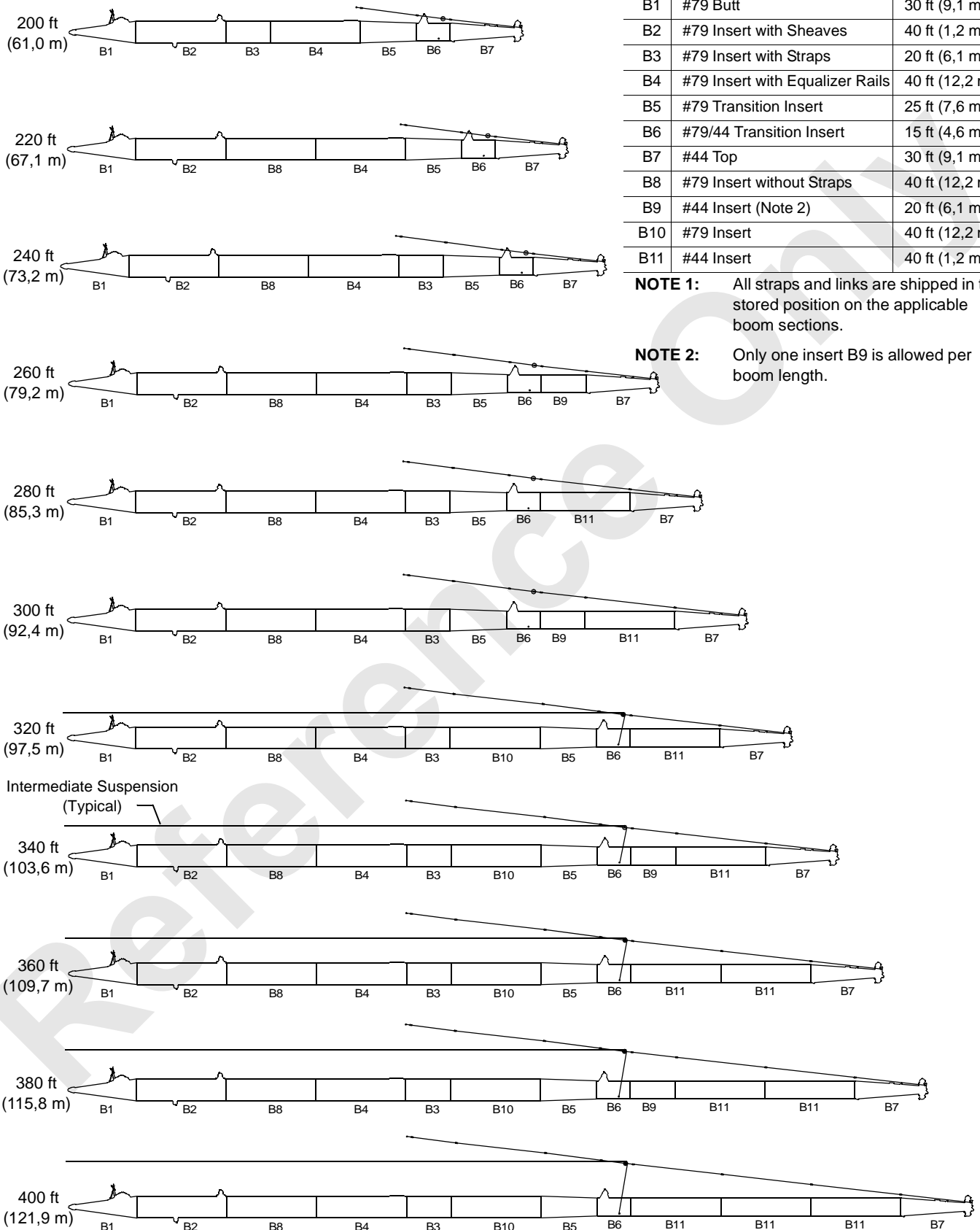


FIGURE 4-30

A1069  
A1080

Item	Description
1	Fixed Vertical Pin
2	Washer (Fixed Vertical Pin)
3a	Retaining Pin with Cotter Pins
3b	Support Cable Assembly
4	Removable Horizontal Pin – 10 -27/32 in (275 mm) – with Cotter Pins

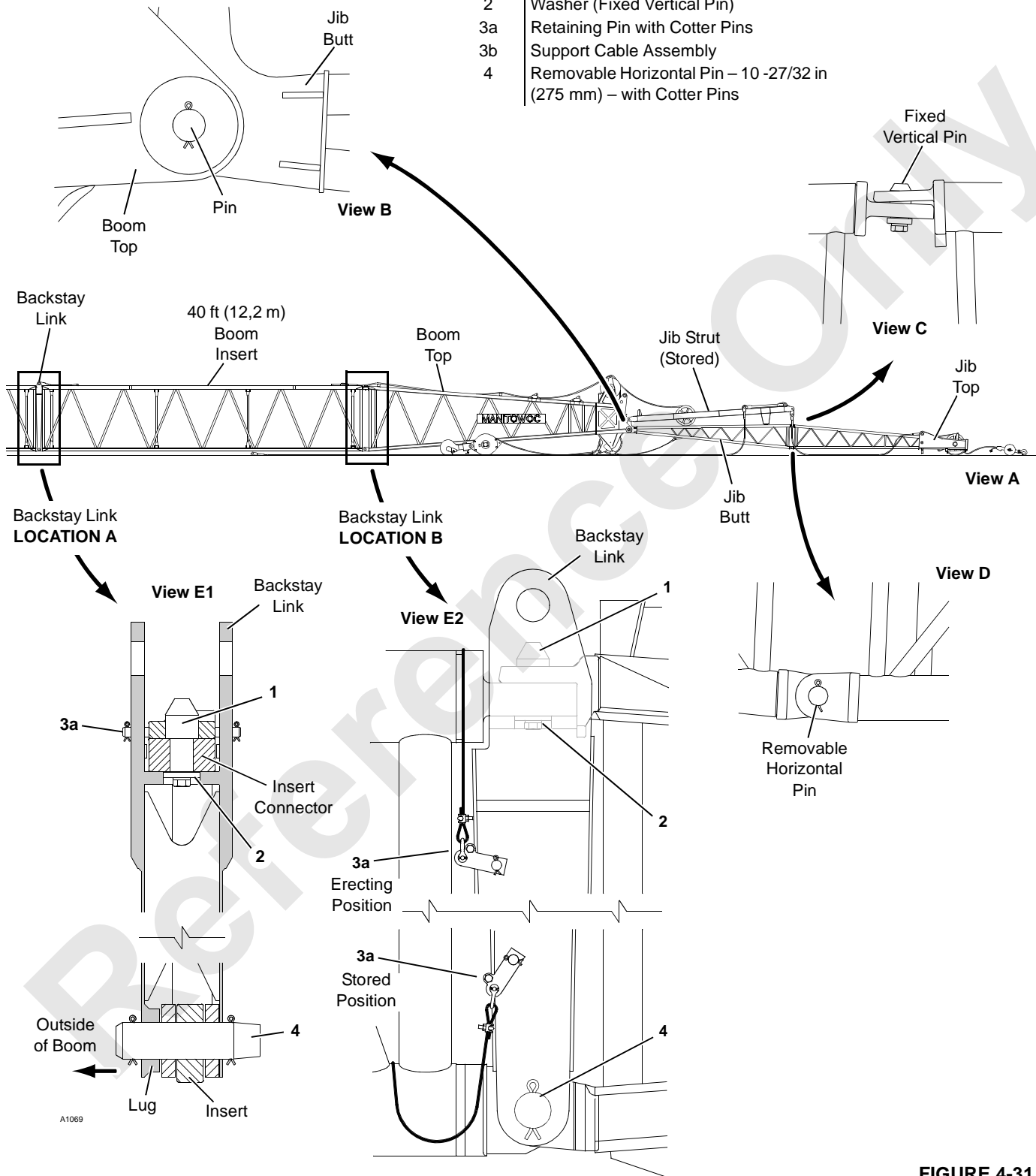


FIGURE 4-31



## JIB INSTALLATION — #132 JIB

### General

The jib consists of a 20 ft (6,1 m) butt and a 20 ft (6,1 m) top, providing a basic length of 40 ft (12,2 m). Inserts are available in 20 ft (6,1 m) lengths, allowing the jib to be lengthened to a maximum of 120 ft (36,6 m) as shown in Figure 4-34.

Jib offsets of 5, 15, and 30° are obtained by changing the length of jib backstay straps, links, and pendants as shown in Figure 4-33.

The following instructions assume the boom is completely installed and ready for operation.

### Assist Crane Requirements

An assist crane with sufficient capacity to lift one half the weight of the jib is required. See the Crane Weights in Section 1 of this section for weights of jib components.



### WARNING

#### Collapsing Jib Hazard!

To prevent death or serious injury, do not stand on, inside, or under jib during assembly or disassembly. Always stand outside of jib when installing or removing connecting pins.

### Jib Assembly Drawing

Jib components (top, inserts, butt, pendants) must be assembled in proper sequence according to this section and the Jib Assembly drawing in the Crane Operator's Manual. See Figure 4-34 to determine quantity and length of inserts and pendants required for various jib lengths.

See applicable Jib Lifting Capacity Chart for boom and jib length limitations.

### Install Jib

#### Prepare Boom

1. Lower boom to ground. Block if necessary.
2. Remove load line from upper boom point, if equipped.
3. Remove and store upper boom point (See Boom Rigging in this section for instructions).
4. Install jib backstay links between boom sections at Location A or B, Figure 4-31. **See Jib Assembly Drawing for proper mounting location.**

- a. If necessary, separate boom sections to provide space for links.
- b. Lift a backstay link into position on either side of required insert.

**Lug at bottom connecting holes in link must be toward outside of boom.** (Figure 4-31, View E1).

- c. Lift backstay link upward and engage hole in link with washer (2, Figure 4-31, View E1) on underside of insert connector.
- d. For Location A, install retaining pin (3a, Figure 4-31, View E1) through holes on butt side of link to prevent link from falling off insert.

For Location B, move support cable assembly (3b, Figure 4-31, View E2) from stored position to erecting position to prevent link from falling off insert. If necessary, adjust cable length so bottom connecting holes are aligned when assist crane is disconnected.

- e. Repeat steps 5b – 5d for backstay link on other side of boom.
- f. Reconnect boom inserts.

**Replace standard horizontal connecting pins with 10-27/32 in (275 mm) long pins (4, Figure 4-31, View E) supplied with backstay links.**

#### Install Jib Butt

**NOTE:** The jib strut is shipped in the stored position on the jib butt (Figure 4-31, View A).

1. Lift jib butt into position at end of boom top.
2. Align holes in jib butt with holes in boom top and install connecting pins (Figure 4-31, View B).

#### Install Jib Inserts

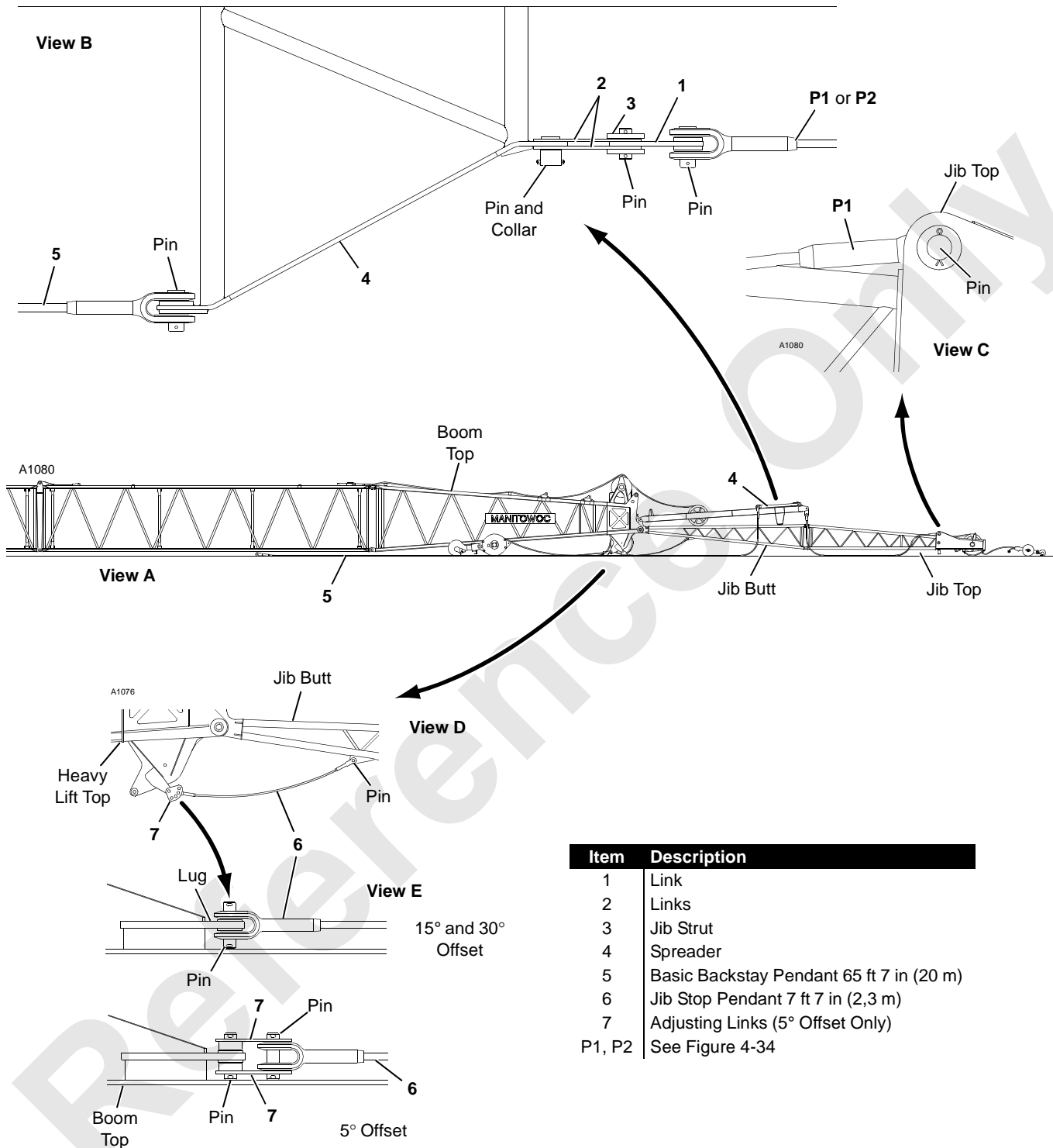
**NOTE:** The jib sections have FACT™ connectors.

- The top connectors are joined by fixed vertical pins that hook into holes in the adjacent section (Figure 4-31, View C).
  - The bottom connectors are joined by removable horizontal pins (Figure 4-31, View D).
1. Pin desired length of jib inserts to butt. **Tapered end of pins must point inward.**
  2. Block inserts at ground level as assembly progresses.

#### Install Jib Top

Pin jib top to last insert or butt, depending on jib length.

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Item	Description
1	Link
2	Links
3	Jib Strut
4	Spreader
5	Basic Backstay Pendant 65 ft 7 in (20 m)
6	Jib Stop Pendant 7 ft 7 in (2,3 m)
7	Adjusting Links (5° Offset Only)
P1, P2	See Figure 4-34

FIGURE 4-32

### Install Jib Pendants

**NOTE:** With the exception of the basic pendants, the jib pendants must be installed in the same sequence as the inserts as shown in Figure 4-34.

The jib pendants are furnished in matched sets of two and must be installed in matched sets — pendant on one side of insert must match pendant on other side of insert.

1. Pin basic jib pendants (P1, Figure 4-32, View C) to lugs on jib top.
2. If jib is longer than 40 ft (12,2 m), pin jib pendants (P2, Figure 4-34) to basic pendants (P1).
3. Pin links (1 and 2, Figure 4-32, View B) to jib strut (3).
4. Pin jib pendants (P1 or P2) to links (1) on jib strut as shown in Figure 4-32, View B.

### Install Backstay Pendants

For the following procedure, see Figure 4-32, View B.

1. Lift spreader (4) into position and pin to links (2) on jib strut (3).
2. Lay spreader (4) on jib strut (3).

3. Pin basic backstay pendants (5) to spreader.
4. Lay basic backstay pendants (5) on ground along boom top.

### Install Jib Stop Pendants and Links

Choose correct jib stop pendants and links for jib offset and boom top being used.

See Figure 4-32, View D and E.

1. Pin jib stop pendants (6) to lugs on boom top.
2. Depending on jib offset, proceed as follows:
  - a. 5° – Pin adjusting links (7) to boom top lugs. **Do not pin pendants (6) to adjusting links (7) until after jib point is raised clear of ground** (see Connect Jib Stop instructions later in this section).
  - b. 15° and 30° – **Do not pin pendants (6) to boom top lugs until after jib point is raised clear of ground** (see Connect Jib Stop instructions later in this section).

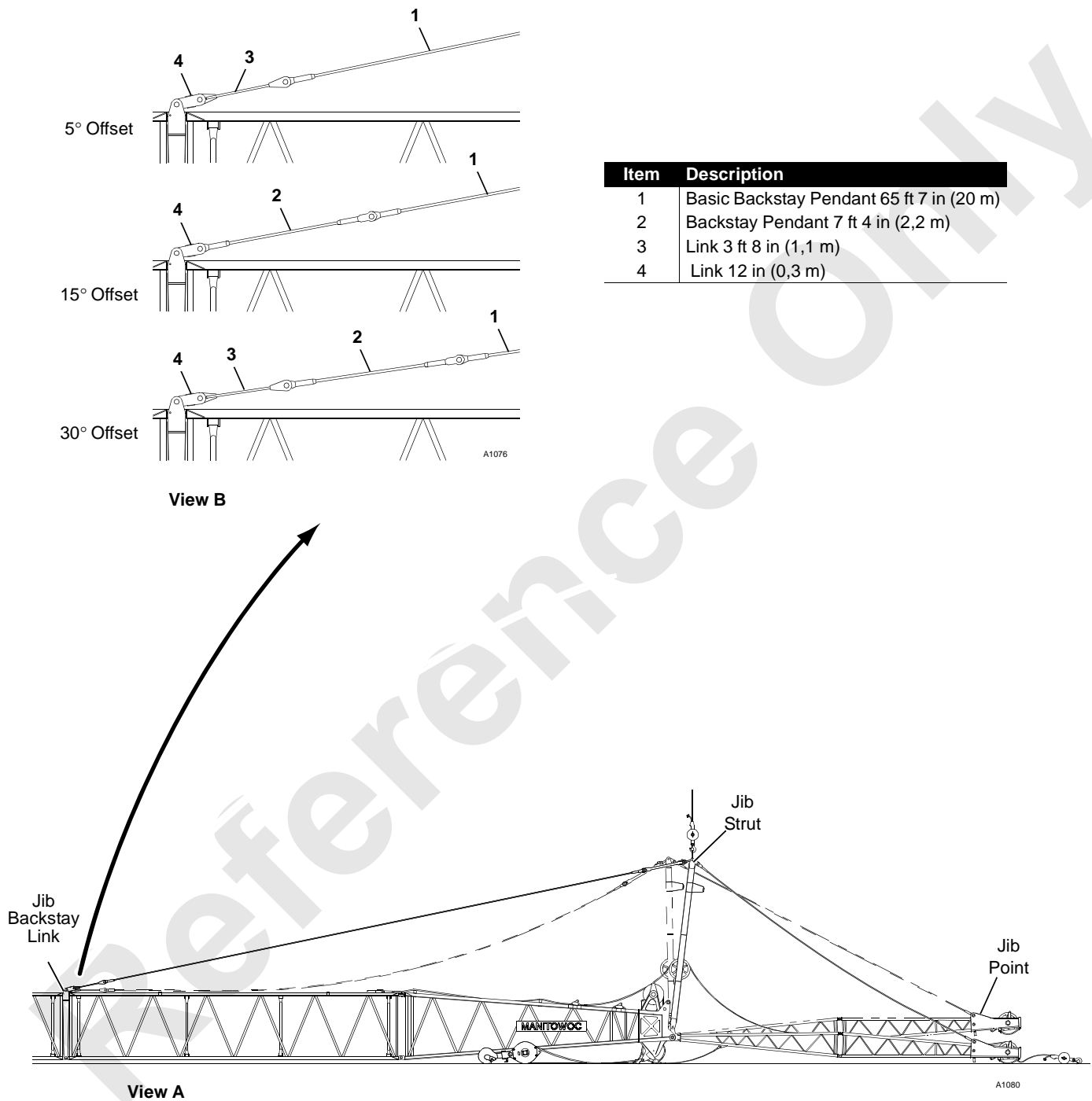


FIGURE 4-33

**Raise Jib Strut**

1. Determine pendants and links required for jib offset (2, 3, 4, Figure 4-33, View B).
2. Pin pendants and links to backstay links.

**NOTE:** Backstay links (3, Figure 4-33, View B), if used, must be adjacent to connecting links (4).

3. Using assist crane or fork-lift truck, lift jib point approximately 3 ft (0,9 m) off ground and block (Figure 4-33, View A).

Raising jib point provides enough slack to allow pinning backstay pendants.

4. Using appropriate slings, attach hook from assist crane to top of jib strut (Figure 4-33, View A).
5. Slowly lift jib strut over center with assist crane. **Use extreme caution not to side load strut while lifting.**
6. Pin jib backstay pendants (1) to links or pendants (2 or 3) previously pinned to boom backstay links (Figure 4-33, View B).
7. Remove blocking from jib point and lower to ground.

**Connect Jib Stop**

1. Slowly raise boom until jib is supported by backstay and jib pendants.
2. Proceed as follows depending on jib offset. See Figure 4-32, Views D and E),:
  - a. 5° – Pin pendants (6) to holes in adjusting links (7) which give **least pendant slack or some preload.**
  - b. 15° and 30° – Pin pendants (6) directly to boom top lugs.

**Finish Assembling Jib**

Perform the following final assembly steps as outlined earlier in this section prior to raising boom and jib:

- Install load lines.
- Install block-up limit control system.
- Make necessary adjustments.
- Perform pre-raising checks.

**JIB REMOVAL**

**WARNING**  
**Collapsing Jib Hazard!**

To prevent death or serious injury, do not stand on, inside, or under jib during disassembly. Always stand on outside of jib when removing connecting pins.

Support jib properly before removing pins. Block sections at connection points.

**Lower Boom and Jib****CAUTION****Jib Stop Damage!**

Do not allow jib point to touch ground until jib stop pendants are disconnected.

1. Lower boom until jib point is approximately 1 ft (0,3 m) from contacting ground.
2. Disconnect jib stop pendants (6, Figure 4-32, View D) from adjusting links (7) or from boom top lugs.
3. Lower boom and jib onto blocking at ground level.
4. Disconnect block-up limit electric cord from jib at cord in boom point and at junction box in jib point, and store cable on jib butt.  
Connect block-up limit electric cable to jib to shorting plug on junction box in boom top.
5. Remove load line and block-up limit chains and weights from jib.

**Lower Jib Strut**

**WARNING**  
**Falling Strut Hazard!**

Do not disconnect backstay pendants until strut is supported and pendants are slack.

1. Using assist crane or fork-lift truck, lift jib point approximately 3 ft (0,9 m) off ground and block (Figure 4-33, View A).  
Raising jib point provides enough slack to allow removing backstay pendant pins.
2. Using appropriate slings, attach hook from assist crane to top of jib strut (Figure 4-33, View A).

3. Disconnect backstay pendants and links (Figure 4-33, View B) from backstay links. Lay pendants on ground along boom top.
4. Slowly rotate jib strut forward over center with assist crane and lower onto jib butt. Avoid lifting jib butt/boom top in process. **Use extreme caution not to side load strut while lowering.**
5. Disconnect assist crane from jib strut.
6. Remove blocking from jib point and lower to ground.

### Remove Backstay Pendants

1. Disconnect backstay pendants (5) from spreader (4, Figure 4-32, View B).
2. Coil backstay pendants and store pendants and links for future use.

**NOTE:** Spreader (4) can be stored on jib strut for shipping.

### Remove Jib Pendants

See Figure 4-32 for following procedure.

1. Disconnect jib pendants (P1 or P2) from links (1) on jib strut (3) and lugs on jib top.
2. Coil jib pendants and store for future use.

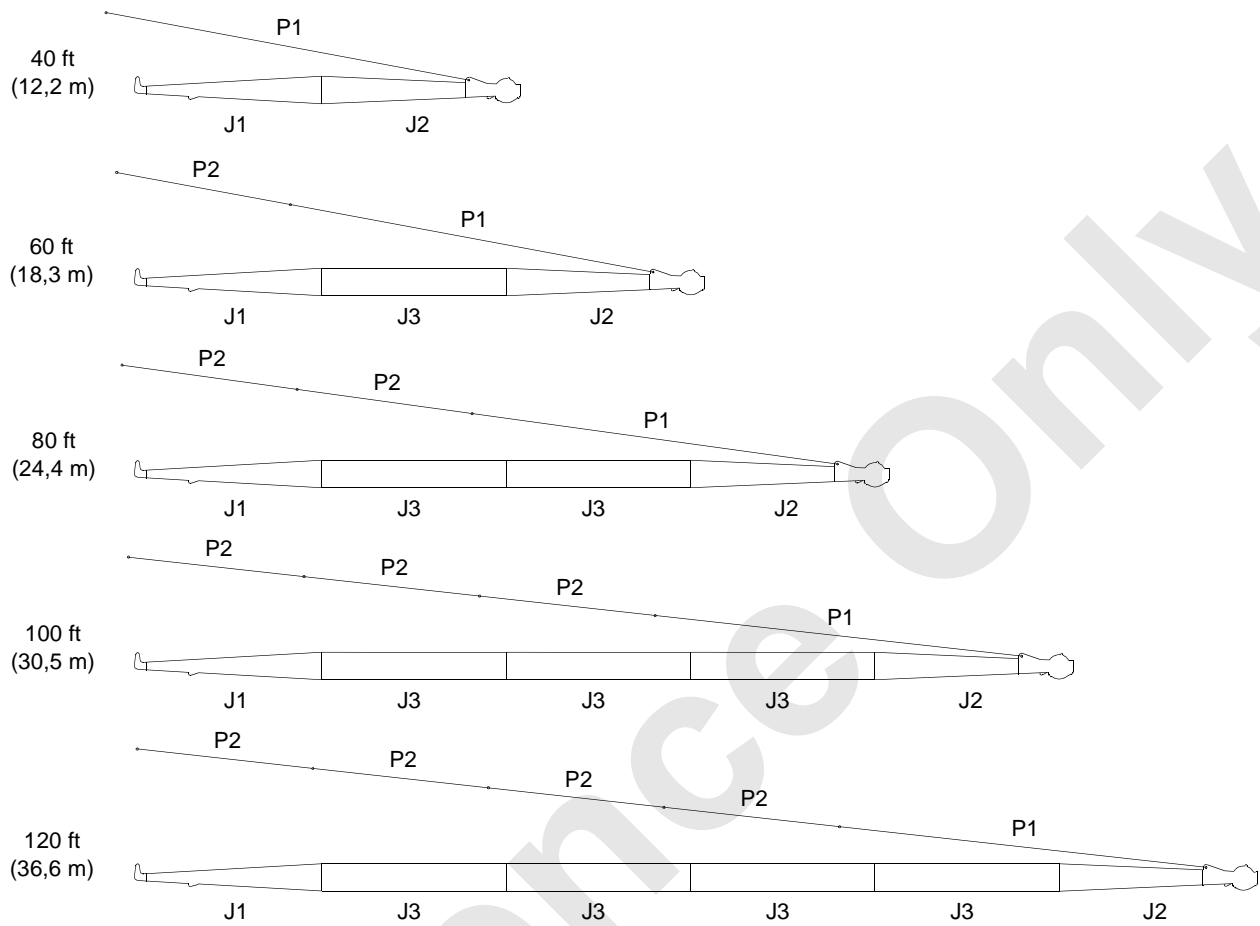
### Remove Jib Top and Inserts

1. Unpin and remove jib top from jib butt or jib insert (Figure 4-31, View C and D).
2. Unpin and remove inserts from butt, as required (Figure 4-31, View C and D).

### Remove Jib Butt

1. Remove jib stop pendants, links, and struts from between boom top and jib butt (Figure 4-32, View D or F).
2. Support jib butt with assist crane.
3. Unpin and remove jib butt from boom top (Figure 4-31, View B).

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Section	Type	Length	Pendant	Type	Length
J1	Jib Butt	20 ft (6,1 m)	P1	Basic Jib	40 ft (12,2 m)
J2	Jib Top	20 ft (6,1 m)	P2	Jib Insert	19 ft 2 in (5,8 m)
J3	Jib Insert	20 ft (6,1 m)			

FIGURE 4-34

## WIRE ROPE INSTALLATION

**NOTE:** Wire rope manufacturer's recommendations take precedence over information in this section.

### Wire Rope Storage

Store wire rope in coils or on reels off the ground or floor in a clean and dry indoor location. If outdoor storage is necessary, the wire rope must be covered with a protective wrapper. Keep the wire rope away from acids, fumes, and other corrosives. Keep the wire rope away from heat that can dry out the lubricant. If the storage period will be long, lubricate the wire rope and perform periodic inspection given in this section at least monthly.

### Removing Wire Rope from Shipping Reel

#### CAUTION!

#### Wire Rope Damage!

Shipping reel must rotate when wire rope is unwound. Attempting to remove wire rope from a stationary reel can result in a "kinked" wire rope, and wire rope will be ruined.

1. Mount wire rope shipping reel on a shaft supported at both ends by jacks or blocks as shown in Figure 4-35.

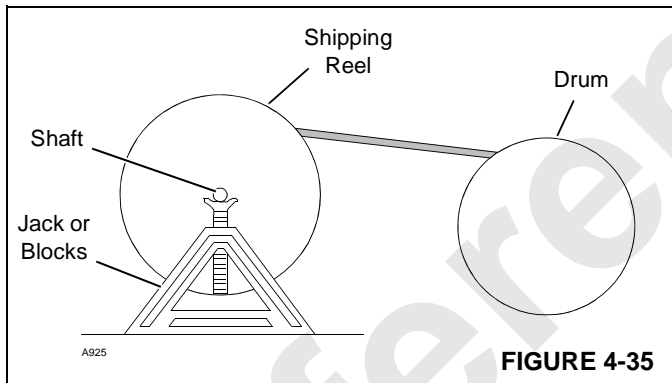


FIGURE 4-35

2. Provide a brake at shipping reel (see Figure 4-36) so wire rope can be wound tightly onto drum.

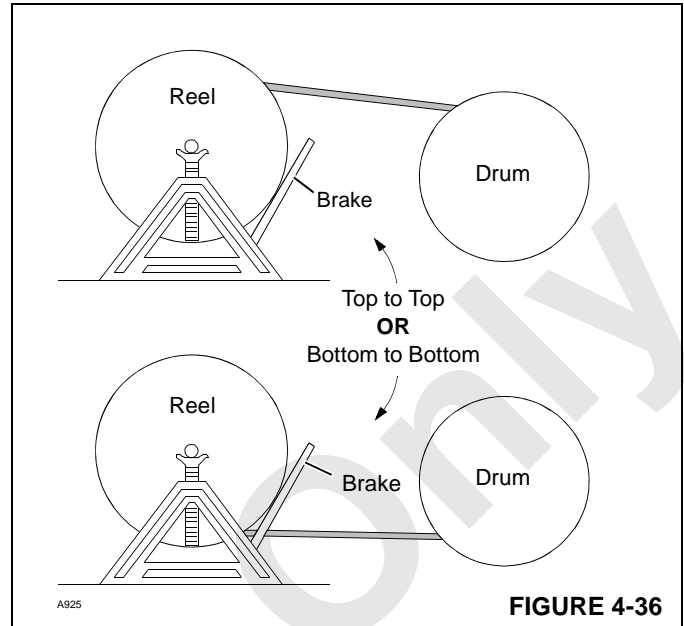


FIGURE 4-36

3. Avoid a reverse bend when winding wire rope onto drum: wind from top of reel to top of drum or from bottom of reel to bottom of drum as shown in Figure 4-36.
4. Avoid dragging wire rope in dirt or around objects that can scrape, nick, cut, or crush wire rope.

### Seizing and Cutting Wire Rope

Apply tight seizings of annealed wire to the ends of all wire rope. If not done, the rope wires and strands may slacken. This action will result in overloading of some strands and underloading of others. Bird caging and breakage of the wire rope can occur.

Before cutting wire rope, apply seizings on both sides of the point where the cut will be made. Then cut the wire rope with a torch, rope cutter, or abrasive cut-off wheel.

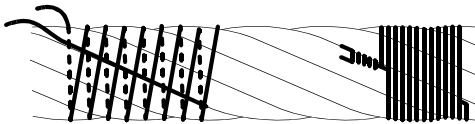
See Figure 4-37 for:

- Number of seizings to be applied to the ends of wire rope and to both sides of the point where a cut will be made.
- Proper application method. Each seizing should be one rope diameter long.



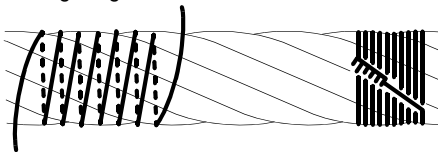
Wire Rope Type	Seizings Required
Preformed	1
Non-preformed	2
7/8 in (22 mm) Diameter or Smaller	2
Non-preformed	3
1 in (26 mm) Diameter or Larger	3

Place free end of seizing wire in valley between two stands. Then wind seizing wire over free end as shown. Finally, twist and pull two ends of seizing wire together until seizing is tight.



View A Rope Diameter 1 in (26 mm) and Larger

Wind seizing wire around wire rope as shown. Then twist two ends of seizing wire together at center of seizing. Alternately twist and pull ends until seizing is tight.



View B Rope Diameter Smaller than 1 in (26 mm)

FIGURE 4-37

## Anchoring Wire Rope to Drum

See Figure 4-38 for following procedure.

Use the correct wedge part number for the size of wire rope being used; see parts drawing for the boom hoist drums or for the load drum shaft to obtain the correct part number.

1. Assemble wire rope and wedge to drum socket.
2. Tighten wedge, rapping back of wedge with a brass drift pin and hammer.



## WARNING! Falling Load Hazard!

Wire rope can be pulled out of drum if following steps are not taken.

- Install straight wedge so corrugated side is against wire rope.
- Install wedge so end of wire rope extends past end of wedge, but not out of drum socket.
- Make sure seizing is not under wedge. Remove seizing if it interferes with assembly.

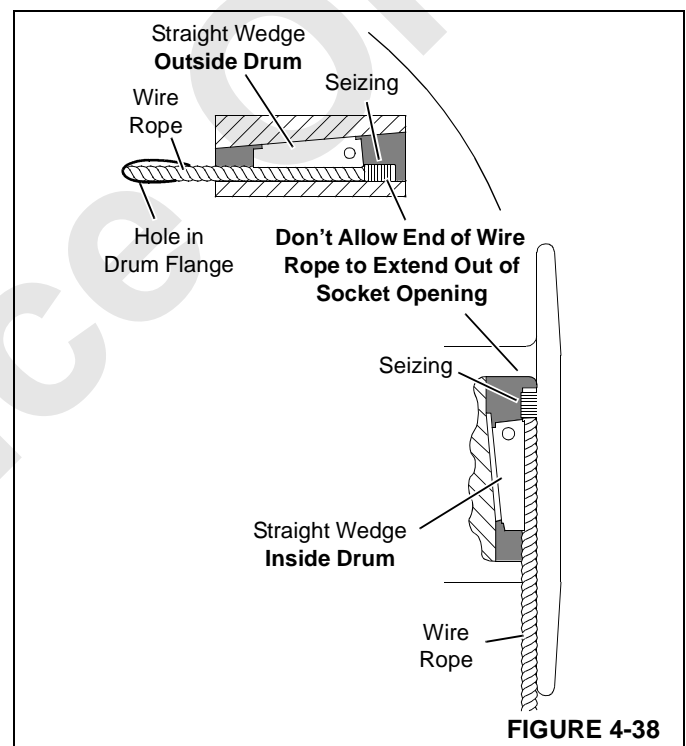


FIGURE 4-38

## Winding Wire Rope onto Drum

See Drum and Lagging Chart in Capacity Chart Manual for correct size of drum laggings, if used.

See Wire Rope Specifications Chart in Capacity Chart Manual for correct type, size, and amount of wire rope to be installed on load drums.

See Boom Rigging Drawing at end of this section for correct type, size, and amount of wire rope to be installed on boom hoist drums.

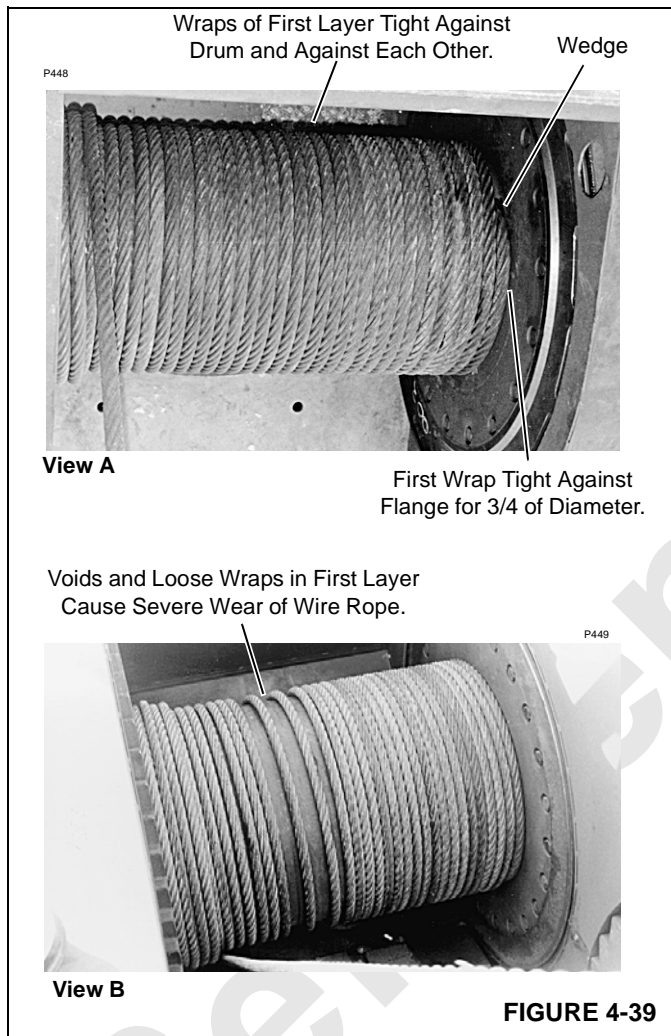
1. Carefully inspect drums and all rope guides, rollers, and sheaves for defects that can cause wire rope to wear or be cut. If defects cannot be fixed, replace faulty parts.

- Apply tension to wire rope as it is wound slowly onto drum.

First wrap must be tight against drum flange for approximately three-fourths of drum diameter (see Figure 4-39).

- Tap adjacent wraps against each other with a soft metal or wooden mallet.

Use extreme care not to put twists or turns in wire rope; allow rope to assume its natural lay.



### CAUTION!

#### Wire Rope Damage!

Voids or spaced wraps in first layer (see Figure 4-39, View B) will permit movement and a wedging action with subsequent layers. Wedging action will cause crushing and abrasion of wire rope.

Never allow wire rope to “cross wind” on drums.

## Anchoring Wire Rope to Wedge Socket



### WARNING

#### Falling Load Hazard!

- Inspect all parts prior to use. Do not use parts that are cracked or otherwise defective.
- Remove minor nicks, burrs, or rough edges from socket, wedge, or pin by lightly grinding. Do not reduce original dimensions by more than 10%.
- Do not reinstall shipping material (bolt, plastic strap or wire) in hole of wedge or socket after assembling. Discard these materials because they can prevent wedge from tightening in socket.
- Only use a wedge and socket which are correct size for wire rope being used. Do not mix and match parts from one assembly with parts from another assembly. Terminator™ socket and wedge has “go” and “no go” holes to check for proper rope size.
- Attach wire rope clip to dead end of wire rope after assembling wire rope to wedge and socket.
- 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 attachment.

See Figure 4-40 for following procedure.

- Assemble wire rope and wedge to socket so live end of wire rope is in a straight line with socket pin hole. *Do not assemble WRONG as shown.*
- Allow dead end of wire rope to extend past end of socket amount shown.
- Allow wire rope to assume its natural lay.
- Pull against wedge and live end of wire rope enough to tighten wedge in socket.

Use a brass hammer to seat wedge and wire rope as deep into socket as possible.

- Attach a wire rope clip to dead end of wire rope using one of the RIGHT methods shown. Rope clip will aid in preventing wire rope from being pulled out of socket.

**NOTE:** Use Right Method A only if wire rope clip is small enough to be securely tightened to dead end. Right Method C is only for a Terminator™ wedge socket.

- After socket is pinned in place, hoist load slowly so wedge seats tight. *Do not shock load socket and wedge.*

**! WARNING**  
**Falling Load Hazard!**

Wire rope can break if following precaution is not observed:

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

**Breaking in Wire Rope**

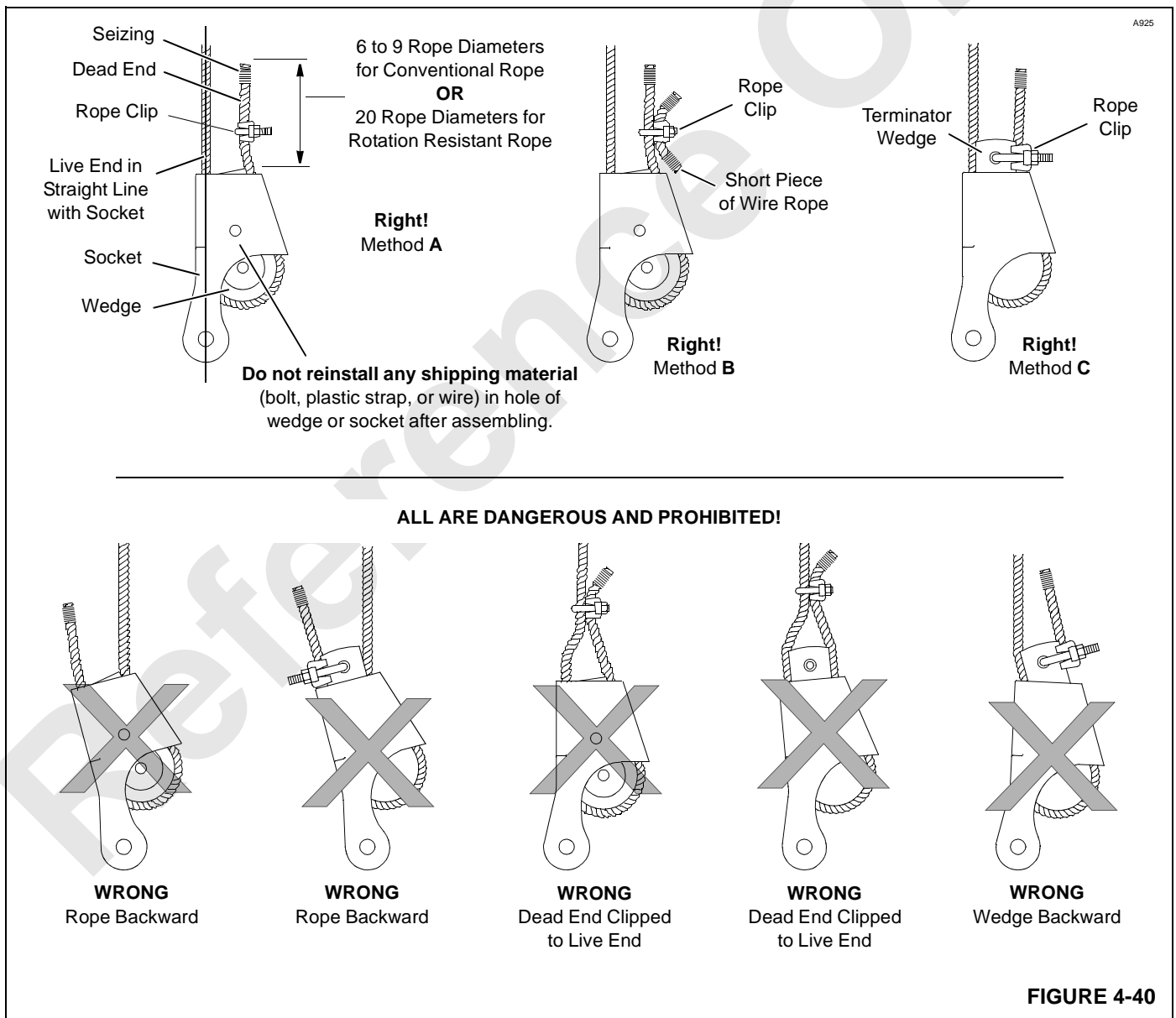
After installing a new wire rope, break it in by operating it several times under light load and at reduced speed. This

practice allows the wire rope to form its natural lay and the strands to seat properly.

**NOTE:** Wire rope will stretch during the break-in period, reducing the wire rope's diameter as the strands compact around the core.

The dead wraps of wire rope on the 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.

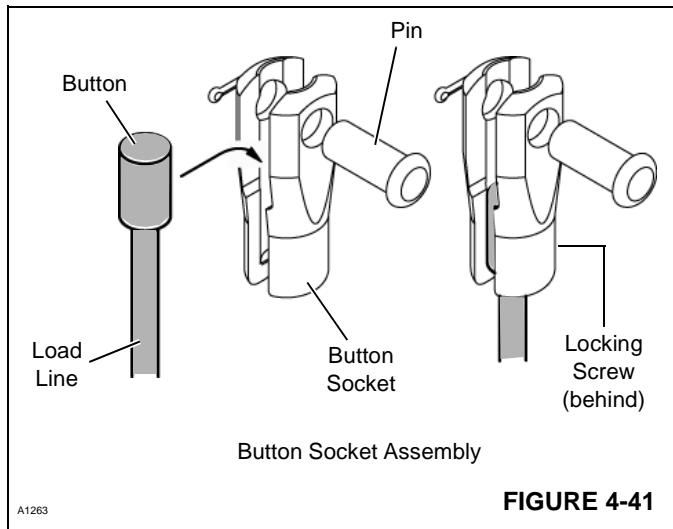
When slackness is noted, tightly wind the dead wraps of wire rope onto the drum. If left uncorrected, a wedging action with subsequent layers will occur, and the resultant abrasion may cause broken wires in the dead wraps.



## Anchoring Wire Rope to Button Socket

See Figure 4-41 for following procedure.

1. Remove pin from socket.
2. Install button end of load line in socket.
3. Pin socket to anchor point.
4. Securely tighten locking screw.



## PAD EYE USAGE FOR WIRE ROPE REEVING

See Figure 4-42 for following procedure.

## General

Some rotation-resistant wire rope supplied by Manitowoc is equipped with a No. 1.5 pad eye welded to the leading end of the wire rope.

A sucker-line can be attached to the pad eye to make it easier to reeve the load block.

## Safety

1. For No. 1.5 pad eye, do not exceed 1,000 lb (4,45 kN) single line pull.
2. Make sure sucker line and rope clips are rated for at least 1,000 lb (4,45 kN) line pull.
3. Inspect pad eye prior to each use. **Replace it if:**
  - Any original dimensions have changed .
  - Cracks or breaks exist in metal or weld.



## WARNING

### Flying Part Hazard!

Pad eye on end of wire rope has been provided **for reeving purposes only**. Any other use is neither intended nor approved.

Pad eye can break and fly apart with considerable force if it is overloaded, not used properly, or not maintained properly.

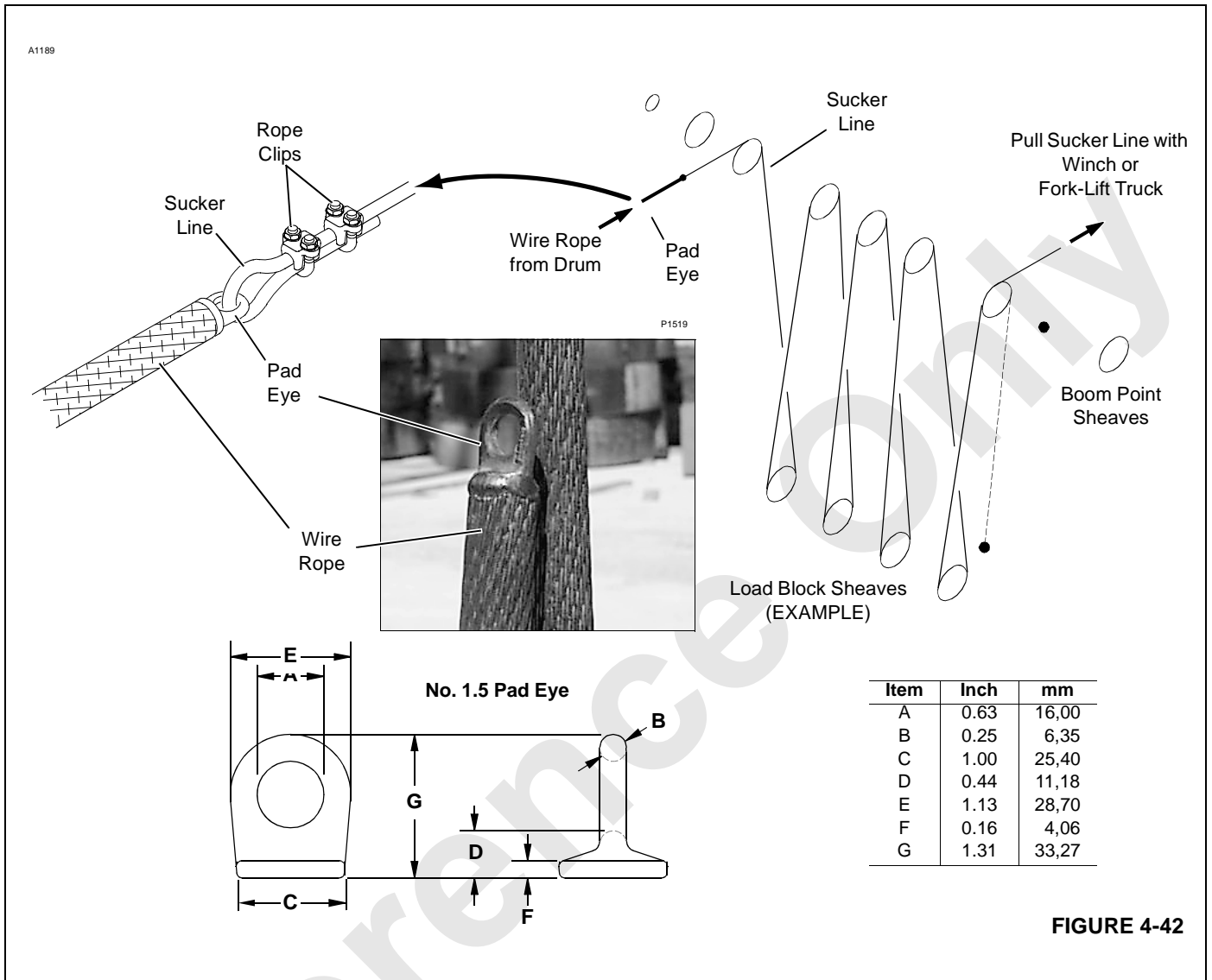


FIGURE 4-42

Reference Only

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## LOAD BLOCK REEVING

### Reeving Diagrams

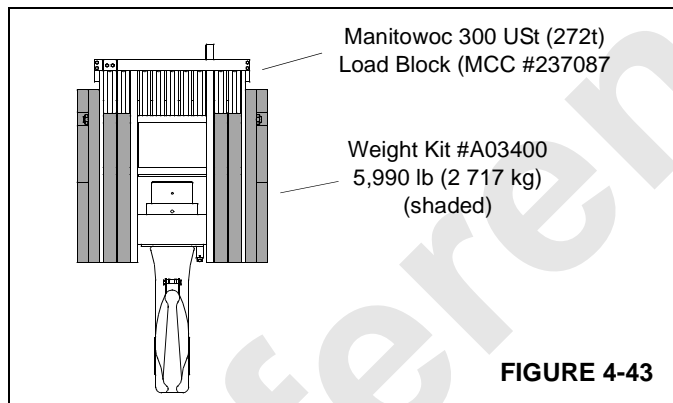
This topic provides load block reeving information for the 2250 MAX-ER 2000 equipped as follows:

- #79 Boom — see Drawing 6063 at the end of this section for recommended reeving.
- #79-44 Boom — see Figure 4-50 for recommended reeving.
- #79-44 Boom with #132 Jib — see Figure 4-49 for recommended reeving.

### Load Block

The following load blocks are available from Manitowoc:

- 500 USt (454 t) – 16,500 lb (7 484 kg)
- 300 USt (272 t) with weight plates – 15,400 lb (7 484 kg)
- 100 USt (91 t) with weight plates – 9,800 lb (6 985kg)
- 60 USt (55 t) with weight plates – 4,425 lb (2 007kg)
- 30 USt (27 t) with weight plates – 3,500 lb (1 587 kg)
- 15 USt (14 t) swivel hook with weight plates – 1,900 lb (861 kg)



**! WARNING**  
**Falling Load Hazard!**

Use only a load block with a capacity equal to or greater than load to be handled.

Avoid overloading bearings of load block sheaves. Attach load to duplex hook so load hangs straight.

Load block can fail if overloaded, allowing load to fall.

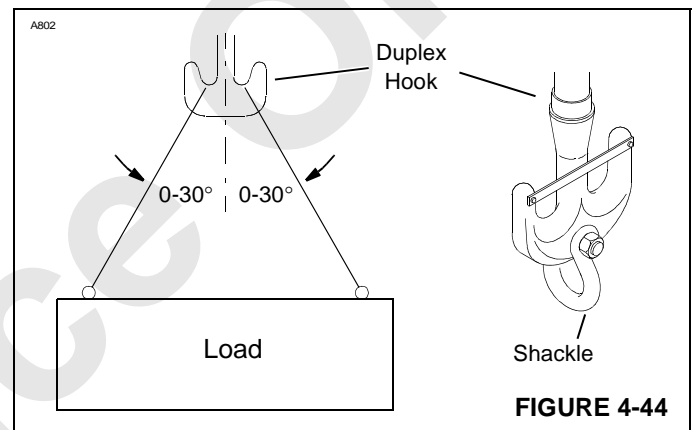
### Duplex Hook

The duplex hook capacities are based on the lifting sling angles given in Figure 4-44. Attach the load so it is balanced equally on each ear of the hook. The duplex hook has a hole to which a shackle can be attached as shown in Figure 4-44.

**! WARNING**  
**Falling Load Hazard!**

Limit load to be handled with shackle to capacity of load block or shackle, whichever is less.

Load block or shackle can fail if overloaded, allowing load to fall.



### Guide Sheaves

See Figures 4-45 – 4-48 for guide sheave identification.

Once wire rope is routed through guide sheaves, be sure to install rope guard pins, bars, and rollers to retain rope on guide sheaves. **Wire rope and sheaves can be damaged if rope is not properly retained on sheaves.**

### Wire Rope Specifications

See Wire Rope Specifications chart in Capacity Chart Manual for parts of line required to handle desired load.

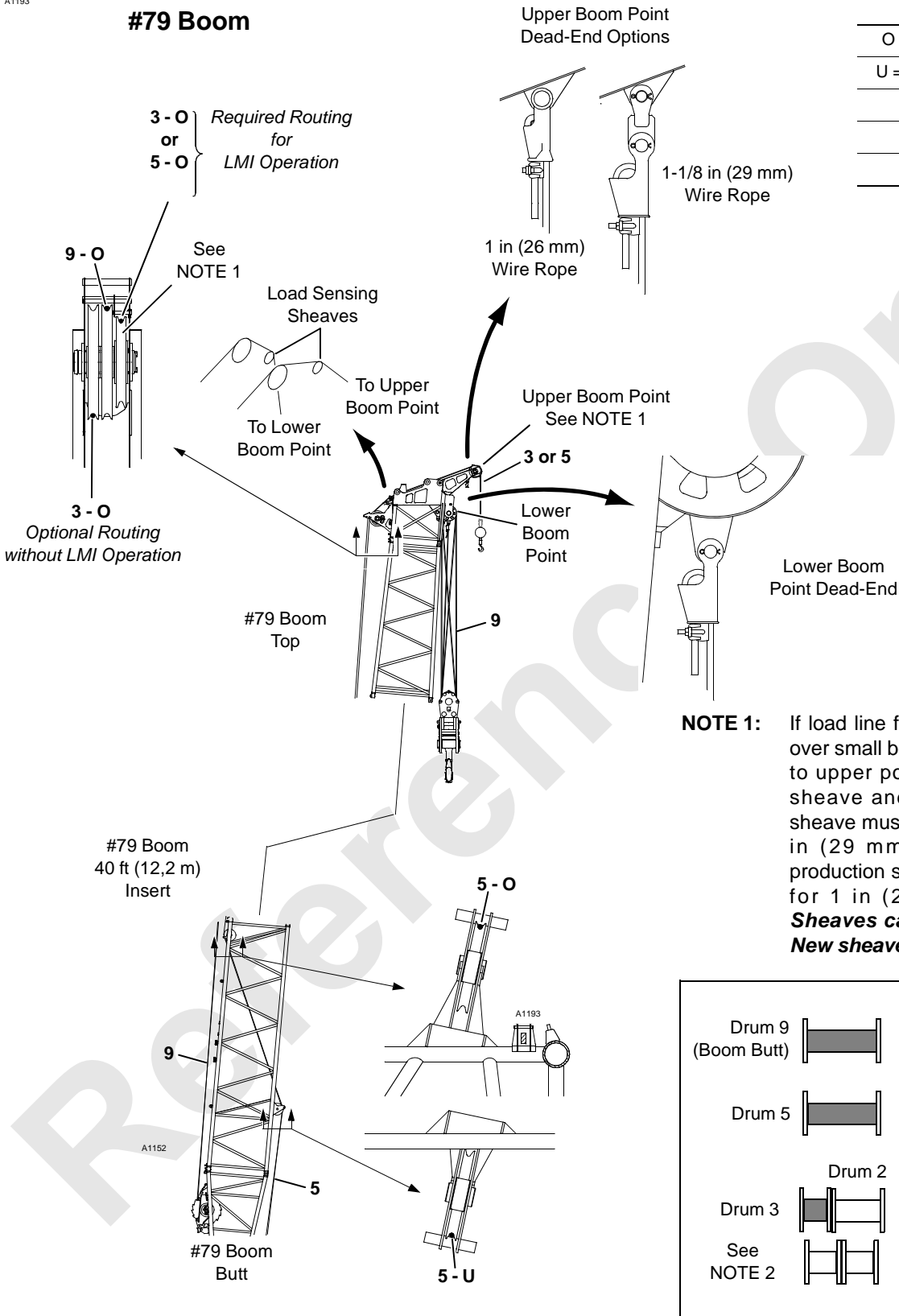
### Wire Rope Installation

See Wire Rope Installation in this section for the following instructions:

- Anchoring wire rope to drum.
- Installing wire rope on drum.
- Anchoring wire rope to wedge socket.

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#79 Boom



Wire Rope Routing	
O	= Route OVER Sheave
U	= Route UNDER Sheave
3	= Drum 3
5	= Drum 5
9	= Drum 9

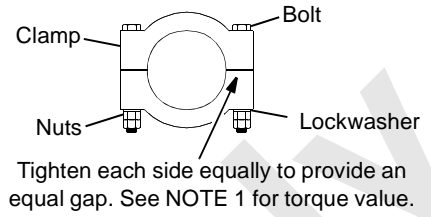
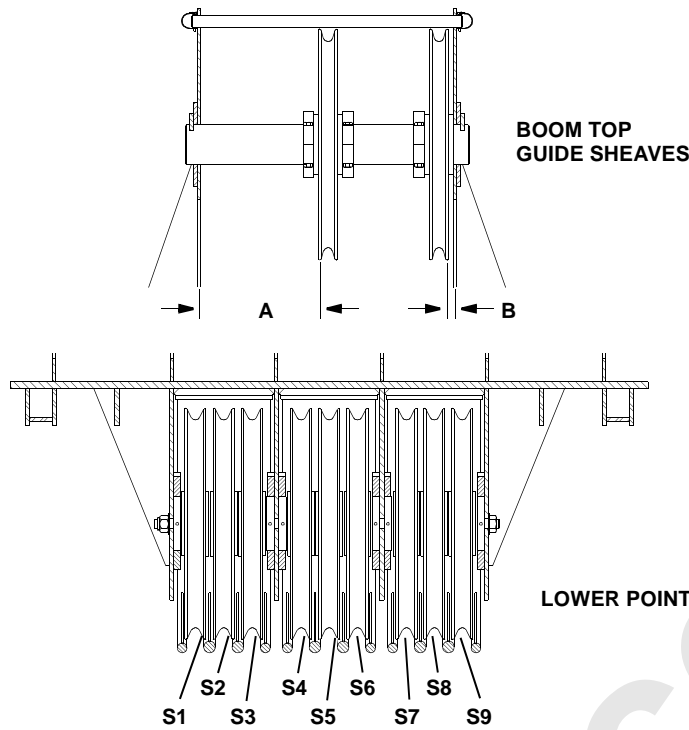
**NOTE 1:** If load line from Drum 3 is routed over small boom top guide sheave to upper point, boom top guide sheave and upper boom point sheave must be grooved for 1-1/8 in (29 mm) wire rope. Past production sheaves were grooved for 1 in (26 mm) wire rope. **Sheaves cannot be machined. New sheaves must be installed.**

FIGURE 4-45



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#79-44 Boom



Location of Guide Sheaves with Lead Line Going to Lower Point Sheave Indicated

Lead Line to Sheave	Dimension A
S1	5/8 in (16 mm) NOTE 2
S2	2-1/16 in (52 mm) NOTE 3
S3	4-15/16 in (127 mm) NOTE 3
S4	10-11/16 in (272 mm) NOTES 3 & 4
	<b>Dimension B</b>
S6	10-7/16 in (265 mm) NOTE 3
S7	4-15/16 in (127 mm) NOTE 3
S8	2-1/16 in (52 mm) NOTE 3
S9	5/8 in (16 mm) NOTE 2

**NOTE 1:** Hand position clamps tight against bearing. Before torquing bolts, check that sheave turns freely. Torque bolts lubricated with S.A.E. 20 oil to 120 ft-lb (163 Nm).

**NOTE 2:** This location requires sheave bearing to bear up against boom top plate as shown at Dimension B.

**NOTE 3:** This location requires four clamps as shown at Dimension A.

**NOTE 4:** Also position guide sheave at this location

FIGURE 4-46

### #79-44 Boom

**CAUTION!**

**Wire Rope Damage!**

Prevent wire rope from disengaging sheaves. Install all guide sheave rope guards and rollers after wire rope is reeved.

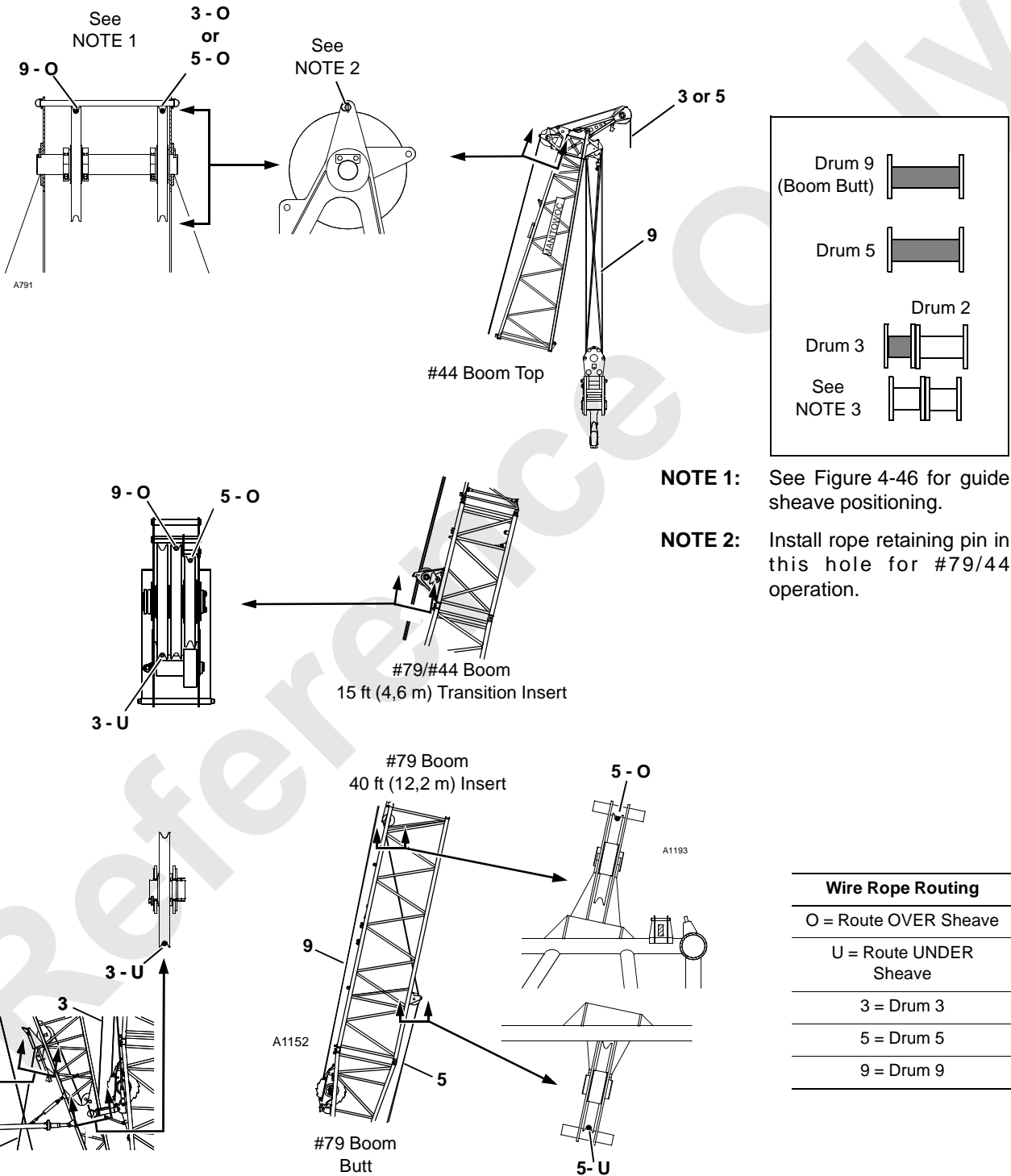
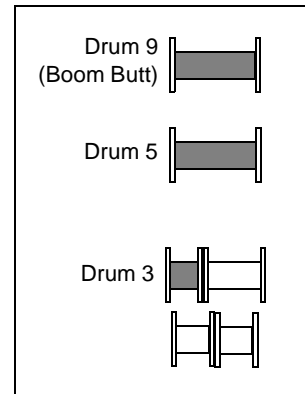
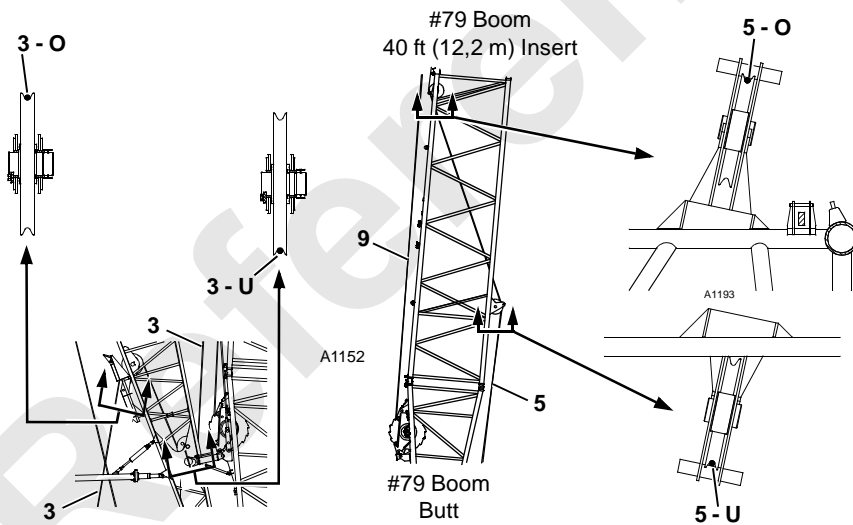
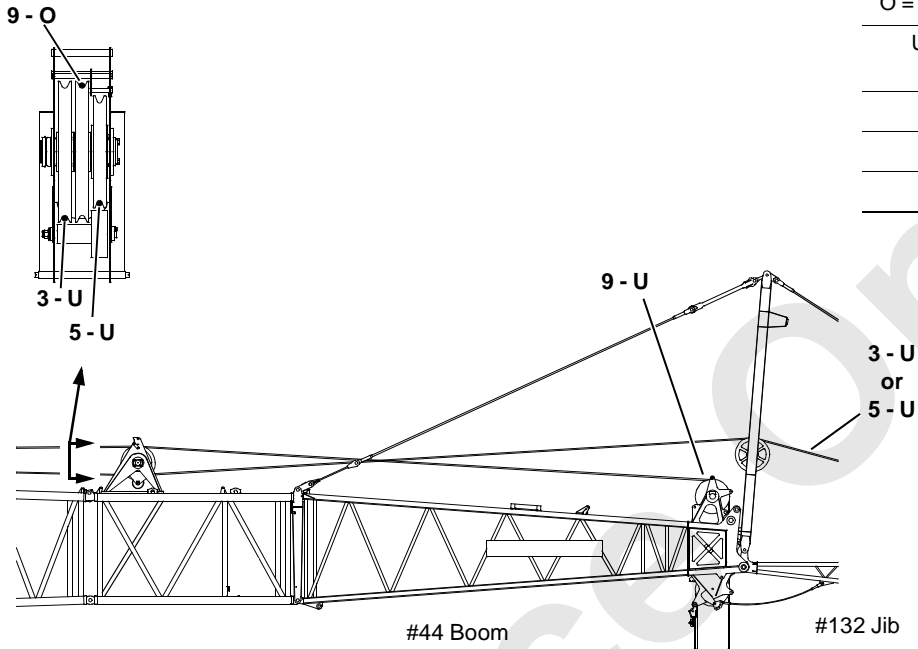


FIGURE 4-47

#132 Jib on #79-44 Boom

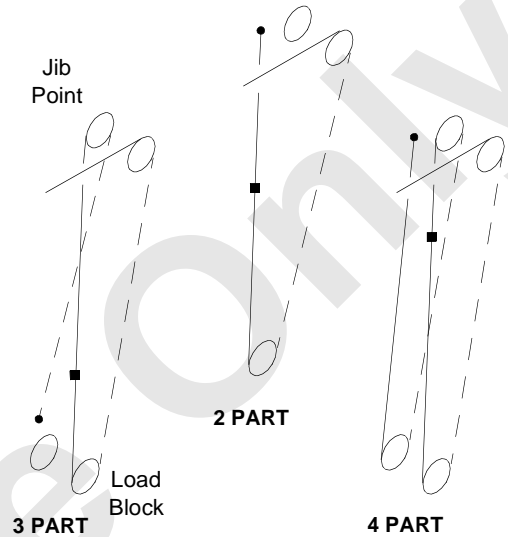
Wire Rope Routing	
O	= Route OVER Sheave
U	= Route UNDER Sheave
3	= Drum 3
5	= Drum 5
9	= Drum 9



4

FIGURE 4-48

#132 Jib on #79-44 Boom

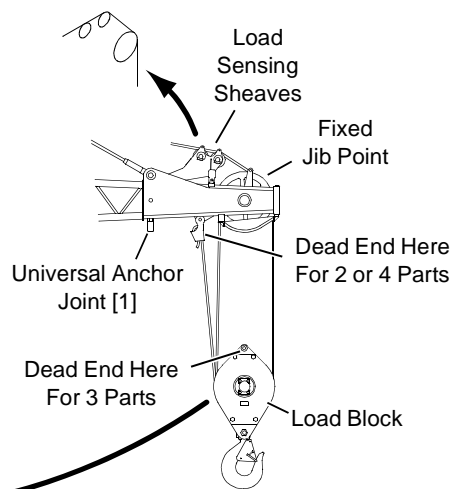


**WARNING**

**Avoid Death or Serious Injury!**

If you are using a load block that can be stood up vertically for reeving, exercise care, as the potential for tipping exists. Potential causes of tipping are unstable work area, boom or jib movement, and the reeving process.

If work area is unstable, lay load block flat on side plate.



[1] Must be removed when 2 or 4 part line is dead ended at upper dead end lug or when 3 part line is used.

Reeving Diagram for 60 US (54 t) Block (#132 Fixed Jib)

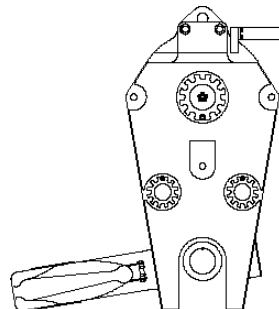


FIGURE 4-49

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### #79-44 Boom

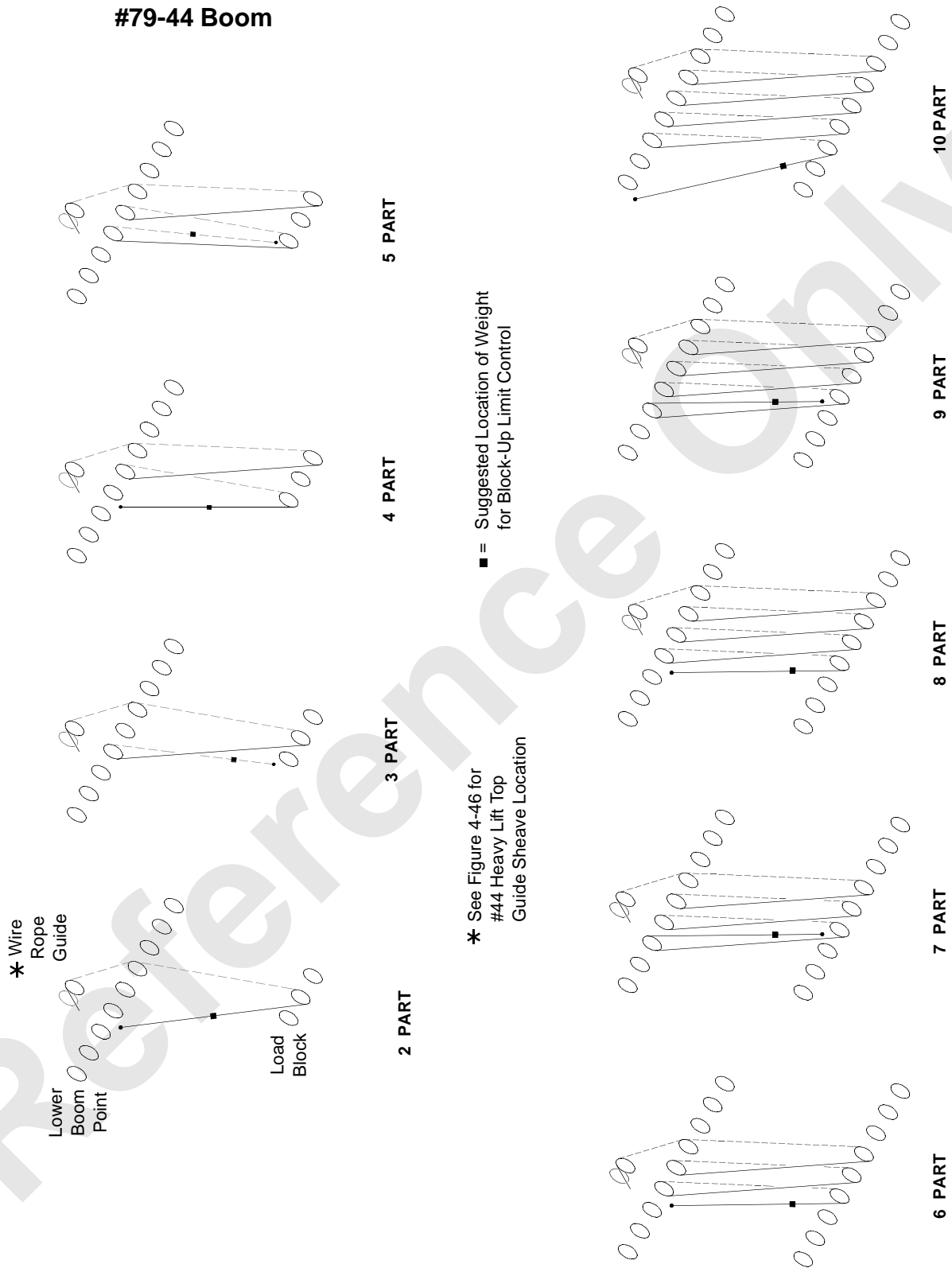


FIGURE 4-50

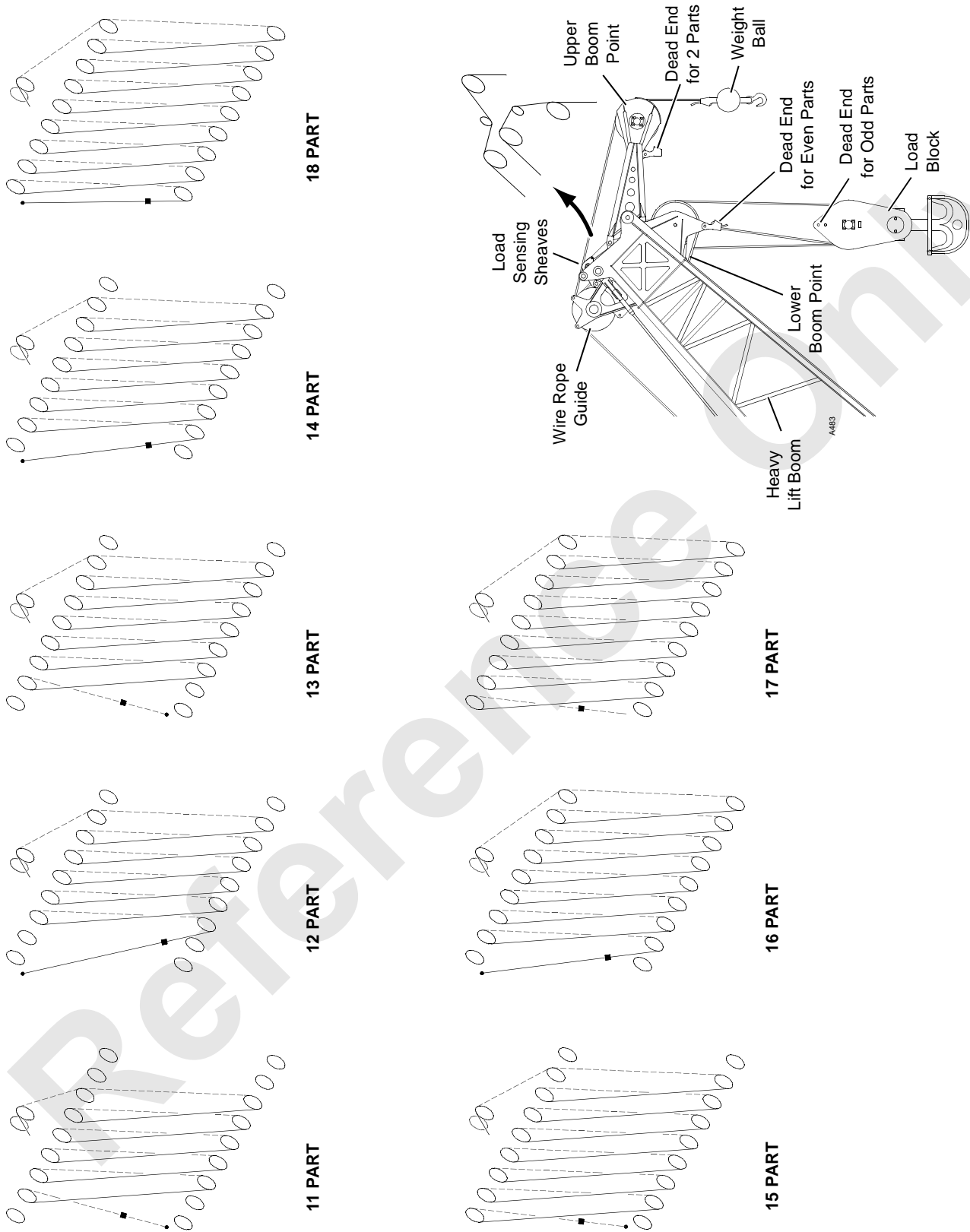


FIGURE 4-50 continued

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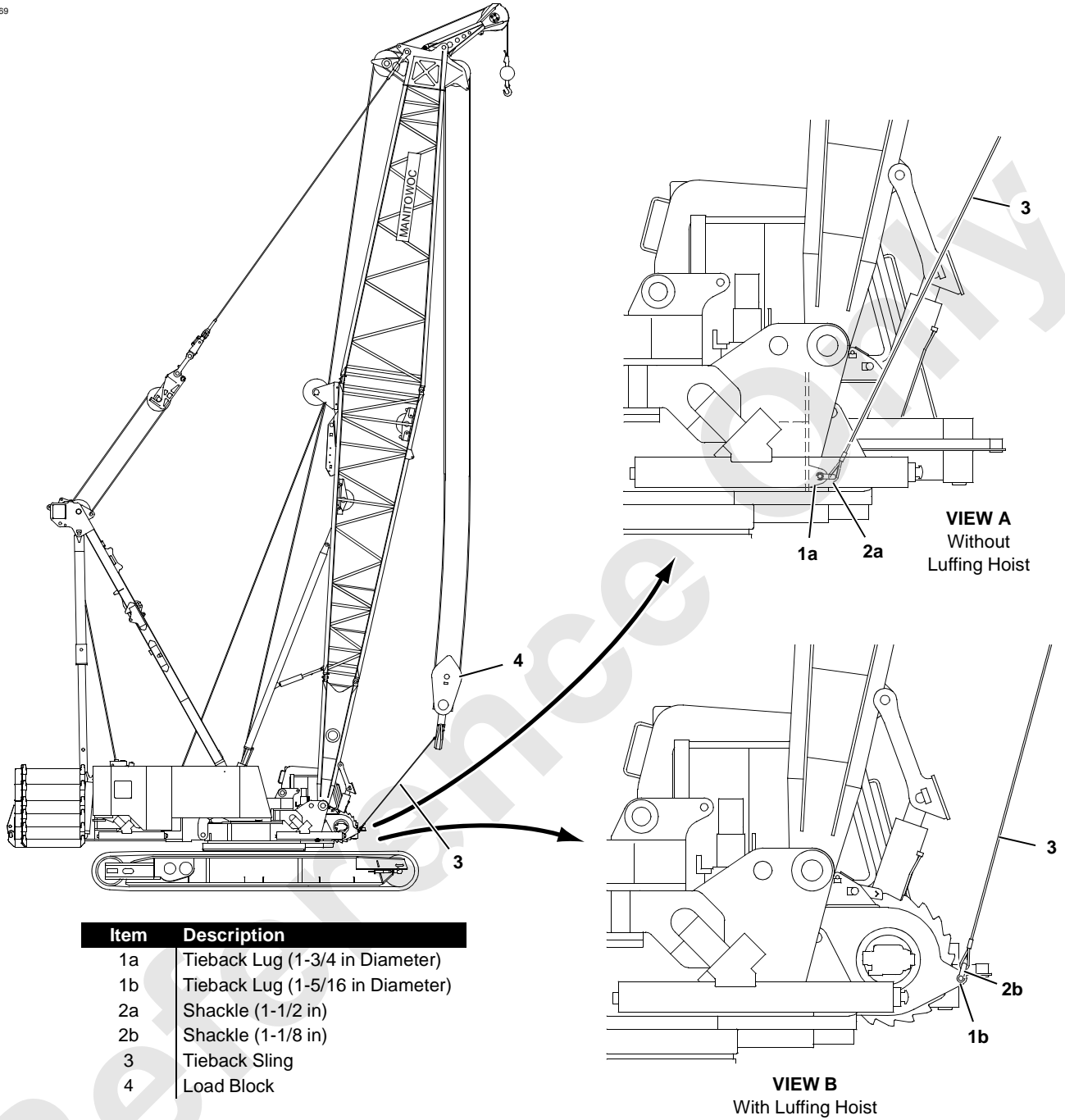


FIGURE 4-51

## LOAD BLOCK TIEBACK

### General

Manitowoc provides a lug on the front of the rotating bed (Figure 4-51, View A) and on the luffing hoist frame (View B) for tying back the load block when not in use.

### Specifications

#### *Sling*

#### Length

The sling should be long enough to connect it to a shackle in the tieback hole and to the hook of the freely suspended load block. This will prevent personnel from having to swing the block in, toward crane, to make the connection.

#### Capacity

The sling must be capable of supporting the weight of the load block and 1/2 the weight of the wire rope suspended from the boom point. When sizing the sling, take into account the dynamic affects of traveling and swinging the crane. ***It is the crane users responsibility to calculate this load.***

### Shackle

See Figure 4-51 for identification of tieback hole diameter and shackle size.

---

### CAUTION

Avoid damage to boom:

- Haul in load line only until tieback sling is taut. Purpose of tieback is only to prevent load block from swinging when not in use.
  - Do not tighten load line to point that load line can rub against lacings in boom sections or load block can bounce into lacings.
  - Operator, be aware that as you boom down load lines and tieback sling will tighten even more. Pay out load line while booming down so that you don't pull load block into boom. Damage to lacings or chords could result.
  - Make sure that tieback sling, load block, and load lines do not interfere with operation of luffing hoist wire rope.
-



**SECTION 5  
LUBRICATION**

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## SECTION 5 LUBRICATION

### LUBRICATION

See F2105 at the end of this section.

Reference Only

Reference Only

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# SECTION 6

## MAINTENANCE CHECKLIST

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## SECTION 6 MAINTENANCE

### GENERAL MAINTENANCE

This section contains maintenance and adjustment instructions for devices used with the MAX-ER 2000 attachment.

For maintenance and inspection of the following components, see the Service Manual supplied with your crane:

- Straps
- Wire Rope
- Load Block and Weight Ball
- Boom and Jib

### BOOM ANGLE INDICATOR ADJUSTMENT

#### General

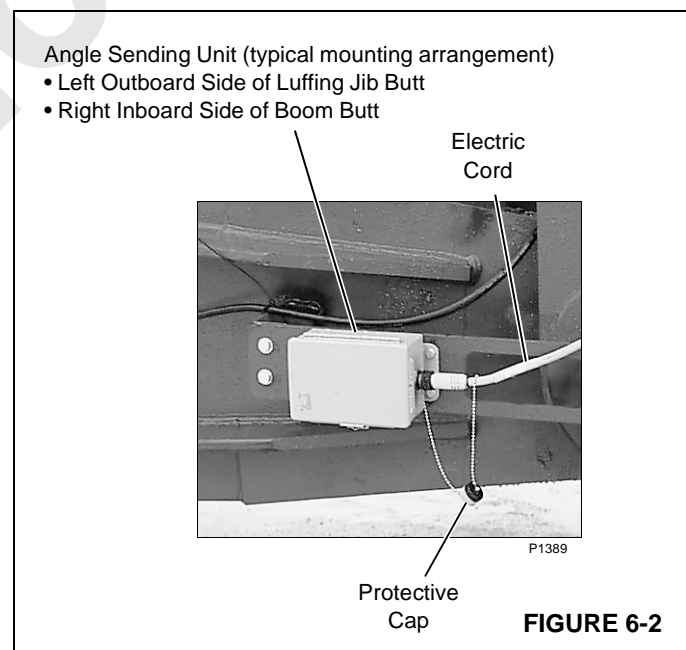
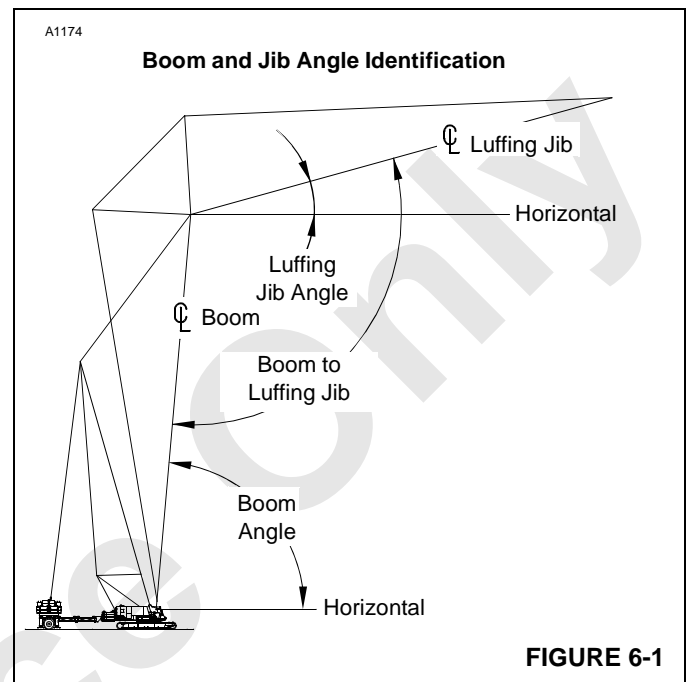
An angle sending unit is mounted on the boom butt and, if equipped, on the luffing jib butt (see Figure 6-2).

Each sending unit houses either a pendulum-type potentiometer or a sensor which sends an electric signal to the crane's programmable controller. The programmable controller converts the electric signal into an angle which can be monitored on the digital display in the operator's cab.

Three angles (see Figure 6-1) can be monitored:

1. Boom angle.
2. Luffing jib angle.
3. Boom to luffing jib angle.

The sending unit for the boom and for the luffing jib are identical in appearance. **The two units are different, however, and must not be interchanged.**



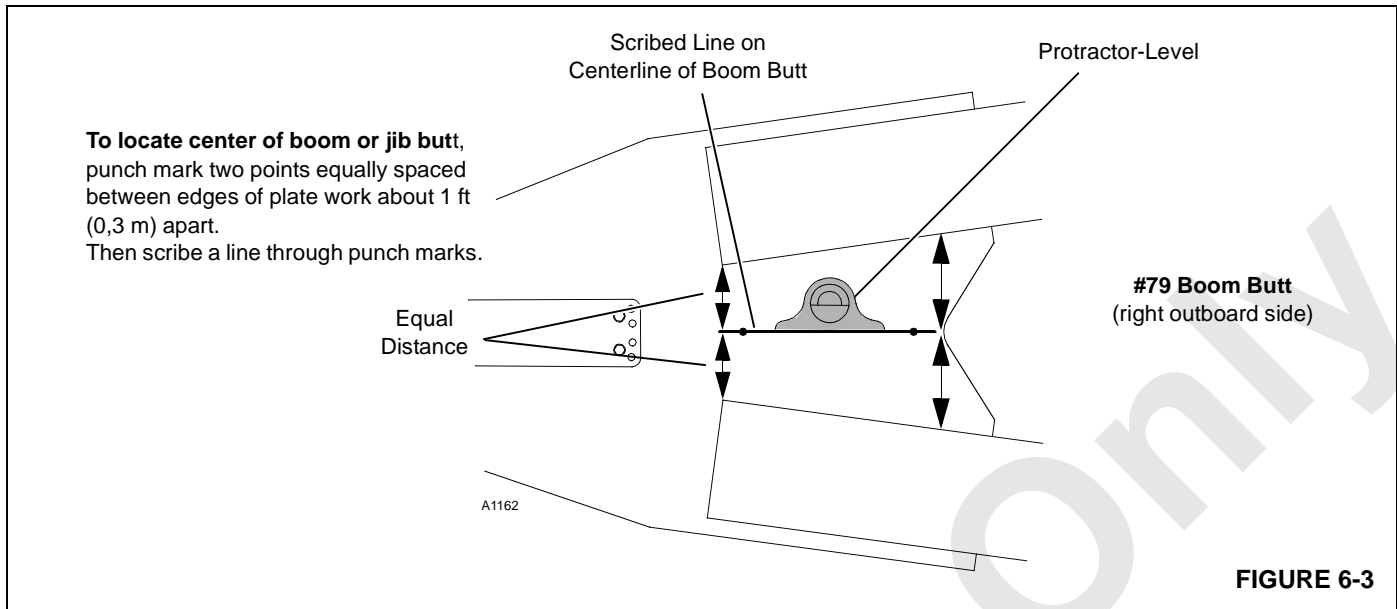


FIGURE 6-3

### Adjusting Angle Indicator

Perform following adjustment steps at initial installation, after installing a new sending unit or potentiometer, and at least monthly when boom is lowered to ground.

1. Lower boom onto blocking at ground level.
2. Scribe a line through punch marks on center line of boom butt as shown in Figure 6-3.
3. If center line of boom butt is not punch marked, locate center line as instructed in Figure 6-3.
4. Hold a protractor-level along scribed line.
5. Record angle indicated on protractor-level.
6. Scroll to corresponding boom angle on digital display in operator's cab.
7. Angle shown on digital display must match angle recorded in step 4 plus or minus one degree.
8. If necessary, loosen mounting screws and rotate sending unit in mounting slots until reading on digital display matches angle on protractor-level.
9. Securely tighten mounting screws to lock adjustment.

### Replacing Sending Unit Assembly

Replacement sending units can be either the pendulum-type potentiometer (past production) or the solid state sensor (current production).

### Pendulum-Type Potentiometer

When replacing parts in the pendulum-type potentiometer sending unit, take the following precautions (see Figure 6-4, View A):

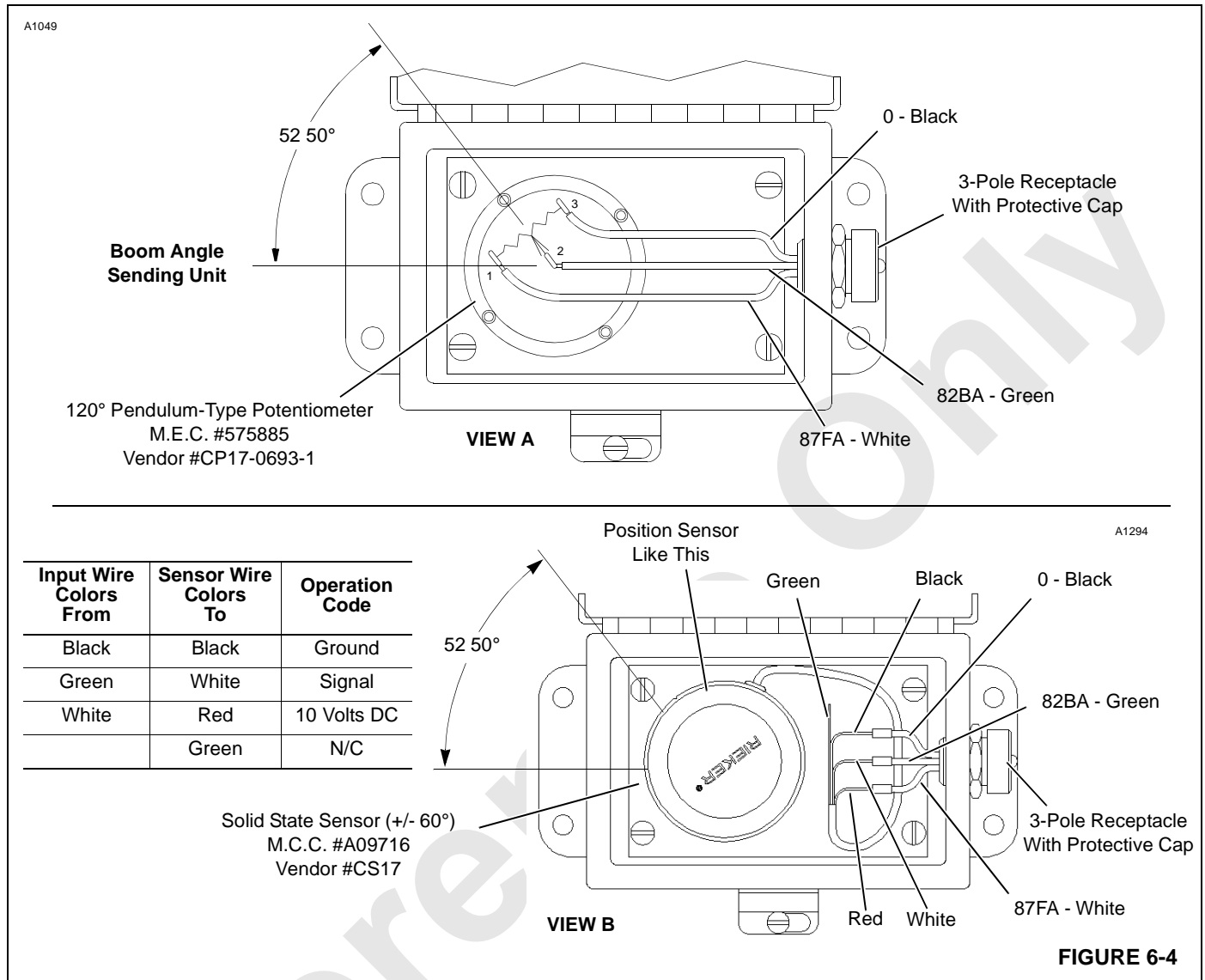
1. Mount potentiometer at angle shown.
2. Connect black, green, and white wires from receptacle to proper terminals on terminal strip.
3. Connect wires from potentiometer to proper terminals on terminal strip.
4. Make sure all parts are securely fastened to their mounting position.

### Solid State Sensor

When replacing an existing pendulum-type potentiometer with a current production solid state sensor, take the following precautions (see Figure 6-4, View B):

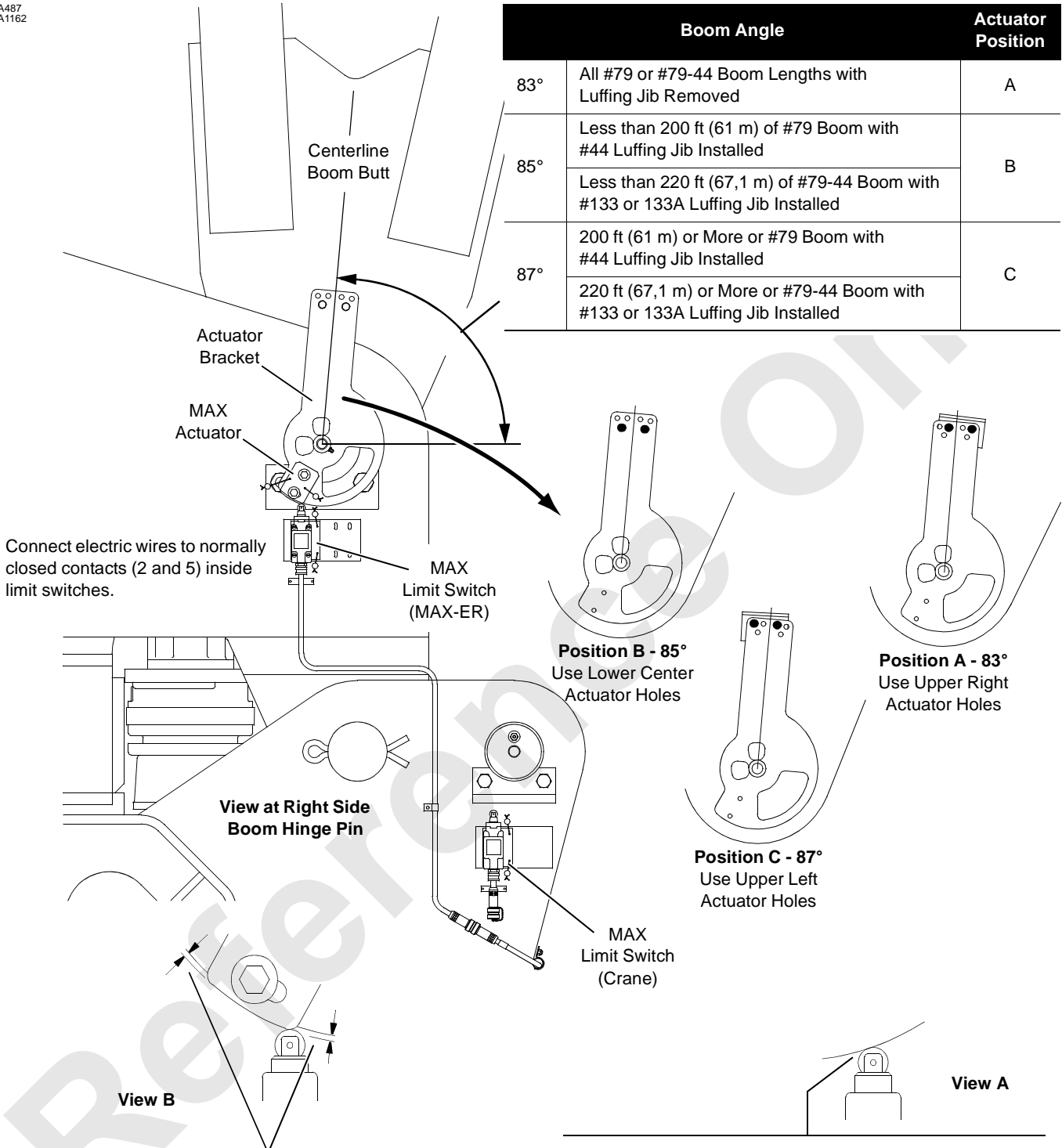
1. Identify all input wires to existing potentiometer.
2. Cut existing input wires near terminal strip (if used) to allow for splicing.
3. Remove existing potentiometer and terminal strip (if used).
4. Mount new sensor in existing holes as shown in View B.
5. See wiring chart in View B and parallel splice sensor wires to existing input wires with crimp, solder, and heat shrink tubing.
6. Seal green wire on sensor with heat shrink tubing and coil up.





Referer

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**CAUTION**

Check this distance after adjusting limit switch. Distance from both ends of MAX actuator to outside edge of actuator bracket must be equal. Limit switch could be damaged from over-travel if either end of actuator is cocked.

**CAUTION**

Before adjusting limit switch, move limit switch up or down in slots so edge of roller is even with edge of actuator bracket. Limit switch will not trip open if positioned too low in slots. Limit switch could be damaged from over-travel if positioned too high in slots.

FIGURE 6-5

## AUTOMATIC BOOM STOP ADJUSTMENT

Unless otherwise specified, see Figure 6-5 for following instructions.

### General

This crane is equipped with a maximum (MAX) boom angle limit switch which automatically stops the boom hoist and applies its brake when the boom is raised to a preset angle.

The limit switch must be set at one of the following angles, depending on boom and luffing jib use:

- 83° for all #79 or #79-44 Boom Lengths with Luffing Jib Removed.
- 85° for Less than 200 ft (61 m) of #79 Boom with #44 Luffing Jib Installed.
- 85° for Less than 220 ft (67,1 m) of #79-44 Boom with #133 or 133A Luffing Jib Installed.
- 87° for 200 ft (61 m) or More of #79 Boom with #44 Luffing Jib Installed.
- 87° for 220 ft (67,1 m) or More of #79-44 Boom with #133 or 133A Luffing Jib Installed.



### WARNING

#### Falling Attachment Hazard!

Do not operate crane unless automatic boom stop is properly adjusted and operational. Do not adjust MAX operating angle higher than specified.

Boom can be pulled over backwards or collapse causing death or serious injury.

Adjust boom angle indicator before adjusting automatic boom stop (see procedure in this section).

### Maintenance

**At least once weekly**, check that the automatic boom stop stops the boom at the specified MAX angle; if not, replace defective parts and/or adjust the boom stop.

Monthly, grease the fitting on the actuator bracket.

### Adjustment

The automatic boom stop was adjusted and sealed at the factory. Readjustment is required only when parts are replaced and when **installing or removing luffing jib**. The seals must be removed to allow readjustment.

1. Make sure actuator bracket is securely fastened in proper position on boom butt (Position A, B, or C).
2. Check position of MAX limit switch with relation to actuator bracket (View A).

3. Loosen capscrews retaining MAX actuator to actuator bracket.
4. Rotate MAX actuator **CLOCKWISE** in its slots so it does not contact limit switch roller when step 5 is performed.
5. Raise boom:
  - a. Slowly raise boom to specified angle – 85° or 87° – while monitoring angle on digital display.
  - b. Check boom angle using an accurate protractor-level placed on centerline of boom butt (Figure 6-3, View B).
  - c. Boom up or down as required to position boom at specified angle as indicated by protractor-level.
 

**Angle on protractor-level should match angle on digital display to within 1°.**
6. Rotate MAX actuator against limit switch roller until limit switch just “clicks” open and hold.
7. Check position of MAX actuator with relation to actuator bracket (View B).
8. Securely tighten capscrews for MAX actuator.
9. Lower boom several degrees.
10. Slowly raise boom.
11. **Boom must stop at specified angle**; if not, repeat adjustment steps.
12. Once adjustments are complete, drill and seal limit switch spacer to mounting bracket and MAX actuator to actuator bracket with dowel pins and lead wire seals as shown in Figure 6-6.

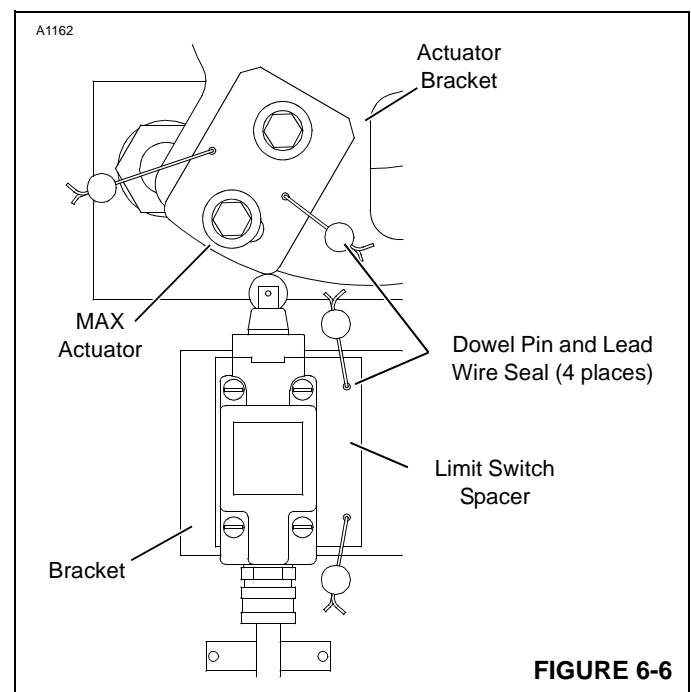
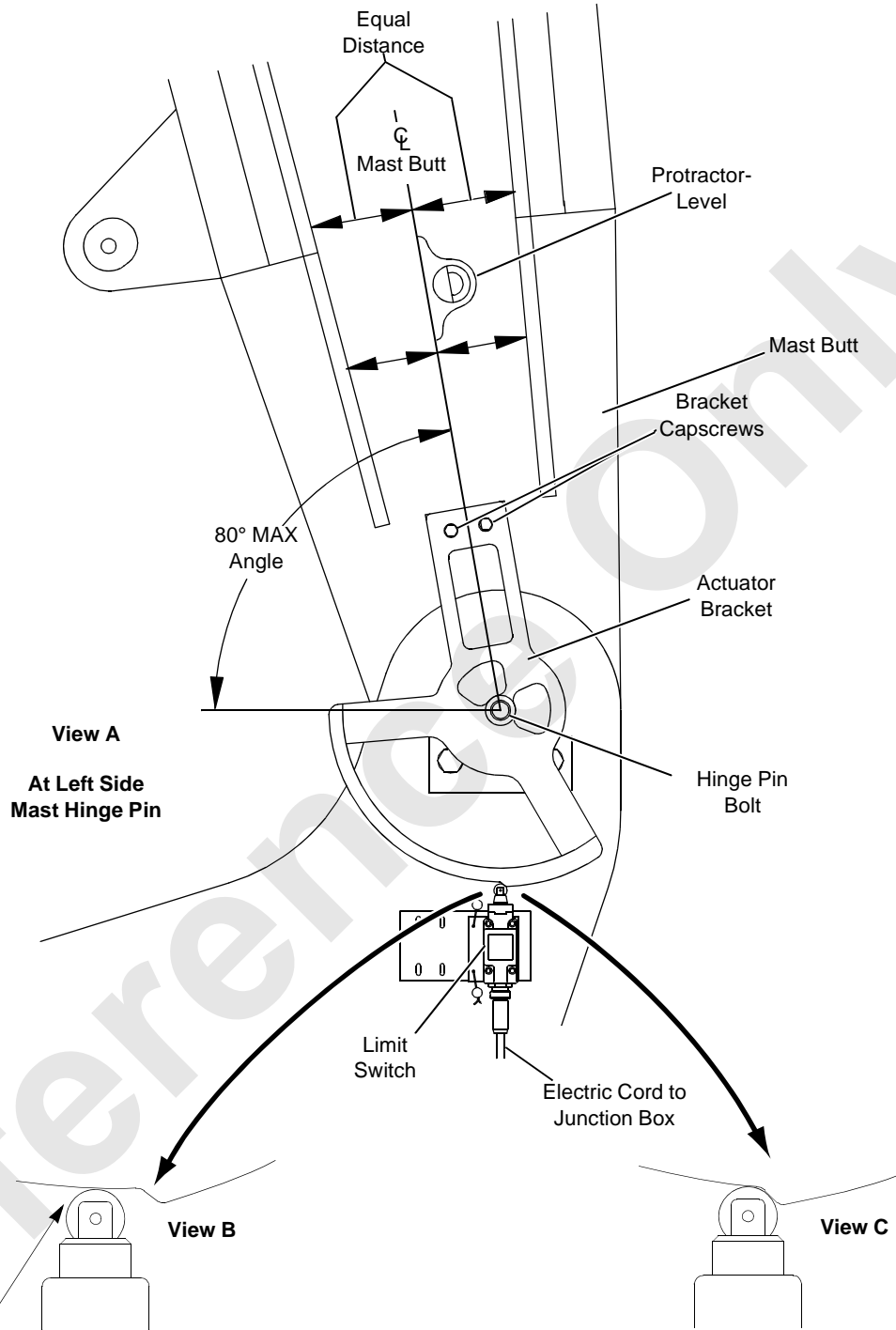


FIGURE 6-6

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**CAUTION**

Before adjusting limit switch, move limit switch up or down in slots so edge of roller is even with edge of actuator bracket. Roller must be fully extended. Limit switch will not trip open if positioned too low in slots. Limit switch could be damaged from over-travel if positioned too high in slots.

Rise in actuator bracket depresses limit switch roller as mast angle reaches 80°. Depressed roller opens normally closed limit switch to stop mast hoist and apply drum brake.

**FIGURE 6-7**

## AUTOMATIC MAST STOP ADJUSTMENT

See Figure 6-7 for following instructions.

### General

The mast can be used as a boom during MAX-ER assembly and disassembly. For this purpose, the MAX-ER attachment is equipped with a limit switch (Figure 6-7) which automatically stops the mast hoist and applies its brake when the mast is raised to 80° maximum angle during operation in the STANDARD mode. The limit switch also turns on the operating limit alert in the operator's cab when the maximum angle is reached.



### WARNING

#### Falling Attachment Hazard!

Do not operate crane unless automatic mast stop is properly adjusted and operational.

Operation of mast above 80° angle is neither intended nor approved when mast is used as boom. See MAX-ER Assembly in Section 4 for details.

Mast can be pulled over backwards or collapse if operated above 80° angle.

### Maintenance

Prior to each use, check that the automatic mast stop stops the mast at the 80° maximum angle; if not, replace any defective parts and/or adjust the mast stop.

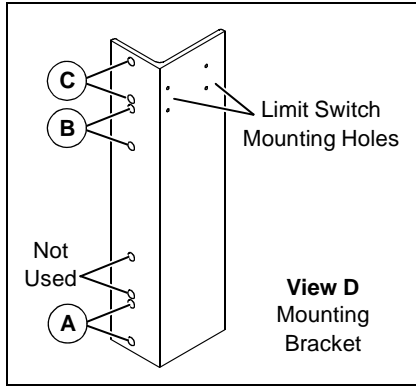
### Electric Cord Connection

Plug the electric cord from the limit switch into the appropriate socket in the electrical junction box on the left side of the crane.

### Adjustment

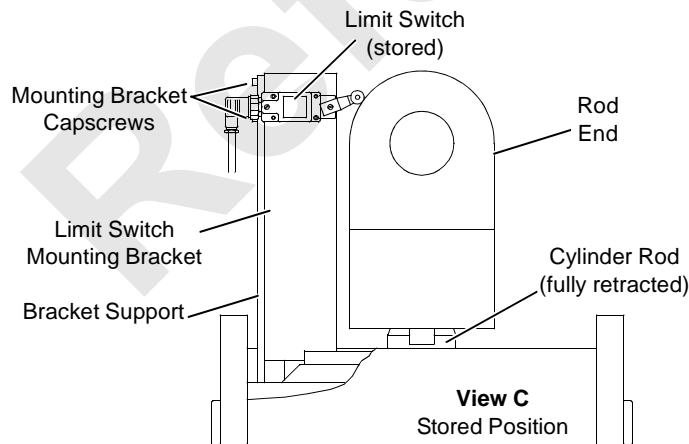
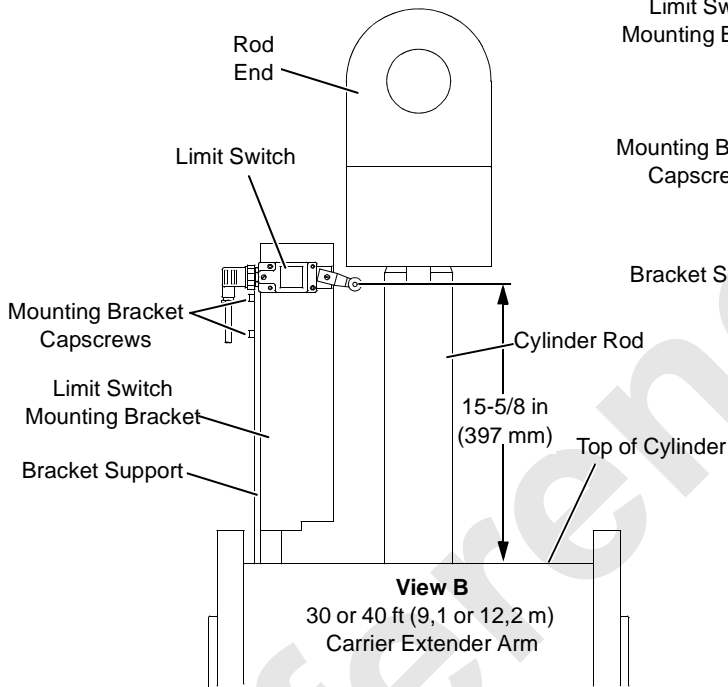
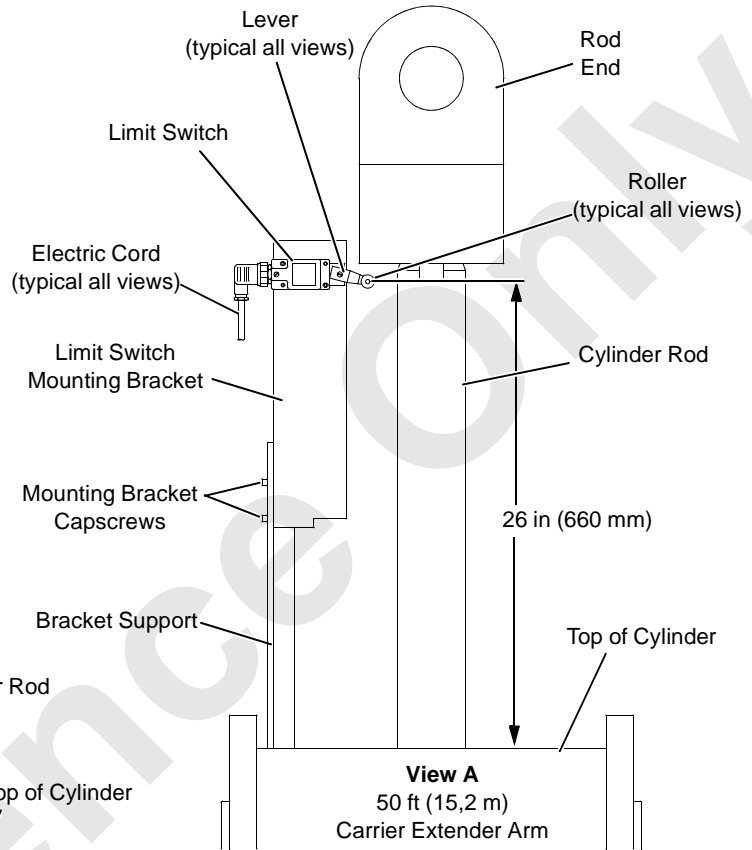
The automatic mast stop must be installed, adjusted and sealed at initial installation. Readjustment is required only when parts are replaced and when changing attachments. The seals must be removed to allow readjustment.

1. Mount actuator bracket to mast hinge pin (View A).
2. Adjust position of limit switch in relation to actuator bracket (View B):
  - a. Move limit switch up or down in slots so edge of roller is even with edge of actuator bracket and roller is fully extended.
  - b. Rotate actuator bracket to assure that overtravel will not damage limit switch.
  - c. Tighten bolts holding limit switch in slots.
3. Using capscrews, mount actuator bracket to mast butt (View A). Make sure capscrews are securely tightened.
4. Select standard mode and confirm.
5. Raise mast.
6. Stop raising mast when rise in actuator bracket just depresses limit switch roller and hold. Limit switch should just "click" open (View C).
7. Verify that mast angle is 80° (View A):
  - a. Measure distance at two points approximately 2 ft (600 mm) apart. Centerline is half the distance measured.
  - b. Place protractor-level on centerline.
  - c. Check that reading is 80°.
8. Lower mast several degrees.
9. Slowly raise mast.
10. **Mast must stop at 80° angle**; if not, contact Crane Care Customer Service at factory.



**Left Strap Cylinder**  
Viewed from Right Side of Trailer

↑ LOWER Counterweight  
(Cylinder Extends)  
↓ RAISE Counterweight  
(Cylinder Retracts)



Operating Radius	View	Mounting Bracket Holes (View D)
50 ft (15,2 m)	A	A
30 or 40 ft (9,1 or 12,2 m)	B	B
Limit Switch Stored	C	C

FIGURE 6-8

## MAX-ER LOAD SENSING PIN CALIBRATION

See Figure 6-9 for following procedure.

When replacing the load sensing pin, check its calibration prior to installation, as follows:

1. Start engine, select and confirm MAX-ER mode and watch CTWT BHITCH on digital display.
2. Connect electric cord to receptacle on end of pin.
3. Backhitch load on digital display should be  $0 \pm 5$  tons (U.S.). LOAD PIN system fault will go away if new pin is okay.
4. Install pin.

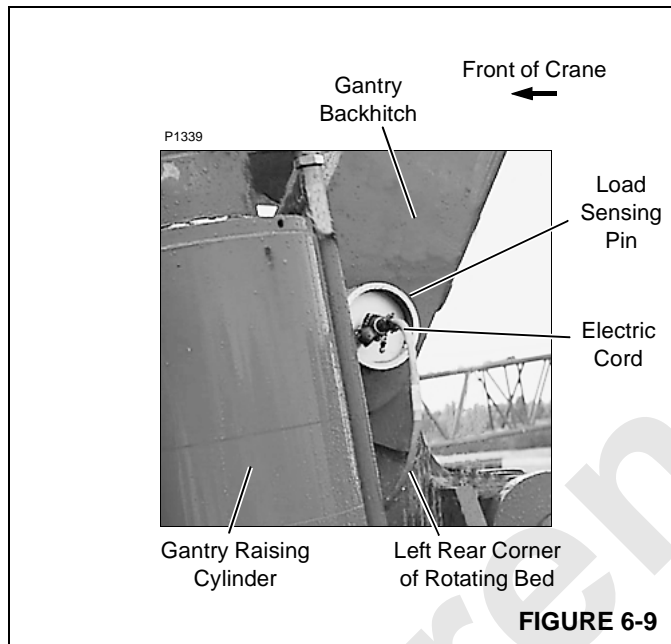


FIGURE 6-9

## MAX-ER COUNTERWEIGHT CYLINDER LIMIT SWITCH ADJUSTMENT

See Figure 6-8 for following procedure.

The left counterweight strap cylinder has a limit switch which serves two purposes:

- Limits how high the wheeled counterweight assembly lifts off its foundation.
- Turns off oil flow to both strap cylinders.

### CAUTION

#### Hydraulic Cylinder Damage!

Cylinders will remain pressurized (stalled out) after counterweight assembly lifts off foundation if limit switch is not adjusted properly. This action can result in overheating which will damage cylinders and other parts.

The following procedure assumes:

- Counterweight assembly is resting on foundation.
- Boom is resting on blocking at ground level.
- Counterweight straps are not connected to cylinders.

### CAUTION

#### Limit Switch Damage!

Extending cylinder rod with limit switch in stored position will damage switch. Remove switch and mounting bracket from stored position before extending cylinder rod.

1. Remove capscrews holding limit switch mounting bracket in stored position (View C).
2. Extend cylinder rod past dimension shown in View A or B.
3. Mount limit switch mounting bracket to bracket support for desired operating radius (View A or B).

Be sure to use correct mounting bracket holes (see table and View D). Limit switch roller must be below cylinder rod end.

4. Verify that center of limit switch roller is at specified dimension. Adjust if necessary (see step 5).
5. If installing or adjusting limit switch:
  - a. Loosen setscrew in limit switch lever.
  - b. Position lever so center of roller is at specified dimension (View A or View B).
  - c. Securely tighten setscrew to lock adjustment.
6. Connect electric cord to limit switch.

## BLOCK-UP LIMIT CONTROL

### General

The block-up limit control (also called anti two-block device) is a **two-blocking prevention device** which automatically stops the load drum from hoisting and the boom from lowering when a load is hoisted a predetermined distance.

**DEFINITION:** Two-blocking is the unsafe condition in which the load block or the weight ball contacts the sheave assembly from which either is suspended.

**Two-blocking can result in failure of sheaves and wire rope, possibly causing load to fall.**



### WARNING

#### Two-Blocking Hazard!

Block-up limit control is a protective device designed only to assist operator in preventing a two-blocking condition; any other use is neither intended nor approved.

Block-up limit control may not prevent two-blocking when load is hoisted at maximum single line speed. Operator must determine fastest line speed that will allow block-up limit control to function properly and, thereafter, not exceed that line speed.

The block-up limit control consists of the following components (see Figure 6-10):

1. Normally closed limit switch assembly fastened at any or all of the following locations (multiple limit switches are wired in series):
  - a. Lower boom point.
  - b. Upper boom point.
  - c. Fixed jib point.
2. Weight freely suspended by chain from each limit switch actuating lever (weight encircles load line).
3. Lift block clamped to single-part load line or lift plates fastened to multiple-part load block.

### Operation

See Figure 6-10 and Figure 6-13 for following procedures. See Section 3 of your Crane Service Manual for an electric schematic of the block-up limit control system.

### Block-Up Limit Control Deactivated

During normal operation, the weight overcomes the spring force and rotates the actuating lever away from the limit switch lever. This action allows the limit switch to close the load drum UP and boom DOWN electric circuits. Therefore, the load can be hoisted and the boom can be lowered.

### Block-Up Limit Control Activated

When the weight is lifted by the lift block or the lift plates, spring force rotates the actuating lever against the limit switch lever. This action causes the corresponding limit switch to open the load drum UP and boom DOWN electric circuits.

The load drum and boom hoist pumps stroke to off. At the same time, the load drum and boom parking brakes apply to stop the load drum from hoisting and the boom from lowering.

The BLOCK UP fault alarm (in operator's cab) will come on to alert the operator.

### Installation

The system must be installed according to the Block-Up Limit Control Assembly Drawing at the end of Section 4 in this manual. **Make sure weights are suspended from proper lengths of chain or system will not operate properly.**

Securely fasten the electric cords to the boom and jib with the nylon straps and cord clips provided.

Connect the electric wires to the normal-closed contacts inside each limit switch.

See Figure 6-12 for installation of the weights.

### Storing Electric Cord

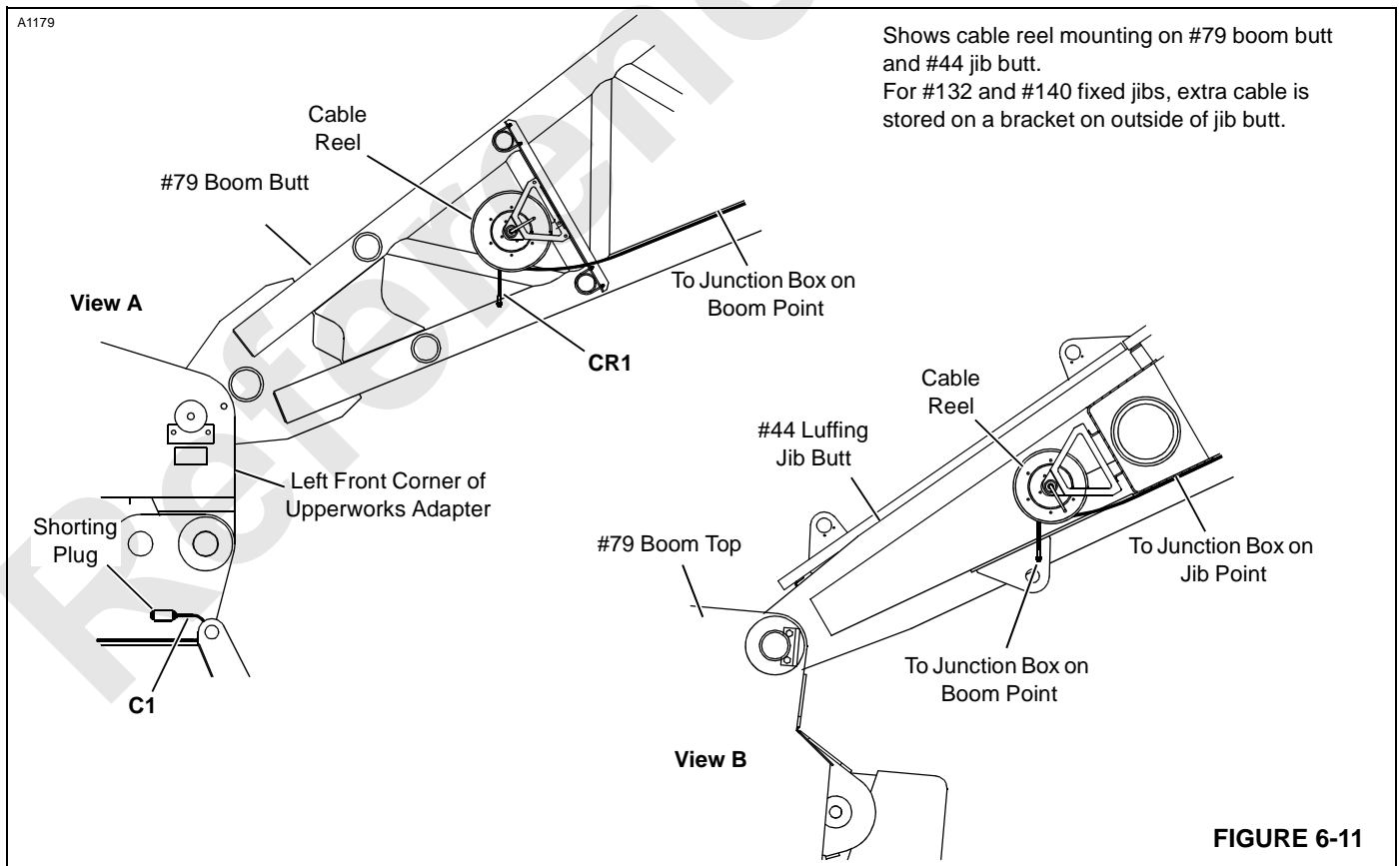
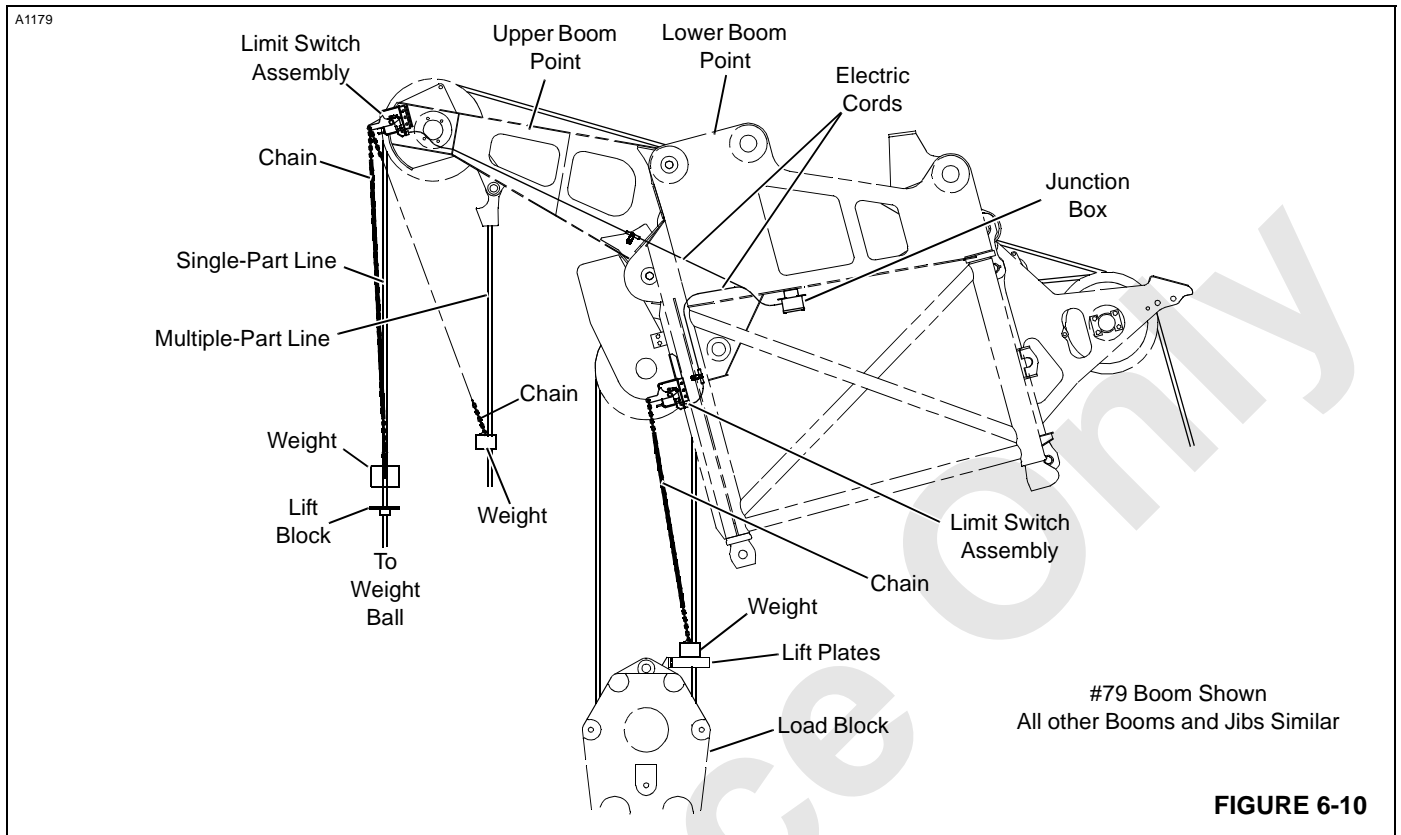
The electric cords for the boom and fixed jib are long enough to accommodate the maximum length of each attachment.

Store the excess cord for the boom on the reel mounted on the boom butt (Figure 6-11).

The reel is equipped with a locking pin. Disengage the locking pin to allow the reel to be wound. Engage the locking pin to lock the reel in position. The power supply cord to the reel must be disconnected before the reel can be wound.

Store the excess electric cord for the fixed jib by winding the cable around the brackets on the jib butt.





### Disconnecting Block-Up Limit Control

A shorting plug (Figure 6-11) is provided on the left front corner of the upperworks adapter so the block-up limit system can be disconnected for the following reasons:

- Crane setup and rigging.
- Maintenance.
- Operations not requiring use of a block-up limit control (clamshell and dragline).

To disconnect the block-up limit system, proceed as follows (see Figure 6-11):

1. Disconnect electric cord (C1) from cable reel (CRI).
2. Remove the closure cap from shorting plug.
3. Connect electric cord (C1) to shorting plug.
4. Reverse steps to reconnect block-up limit control.

### Removing Jib or Boom Point

The junction boxes on the boom and jib points are equipped with shorting plugs.

If the fixed jib or upper boom point is equipped with a block-up limit switch, the electric cord from the limit switch must be connected to the proper shorting plug when the corresponding attachment is removed.

Failing to perform this step will prevent the load drum from hoisting and the boom from lowering. Also the operating limit alert will come on.

See Block-Up Limit Control Assembly Drawing in Section 4 of this manual for identification and location of the shorting plugs.

**Be sure to reconnect electric cord to proper block-up limit switch when corresponding attachment is reinstalled.**

### Maintenance

Inspect and test the block-up limit control **weekly or every 40 hours of operation**, as follows:

**Do not operate crane until cause for improper operation and all hazardous conditions have been found and corrected.**

1. Lower boom and jib (if equipped) onto blocking at ground level and carefully inspect following items:
  - a. Inspect each limit switch lever and actuating lever for freedom of movement. Apply one-half shot of grease to fitting on actuating lever; wipe away any excess grease.
  - b. Inspect each weight for freedom of movement on load line.
  - c. Inspect each weight, each chain, each shackle and each connecting pin for excessive or abnormal wear. Make sure cotter pins for shackles are installed and spread.
  - d. Inspect entire length of electric cords for damage.
  - e. Check that electric cords are clear of all moving parts on boom and jib and that cords are securely fastened to boom and jib with nylon straps.
  - f. Check that all plugs are securely fastened.

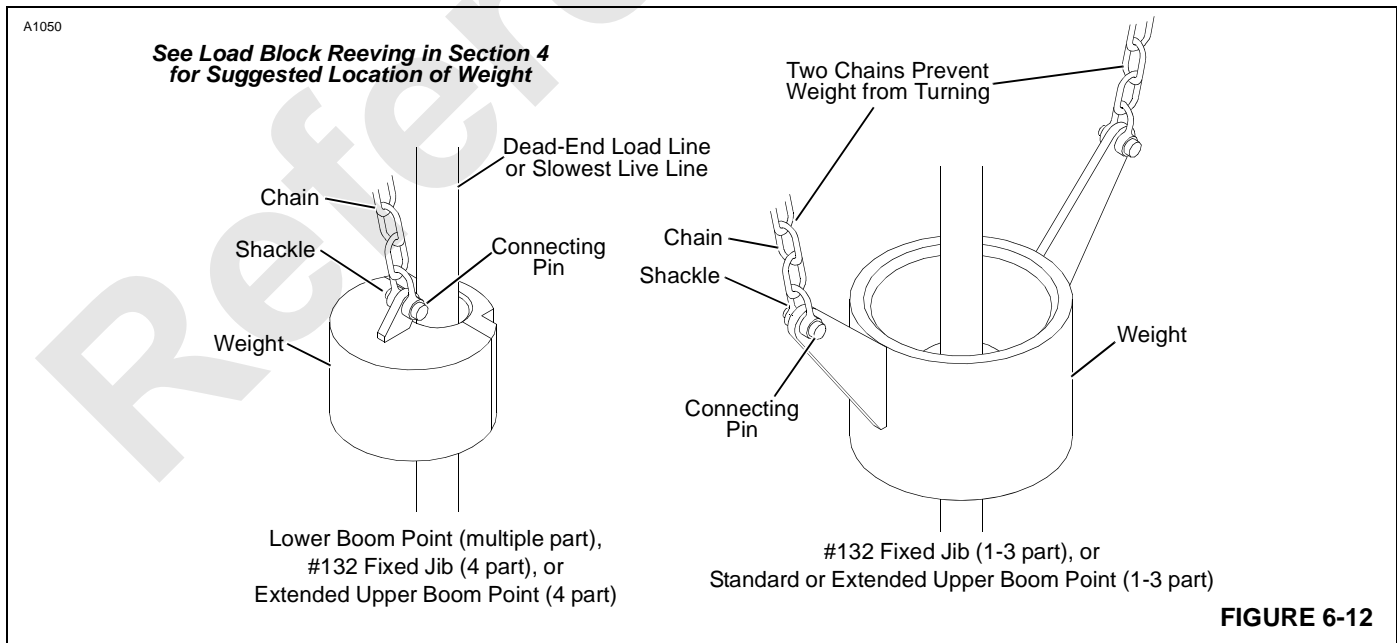


FIGURE 6-12

2. Test block-up limit control for proper operation using either of following methods:
  - a. **BOOM LOWERED:** Manually lift each weight — **one at a time** — while engine is running. Load drum should not operate in HOIST direction and boom hoist should not operate in LOWER direction.
  - b. **BOOM RAISED:** **Slowly** hoist each load block and weight ball — **one at a time** — against weight. When chain goes slack, corresponding load drum should stop HOISTING and boom hoist should not operate in LOWER direction.



### WARNING

Use extreme care when testing block-up limit control when boom is raised. If block-up limit control fails to stop load, immediately stop load by moving drum control handle to off or by applying drum working brake; otherwise, two-blocking may occur.

## Adjustment

See Figure 6-13 for following procedure.

Lower boom onto blocking at ground level and adjust each limit switch as follows:

1. Adjust spring tension so there is enough force to lift weight of chain and rotate actuating lever when weight is lifted. Note that limit switch at #79 lower boom point has two springs.
2. Loosen setscrew in limit switch lever so lever is free to rotate.
3. Manually lift weight so actuating lever rotates upward.
4. Hold lever at Dimension A.
5. Hold roller on limit switch lever against actuating lever while performing step 6.
6. Turn limit switch shaft **CLOCKWISE** **only enough to "click" limit switch open and hold**. Then securely tighten setscrew in limit switch lever.
7. Test limit switch for proper operation (see Maintenance); repeat adjustment steps until limit switch operates properly.

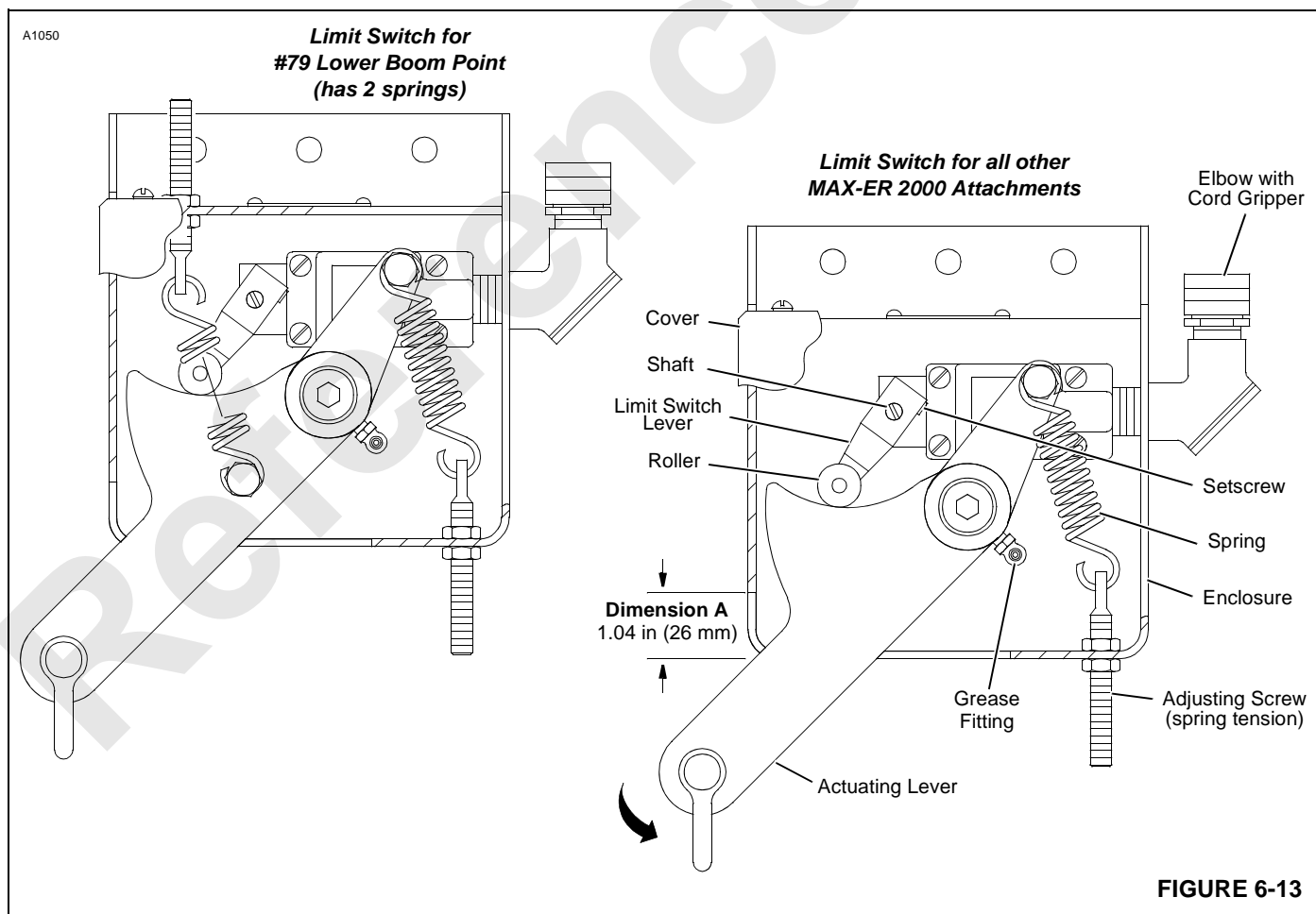


FIGURE 6-13

## STEERING POST BEARING BOLT TORQUE

See Figure 6-14 for following procedure.

### Torque Requirements



#### WARNING

Loose or improperly torqued bolts can cause bolts or turntable bearing to fail, possibly allowing upperworks to break away from carbody or carrier.

#### Lubrication

Before installing the turntable bearing bolts, lubricate the threads of each bolt with Never-Seez (MCC 361010) or an equivalent antiseizing lubricant.

#### Torque Values

Torque each turntable bearing bolt to 1,300 ft-lb (1 763 Nm).

When new bolts are installed, torque the bolts in two steps: first to 450 ft-lb (610 Nm) and then to 1,300 ft-lb (1 763 Nm).

#### Torque Sequence

Torque the bolts in the numbered sequence shown. Torque the bolts two at a time unless the sequence indicates one

bolt should be torqued. It does not matter which pair of bolts is torqued first, but bolt torquing must allow for access to grease points.

#### Torque Intervals

INITIAL OPERATION: torque all bolts to the specified value after the first 50 hours of operation.

YEARLY OR EVERY 2,000 HOURS OF OPERATION (whichever comes first): torque all bolts to the specified value.

#### Bolt Replacement

If at the yearly inspection interval one or more bolts are found to be torqued to less than 1,300 ft-lb (1 763 Nm), replace each loose bolt. Also replace the bolt on each side of each loose bolt.

If at the yearly inspection interval four or more bolts for the inner ring or five or more bolts in the outer ring are found to be torqued to less than 1,300 ft-lb (1 763 Nm). replace all of the bolts for the corresponding ring.

Replace all of the bolts every 7 years or 14,000 hours of operation (whichever comes first) and each time a new turntable bearing is installed.

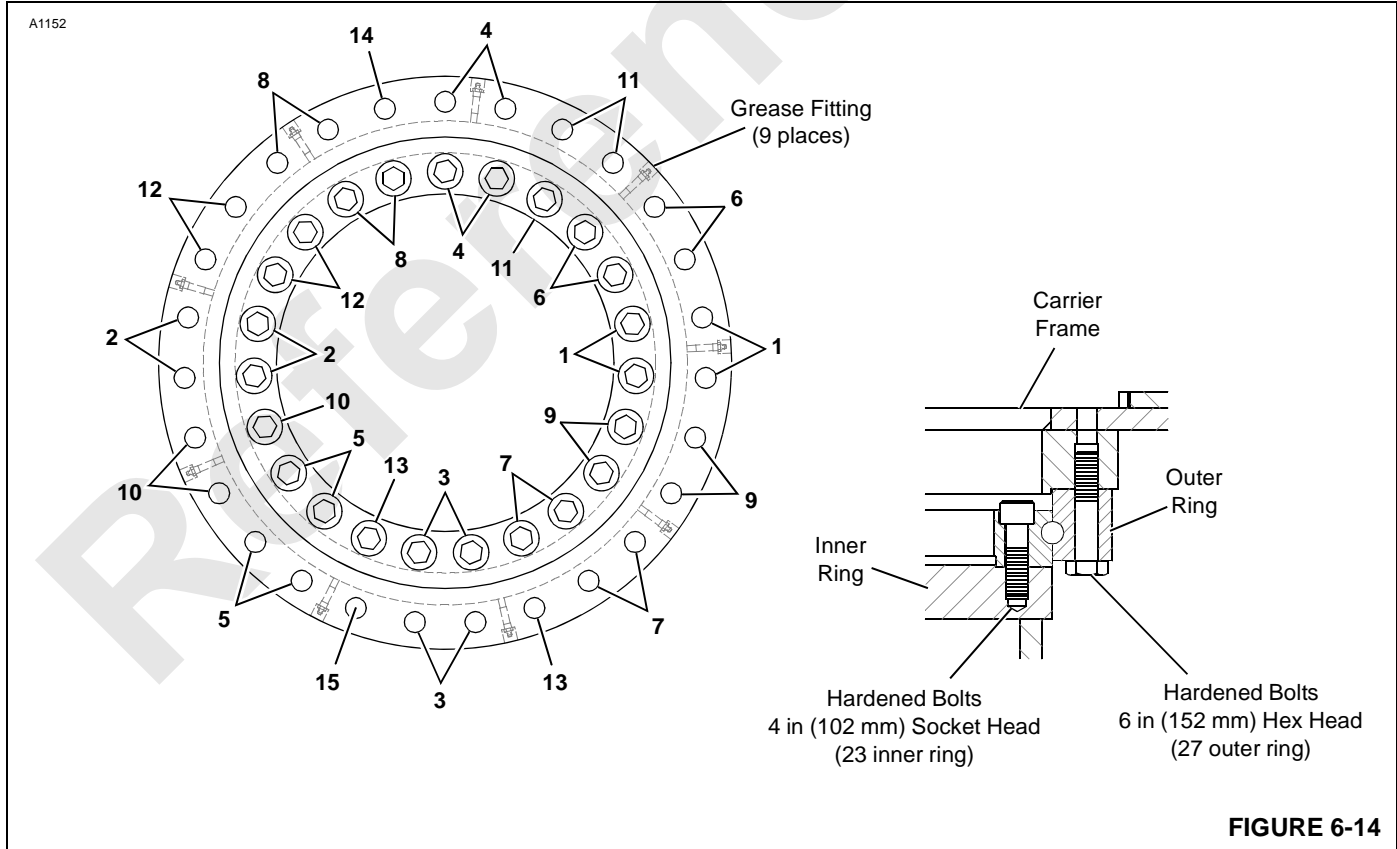


FIGURE 6-14

## BOOM HOIST RATCHET AND PAWL ADJUSTMENT

See Figure 6-15 for following procedure.

### General

This topic applies only to the ratchet and pawl provided on the right rear drum (Drum 2 used for boom hoist on MAX-ER 2000).

The pawl limit switch must be properly adjusted to ensure proper operation of the drum.

When DRUM 2 PARK switch is ON, Drum 2 park brake is applied, the control handle is disabled, and the pawl is engaged. When the pawl is engaged, the limit switch closes the electric circuit to the crane's programmable controller. This action prevents Drum 2 from being operated in either direction. Drum 3 is operable when Drum 2 is parked.

When DRUM 2 PARK switch is OFF, Drum 2 park brake is released, the control handle is enabled, and pawl is disengaged. When the pawl is disengaged, the limit switch opens the electric circuit to the crane's programmable controller. This action allows Drum 2 to be operated in either direction as long as Drum 3 is parked.

If the operator attempts to operate either drum (2 or 3) when the other drum is not parked, the operating limit alert will come on and FUNCTION NOT PARKED will appear on the digital display.



### WARNING

#### Moving Parts Hazard!

To make adjustments, engine must be running and drums and pawl must be operated.

Avoid injury from moving machinery. Stay clear of drums and pawl while either is being operated.

Maintain constant communication between operator and adjuster so drums and pawl are not operated while adjuster is in contact with parts.

The pawl limit switch is factory set and does not require periodic adjustment. The limit switch must be adjusted if parts are replaced and checked if the drum is not operating properly.

### Limit Switch Adjustment

1. Loosen screw so limit switch lever is free to rotate on shaft.
2. Disengage Drum 2 pawl by toggling DRUM 2 PARK switch to OFF. It may be necessary to hoist slightly before pawl will disengage ratchet.

3. Rotate lever and hold it so roller is against pawl.

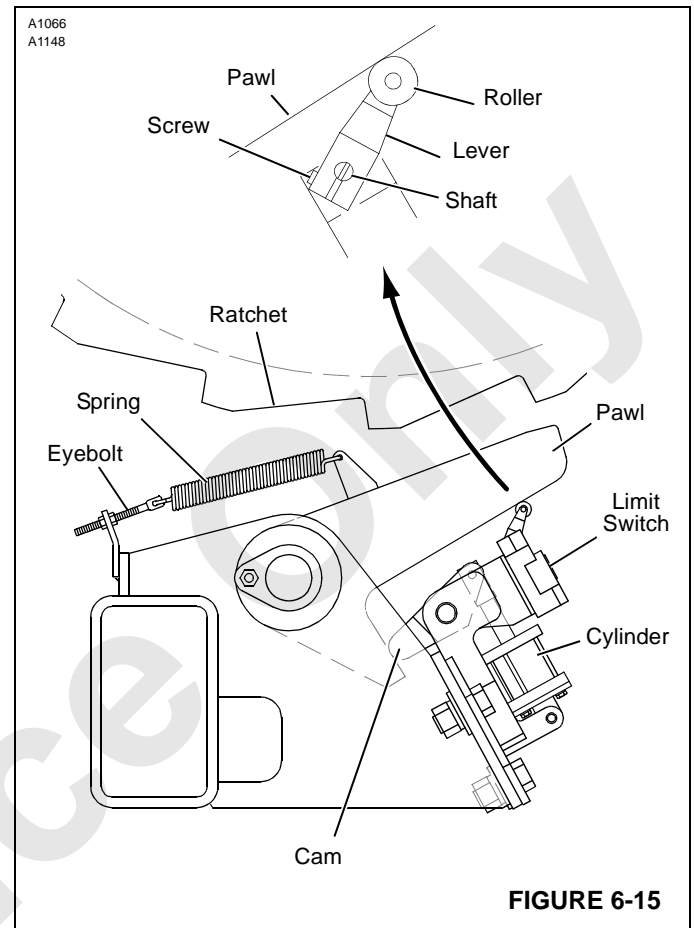
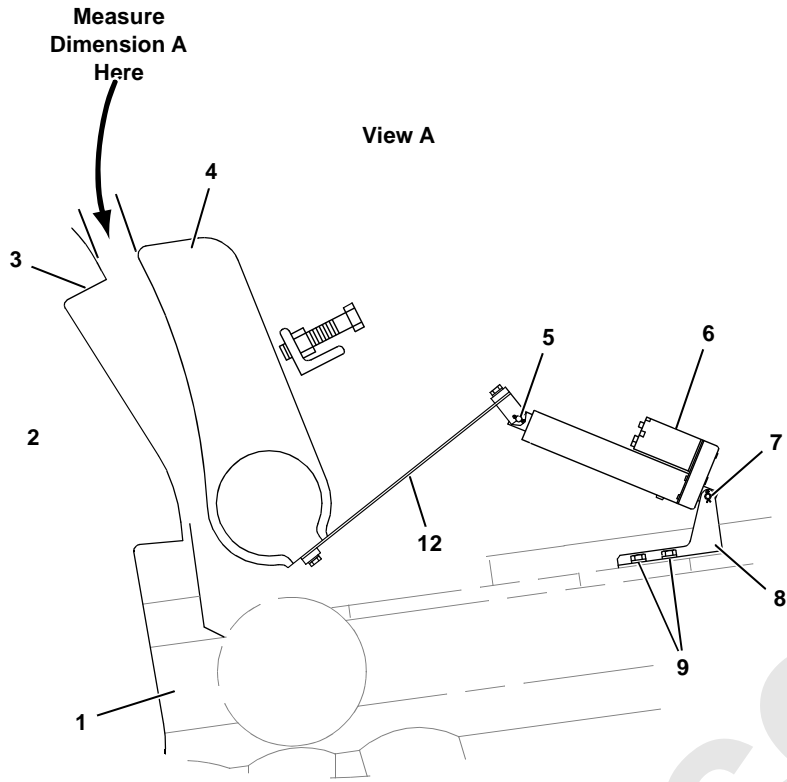


FIGURE 6-15

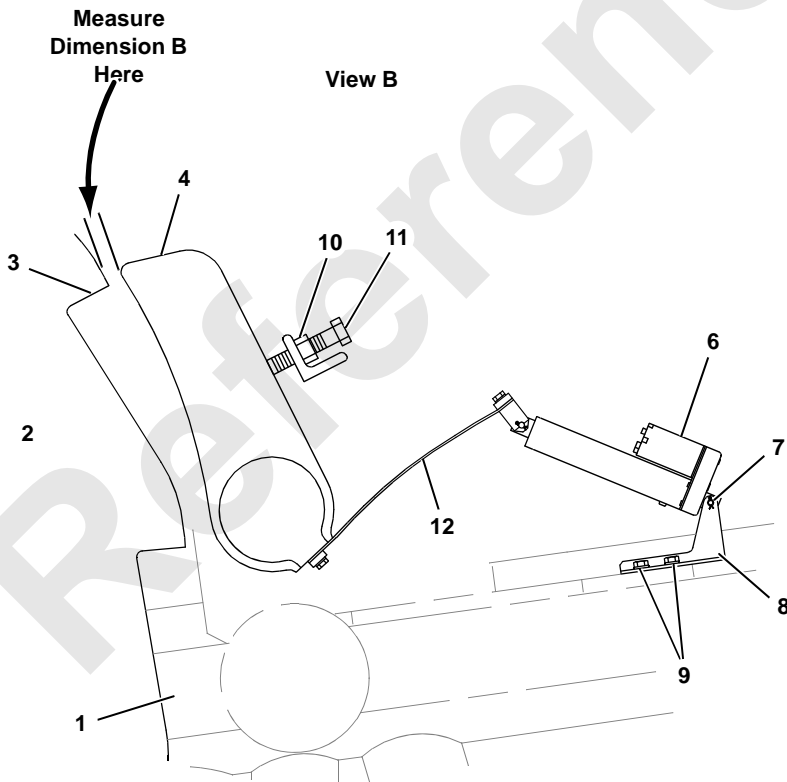
4. Turn limit switch shaft — *not the lever* — COUNTERCLOCKWISE until limit switch clicks open and hold.
5. Make sure roller is against pawl and securely tighten screw in lever to lock adjustment.
6. Check for proper operation:
  - Engage Drum 2 pawl by toggling DRUM 2 PARK switch to ON. Try to operate Drum 2. **Drum 2 should not operate in either direction.** Drum 3 should be operable.
  - Disengage Drum 2 pawl by toggling DRUM 2 PARK switch to OFF. Toggle DRUM 3 PARK switch to ON. Try to operate Drum 2. **Drum 2 should operate in either direction.** Drum 3 should be inoperable.
7. Readjust limit switch if required.

### Return Spring

Adjust the eyebolt so the return spring has enough tension to fully engage and hold the pawl against the ratchet.



Dimension A		Dimension B	
1-9/16 in	40 mm	21/32 in	17 mm



Item	Description
1	Boom Butt
2	Main Load Drum
3	Ratchet Tooth
4	Pawl
5	Pin
6	Actuator
7	Actuator Pin
8	Bracket
9	Bracket Nuts
10	Jam Nut
11	Adjusting Screw
12	Leaf Spring

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FIGURE 6-16

## MAIN LOAD DRUM RATCHET AND PAWL ADJUSTMENT

See Figure 6-16 for following procedure.

### General

The main load drum (Drum 9) is equipped with a drum pawl as shown in Figure 6-16. The drum is mounted in the boom butt.

The pawl is a positive locking device which, when engaged, prevents the drum from turning in the DOWN direction.

The drum pawl is engaged and disengaged electrically by a motor driven screw-type actuator controlled by a switch in the operator's cab. A limit switch inside both ends of the actuator turns off the motor when the actuator is fully extended or retracted.

The drum pawl was adjusted at the factory and should not need further adjustment during the service life of the actuator. Adjustment is necessary when a new actuator is installed.

### Actuator Removal

1. Toggle DRUM 9 PARK switch to OFF to disengage pawl (4), and **stop engine**. Actuator will retract.

**NOTE:** It may be necessary to hoist slightly before the pawl will fully disengage.

2. Disconnect electrical cord from actuator (5).
3. Loosen jam nut (10) and back out adjusting screw (11) until leaf spring (12) is fully relaxed.

### **WARNING** Flying Part Hazard!

Leaf spring is preloaded. Do not proceed to step 4 until step 3 is performed. Parts will fly apart with sudden and dangerous force if spring preload is not relieved.

4. Carefully remove pin (7) securing actuator (6) to bracket (8).
5. If necessary, loosen bracket nuts (9) to loosen actuator pin (7).
6. Remove pin (5) to disconnect leaf spring (12) from actuator (6).
7. Remove actuator (6).

### Actuator Installation and Adjustment

**Actuator must be fully retracted during installation and adjustment.**

1. Move cab power switch to ON position and engine run-stop switch to RUN position. **Do not start engine.**

2. Toggle DRUM 9 PARK switch to OFF to disengage pawl (4).

### **WARNING** Pinch Point Hazard!

Actuator rod will retract when step 3 is performed, To prevent crushing injury, keep hands away from actuator and actuator clear of all other parts while performing step 3.

3. Connect electrical cord to actuator (6). **Actuator will retract.**
4. Insert pin (5) to connect leaf spring (12) to actuator (6).
5. Pin actuator (6) to bracket (8).
6. Set Dimension A (View A):
  - a. Loosen bracket nuts (9).
  - b. Adjust position of bracket (8) until dimension between pawl (4) and ratchet tooth (3) equals Dimension A.
  - c. Securely tighten nuts (9) to hold bracket (8) in position.
7. Set Dimension B (View B):
  - a. Loosen jam nut (10).
  - b. Turn adjusting screw (11) IN until dimension between pawl (4) and ratchet tooth (3) equals Dimension B.
  - c. Securely tighten jam nut (10) to lock adjusting screw (11).

### **WARNING** Pinch Point Hazard!

Actuator rod will extend when step 8 is performed, To prevent crushing injury, keep hands away from actuator and pawl while performing step 8.

8. Toggle DRUM 9 PARK switch to ON to engage pawl. Actuator (6) will extend and pawl (4) will engage.
9. Using park switch, operate pawl (4) to make sure that internal limit switches stop actuator motor when actuator (6) is fully extended and fully retracted and that pawl (4) fully engages and disengages ratchet tooth (3).

### **CAUTION**

Actuator must be free to fully extend and retract. Motor will overheat and be ruined if actuator stroke is restricted in either direction.

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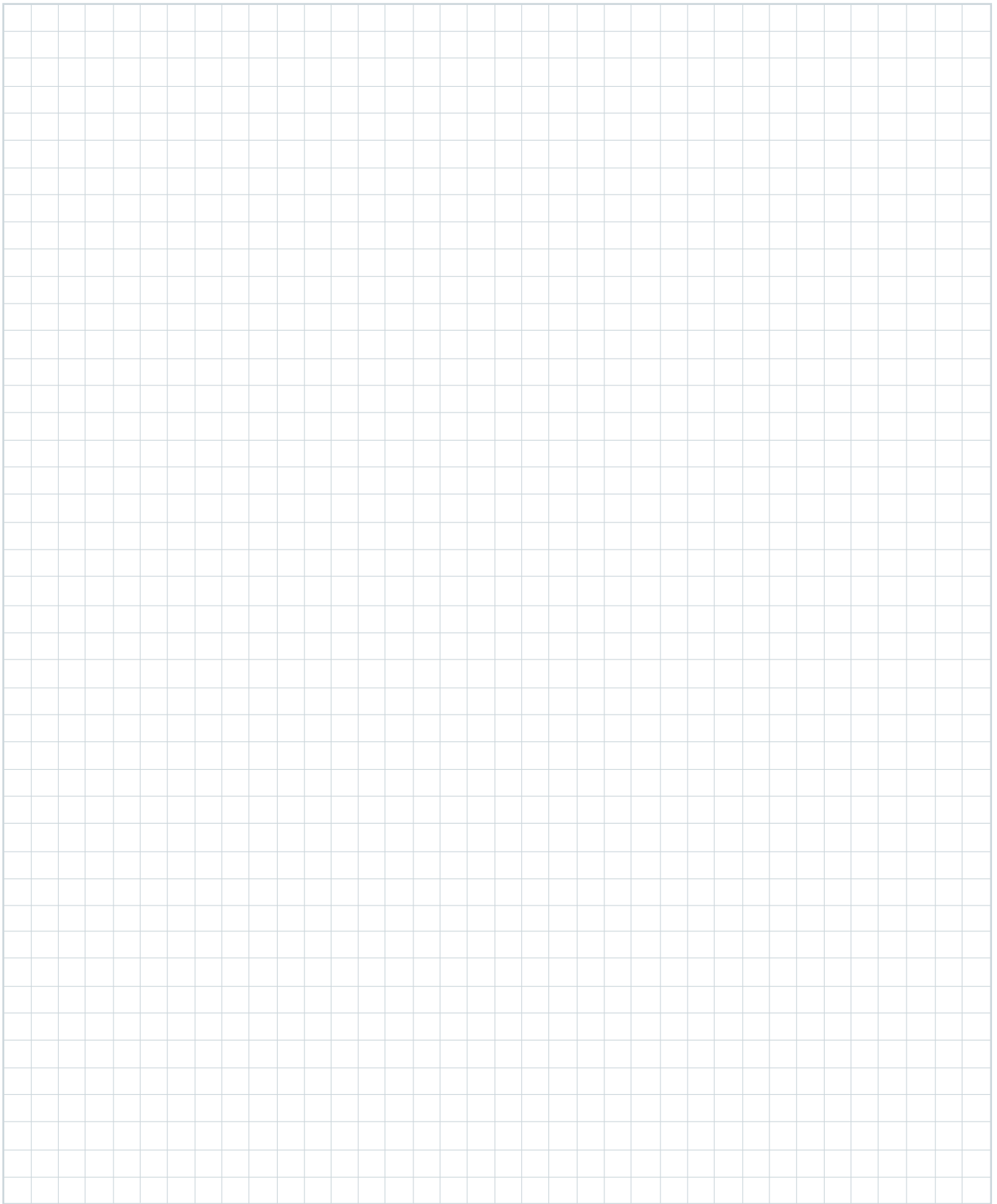
Reference Only



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Grove

Manitowoc

National Crane

Potain



Grove

Manitowoc

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Potain

