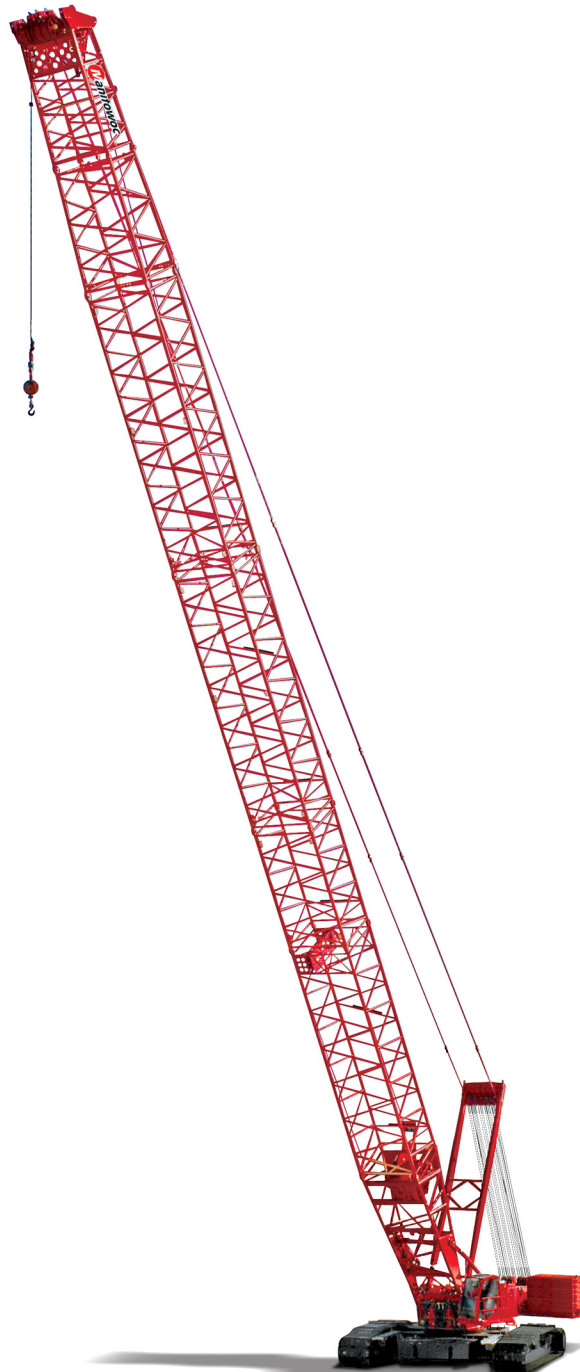


Manitowoc 16000

Operator Manual Wheeled MAX-ER[®] Attachment





OPERATOR MANUAL

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

16000

Wheeled MAX-ER Model Number

16003Ref

Wheeled MAX-ER Serial Number

This manual is divided into the following sections:


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

NOTICE

The serial number of the crane and applicable attachments (i.e. luffing jib, MAX-ER®) is the only method your Manitowoc dealer or the Manitowoc Crane Care Lattice Team 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 the Manitowoc Crane Care Lattice Team.

	! WARNING
	<p>To prevent death or serious injury:</p> <ul style="list-style-type: none">• 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.• 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.• Store Operator Information Manual and Service Manual in operator's cab. <p>If Operator Information Manual or Service Manual is missing from cab, contact your Manitowoc dealer for a new one.</p>

THE ORIGINAL LANGUAGE OF THIS PUBLICATION IS ENGLISH

See end of this manual for Alphabetical Index

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Reference Only

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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)

MAX-ER WEIGHTS

See the end of this section for MAX-ER weights.

CHANGE OF OWNERSHIP REGISTRATION

If you are the new owner of a Manitowoc crane, please register it with Manitowoc Crane Care so we can contact you if the need arises.

1. Go to www.manitowoccranes.com
2. Go to Service > Manitowoc Crane Care > Service Information > Change of Ownership Form.
3. Complete the form.

MANITOWOC DEALER

For questions about this manual or the 16000 crane, contact your Manitowoc dealer. If you do not know the contact information for your dealer, locate the Manitowoc dealer nearest you as follows:

1. Go to www.manitowoccranes.com
2. Go to Dealer Locator.
3. Follow the on-screen prompts to locate your Manitowoc dealer.

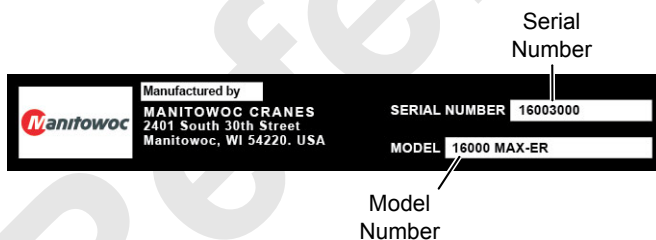


FIGURE 1-1

CRANE/ATTACHMENT IDENTIFICATION

An identification plate is attached to the outside of the operator's cab (see [Figure 1-1](#)) and to the attachments (for example luffing jib and MAX-ER attachment) available for this crane.

The crane or attachment model and serial number are provided on the plate.

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

CRANE ORIENTATION

The terms RIGHT, LEFT, FRONT, REAR used in this manual refer to 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 rotating bed.
- The carbody and crawler controls are on the front of the carbody.

DESCRIPTION OF COMPONENTS

See [Figure 1-2](#) for following description.

The MAX-ER Attachment has a wheeled counterweight assembly which supplements the crane's counterweight. Added counterweight increases the crane's capacity and the amount of boom it can operate with while maintaining its ability to travel and swing with and without load (See MAX-ER Capacity Charts for swing and travel limitations).

The attachment consists of the following components ([Figure 1-2](#)):

Wheeled Counterweight Assembly (22) suspended from a fixed mast (14) by straps (16) and lifting cylinder (34) (fastened to counterweight base). The wheeled counterweight assembly is connected to the rear of the crane by a telescopic beam (24) which has three operating positions.

Counterweight Straps (16) and Lifting Cylinder (34) which suspend the wheeled counterweight assembly from the fixed mast. The cylinders automatically raise and lower the wheeled counterweight assembly in response to changes in load (weight of lifted load and boom angle).

Load Sensing Pin (21) which monitors mast loading. The pin sends 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 boom hoist control handle.

Sensors which monitor and limit wheeled counterweight assembly operations.

IDENTIFICATION AND LOCATION OF COMPONENTS

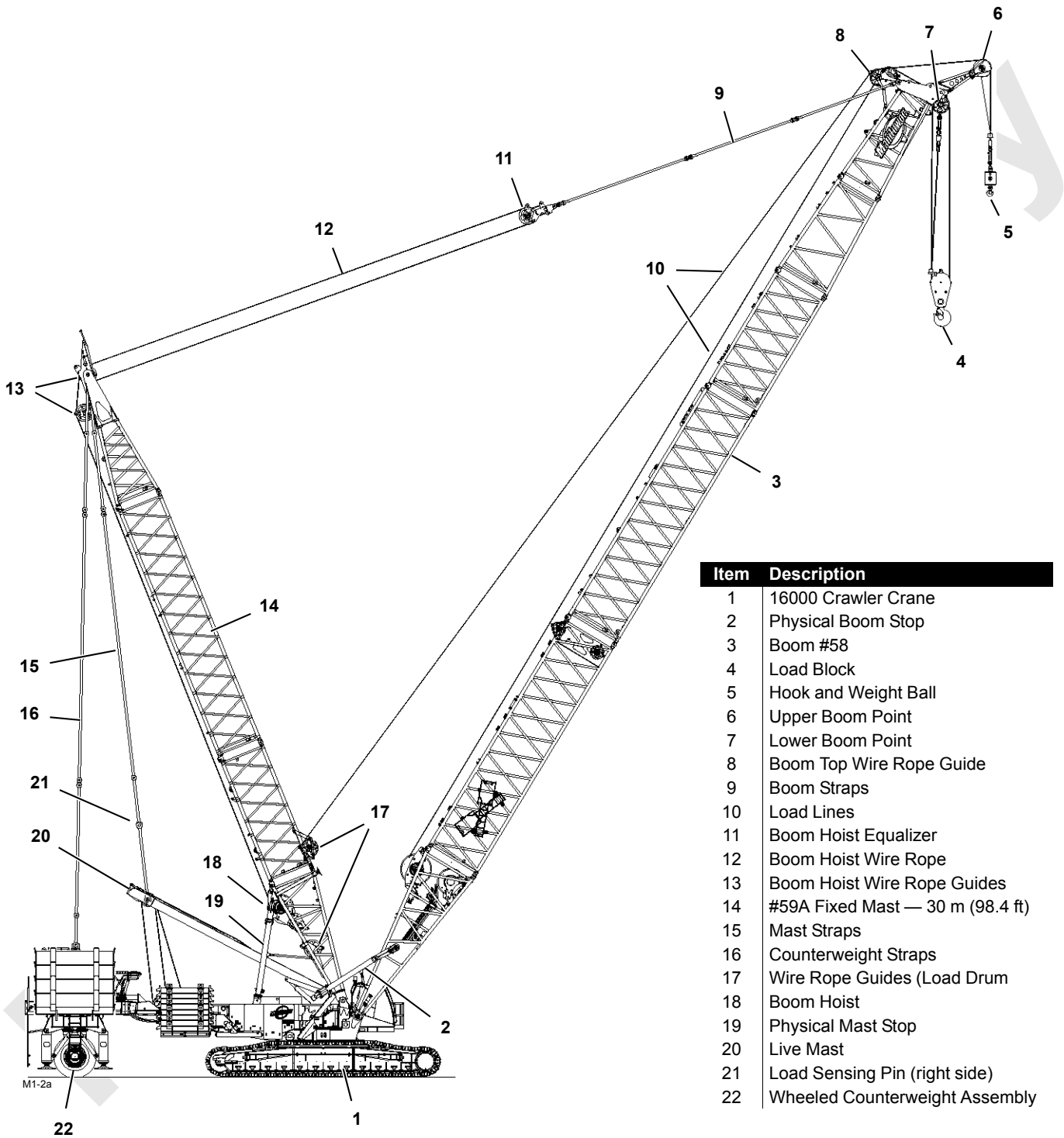
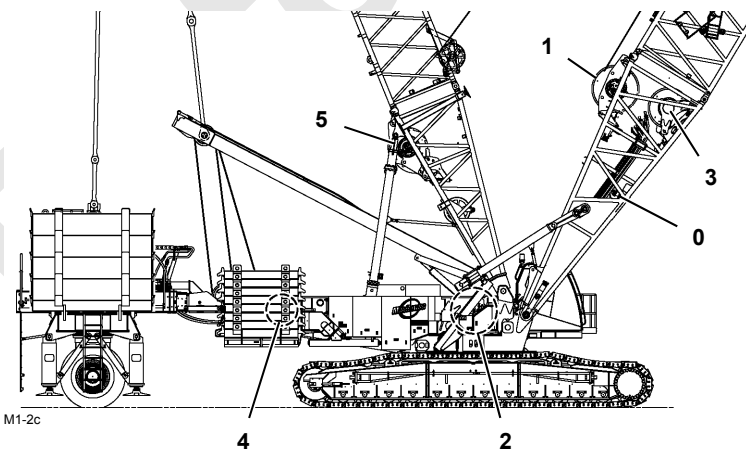
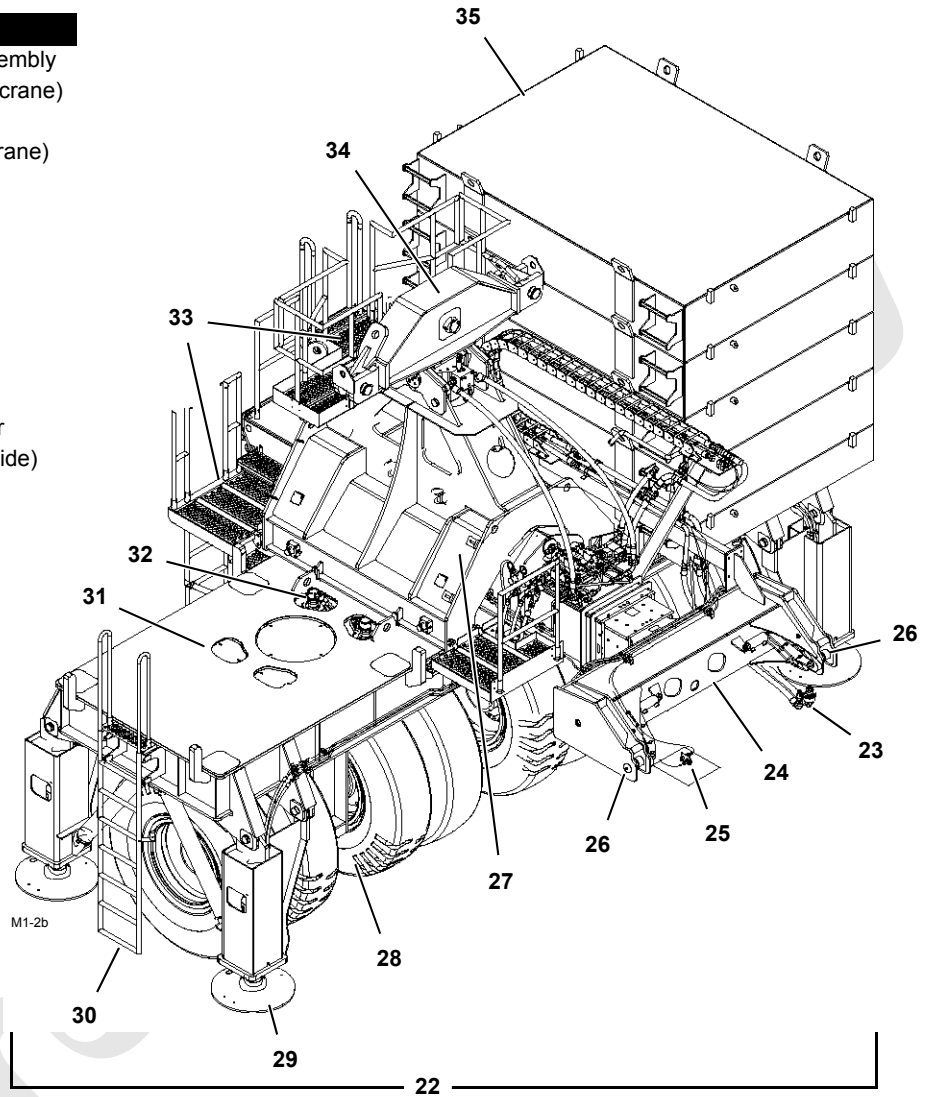


FIGURE 1-2

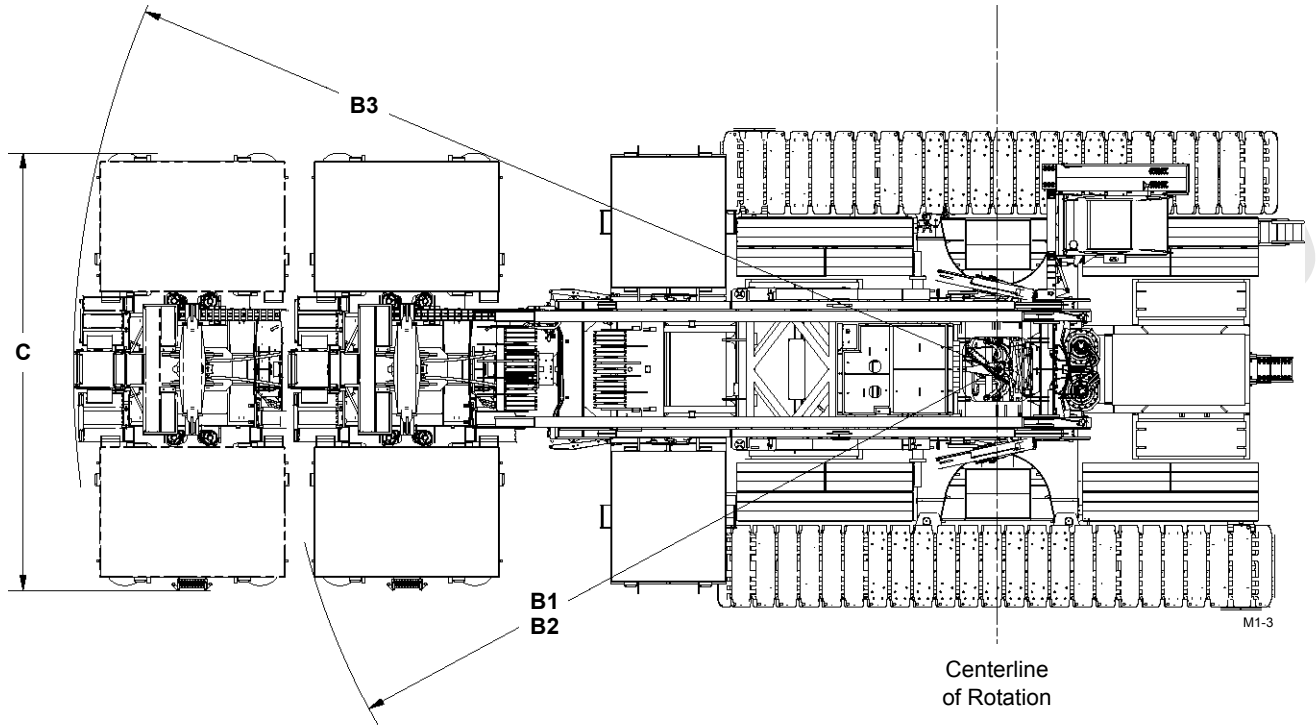
Item	Description
22	Wheeled Counterweight Assembly
23	Hydraulic Hoses (connect to crane)
24	Telescopic Beam
25	Electric Cables (connect to crane)
26	Connecting Pin (2 places)
27	Lifting Frame
28	Axles with Wheels (2 places)
29	Jack with Pad (4 places)
30	Ladder (3 places)
31	Counterweight Carrier Base
32	Swing Drive (4 places)
33	Platform (4 places)
34	Lifting Cylinder with Spreader
35	Counterweight Box (5 each side)



Drum No.	Identification
0	Rigging Winch (in boom butt)
1	Load Drum (in boom butt)
2	Load Drum
3	Load/Luffing Drum (in boom butt)
4	Mast Hoist
5	Boom Hoist

FIGURE 1-2 continued

MAX-ER OUTLINE DIMENSIONS



Item	Dimension
A1	36.1 ft (11 m Working Position)
A2	42.7 ft (13 m Working Position)
A3	49.2 ft (15 m Working Position)
B1	43 ft 8 in (13,30 m) at 11 m Working Position
B2	50 ft 0 in (15,24 m) at 13 m Working Position
B3	56 ft 6 in (17,22 m) at 15 m Working Position
C	26 ft 8-3/4 in (8,14 m)
D	7 ft 3 in (2,21 m)

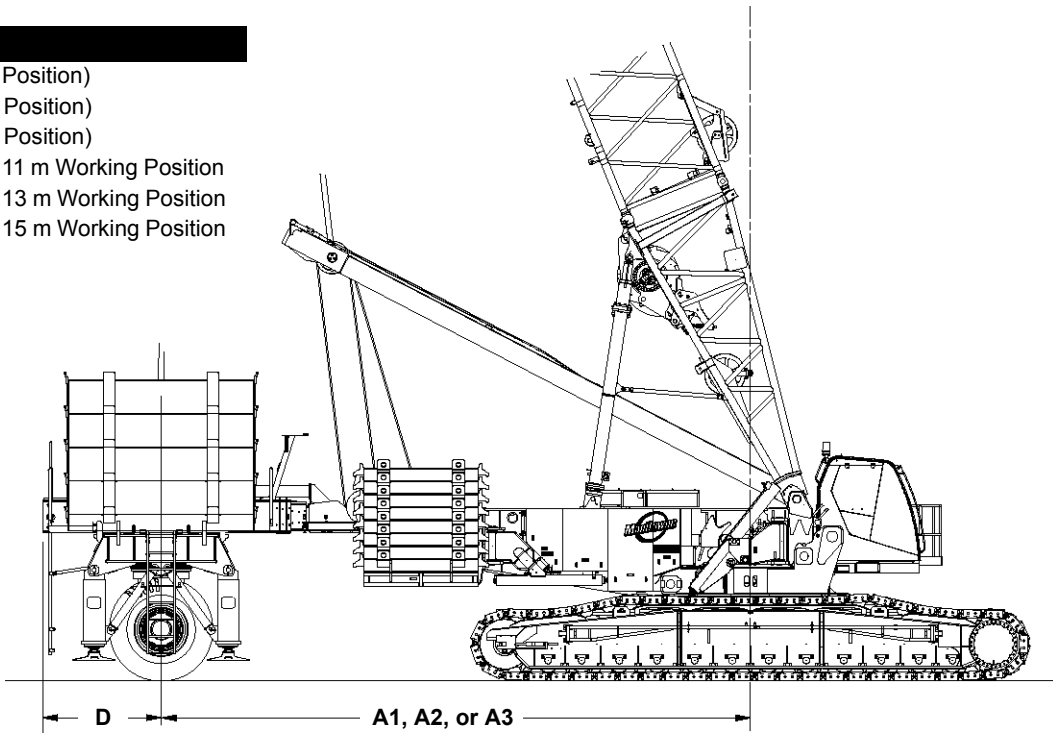


FIGURE 1-3

ENGLISH AND METRIC CONVERSIONS

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:

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

Inverse Conversion

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

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

To Convert	Symbol	Application	To	Symbol	Multiply By
AREA					
Square Inch	in ²	Filter Area Clutch Contact	Square Centimeter	cm ²	6.4516
Square Foot	ft ²	Ground Contact	Square Meter	m ²	0.0929
FORCE					
Pound Force	lb	Pedal Effort	KiloNewton Newton	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	Nm	0.1751
Pound Force Per Foot	lb/ft		Newton per meter	Nm	14.5939
LENGTH					
Inch	in.	Adjustments	Millimeter	mm	25.4000
Foot	ft	Outline Dimensions	Meter	m	0.3048
Mile	miles	Travel Distance	Kilometer	km	1.6093
POWER					
Horsepower	hp	Engine	Kilowatt	kW	0.7457
PRESSURE					
Pound/Sq. In.	psi	Hydraulic & Air	Bar		0.0689
TEMPERATURE					
Degrees Fahrenheit	°F	Oil, Air, Etc.	Degrees Centigrade	°C	°F - 32 ÷ 1.8
Degrees Centigrade	°C		Degrees Fahrenheit	°F	°C x 1.8 + 32
TORQUE					
Inch Pound	in lb	Bolt Torque	Newton Meter	Nm	0.1129
Foot Pound	ft lb		Newton Meter	Nm	1.3558
VELOCITY					
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
VOLUME					
Cubic Yard	yd ³	Bucket Capacity	Cubic Meter	m ³	0.7646
Cubic Foot	ft ³		Cubic Meter	m ³	0.0283
Cubic Inch	in ³	Pump Displacement	Cubic Centimeter	cm ³	16.3871

To Convert	Symbol	Application	To	Symbol	Multiply By
VOLUME (LIQUID)					
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
WEIGHT					
Pound	lb	Unit/Component	Kilogram	kg	0.4536
US Ton (2000 lb)	USt	Load Ratings	Metric Ton	t	0.9072
US Ton (2000 lb)	USt		Kilogram	kg	907.1847

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Reference Only

SECTION 2

SAFETY INFORMATION



WARNING

California Proposition 65

Breathing diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

- Always start and operate the engine in a well-ventilated area.
- If in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system.
- Do not idle the engine except as necessary.

For more information go to www.P65warnings.ca.gov/diesel.

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.

CONTINUOUS INNOVATION

Due to continuing product innovation, the information in this manual is subject to change without notice. If you are in doubt about any procedure, contact your Manitowoc dealer or Crane Care Lattice Team.

NAMEPLATES AND DECALS

See drawing at the end of this section.

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.

Symbol Identification

Many of the symbols used in the safety and information signs and nameplates on this crane are identified in [Table 2-1](#) and [Table 2-2](#).

Table 2-1 Common Safety Symbols





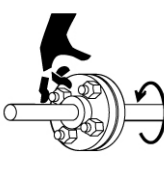


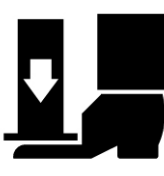












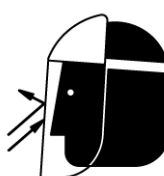




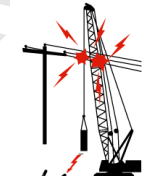


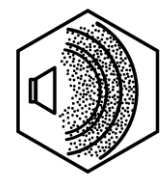







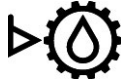

Cut or Crush Hazards					Cut Hazard
 M100090	 M100091	 M100066	 M100065	 M100069	 M100067
Crush Hazards					Fire Extinguisher
 M100070	 M100071	 M100072	 M100073	 M100074	 M100082
Fall Hazards			Falling Boom (Crush) Hazards		Explosion Hazard
 M100083	 M100084	 M100085	 M100068	 M100075	 M100080
Falling Load Hazards		Flying Objects Hazards		Overhead Obstruction Hazard	Pressure Release Hazard
 M100076	 M100077	 M100088	 M100088	 M100089	 M100081
Electrocution Hazards		Personal Fall Protection	Pressure Cleaning	Sound Power Level	Read Manual
 M100078	 M100079	 M100095	 M100087	 M100096	 M100093

Table 2-2 Miscellaneous Symbols

Diesel Fuel	Engine Coolant	Engine Coolant Vent	Engine Oil Level	Hydraulic Filter	Hydraulic Oil
 M100271	 M100267	 M100268	 M100269	 M100272	 M100273
Pump Drive Oil Level	Tire Pressure (if equipped)				
 M100270	 M100266				

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.

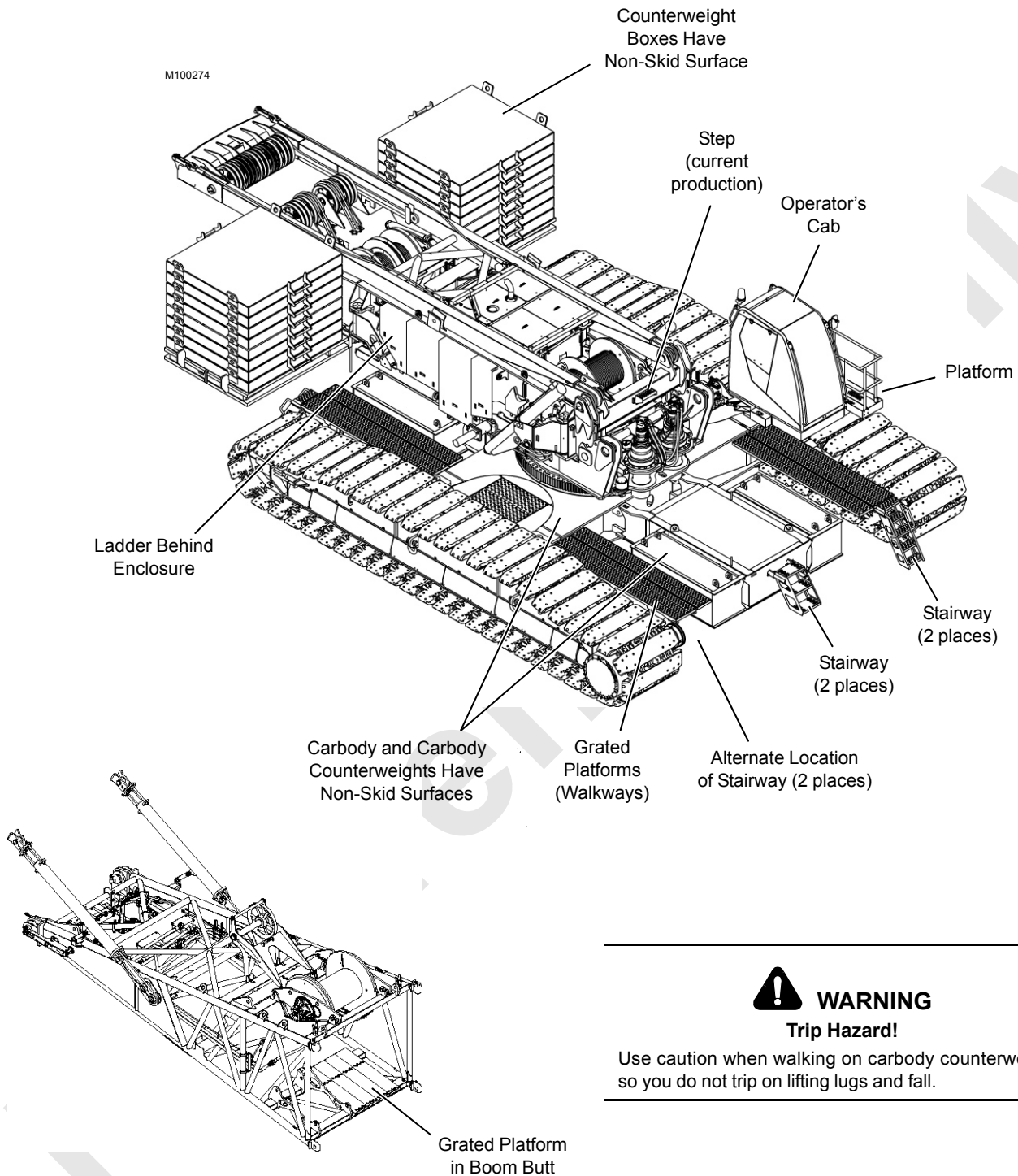


FIGURE 2-1

CRANE ACCESS POINTS



WARNING

Crush Hazard!

Upperworks 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. See Swing Radius Barrier topic in this section.
- Do not climb onto or off crane while upperworks is being swung or crane is being traveled.
- Signal operator for permission to climb onto/off crane.
- Operator: do not swing or travel while personnel are climbing onto or off crane. Stop swing and travel motions. Apply swing brake and turn on travel park.
- Operator: Always sound horn to alert personnel before you swing or travel.
- 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 shall alert personnel to crane movement using the horn on the control console.

General

Take necessary precaution to prevent slipping and/or falling off the crane 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 2-1](#).

The owner/user shall 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. Store 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 risk of slipping, non-skid material (sand in paint) has been applied to painted walkways and platforms.

Walkways and platforms can be slippery when wet and when oil or is 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 cab. 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 catwalks.

NOTE: Catwalks are available from Manitowoc for boom and jib sections.

Two optional ladders, stored in 40 ft (12 m) insert next to the boom butt, are available for boom assembly and disassembly. See Boom Ladder Assembly in Section 4 for instructions.

GETTING ON OR OFF CRANE

Personnel getting on and off crane shall do so only at steps or ladders 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, their hands shall be free of any objects. Objects which cannot be carried in pockets or tool belts must be lifted into place with a hand line or hoist.

OPERATOR MANUAL/CAPACITY CHART STORAGE

General

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

- **Operator 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.
- **RCI/RCL 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 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 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 manual 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 on the bookshelf in the operator's cab ([Figure 2-2](#)).

Attach the chain from the manual in use to the link behind the operator's seat.

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

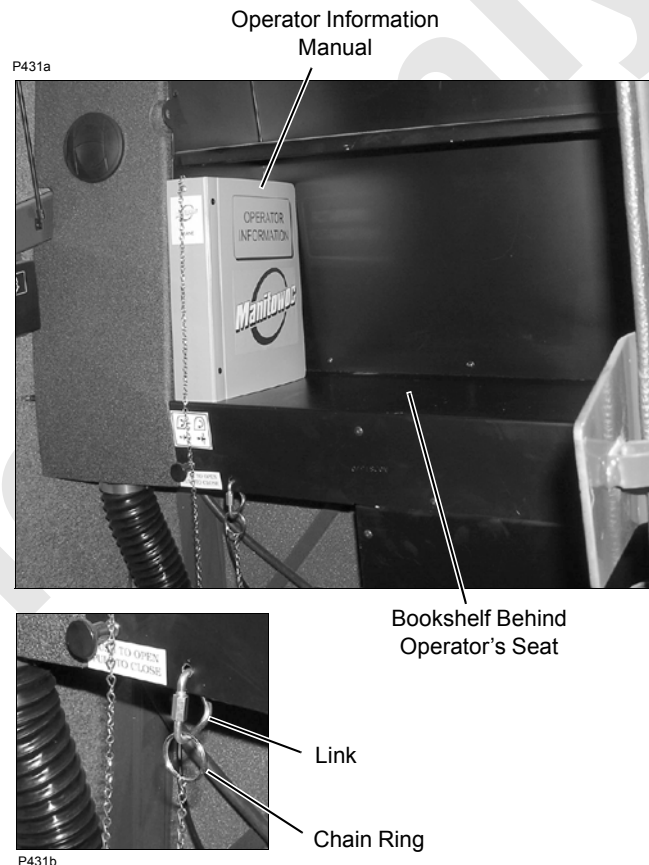


FIGURE 2-2

SWING RADIUS BARRIER

Manitowoc's optional swing radius barrier is shown in [Figure 2-3](#).

! WARNING Crush Hazard!

To prevent personnel from being crushed by swinging crane, deploy swing radius barrier before operating crane.

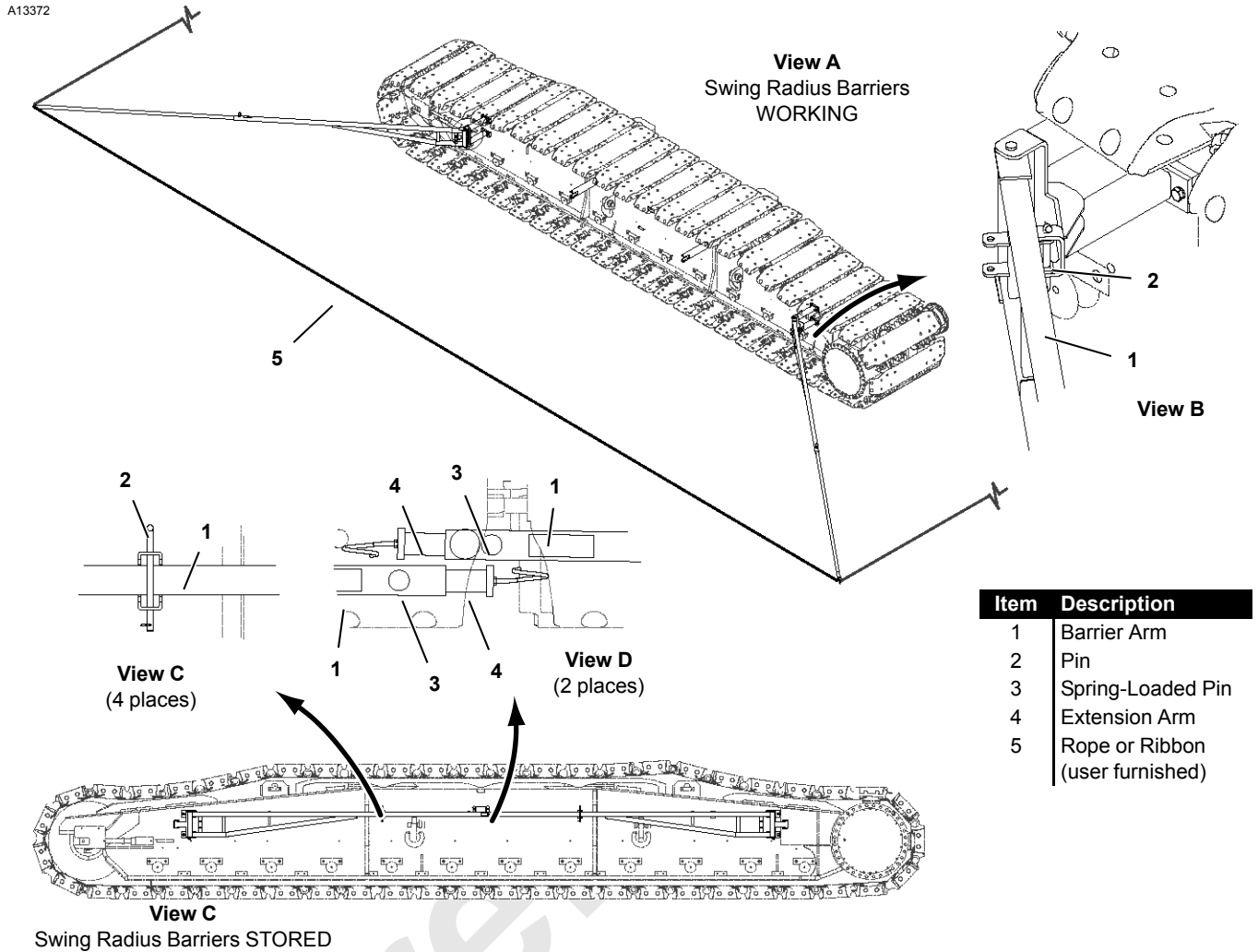


FIGURE 2-3

Deploying Swing Radius Barrier

1. Remove pins (2, View C) from shipping position.
2. Rotate barrier arms (1) outward to working position (View A).
3. Install pins (2, View B) in working position.
4. Pull on spring-loaded pins (3, View D), pull extension arms (4) out part way, and release pins.
5. Pull extension arms (4) out fully until they are locked in position by spring-loaded pins (5) as shown in View A.
6. Form a safety perimeter by attaching user supplied high visibility rope or ribbon to hooked ends of extension arms.

Storing Swing Radius Barrier

1. Remove rope or ribbon from hooked ends of extension arms (4).
2. Pull on spring-loaded pins (3, View D), push extension arms (4) in part way, and release pins.
3. Push extension arms (4) in fully until they are locked in position by spring-load pins (5).
4. Remove pins (2, View B) from working position.
5. Rotate barrier arms (1) inward and install pins (2, View C) in shipping position.

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

The Operator Manual shall 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 Manual at any time without notice. If you have any questions regarding the crane or its Operator Manual, please contact your Manitowoc dealer.

Operator Qualifications

The crane must 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 crane or enter 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

ASME (formerly ANSI) B30 Series American National Standards are available by mail from the ASME, 22 Law Drive, Fairfield, New Jersey, 07004-2900 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

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 must 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 must 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 the off 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 must 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

7. The operator shall test all controls, limits, and communication systems at the start of each shift. Any defects found must 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.

12. 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 shall 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 Manual.

13. 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.

14. 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 must be illuminated.

15. 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 12 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.

16. 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 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.

17. Booms, jibs, or masts which are being assembled or disassembled on the ground (with or without support of boom rigging) must 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.

18. Each outrigger must be visible to the operator or the signal person during extension and retraction.

Handling Load

Size of Load

1. The crane must 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 shall 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 shall 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 radius at which load will be lifted.

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

Attaching Load

1. Attach the hook to the load with slings, or other suitable rigging. Each hook must have a latch that is in proper working order. **Hook latches must 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 must 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 must 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*

- 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 must 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 must 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 must be thoroughly inspected by a qualified person prior to setup.
4. The crane must be thoroughly inspected for load line interference caused by routing and reeving of multiple load lines. If interference is found it must 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 shall 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 must 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 shall 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 shall 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 (found in OSHA document) 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 judgment. 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 must be deenergized OR,
 - Tests must 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.

Electrocution Hazard Devices

1. The use of insulated links, insulated boom cages/guards, proximity warning devices, or mechanical limit 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 (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 to 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.
 - 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 shall:

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.

- 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 the Manitowoc Crane Care Lattice Team. 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

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

FIRE EXTINGUISHERS

- A portable fire extinguisher with a minimum rating of 10 BC must be installed in operator's or machinery cab of crane.
- 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 your Manitowoc dealer or the Product Safety and Reliability Department at the following address:

Manitowoc Cranes
2401 So. 30th St.
Manitowoc, WI 54220
Phone: 920-684-6621

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

The crane must not be returned to service until it is thoroughly inspected for any evidence of damage. All damaged parts must be repaired or replaced as authorized by Manitowoc.

SAFE MAINTENANCE



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 shall **read Operator 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

- Perform the following steps (as applicable) before starting a maintenance procedure:
 - Park the crane where it will not interfere with other equipment or operations.
 - Lower all loads to the ground or otherwise secure them against movement.
 - Lower the boom onto blocking at ground level, if possible, or otherwise secure the boom against dropping.
 - Move all controls to off and secure all functions against movement by applying or engaging all brakes, pawls, or other locking devices.
 - 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 the crane while the engine is running, unless absolutely necessary.
If the engine must be run, keep your clothing and all parts of your body away from moving parts. **Maintain constant verbal communication between person at controls and person performing maintenance or repair procedure.**
 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.

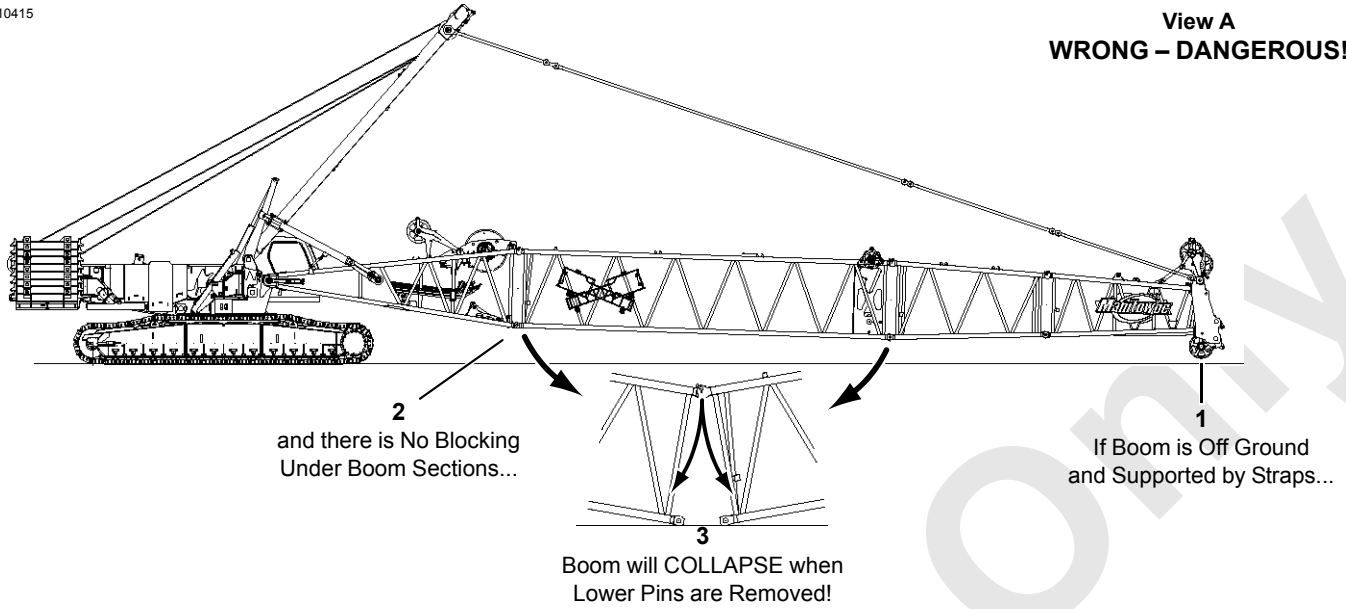
- Always drain waste fluids into leak proof containers that are clearly marked with what they contain
- Always fill or add fluids with a funnel or a filling pump
- Immediately wipe up any spills

Reference Only

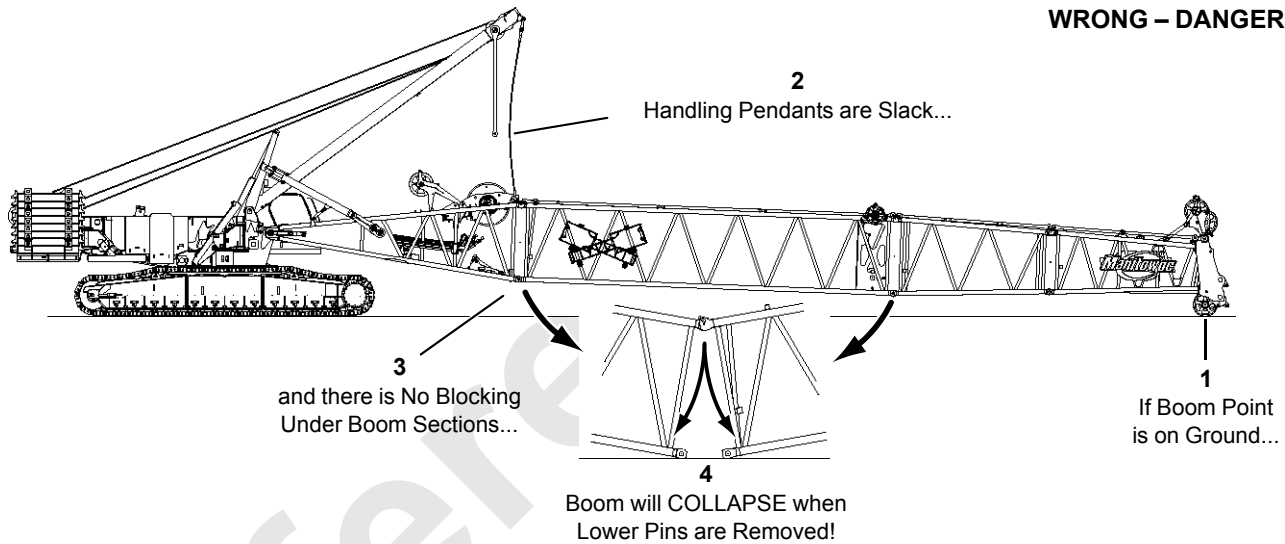
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**View A
WRONG – DANGEROUS!**



**View B
WRONG – DANGEROUS!**



**View C
RIGHT – SAFE**

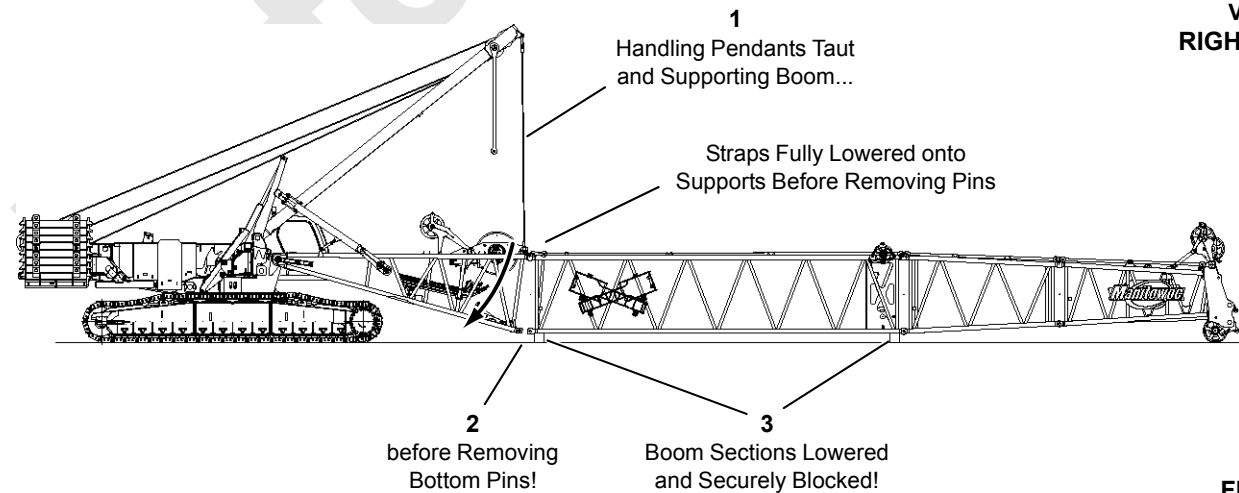


FIGURE 2-4

BOOM DISASSEMBLY SAFETY

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



DANGER!

Collapsing Boom Hazard!

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

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

General

Safety decals ([Figure 2-5](#)) 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 shall be trained and experienced in the operation and disassembly of construction cranes. Everyone shall read and understand these instructions, the information in the Boom Assembly Drawing, and the 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 endanger other workers.**

Location

Select a suitable location for boom disassembly. It must be firm, level, and 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

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.



FIGURE 2-5

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.**



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 2-4](#), View A.
- Do not remove strap connecting pins until straps are fully lowered into supports as shown in [Figure 2-4](#), View C.
- Do not remove bottom connecting pins from any boom section when boom point is resting on ground and handling pendants are slack as shown in [Figure 2-4](#), View B.
- Never work or stand inside boom unless it is lowered and securely blocked as shown in [Figure 2-4](#), View C.
- Do not stand or walk on top of boom unless it has walkways.



DANGER

Falling Boom Hazard!

Crane can tip or boom can collapse if excess boom is cantilevered. Never cantilever more boom than allowed in rigging drawings or capacity charts.

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 must 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 shall 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 must 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 must 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 Manual is in the 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 must 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 (personal fall-protection system for example)

- 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) must 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 your Manitowoc dealer or the Product Safety and Reliability Department at the following address:

Manitowoc Cranes
2401 So. 30th St.
Manitowoc, WI 54220
Phone: 920-684-6621

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 shall 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](#)).

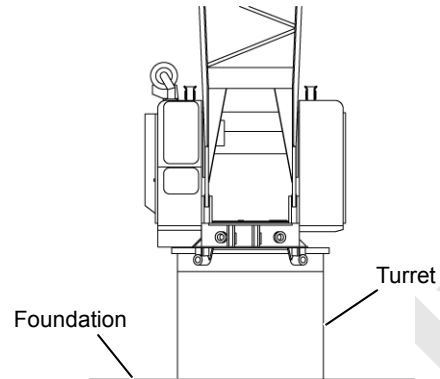
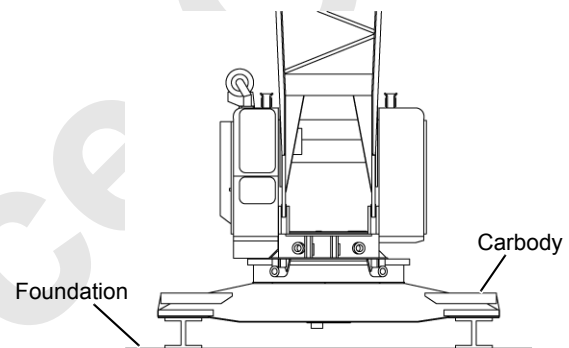


FIGURE 2-6

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



NOTE: If bolting carbody to foundation, contact your Manitowoc dealer for recommended bolt pattern and for type and quantity of bolts to be used.

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](#)).

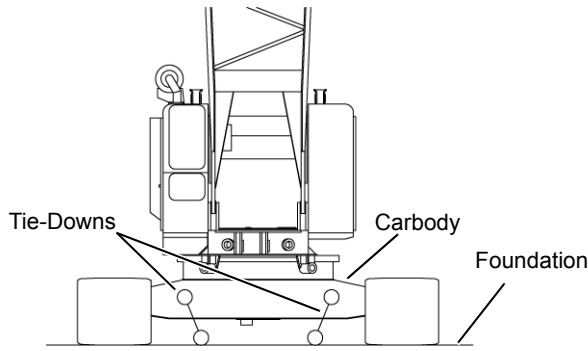
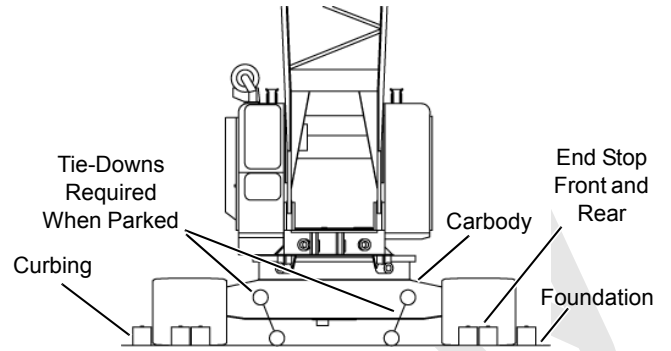


FIGURE 2-8

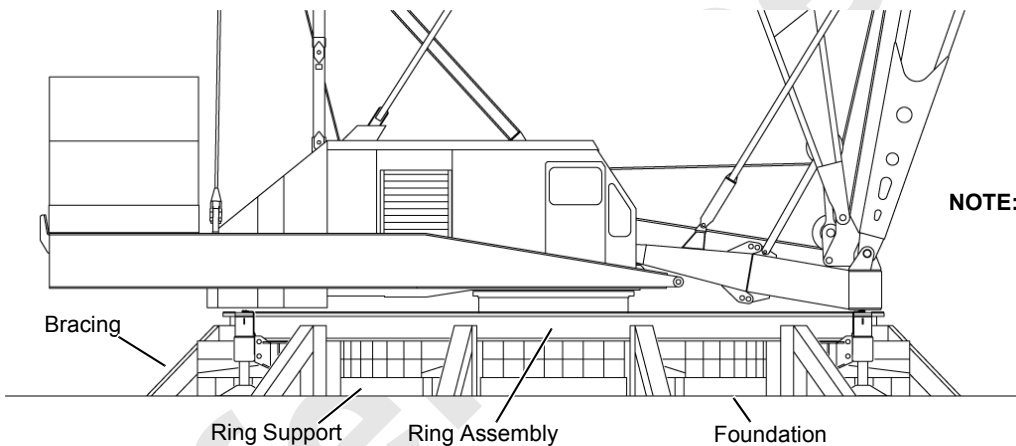
2. Crawler-mounted crane working on a timbered area of the barge, ship, or floating platform with the crawlers restrained by curbing and end stops (Figure 2-9). When not working, the crane carbody is anchored with tie-downs to the foundation. **Traveling with load is not permitted.**



NOTE: Manitowoc does not permit traveling with load.

FIGURE 2-9

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.



NOTE: Ringers must be equipped with hook rollers on boom and counterweight carriers.

FIGURE 2-10

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

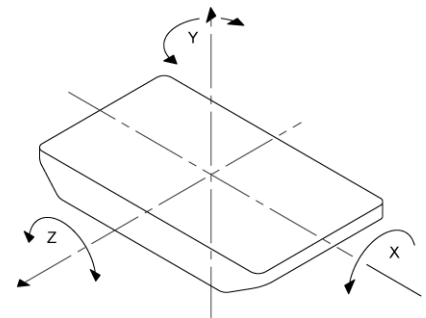


FIGURE 2-11

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!

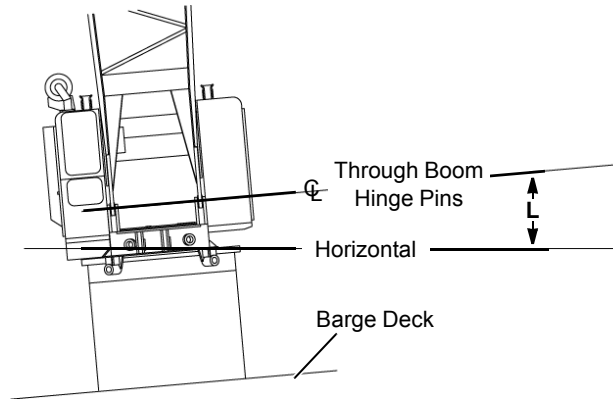
Tie-downs which only prevent crane from shifting as in barge, ship or floating platform mounting, may not provide adequate support when using a Capacity Chart for pedestal mounting. Before operating a crane on a barge, ship or floating platform, crane user shall verify that correct Capacity Chart is 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° 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° 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 the 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.



L = Degrees of Machine List
(Maximum allowable is
specified in Capacity Chart)

FIGURE 2-12

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 must be lowered onto a cradle (or other support) and the crane's boom, rotating bed, and lowerworks must be secured against movement. If the crane is equipped with a mast, the mast must 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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SECTION 3
OPERATING CONTROLS AND PROCEDURES


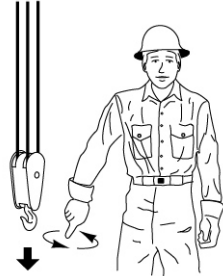
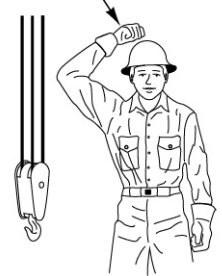
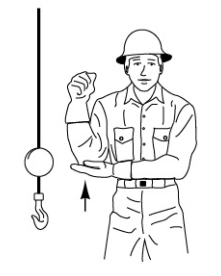
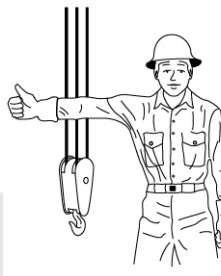

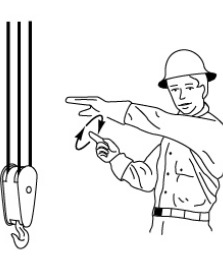


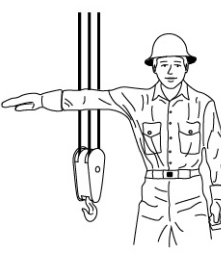

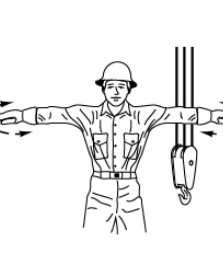
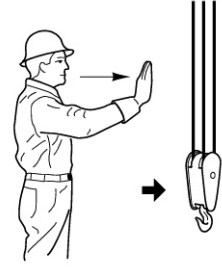

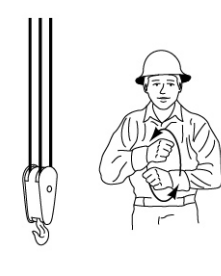

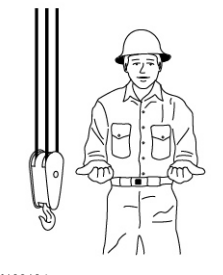
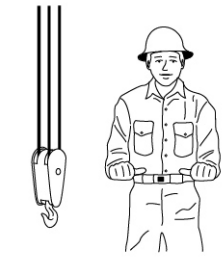


Reference Only

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STANDARD HAND SIGNALS FOR CONTROLLING CRANE OPERATIONS

The following standard hand signals comply with ASME B30.5-2014.

Table 3-1 Standard Hand Signals For Controlling Crane Operations

<p style="text-align: center;">1</p>  <p>M100118</p>	<p style="text-align: center;">2</p>  <p>M100119</p>	<p style="text-align: center;">3</p>  <p>M100120</p>	<p style="text-align: center;">4</p>  <p>M100121</p>	<p style="text-align: center;">5</p>  <p>M100122</p>
<p style="text-align: center;">6</p>  <p>M100123</p>	<p style="text-align: center;">7</p>  <p>M100124</p>	<p style="text-align: center;">8</p>  <p>M100125</p>	<p style="text-align: center;">9</p>  <p>M100126</p>	<p style="text-align: center;">10</p>  <p>M100127</p>
<p style="text-align: center;">11</p>  <p>M100128</p>	<p style="text-align: center;">12</p>  <p>M100129</p>	<p style="text-align: center;">13</p>  <p>M100130</p>	<p style="text-align: center;">14</p>  <p>M100131</p>	<p style="text-align: center;">15</p>  <p>M100132</p>
<p style="text-align: center;">16</p>  <p>M100133</p>	<p style="text-align: center;">17</p>  <p>M100134</p>	<p style="text-align: center;">18</p>  <p>M100135</p>	<p style="text-align: center;">19</p>  <p>M100136</p>	<p style="text-align: center;">20</p>  <p>M100137</p>

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Item	Description
1	HOIST —With forearm vertical, forefinger pointing up, move hand in small horizontal circles.
2	LOWER —With arm extended downward, forefinger pointing down, move hand in small horizontal circles.
3	USE MAIN HOIST —Tap fist on head. Then use regular signals.
4	USE WHIPLINE (Auxiliary Hoist) —Tap elbow with one hand. Then use regular signals.
5	RAISE BOOM —Arm extended, fingers closed, thumb pointing upward.
6	LOWER BOOM —Arm extended, fingers closed, thumb pointing downward.
7	MOVE SLOWLY —Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal (hoist slowly shown as an example).
8	RAISE BOOM & LOWER LOAD —With arm extended, thumb pointing up, flex fingers in and out as long as load movement is desired.
9	LOWER BOOM & RAISE LOAD —With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.
10	SWING —Arm extended, point with finger in direction of swing of boom.
11	STOP —Arm extended, palm down, move arm back and forth horizontally.
12	EMERGENCY STOP —Both arms extended, palms down, move arms back and forth horizontally.
13	TRAVEL —Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.
14	DOG EVERYTHING —Clasp hands in front of body.
15	TRAVEL (Both Tracks) —Use both fists in front of body, making a circular motion about each other, indicating direction of travel forward or backward. (For Land Cranes Only).
16	TRAVEL (One Track) —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. (For Land Cranes Only).
17	EXTEND BOOM (Telescoping Booms) —Both fists in front of body with thumbs pointing outward.
18	RETRACT BOOM (Telescoping Boom) —Both fists in front of body with thumbs pointing toward each other.
19	EXTEND BOOM (Telescoping Boom) —One Hand Signal. One fist in front of chest with thumb tapping chest.
20	RETRACT BOOM (Telescoping Boom) —One hand signal. One fist in front of chest, thumb pointing outward and heel of fist tapping chest.

CONTROL SYMBOLS IDENTIFICATION

The following symbols are used on the remote control.

Cylinder	Extend		Pin, Hinge (telescopic beam)	
	Retract			
Cylinder, Counterweight Lifting			Energize (turn on)	
Cylinder, Telescopic Beam			Set-Up (remote)	
Engine			Speed:	Fast
Jack:	Extend		Slow	
	Retract		Stop, Emergency	
Jack (location):	Left Front		Wheels, Right	
	Left Rear		Wheels, Left	
	Right Front		Wheels, Rotate:	Clockwise
	Right Rear		Counterclockwise	
	All			
Pin:	Extend			
	Retract			

M3-2

FIGURE 3-1

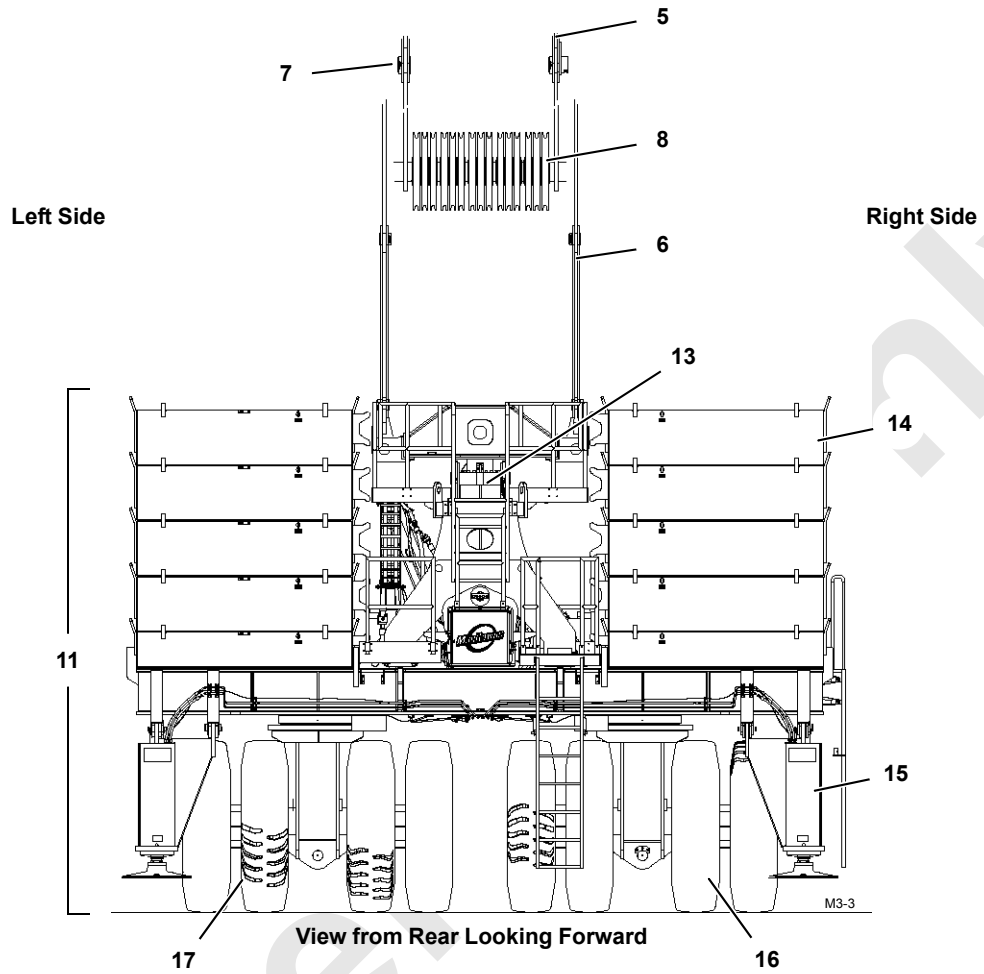
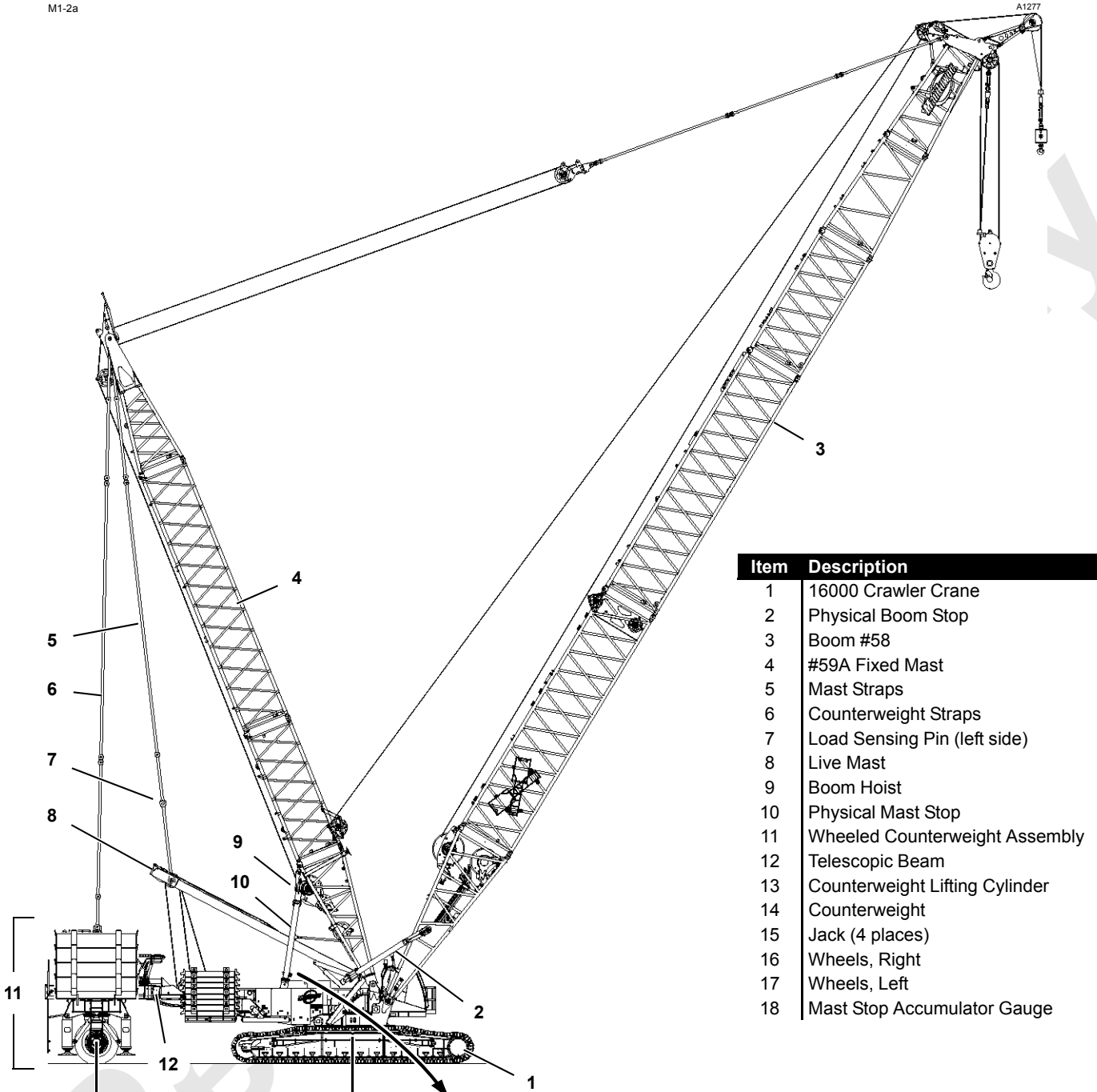


FIGURE 3-2

3

M1-2a



Item Description

- 1 16000 Crawler Crane
- 2 Physical Boom Stop
- 3 Boom #58
- 4 #59A Fixed Mast
- 5 Mast Straps
- 6 Counterweight Straps
- 7 Load Sensing Pin (left side)
- 8 Live Mast
- 9 Boom Hoist
- 10 Physical Mast Stop
- 11 Wheeled Counterweight Assembly
- 12 Telescopic Beam
- 13 Counterweight Lifting Cylinder
- 14 Counterweight
- 15 Jack (4 places)
- 16 Wheels, Right
- 17 Wheels, Left
- 18 Mast Stop Accumulator Gauge

Working Positions

- 36.1 ft — 11 m
- 42.7 ft — 13 m
- 49.2 ft — 15 m



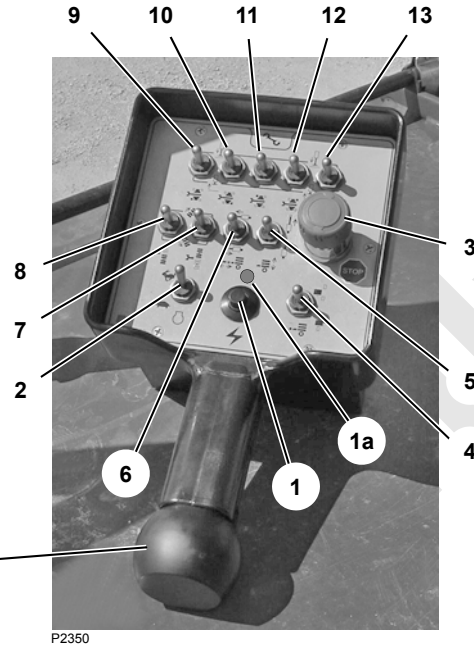
Typical 2 Places

FIGURE 3-2 continued

Item	Description
1	Power Switch
1a	Power ON Light
2	Engine Speed Switch
3	Emergency Stop Switch
4	Hinge Pin Switch (telescopic beam)
5	Counterweight Lifting Cylinder Switch
6	Telescopic Beam Switch
7	Right Wheels Steering Switch
8	Left Wheels Steering Switch
9	Left Front Jack Switch
10	Left Rear Jack Switch
11	Right Front Jack Switch
12	Right Rear Jack Switch
13	All Jacks Switch

Unscrew for Battery Access.

- Use two, AA lithium batteries. Two AA alkaline batteries can be used, but battery life will be less during cold weather.
- Make sure gasket is intact.



P2350

FIGURE 3-3

MAX-ER OPERATION — GENERAL

Manitowoc assumes that a qualified crane operator will be used to operate the 16000 with MAX-ER attachment. The operator shall be thoroughly familiar with the 16000 operating controls, RCL (Rated Capacity Indicator/Limiter) display, and main display.

If the MAX-ER is equipped with a luffing jib, see Section 3 of Luffing Jib Operator Manual for identification and operation of the luffing jib controls and additional operating precautions.

COUNTERWEIGHT REQUIREMENTS

! 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 section, in Section 3 of Crane Operator Manual, in Section 3 of Luffing Jib Operator Manual, and in RCL Operation Manual.*

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

The instructions in this section supplement the operating control instructions in the Crane Operator Manual.

! WARNING

Tipping Hazard!

Tipping or structural damage can occur if proper counterweight is not installed.

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

See Section 4 of this manual and MAX-ER Capacity Charts for counterweight identification and requirements.

MAX-ER SET-UP MODE

To operate Drums 4 and 5 (live mast and fixed mast) when assembling and disassembling the MAX-ER attachment, the MAX-ER set-up mode must be selected.

See Selecting Crane Configuration in RCL Operation Manual for detailed instructions.

When properly configured, the MAX-ER Set-Up Capacity Chart number and icon appear on the RCL working screen as shown in [Figure 3-4](#).

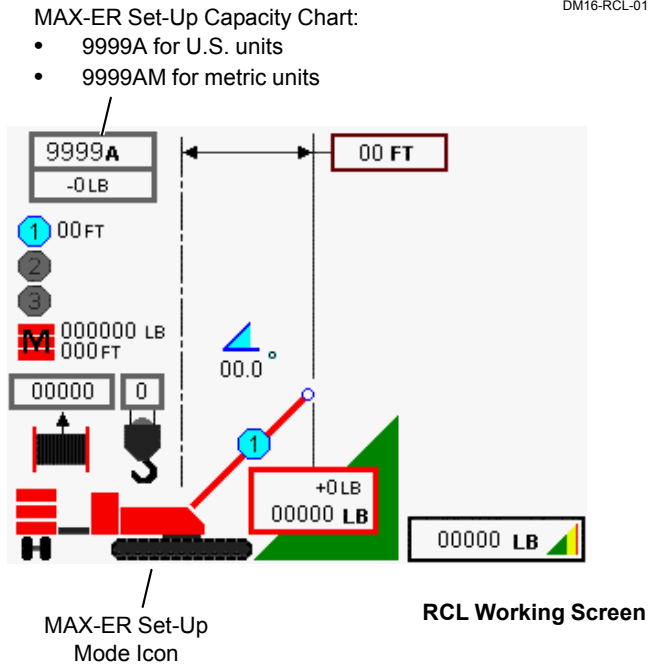


FIGURE 3-4

MAX-ER REMOTE CONTROL

Crane Serial Number 16001128 and Newer

The swing and travel alarm will sound continuously when a function is being operated with any of the following controls:

- Carbody Manual Remote Controls — Priority 1
- Crane Setup Remote Control — Priority 2
- Wheeled MAX-ER Setup Remote Control — Priority 3
- Hanging MAX-ER Setup Remote Control — Priority 4

Additionally on cranes meeting 2010 European Requirements and with crane software version FCN 2.654 and newer:

- No two remote controls can be operated at the same time. Each has an operating priority as indicated above.
- If you try to operate two remote controls at the same time, the remote control with the higher priority will operate. The other remote control will be disabled (turned off).

NOTE: Cranes Meeting 2010 European requirements have an RCL override switch mounted on the rear of the operator's cab (see Rated Capacity Indicator/Limiter Manual).

Turning On Remote Control

NOTE: The MAX-ER remote control can be operated in any mode.

To turn on the MAX-ER remote control, proceed as follows:

1. In function mode screen, enter MAX-ER remote control data box (Figure 3-5).
2. Verify that TXID number on screen matches number on top of remote control. If not, enter proper number.
3. Hold down power button on remote control.
4. Scroll up or down to turn on remote control (Figure 3-6).

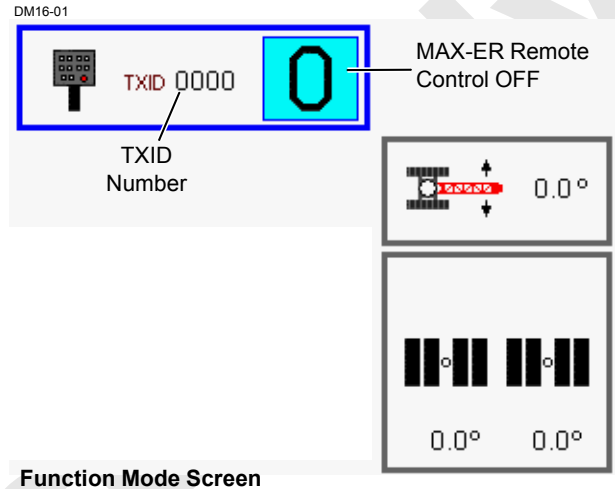


FIGURE 3-5

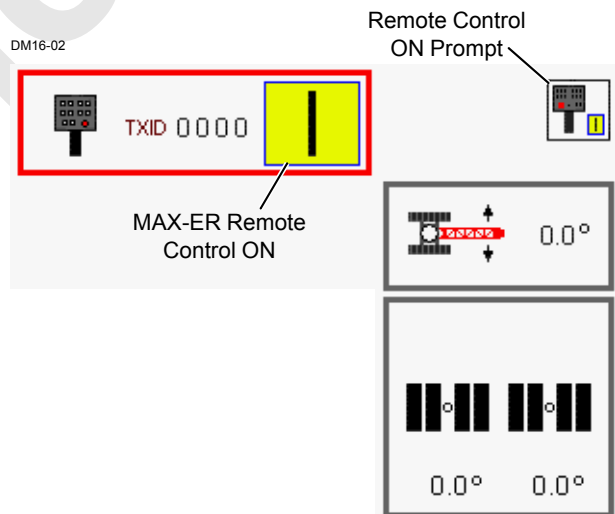


FIGURE 3-6

5. Continue to hold down power button on remote control until remote control ON prompt flashes in display. This could take 5-10 seconds.

The flashing prompt indicates the remote control is communicating properly.

6. Exit MAX-ER remote control data box to save setting.

7. Remote control remains on (remote control ON prompt remains in display) until it is turned off in function mode screen or until power is turned off.

Operating Remote Control

See [Figure 3-3](#) in the following procedure.

1. Power Switch

Button held DOWN to TURN ON the remote control and operate the remote controlled functions.

Button UP (released) to TURN OFF the remote control.

1a. Power ON Light

On cranes meeting 2010 European Requirements, the light glows amber when power is on.

NOTE: Cranes Meeting 2010 European requirements have an RCL override switch mounted on the rear of the operator's cab (see Rated Capacity Indicator/Limiter Manual).

2. Engine Speed Switch

Toggle UP to operate the engine at FAST speed.

Toggle DOWN to operate the engine at SLOW speed.

3. Emergency Stop Switch

Knob held DOWN to STOP the engine and all remote controlled functions in an emergency only — for example: if a function does not stop when the control is released to off or if any other uncontrolled motion of a function is observed.

Always use ignition switch in cab to stop engine for normal operating conditions.

Beware — when knob is pushed down, engine stops and any function being operated comes to an abrupt stop.

NOTE: The knob must be pulled UP to RESTART the engine and operate remote controlled functions.

4. Hinge Pins Switch

Toggle held UP to RETRACT the telescopic beam hinge pins.

RELEASE toggle to STOP hinge pins and lock them in last position.

Toggle held DOWN to EXTEND the telescopic beam hinge pins.

5. Counterweight Lifting Cylinder Switch

This switch is provided for set-up purposes only. It allows the counterweight straps to be slackened during MAX-ER installation and removal.

Toggle held UP to EXTEND counterweight lifting cylinder.

RELEASE toggle to STOP cylinder and lock it in last position.

Toggle held DOWN to RETRACT counterweight lifting cylinder.

6. Telescopic Beam Switch

Observe telescopic beam length on information screen or on MAX-ER diagnostic screen 2 when beam is being extended or retracted.

Toggle held UP to EXTEND telescopic beam.

RELEASE toggle to STOP telescopic beam and lock it in last position.

Toggle held DOWN to RETRACT telescopic beam.

7. Right Wheels Steering Switch

8. Left Wheels Steering Switch

Toggle held UP to rotate wheels CLOCKWISE.

RELEASE toggle to STOP wheels and lock them in last position.

Toggle held DOWN to rotate wheels COUNTER-CLOCKWISE.

9. Left Front Jack Switch

10. Left Rear Jack Switch

11. Right Front Jack Switch

12. Right Rear Jack Switch

Toggle held UP to EXTEND jack (raise carrier base).

RELEASE toggle to STOP jack and lock it in last position.

Toggle held DOWN to RETRACT jack (lower carrier base).

NOTE: The crane's crawler control handles can be used to position the wheels and jacks from inside the operator's cab. See Crawler Control Handles topic in this section.

13. All Jacks Switch

Toggle held UP to EXTEND all jacks at the same time.

RELEASE toggle to STOP jacks and lock them in last position.

Toggle held DOWN to RETRACT all jacks at the same time.

NOTE: When the ALL jacks switch is used, all of the jacks extend or retract at the same time. The crane's programmable controller will attempt to keep the carrier base as level as possible.

The swing and travel alarm will sound if the carrier base gets 3° out of level and the MAX-ER system fault icon ([Figure 3-7](#)) will appear in the fault screen.

The operator shall then level the base with the individual jack switches.

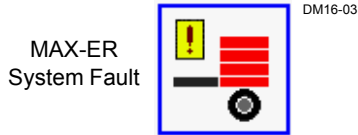


FIGURE 3-7

WARNING
Tipping Hazard!

Do not allow carrier base to go more than 3° out of level while jacking.

Jacks could buckle allowing wheeled counterweight to tip over.

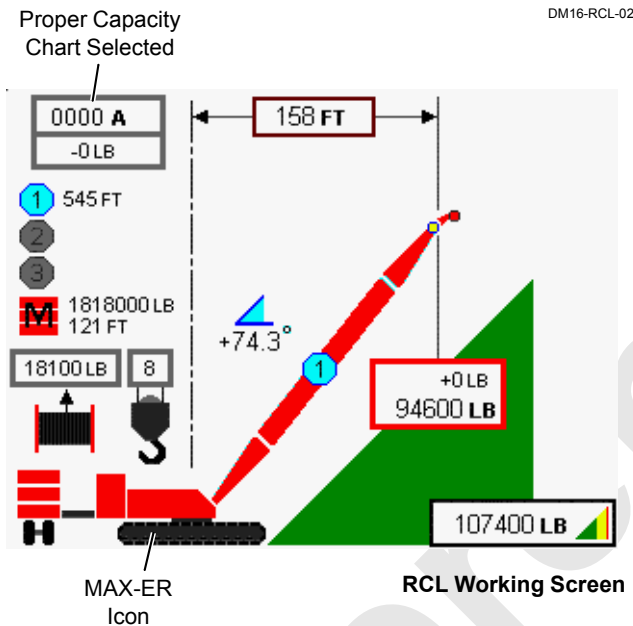


FIGURE 3-8

MAX-ER OPERATING MODE

The drum, swing, and travel controls operate in the same manner for MAX-ER operation as they do for standard crane operation. See Section 3 in the Crane Operator Manual for operation of the controls.

To operate the crane with the MAX-ER attachment, the RCL must be properly configured. See Selecting Crane Configuration in RCL Operation Manual for detailed instructions.

When properly configured, the proper MAX-ER Capacity Chart and icon will appear on the RCL working screen as shown in Figure 3-8. See MAX-ER Operator Information Manual in the crane cab for a complete list of MAX-ER capacity charts for your crane.

When the MAX-ER mode is on:

- The load sensing pin measures mast tension created by the lifted load.
- The load sensing pin sends a proportional voltage signal to the programmable controller.
- The programmable controller activates the crane’s electric and hydraulic systems to automatically extend and retract the counterweight lifting cylinder (raise and lower wheeled counterweight) in response to changes in mast tension as shown in Table 3-2.

Table 3-2

Mast Tension U.S. Tons	Counterweight Lifting Cylinder	Wheeled Counterweight
30	Retract	Raise
25	Stop Raising Carrier Base	
10	Extend	Lower
15	Stop Lowering Carrier Base	

Counterweight lifting cylinder will stop extending if straps get too slack.

CRAWLER CONTROL HANDLES

The crane’s crawler control handles can be used to operate the MAX-ER wheels and jacks from the operator’s cab.

To activate the crawler control handles for MAX-ER operation, proceed as follows:

- Select appropriate MAX-ER capacity chart on RCL.
- TURN ON travel park switch. The crane cannot be traveled.
- Depress and hold confirm button on display while operating either crawler handle.

Left Crawler Handle

Push handle FORWARD to EXTEND all jacks (raise carrier base).

Release handle to CENTER to STOP jacks and lock them in last position.

Pull handle BACK to RETRACT all jacks (lower carrier base).

CAUTION

Structural Damage!

There is no display or alarm in crane cab to indicate position of MAX-ER jacks.

When operating MAX-ER jacks from operator’s cab, signal person shall be used to signal position of jacks to operator.

Do not attempt to swing or travel until jacks are fully retracted. Jacks could buckle causing structural damage.

Right Crawler Handle

Push handle FORWARD to rotate wheels to SWING position. The wheels will stop automatically when they have rotated to the proper swing position. There are three positions corresponding to beam length (Figure 3-15).

Release handle to CENTER to LOCK wheels in last position.

Pull handle BACK to rotate wheels to STRAIGHT position. The wheels will stop automatically when they are straight.

To deactivate the crawler control handles for MAX-ER operation, TURN OFF travel park switch. The crane can now be traveled.

MAIN DISPLAY

See Main Display topic in Section 3 of Crane Operator Manual for detailed screen operation instructions.

MAX-ER Information Screens

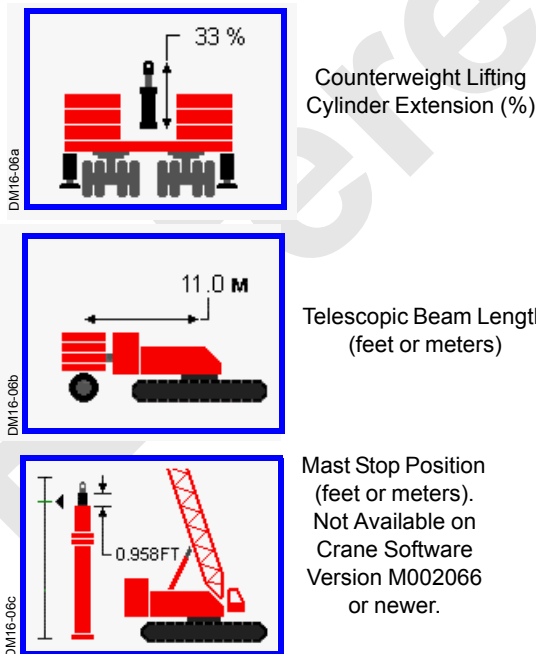


FIGURE 3-9

Information Screen

The information screen displays the MAX-ER information shown in Figure 3-9 and the faults shown in Figure 3-10. Press scroll button to access the four MAX-ER information screens.

There are three faults that can be activated during MAX-ER operation:

- Fault # 9 – MAX-ER Swing Park Fault
Activated if swing park switch is on when you attempt to travel. **Structural damage to swing drive can occur if swing brake is applied and swing lock (if equipped) is engaged when you travel.**

NOTE: Crane Serial Number 16001160 and newer do not have a swing lock.

- Fault # 27 – Mast Stop Retracted
MAX-ER lift and boom hoist up will be disabled. This fault cannot be bypassed. This fault will also activate if Node-6 electric cables are not connected properly.

NOTE: Fault #27 will only be available with crane software version M002066 or newer. The MAX-ER mast stop position information screen will not be available. See Mast Stop Limit Switch operation procedure.

- Fault # 47 – MAX-ER Wheel Alignment Fault
Activated if wheels are not in straight position when you attempt to travel. The travel handles will be inoperable.
- Fault # 48 – MAX-ER System Fault
Activated by any of the faults listed below. Check both MAX-ER diagnostic screens to see which fault has occurred.

- Counterweight lifting cylinder out of range. Use counterweight lifting cylinder switch to manually position lift cylinder.
- Counterweight lifting cylinder sensor out of range.
- MAX-ER base level sensor out of range.
- Wheel position encoder calibration is faulty.
- Mast position sensor out of range (Not available on Software Version M002066 and newer).
- Backhitch load sensor out of range.
- Telescopic beam length sensor out of range. Perform Telescopic Beam Sensor Calibration steps in Section 6.

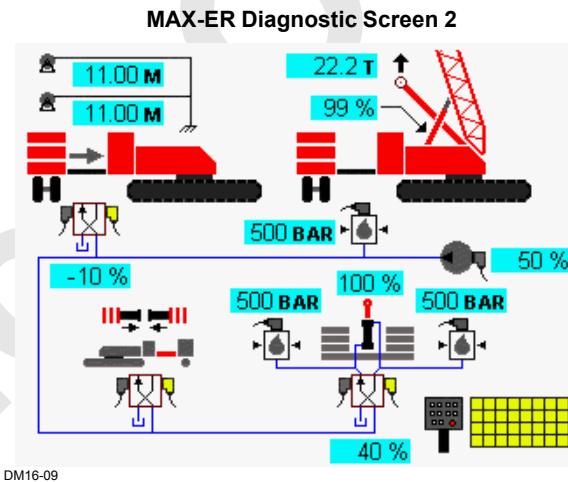
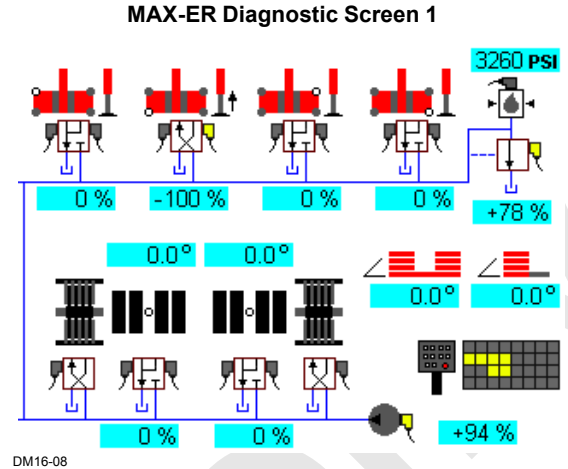
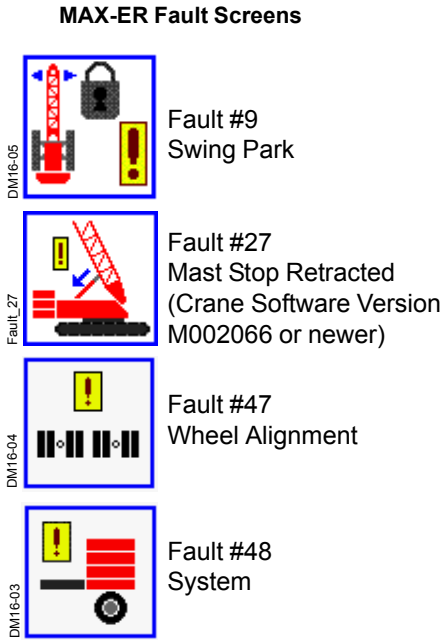


FIGURE 3-10

Diagnostic Screen

Select MAX-ER icon in diagnostic screen *level 1* as shown in [Figure 3-11](#). Press Enter button to go to *level 2*.

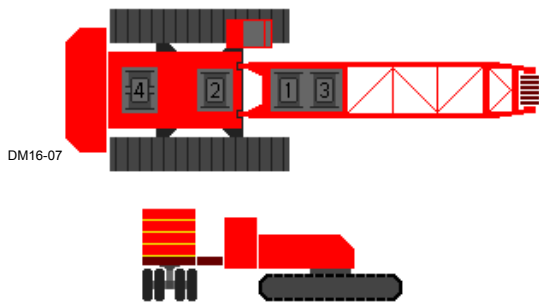


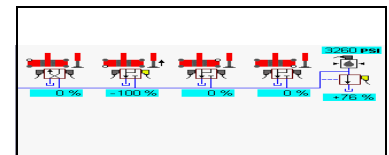
FIGURE 3-11

There are two level 2 MAX-ER diagnostic screens shown in [Figure 3-12](#): MAX-ER diagnostic screen 1 and MAX-ER diagnostic screen 2.

NOTE: MAX-ER diagnostic screen 2, the mast stop position in percent is not available with crane software version M002066 and newer.

MAX-ER Jacking

Displays command state of jacks in percent. Left rear jack retracted as shown.



- Full Retract Command is -100%
- Full Extend Command is +100%

Jacks must be fully retracted before traveling or swinging.

Wheel Assemblies

Displays command state of wheel assemblies in degrees and wheel brake on/off status. Brakes are released and wheel assemblies positioned for swinging shown in graphic.

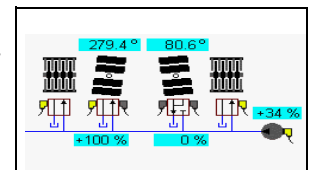
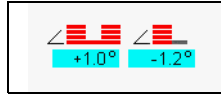


FIGURE 3-12

Counterweight Base Level

Displays image of the counterweight base level condition forward to rear and side to side in degrees. Unless otherwise specified in capacity charts, all operations must be performed with MAX-ER level to within one 1% of grade in all directions — 1 ft in 100 ft (0,3 m in 30 m); or MAX-ER could tip.



Wireless Remote Control

Displays wireless remote control status by indicating which switches are closed (displayed on both diagnostic screens). Each control switch corresponds with a number (Table 3-3). Switch numbers start from 1 through 8 in row one, 9 through 16 in row two, 17 through 24 in row three and 25 through 32 in row four. Not all switch numbers are used. Switch number 16 (Left Rear Jack - Extend) is enabled in example shown.

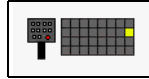
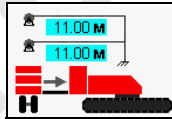


Table 3-3 Wireless Remote Switch Identification

No.	Description	No.	Description
1	Engine Low Speed	17	Right Front Jack - Retract
2	Engine High Speed	18	Right Front Jack - Extend
7	Left Wheel - Swing Left	19	Right Rear Jack - Retract
8	Left Wheel - Swing Right	20	Right Rear Jack - Extend
9	Right Wheel - Swing Left	21	All Jacks - Retract
10	Right Wheel - Swing Right	22	All Jacks - Extend
11	Telescopic Beam - Retract	23	Lift Cylinder - Retract
12	Telescopic Beam - Extend	24	Lift Cylinder - Extend
13	Left Front Jack - Retract	25	Telescopic Beam Pins- In
14	Left Front Jack - Extend	26	Telescopic Beam Pins - Out
15	Left Rear Jack - Retract	27	Emergency Stop
16	Left Rear Jack - Extend		

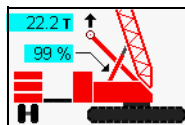
Telescopic Beam

Displays image of telescopic beam cable reel position in feet or meters when setting beam length to match crane configuration. The length shown is from center of MAX-ER to center of rotating axis of crane.



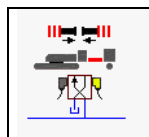
Mast Stop and Backhitch

Displays image of mast stop position in percent (not available with crane software version M002066 or newer). Also displays backhitch tension in weight.



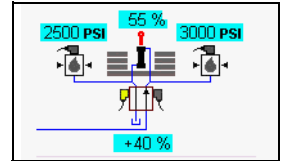
Telescopic Beam Hinge Pins

Displays command state of a telescopic beam hinge pins (engaged/disengaged). Pins shown disengaged in graphic.



Counterweight Lifting Cylinder

Displays command state of counterweight lifting cylinder in percent. Lifting cylinder shown at 55% in this graphic.



- Fully Retracted is 0%
- Fully Extended is 100%

MAST STOP LIMIT SWITCH

NOTE: The Mast Stop Limit Switch applies to software version M002066 or newer.

CAUTION

Structural Damage!

A qualified signal person watching the mast stop indicator rods will be necessary to alert the crane operator the mast is in position when performing crane set up procedures.

1. Verify the mast stop position information screen is not available on the front console crane display.
2. The MAX-ER mast stop limit switch will trigger crane fault #27 as the mast retracts the cylinders to 80% or beyond.
3. The crane controller will disable the MAX-ER lift cylinder and the boom hoist up functions.
4. Pay-out on drum 4 mast hoist to relieve cylinder pressure on the mast stops.
5. Fault #27 will clear when the cylinders extend beyond 80%.
6. All crane functions will be enabled.

MAINTENANCE CHECKS

Mast Stop Accumulator Gauge

See Item 18, [Figure 3-2](#).

Check both gauges WEEKLY. The gauges should read 200–280 psi (13,8–19,3 bar) regardless of outside air temperature.

If proper reading is not indicated at either gauge, determine cause of faulty pressure and take corrective action.

WARNING **Explosion Hazard!**

Mast stop cylinders are equipped with nitrogen pre-charged accumulators.

Do not tamper with accumulators unless authorized and trained to do so.

Tire Inflation

This topic applies only to the wheeled counterweight.

Check tire inflation weekly. Inflate tires equally:

- Goodyear: 140 – 145 psi (9,6 – 10,0 bar)
- Yokohama: 138 – 148 psi (9,5 – 10,2 bar)

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

Wheel Bolt Torque

Check wheel bolt torque MONTHLY. Torque wheel bolts ([Figure 3-13](#)) to 1,700 ft-lbs (2 305 Nm).

At assembly, apply Never-Seeze (or equivalent anti-seizing compound) to bolt threads, underside of bolt heads, and both sides of washers.

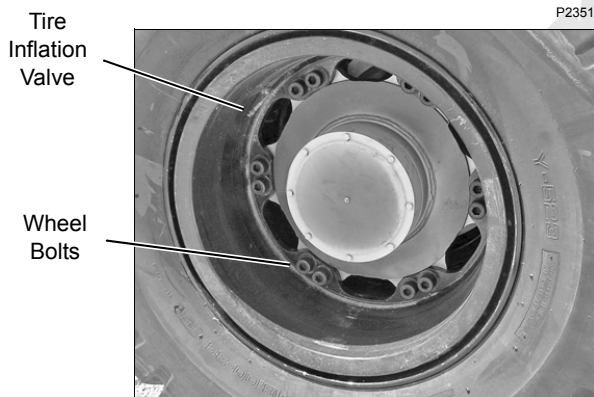


FIGURE 3-13

Mast Stop Limit Switch

Inspect and test the mast stop limit switch (software version M002066 and newer) during MAX-ER setup as follows:

1. Inspect the limit switch lever and actuating lever for freedom of movement.
2. Confirm Fault #27, Mast Stop Retracted, is active on the crane display when the mast stop limit switch is tripped at 26°.

OPERATING PRECAUTIONS

DANGER

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

1. Read instructions in this section and in MAX-ER Capacity Charts before operating crane.
2. If equipped with a luffing jib, also read instructions in Luffing Jib Operator Manual and in Luffing Jib Capacity Charts.
3. **Read and comply with instructions in MAX-ER Capacity Charts.** Do not operate beyond limits given.
4. Make sure the wheel position encoders and cable reel length potentiometers have been properly calibrated (see Section 6 in this manual).
5. Make sure proper counterweight is installed.
6. Make sure wheeled counterweight assembly is at proper operating position as specified in MAX-ER Capacity Charts.
7. When tires are on foundation, do not travel or swing crane until wheel assemblies have been rotated to proper position.
8. Make sure crawlers are blocked and proper amount of wheeled counterweight is installed — as specified in MAX-ER Capacity Chart — before raising and lowering boom from and to ground.
9. Make sure load sensing pin and all sensors are properly calibrated (counterweight lifting cylinder, beam cylinder, and wheels); otherwise, wheeled counterweight assembly will not operate properly. See Section 6 of this manual for procedures.
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. Turn on MAX-ER operating mode for operation with wheeled counterweight assembly installed (see MAX-ER Operating Mode topic in this section).

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 operating mode or engine is turned off during operation.

12. Access information screen on main display to monitor MAX-ER operating conditions.
13. Operate only with crane on a firm surface that is uniformly supporting:
 - **With load**, grade must not exceed 1% in any direction — 1 ft in 100 ft (0,3 m in 30 m).
 - **Without load**, see Maximum Allowable Travel Specifications Chart.
 - Make sure foundation under crane and under wheeled counterweight assembly is at same level. **Mast can buckle if counterweight is lowered below grade.**
14. Do not operate crane, to include raising boom and luffing jib from ground level, if wind exceeds limits given in MAX-ER Capacity Charts. Contact your local weather station for wind velocity.
15. Be aware of increased tail swing with wheeled counterweight assembly installed. Counterweight assembly can strike objects or personnel in area of travel and swing paths.
16. 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.
17. Do not swing or travel until jacks are fully retracted.
18. Provide a signal person for all crane operations.

Have signal person watch for clearance under tires while swinging and traveling. Do not allow wheeled counterweight assembly to strike obstructions.

Depending on lifted load, clearance under tires can be as much as 20 in (508 mm).
19. Before disconnecting wheeled counterweight assembly from rear of crane (operating from 0 counterweight column of capacity chart), **fully retract telescopic**

beam to prevent wheeled counterweight assembly from tipping over.

20. Observe the following precautions for jacks:
 - Make sure foundation is strong enough to support load placed on jack pads. Steel or timber mats must be used to distribute loading as required.

Maximum load on each jack is 161,635 lb (73 316 kg).

Area of each jack pad is 731 in² (4 716 cm²).
 - Prior to operating jacks when wheeled counterweight assembly is connected to crane, disconnect struts from jacks (Figure 3-14). **Struts will be damaged if this step is not performed.**
 - Prior to disconnecting wheeled counterweight assembly from crane, connect struts to jacks (Figure 3-14). **Wheeled counterweight assembly will fall over if this step is not performed.**

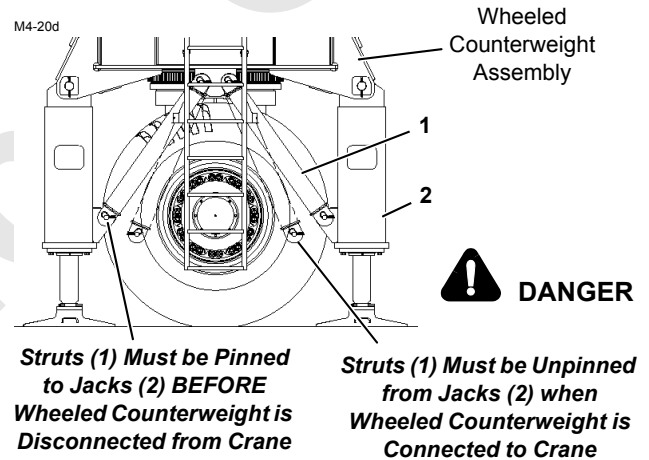


FIGURE 3-14

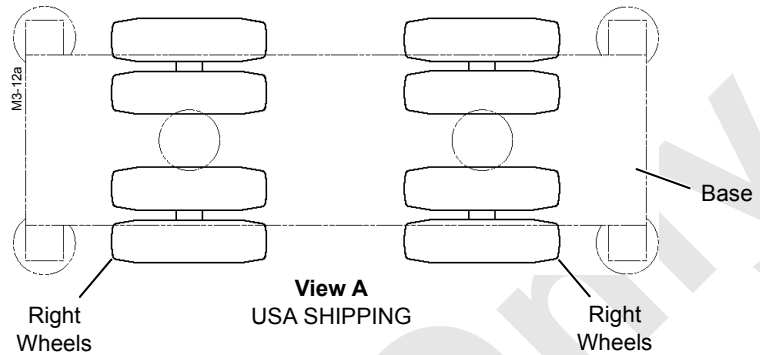
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All Views from TOP Looking FORWARD

Wheel Angles in Tables are Viewable in Function Mode Screen (Figure 3-5)

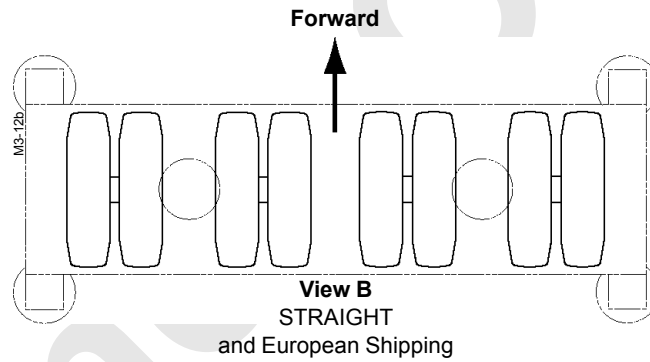
WHEEL ANGLES	
Left Wheels	Right Wheels
90°	270°

Wheels do not stop automatically at these positions. Operator shall stop wheels at these positions using right crawler handle or remote control.



WHEEL ANGLES	
Left Wheels	Right Wheels
0°	0°

Wheels stop automatically at these positions.



WHEEL ANGLES		
Beam Length	Left Wheels	Right Wheels
36.1 ft — 11 m	279.4°	80.6°
42.7 ft — 13 m	278.2°	81.8°
49.2 ft — 15 m	276.9°	83.1°

Wheels stop automatically at these positions.

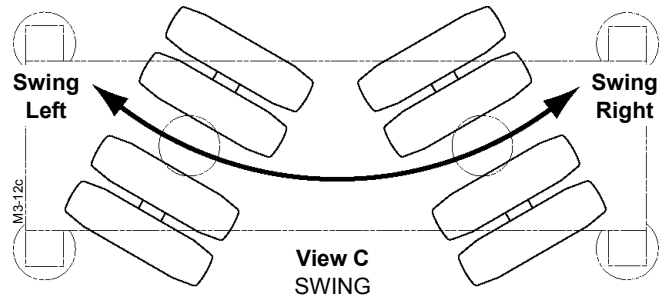


FIGURE 3-15

MAX-ER OPERATION

Handling Loads

1. Turn on MAX-ER mode as described earlier in this section.
2. Access desired MAX-ER screen on main display to monitor MAX-ER operating conditions.

3. Position a signal person in clear view of counterweight carrier and crane operator. **Signal person shall signal position of wheels and jacks to operator.**

NOTE: If the operator tries to swing when the wheels are in the straight position, the swing handle will be inoperable and the fault alert will come on.

If the operator tries to travel when the wheels are in the swing position, the crawler handles will be inoperable and the fault alert will come on.

- Extend or retract telescopic beam (with switch on remote control) to position counterweight carrier at required working position per capacity chart in use ([Figure 3-2](#)).

Beam does not stop automatically. Operator shall stop it at required working position.

- The counterweight lifting cylinder will automatically lift the wheeled counterweight assembly off the foundation and set it back down when required depending on load (governed by boom angle, boom length, lifted load).
- The wheels must be in the straight position to travel. If they are not, the travel handle will be inoperable and the MAX-ER wheel alignment fault will come on when you try to travel.
- The wheels must be in the proper swing position to swing. If they are not, the swing handle will be inoperable and the MAX-ER wheel alignment fault will come on when you try to swing.
- Block crawlers if required before lowering boom to ground (see MAX-ER Capacity Chart for requirements).

Traveling

Straight Travel / Gradual Turns

See [Figure 3-15](#), View B for the following procedure.

- Swing upperworks and wheeled counterweight assembly in-line with crawlers (perform Swinging steps).
- Raise wheeled counterweight assembly with jacks until bulge is out of tires. Use left crawler handle in cab or switch on remote control.
- Rotate wheel assemblies to straight position using right crawler handle in cab. The wheels will stop automatically when they are straight. The wheel angles given in [Figure 3-15](#) will be displayed in the Function Mode Screen ([Figure 3-5](#)).

If the wheels are not in the straight position when you try to travel, the crawler handles will be inoperable and the MAX-ER wheel alignment fault will come on.

- Fully retract jacks. Use left crawler handle in cab or switch on remote control.

CAUTION **Structural Damage!**

Do not attempt to swing or travel until jacks are fully retracted. Jacks could buckle causing structural damage.

- Turn off travel park and swing park with switches on front console.

CAUTION

Swing Drive Damage!

Do not attempt to travel straight or make turns while swing park is on. Damage to swing drives will result.

- Proceed to travel forward or in reverse.
- Gradual turns while traveling straight are permitted in forward direction only. However, keep a close watch on tires during this procedure. If tire scraping is excessive, reduce radius of turn.

CAUTION

Machinery Damage!

Do not attempt gradual turns while traveling in reverse. Telescopic beam can be damaged.

Sharp Turns

- Pin wheels in straight position (perform Straight Travel steps).
- Disengage swing lock and release swing brake.
- Counter-rotate crawlers to desired position.

CAUTION

Machinery Damage!

Do not counter-rotate crawlers without first disengaging swing lock, releasing swing brake, and rotating wheels to straight position. Swing drives or telescopic beam between wheeled counterweight assembly and crane can be damaged.

- Swing upperworks and wheeled counterweight assembly in-line with crawlers (perform Swinging steps).
- Proceed to travel straight (perform Straight Travel steps).

Swinging

See [Figure 3-15](#), View C for the following procedure.

- Raise wheeled counterweight assembly with jacks until bulge is out of tires. Use left crawler handle in cab or switch on remote control.
- Rotate wheel assemblies to swing position using right crawler handle in cab. The wheels will stop automatically at the proper swing position.

If the wheels are not in the proper swing position when you try to swing, the swing handle will be inoperable and the MAX-ER wheel alignment fault will come on.

3. Fully retract jacks. Use left crawler handle in cab or switch on remote control.
4. Turn off travel park and swing park with switches on front console.
5. Proceed to swing right or left.

CAUTION**Structural Damage!**

Do not attempt to swing or travel until jacks are fully retracted. Jacks could buckle causing structural damage.

For additional swing and travel information, see Swing and Travel Specifications in MAX-ER Capacity Chart Manual.

LEAVING CRANE UNATTENDED

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

1. Position boom at mid-point of boom angle range given in MAX-ER Capacity Chart.
2. If wheeled counterweight did not lower to ground when step 1 was performed, extend jacks using remote control until jack pads are as close to ground as possible, but no closer than 1 – 2 in (25 – 51 mm).
3. Engage boom hoist pawl and secure boom against movement by wind or other outside forces.

WIND CONDITIONS



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, reducing 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 adversely affects lifting capacity and stability. The result could be loss of control over the load and crane, even if the load is within the crane's capacity.

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

Beware that wind speed at boom point can be greater than wind speed at ground level. Also beware 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 the end of this section or, if applicable, see wind conditions in Capacity Charts provided with MAX-ER attachment.

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.

GENERAL SET-UP AND INSTALLATION

This section contains installation and removal instructions for the wheeled counterweight assembly, the fixed mast, and the boom.

For set-up and installation of the luffing jib, see the instructions in Section 4 of the Luffing Jib Operator Manual.

The attachment must be installed, operated, and removed by experienced personnel trained in erection and operation of construction cranes. These personnel shall read and become thoroughly familiar with instructions in this section, in the Operator Manual supplied with the crane, and in the MAX-ER Capacity Charts before attempting to install, operate, or remove attachment.

Contact the Manitowoc Crane Care Lattice Team for a detailed explanation of any procedure you do not fully understand.

The installation and removal area must be firm, level, and free of ground and overhead obstructions.

Level = 1% of grade or 1 ft (0,03 m) in 100 ft (30,5 m).

The area selected must be large enough to accommodate the crane with wheeled counterweight and the selected boom length.

There should be at least 35 ft (10,7 m) of clearance on both sides of the crane and boom to allow for movement of an assist crane and aerial work platforms.

CRANE ORIENTATION

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

ACCESSING PARTS

Some parts of the crane and MAX-ER Attachment cannot be reached from the ground. Take necessary precautions to prevent slipping and /or falling off the wheeled counterweight assembly and the crane during assembly, disassembly, maintenance, or other work. **Falling from any height could result in serious injury or death.**

The owner/user shall provide workers with approved ladders or aerial work platforms to access those areas of the crane, wheeled counterweight assembly, fixed 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.

Do not use top of fixed mast, boom, or telescopic beam as walkways.

ASSIST CRANE REQUIREMENTS

An assist crane is required to install and remove parts.

The heaviest individual weight to be lifted is the counterweight base and wheel support assembly which weighs approximately 63,000 lb (28 580 kg).

Owner/user shall ensure that all rigging used to handle loads (hooks, slings, shackles, etc.) and assist crane are in safe, proper working order and sized to lift applicable load.

NOTE: If desired once the fixed mast is raised, the boom can be raised and used to assemble the wheeled counterweight assembly. The Model 16000 can then be traveled and swung to connect the counterweight assembly to the crane.

See MAX-ER Capacity Charts to determine how much boom can be raised with 0 lb (0 kg) of wheeled counterweight installed. The crane must be equipped with full counterweight (C1 and C2 in [Figure 4-3](#)).

A hold-back force is required to raise and lower the fixed mast. Either an assist crane or the crane's own boom can be used.

- If an assist crane is used, it must provide the forces given in [Figure 4-1](#).

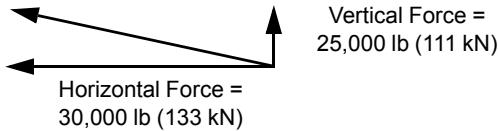


FIGURE 4-1

- If crane's own boom is used, a minimum boom length of 137.8 ft (42 m) is required.

MAX-ER WEIGHTS

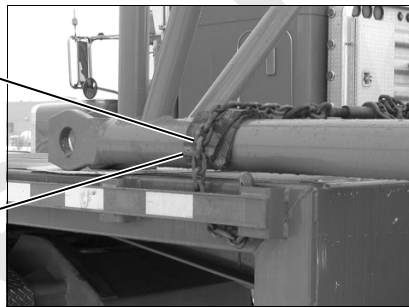
See Section 1 for the weights of individual MAX-ER components.

SHIPPING COMPONENTS



Nylon Tie-Down Wrapped Over Boom Chord

View A



Chain Tie-Down Wrapped Over Boom Chord

Protective Covering (section of rubber tire)

View B

FIGURE 4-2

It is the owner/user's responsibility to ensure the following:

- All trailer loads comply with local, state, and federal transportation requirements
- All crane components are properly blocked and secured so they cannot shift or fall off trailers
- To avoid damage to components:

Use nylon tie-downs to secure components as shown in View A

If chain tie-downs are used, install protective covering (such as sections of rubber tire) between the chain and component being secured as shown in View B.

When securing boom sections, wrap tie-downs over chords — never over lacings. Keep tie-downs as close to blocking as possible (View A) to prevent bending the chords.

OPERATING CONTROLS

Become thoroughly familiar with the location and function of all operating controls provided for the crane and attachment. Read and understand the instructions in Section 3.

- To operate Drum 5 (and Drum 4) while performing procedures in this section, the **MAX-ER Set-Up Mode** in the RCL (Rated Capacity Indicator/Limiter) must be selected. See Selecting Crane Configuration topic in RCL Operation Manual for detailed instructions.
- To operate the MAX-ER remote control while performing procedures in this section, you shall turn ON the wireless remote mode in the MAX-ER Function Mode screen of the Main Display. See Section 3 for detailed instructions.

NOTE: The engine will not start when the boom is removed until terminating plug (11, View E, [Figure 4-4](#)) is connected to electric cable (WNE16T).

COUNTERWEIGHT REQUIREMENT

MAX-ER operation requires the amount of counterweight specified in [Figure 4-3](#).

! WARNING
Tipping Hazard!

Tipping can occur if proper counterweight is not installed. Do not operate crane with MAX-ER Attachment until proper counterweight is installed.

BLOCKED CRAWLERS

To prevent crane from tipping, some boom lengths must be raised and lowered over end of blocked crawlers. See the Capacity Charts for blocked crawler requirements and the Crawler Blocking Diagram in the Capacity Chart Manual for instructions.



DANGER

Tipping Hazard!

Do not attempt to raise or lower boom from or to ground until crawlers are blocked if required. Crane will tip.

RETAINING CONNECTING PINS

Connecting pins are retained in various ways:

- Snap pins
- Safety Pins
- Quick-release pins
- Cotter pins
- Keeper plates with cap screws and lock washers

Do not operate crane until all connecting pins are installed and properly retained.

HANDLING FIXED MAST AND BOOM SECTIONS

Handle fixed mast and boom sections with care to avoid damaging lacings and chords. The mast and boom sections have lifting lugs designed to provide a balanced load and to prevent damage during lifting.



WARNING

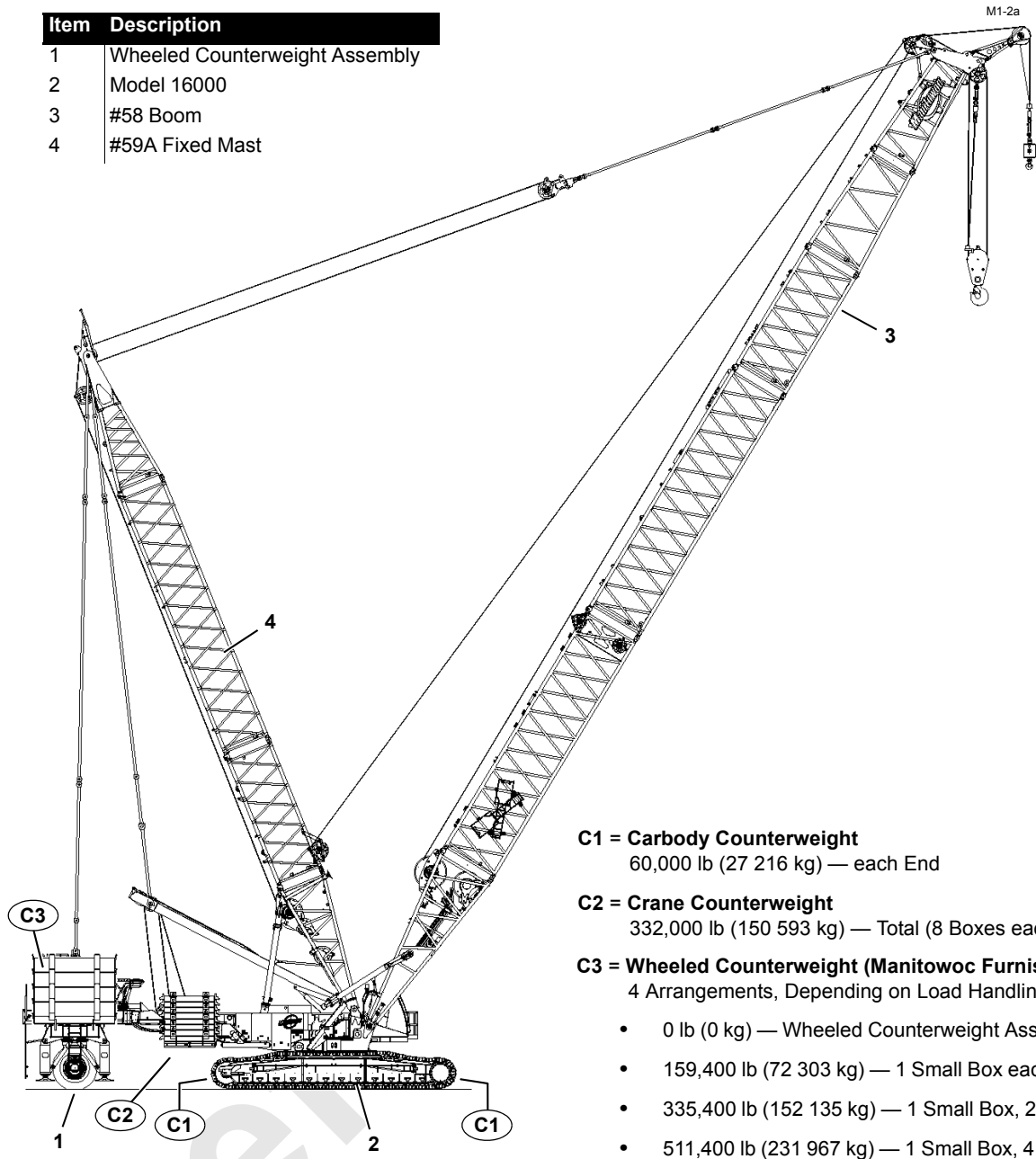
Falling Load Hazard!

Lifting lugs on a particular mast or boom section are designed for lifting that section only. Do not attempt to lift two or more mast or boom sections with lifting lugs only on one section. Lifting lugs may break allowing sections to fall.

When lifting lugs are not used:

- 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.
-

Item	Description
1	Wheeled Counterweight Assembly
2	Model 16000
3	#58 Boom
4	#59A Fixed Mast



C1 = Carbody Counterweight

60,000 lb (27 216 kg) — each End

C2 = Crane Counterweight

332,000 lb (150 593 kg) — Total (8 Boxes each Side)

C3 = Wheeled Counterweight (Manitowoc Furnished Boxes)

4 Arrangements, Depending on Load Handling Requirements —

- 0 lb (0 kg) — Wheeled Counterweight Assembly Removed *
- 159,400 lb (72 303 kg) — 1 Small Box each Side
- 335,400 lb (152 135 kg) — 1 Small Box, 2 Large Boxes each Side*
- 511,400 lb (231 967 kg) — 1 Small Box, 4 Large Boxes each Side*

* Also Used for Luffing Jib with MAX-ER Attachment.

FIGURE 4-3

INSTALLING MAX-ER ATTACHMENT

Prepare Crane

The 16000 must be traveled and swung to connect the wheeled counterweight assembly to the crane.

If another crane is used to assemble wheeled counterweight assembly, connect the wheeled counterweight assembly to the 16000 before the fixed mast and boom are installed so the 16000 can be traveled and swung.

If 16000 is used to assemble wheeled counterweight assembly, completely assemble the 16000, to include the

following (see Section 3 of Crane Operator Manual for detailed assembly instructions):

- Carbody counterweight
- Crane counterweight
- Fixed Mast — 98.5 ft (30 m) raised to operating position
- Boom — It will be necessary to raise the boom so the crane can be traveled and swung while installing the wheeled counterweight assembly. ***Do not install any more boom than can be raised with 0 lb (0 kg) of wheeled counterweight installed (see MAX-ER Capacity Charts)***

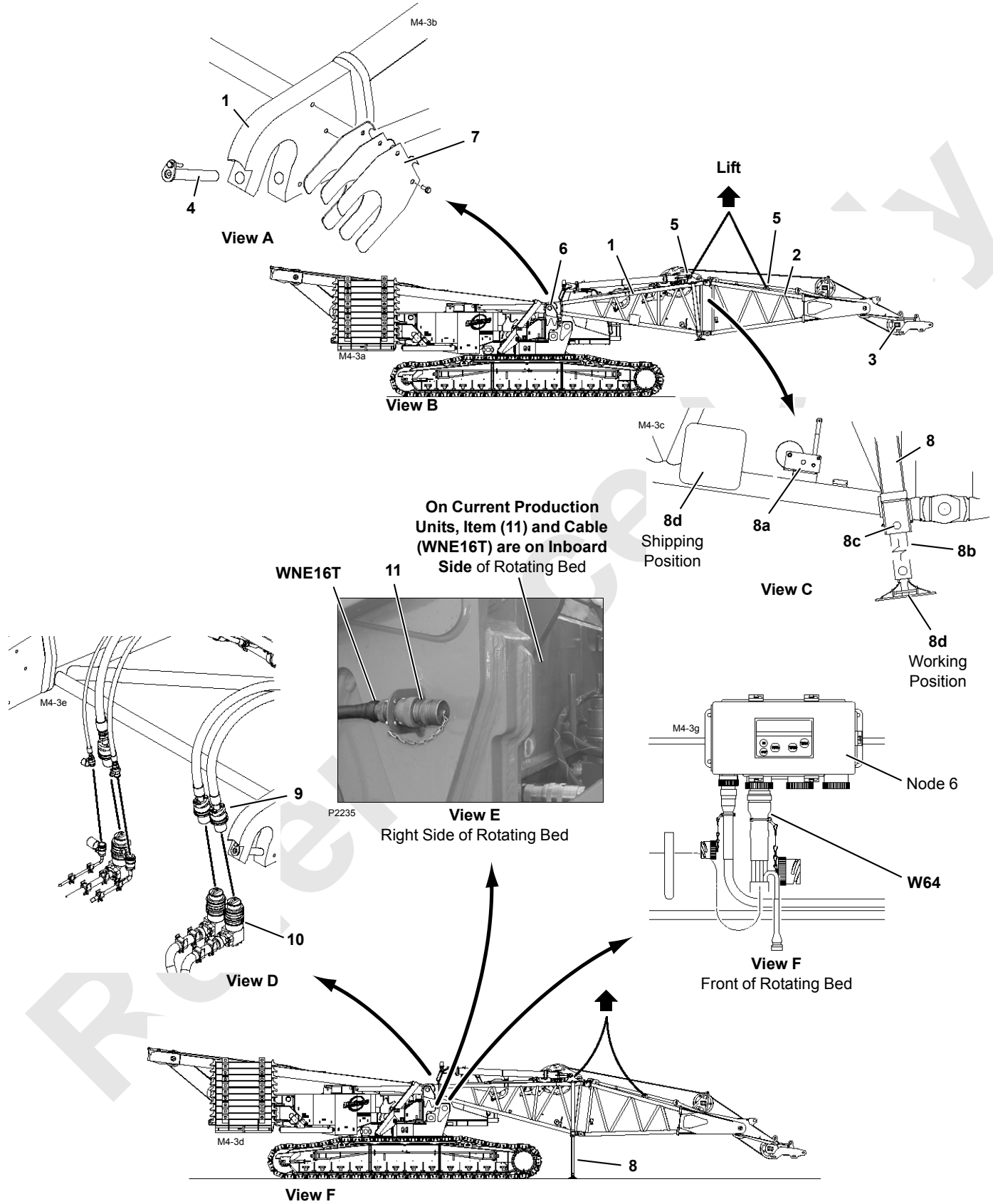


FIGURE 4-4

Legend for [Figure 4-4](#)

Item	Description	Item	Description
1	Mast Butt	8b	Mast Support Leg
2	Mast Top	8c	Pin with Cotter Pin
3	Equalizer	8d	Pad with Pin and Cotter Pin
4	Pin with Cap Screw and Lock Washer (2 places)	9	Hydraulic Hoses in Mast Butt
5	Lifting Lugs (4 places)	10	Couplers on Rotating Bed
6	Mast Hinge Pin (2 places)	11	Terminating Plug with Protective Cap
7	Shims with Cap Screws and Lock Washers	WNE16T	Electric Cable on Crane
8	Mast Support (2 places)	W64	Electric Cable from Drum 5 in Mast Butt
8a	Hand Winch		

Assemble Fixed Mast

An assist crane is required to assemble and install the fixed mast.

NOTE: Disconnect hydraulic hoses for boom from storage position on front of rotating bed ([Figure 4-15](#), View F, in this section). Allow hoses to hang down at front of rotating bed.

Hoses will be damaged when mast is raised if you do not perform this step.

Install Mast Butt and Top

See [Figure 4-4](#) for the following procedure.

Mast butt (1), mast top (2), and boom hoist equalizer (3) are shipped assembled as shown in View B.

1. Remove pins (4, View A) from end of mast butt (1).
2. Attach lifting slings from assist crane to lifting lugs (5, View B) on mast butt (1) and mast top (2).
3. Lift mast butt and top into position at front of crane so hooked ends of mast butt (1) engage mast hinge pins (6) in rotating bed.
4. Install pins (4).
5. Shim mast (View A):
 - a. Center mast on rotating bed.
 - b. Install thickest shim (7) between both outboard sides of mast butt and rotating bed lugs.
 - c. Install next thickest shim between both sides of mast butt and first shim.
 - d. If possible, install the thinnest shim between both sides of mast butt and previous shim.

- e. Mast side play must not exceed 0.08 in (2 mm).
 - f. Align holes in shims with holes in mast butt and securely install cap screws with lock washers.
6. Lower mast supports (View C):
- a. Lower mast to approximately 5° below horizontal.
 - b. Take up slack in mast support cable with hand winch (8a).
 - c. Tension cable just enough to hold mast support legs (8b) in position when step [6d](#) is performed.
 - d. Remove pins (8c).
 - e. Extend mast support legs until pins (8c) can be reinstalled. **If legs are lowered too far they will fall out of support tubes.**
 - f. Remove mast support pads (8d) from shipping position and install them on mast support legs.
7. Lower mast butt and top until mast support pads are on foundation and lifting slings are slack.
8. Remove protective caps from five hydraulic hoses (9, View D) on mast butt and from five couplers (10) on rotating bed. **Thoroughly clean couplers.**
9. Connect hydraulic hoses from mast butt to couplers on rotating bed. Hoses must not cross.
10. Unscrew protective cap from electric cable (W64) in mast butt.
11. **Thoroughly clean connectors**, and connect electric cable (W64) to corresponding receptacle on Node 6 (View F).

NOTE: Refer to [Figure 4-5](#) for electrical connections on current production cranes with software version M002066 or newer.

**NODE 6 Electrical Connections for Current Productions Cranes
with Software Version M002066 or Newer**

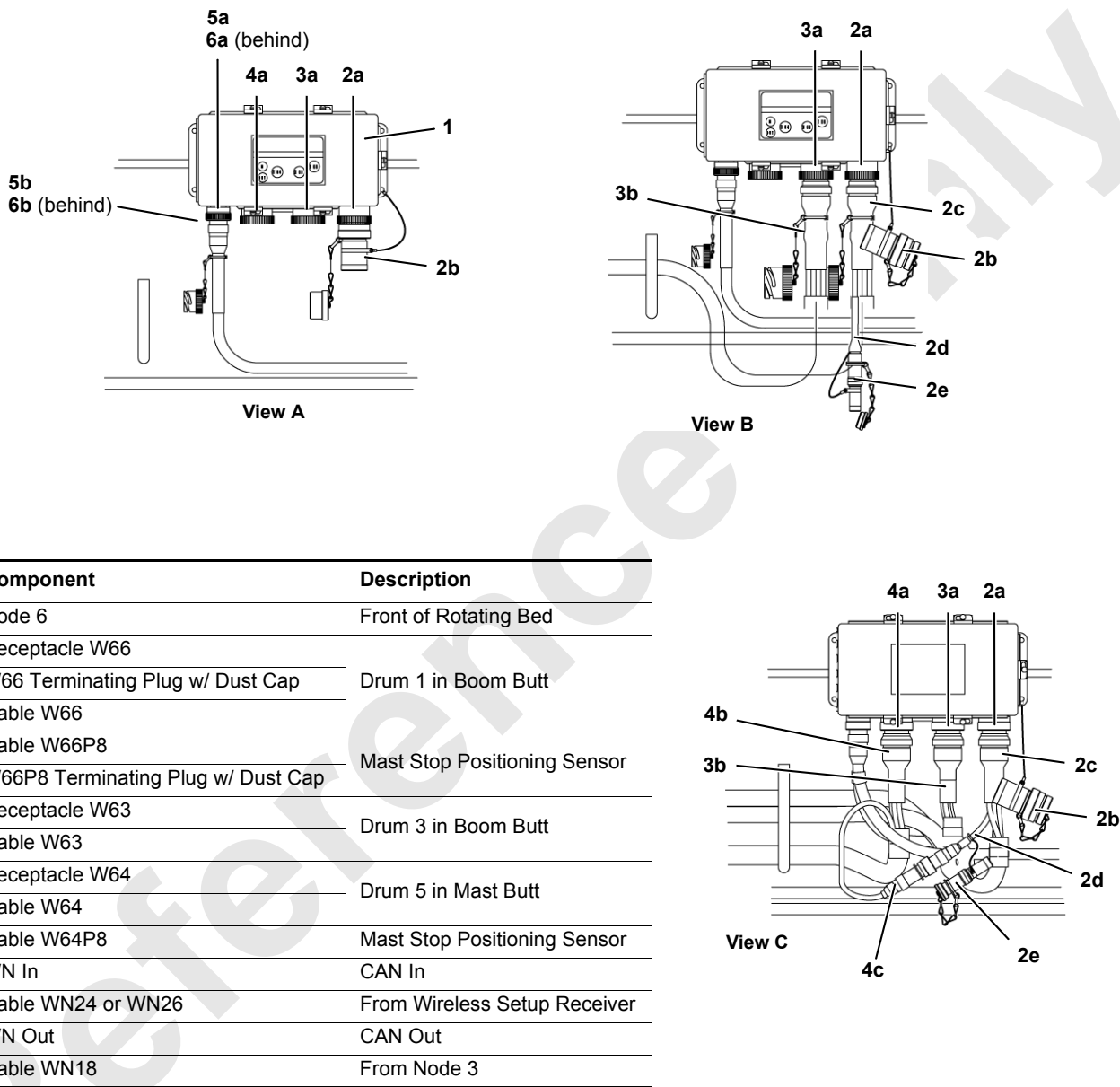


FIGURE 4-5

See [Figure 4-5](#) for the following procedure.

View A — Shipping Configuration

1. Connect terminating plug (2b, View A) to Node-6 receptacle (2a).

View B — Working Configuration with Boom

1. Disconnect terminating plug (2b, View A) from receptacle (2a). Connect the sealing cap to the end of the terminating plug and let the terminating plug hang freely.
2. Connect electric cable (2c, View B) from the boom butt to receptacle (2a).
3. Connect terminating plug (2e, View B) to electric cable (2d).
4. If equipped with a luffing hoist, connect electric cable (3b, View B) to receptacle (3a).

View C — Working Configuration with MAX-ER

1. Disconnect terminating plug (2b, View A) from receptacle (2a). Connect the sealing cap to the end of the terminating plug and let the terminating plug hang freely.
2. Connect electric cable (2c, View B) from the boom butt to receptacle (2a).
3. Connect terminating plug (2e, View B) to electric cable (2d).
4. If equipped with a luffing hoist, connect electric cable (3b, View B) to receptacle (3a).
5. Disconnect terminating plug (2e, View B) from electric cable (2d). Connect the sealing cap to the end of the terminating plug and let the terminating plug hang freely.
6. Connect electric cable (4b, View C) from the mast butt to receptacle (4a).
7. Connect electric cable (2d, View C) to electric cable (4c).

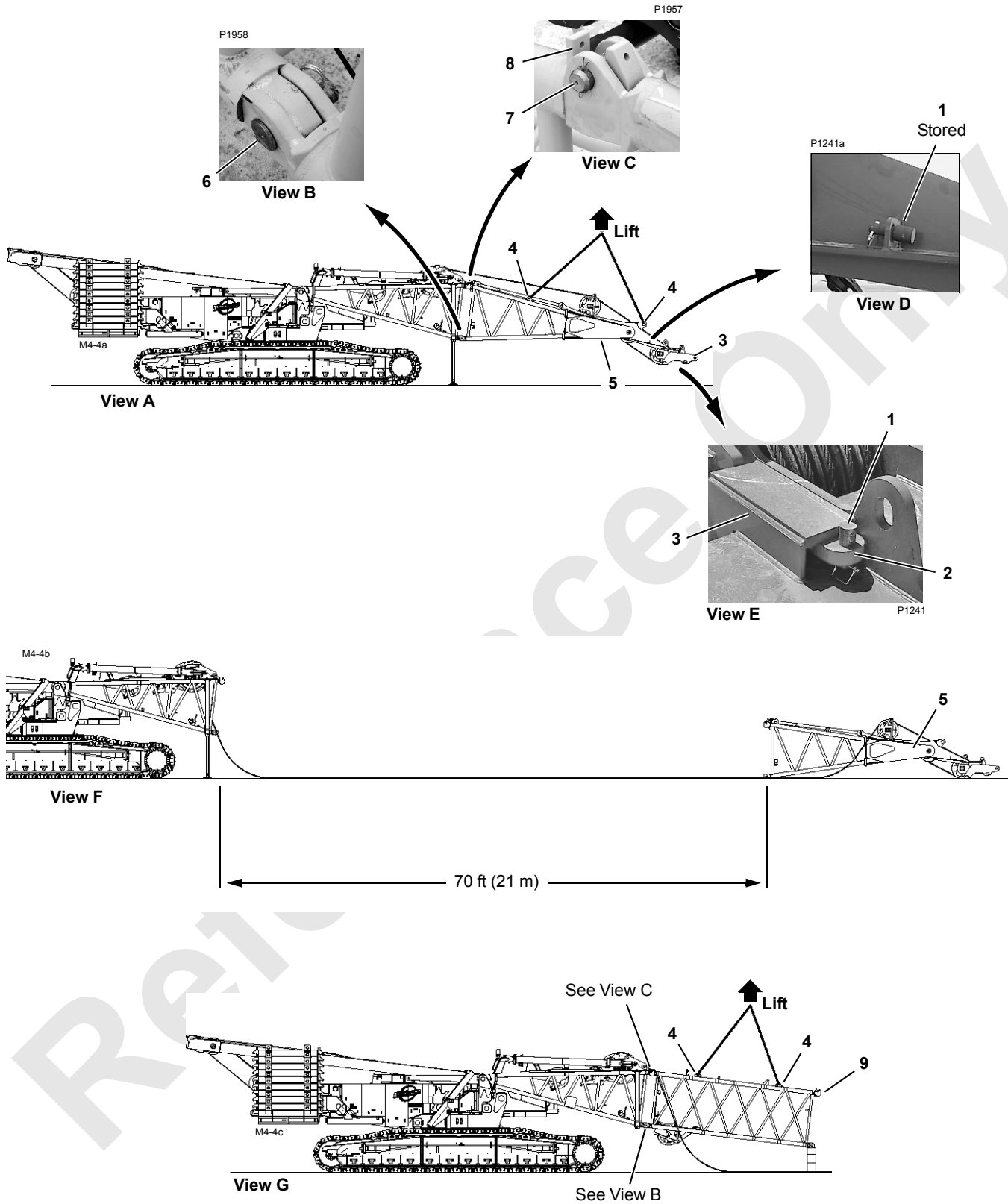


FIGURE 4-6

Legend for [Figure 4-6](#)

Item	Description	Item	Description
1	Retaining Pin with Snap Pin (2 places)	6	Pin with Safety Pin (2 places)
2	Mast Top Fork	7	Fixed Pin (2 places)
3	Equalizer	8	Hooked Connector
4	Lifting Lug (4 places)	9	Insert — 20 ft (6 m)
5	Mast Top		

Remove Top from Shipping Position

See [Figure 4-6](#) for the following procedure.

1. Check that retaining pins (1, View E) are installed in equalizer forks (2) so boom hoist equalizer (3) cannot fall off forks when step [6](#) is performed.
2. Disconnect lifting slings from mast butt.
3. Attach lifting slings from assist crane to lifting lugs (4, View A) on mast top (5). Hoist so slings are just taut.
4. Remove bottom connecting pins (6, View B) and lift mast top clear of mast butt.
5. Pay out wire rope from Drum 5 in mast butt while performing step [6](#). Remember that *MAX-ER Mast Configuration in RCL* must be selected.
6. Lift mast top away from mast butt and place mast top on blocking in front of mast butt *at dimension given in View F*.
7. Disconnect lifting slings from mast top.
8. Lay wire rope from Drum 5 on foundation alongside mast butt and top so wire rope does not interfere with installation of inserts.

Install 20 ft (6 m) Insert

See [Figure 4-6](#) for the following procedure.

1. Attach lifting slings from assist crane to lifting lugs (4, View G) on insert (9).
2. Lift insert into position at end of mast butt (View G) so fixed pins (7, View C) in insert engage hooked connectors (8) in mast butt.

3. Lower insert until bottom connecting holes line up and install pins (6, View B).

Pins (6) are stored in pockets in the lacings next to the connectors.
4. Lift insert so mast support pads are just off foundation and securely block under end of insert (View G).
5. Disconnect slings from insert (9).

CAUTION

Avoid Structural Damage to Mast Supports

Mast supports are designed to support only weight of 20 ft (6 m) insert. Do not attempt to install 40 ft (12 m) insert on end of 20 ft (6 m) insert while mast supports are deployed.

6. Store mast supports ([Figure 4-4](#), View C):
 - a. Remove pads (8d) from working position and pin in shipping position.
 - b. Tension cable with hand winch just enough to hold mast supports legs (8b) in position when step [6d](#) is performed.
 - c. Remove pins (8c).
 - d. Retract mast support legs until pins (8c) can be reinstalled.

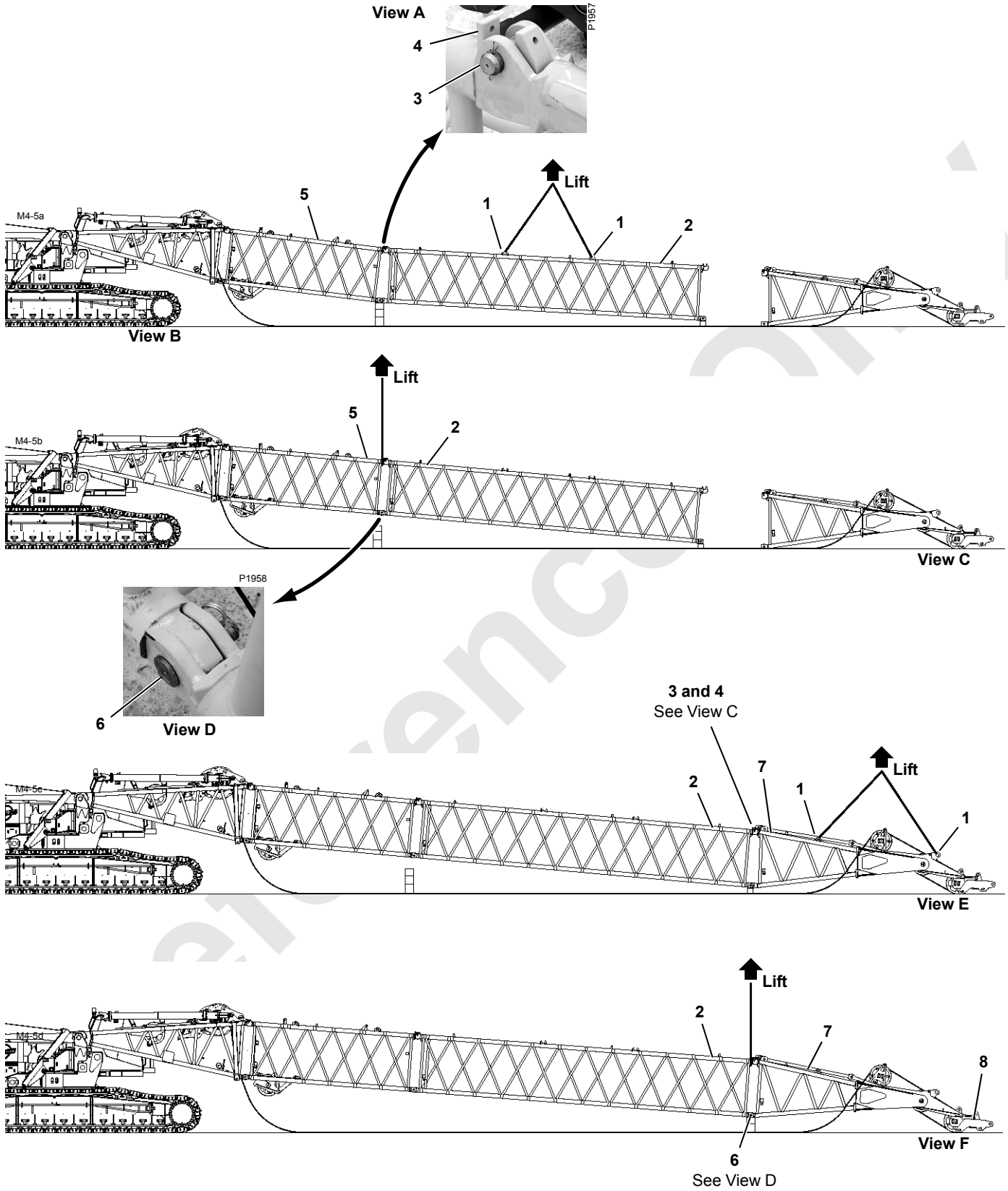


FIGURE 4-7

Legend for [Figure 4-7](#)

Item	Description	Item	Description
1	Lifting Lug (4 places)	5	Insert — 20 ft (6 m)
2	Insert — 40 ft (12 m)	6	Pin with Safety Pin (2 places)
3	Fixed Pin (2 places)	7	Mast Top
4	Hooked Connector	8	Boom Hoist Equalizer

Install 40 ft (12 m) Insert)

See [Figure 4-7](#) for the following procedure.

1. Attach lifting slings from assist crane to lifting lugs (1, View B) on insert (2).
2. Lift insert (2) into position so fixed pins (3, View A) engage hooked connectors (4) on insert (5).
3. Block under top end of insert (2, View B), lower insert onto blocking, and disconnect lifting slings.
4. Attach lifting slings to top chords directly behind connectors at top end of insert (5, View C).
5. Lift inserts to align bottom connecting holes.
6. Install pins (6, View D).

Pins (6) are stored in pockets in the lacings next to the connectors.

7. Disconnect lifting slings.

Install Mast Top

See [Figure 4-7](#) for the following procedure.

1. Attach lifting slings from assist to lifting lugs (1, View E) on mast top (7).
2. Lift mast top (7) into position so fixed pins (3, View A) engage hooked connectors (4) on insert (2).
3. Lower mast top onto foundation and disconnect lifting slings.
4. Attach lifting slings to top chords directly behind connectors at top end of insert (2, View F).
5. Lift insert to align bottom connecting holes.
6. Install pins (6, View D).

Pins (6) are stored in pockets in the lacings next to the connectors.

7. Block mast so equalizer (8, View F) is clear of foundation.
8. Disconnect lifting slings.
9. Using assist crane, lift wire rope from Drum 5 onto top of mast and spool slack wire rope onto drum.

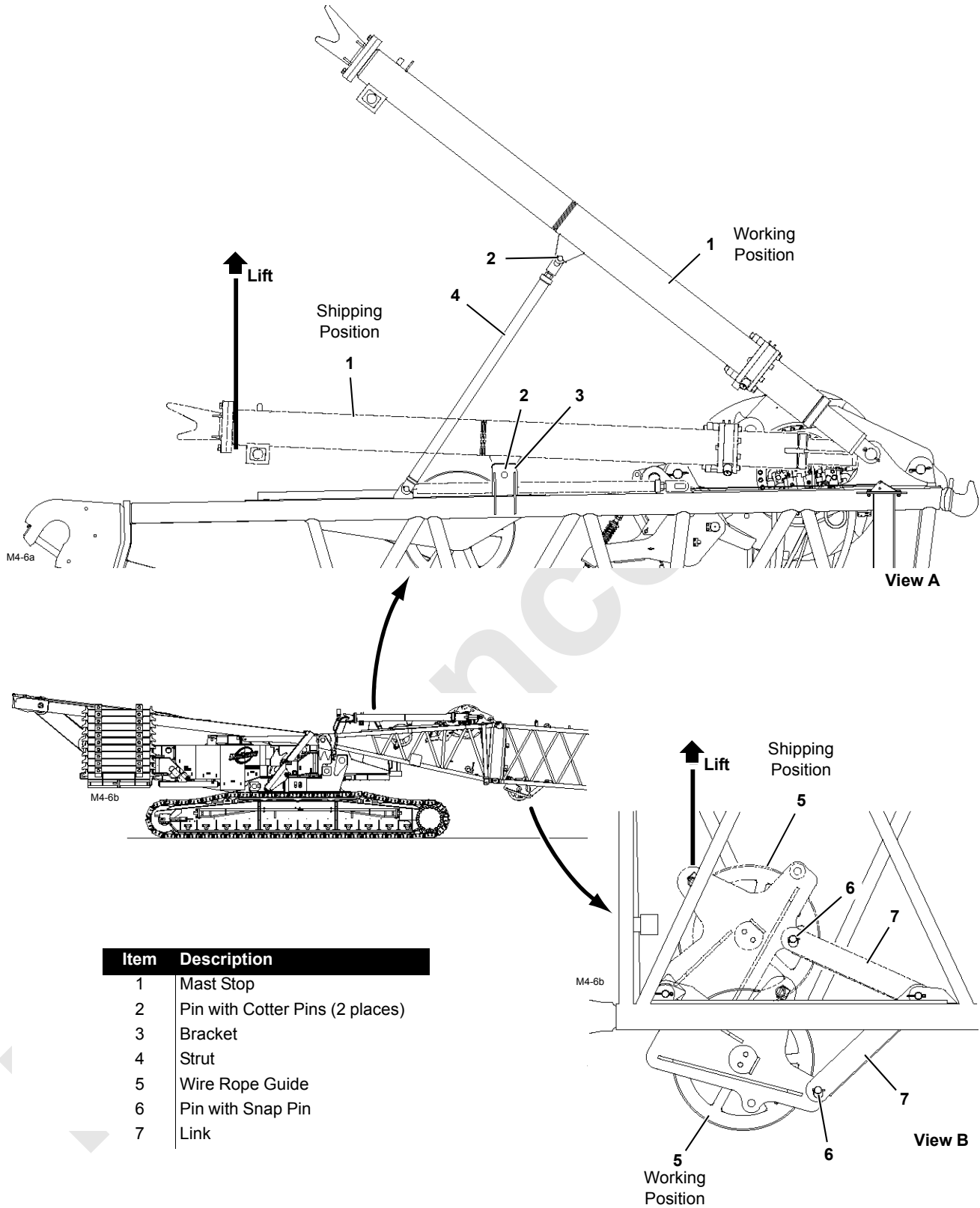


FIGURE 4-8

Raise Mast Stops

See [Figure 4-8](#), View A for the following procedure.

Perform the following steps on both sides of mast butt.

1. Support mast stop (1) with lifting sling from assist crane.
2. Remove pin (2) securing mast stop to storage bracket (3).
3. Raise mast stop to working position.
4. Raise strut (4) to working position and pin to mast stop with pin (2).

Lower Wire Rope Guide

See [Figure 4-8](#), View B for the following procedure.

1. Support wire rope guide (5) with a lifting sling from assist crane.
2. Remove pins (6) and lower links (7) to vertical. Each Link weighs 20 lb (9 kg).
3. Lower wire rope guide (5) to working position.
4. Pin links to wire rope guide.

Reference Only

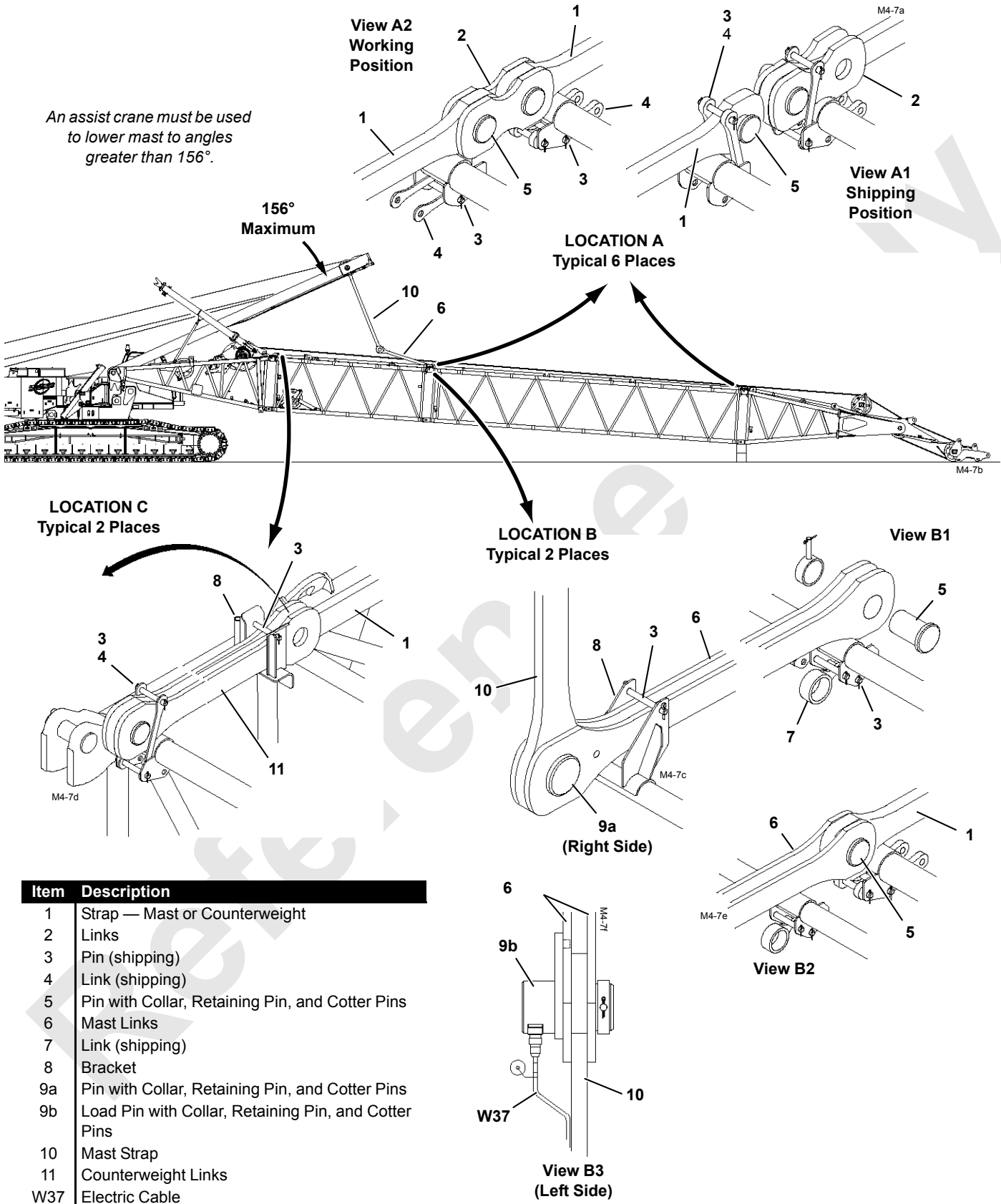


FIGURE 4-9

Connect Mast and Counterweight Straps

See [Figure 4-9](#) for the following procedure.

The mast and counterweight straps and links are shipped on the mast sections.

1. Connect straps at **LOCATION A on both sides of mast:**
 - a. Remove pins (3, View A1) and rotate links (4) to working position (View A2).
 - b. Pin links (4, View A2) in working position.
 - c. Remove pin (5, View A1) from end of strap (1).
 - d. Rotate links (2, View A1) rearward and pin to adjacent strap with pin (5, View A2).
2. Connect straps at **LOCATION B on both sides of mast:**
 - a. Attach a sling from assist crane to links (6, View B1). Hoist just enough to support links so they cannot fall off insert.
 - b. Remove pin (5, View B1) and rotate link (7) to storage position.
 - c. Pin link (7) in storage position.
 - d. Remove pin (3, View B1) from butt end of links (6).
 - e. Store pin (3) in pocket on bracket (8).
 - f. Slide links (6) toward mast top and pin links (6) to strap (1, View B2).



WARNING Falling Mast Hazard!

Do not use limit bypass to lower live mast below 156°. Mast will fall suddenly. **Connect an assist crane to end of live mast when it is necessary to lower it below 156°.**

- g. Lower live mast to 156° and STOP.
- h. Remove pin (9a, View B1). On right side remove load pin (9b).
- i. Pin mast strap (10) to links (6) with pin (9a) or load pin (9b).
- j. On left side of mast unscrew protective caps from electric cable (W37, View B3). **Thoroughly clean connectors.**
- k. Connect cable (W37) to receptacle on load pin (9b) and to cable on live mast.
3. Prepare links at **LOCATION C on both sides of mast:**
 - a. Remove pin (3) from top end of links (11).
 - b. Store pin (3) in pocket on bracket (8).
 - c. Store pin (3) and links (4) at butt end of links (11) — same as shown in View B.
 - d. Rotate links (11) rearward and lay them on top of mast butt.

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Raise Fixed Mast

NOTE: No counterweight — carbody or crane — is required to raise the fixed mast.

General

A hold-back force is required to raise and lower the fixed mast. Either an assist crane or the crane’s own boom can be used.

- If an assist crane is used, it must provide the forces given in [Table 4-1](#). Letters in [Figure 4-11](#), View A correspond to letters in the table.
- If crane’s own boom is used, a minimum boom length of 137.8 ft (42 m) is required.

REMINDER — the **MAX-ER Mast Configuration must be selected in the RCL** to enable simultaneous operation of Drum 4 (mast hoist on rear of rotating bed) and Drum 5 (boom hoist in mast butt).

The following controls are used to raise the mast:

- Drum 4 (mast hoist) on left console
- Drum 5 (boom hoist) on right console
- Drum park switches

A qualified operator is required to raise the mast. The operator shall be experienced with the 16000 and thoroughly familiar with its operation.

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

Table 4-1 Mast Holdback Requirements

Mast	A From End of Crawler	B Horizontal	C Vertical
98 ft (30 m)	105 ft (32 m) (see Note)	30,000 lbf (133 kN)	25,000 lbf (111 kN)

NOTE: Assist crane and equalizer must be traveled to dimension A once mast is out of way.

Calibrate Mast Stop with Position Sensor

See [Figure 4-10](#) for the following procedure.

NOTE: The MAX-ER mast stop position information screen will not be available with crane software version M002066 or newer. Position Sensor calibration will not be required.

NOTE: Best results are obtained when the yoke on the mast stop is below horizontal.

1. On the main display in the crane cab, select the mast stop box in the information screen (see [Figure 4-10](#)).
2. Press the enter button (red down arrow) on the display touch pad to turn the border GREEN around the mast stop box.
3. Press the confirm button (purple star) on the display touch pad. The dimension in the mast stop should turn to either 1.0 ft or 0,305 m.
4. Press the exit button (red up arrow) on the display touch pad to turn the border BLUE around the mast stop box.

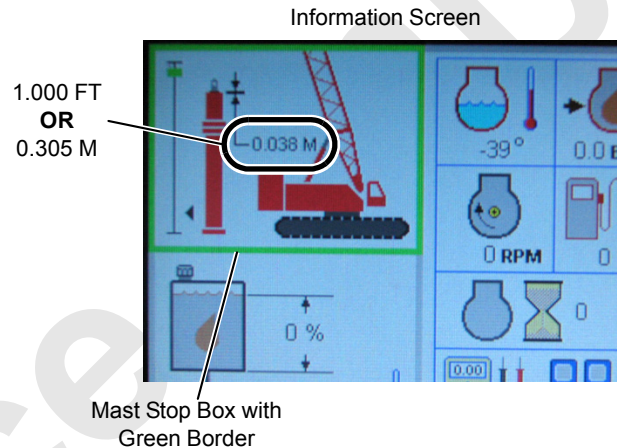


FIGURE 4-10

Perform Pre-Raising Checks

Perform the following pre-raising checks and correct any defects before raising fixed mast.

- o Crane on firm, level surface.
- o Mast shims installed.
- o Mast inserts installed in proper sequence.
- o Mast and counterweight straps pinned in working position.
- o All insert connector pins installed and properly retained.
- o **MAX-ER Mast Configuration selected in RCL.**
- o Live mast arms fully lowered.
- o All blocking, tools, and other items removed from mast.
- o Mast and boom hoist wire rope spooled tightly onto drums and engaged with proper sheaves.
- o Equalizer securely attached to proper size assist crane, and positioned at proper distance from end of mast.
- o Wind within allowable limits for operation.

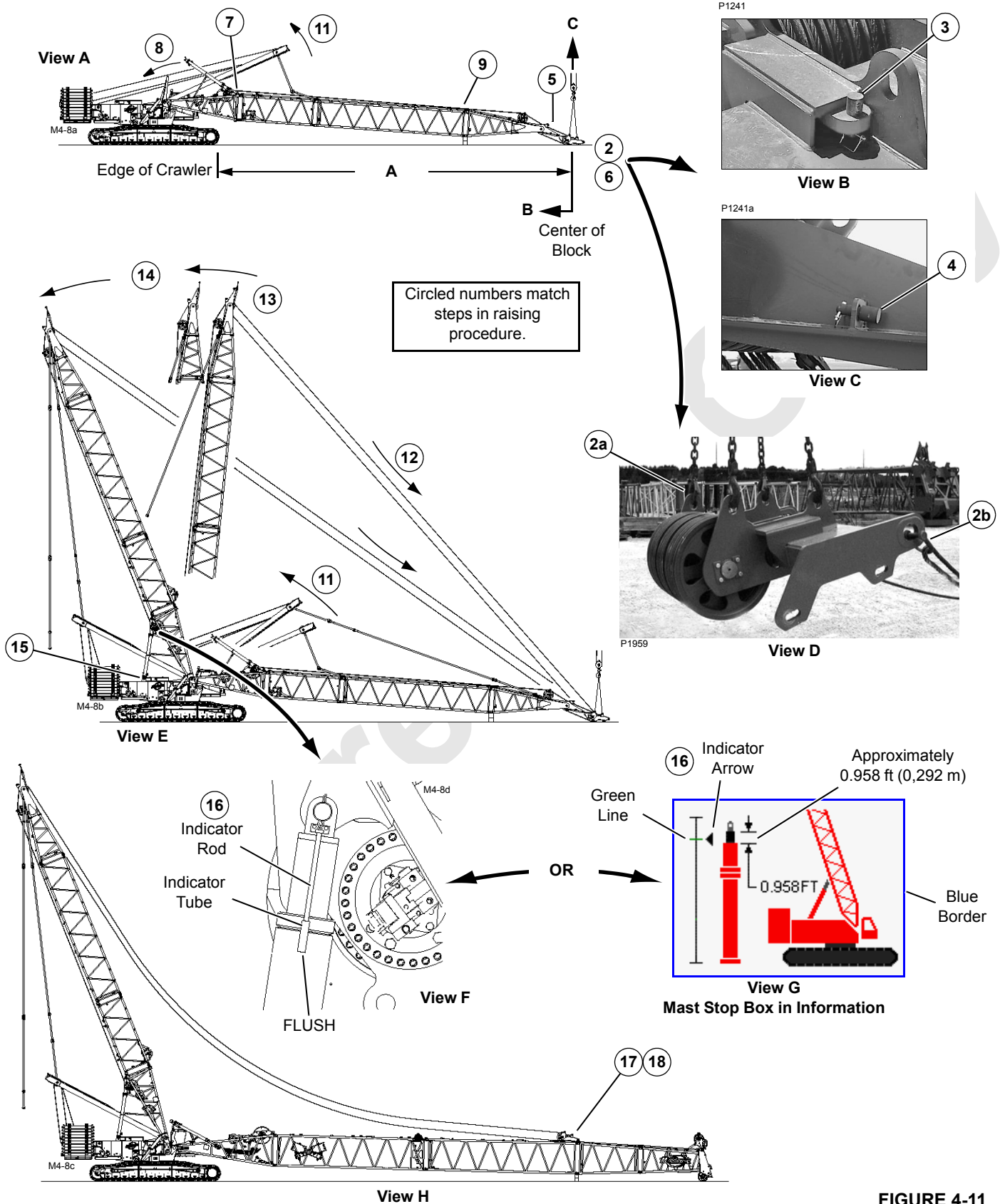


FIGURE 4-11

Raise Fixed Mast Using Assist Crane as Hold-Back

Circled numbers in [Figure 4-11](#) match the following steps.

1. Start crane engine.

CAUTION**Wire Rope Damage!**

Boom hoist equalizer will tip if it is not properly supported, possibly resulting in damage to wire rope. Support boom hoist equalizer properly while raising fixed mast.

2. Attach assist crane to boom hoist equalizer (View D):
 - a. Attach lifting slings to holes in equalizer.
 - b. Securely attach slings between equalizer and rotating bed or carbody of assist crane.
3. Remove boom hoist equalizer retaining pins (View B) from mast top forks.
4. Store equalizer retaining pins (View C) in mast top lugs (View C).
5. Lift boom hoist equalizer and pull equalizer off forks on end of mast. Pay out boom hoist wire rope as required.
6. Park assist crane so equalizer is at Dimension A from end of crawlers (View A, and [Table 4-1](#)). **Equalizer must be centered with relation to mast to prevent side loading mast.**

Assist crane must provide specified hold-back forces (B and C, View A and [Table 4-1](#)).
7. Connect a 50 ft (15 m) long tagline to the following:
 - End of each counterweight strap nearest the crane
 - Just above the flange on the bottom of each mast stop

**WARNING****Mast Damage!**

Lower live mast arms before raising fixed mast. Mast can collapse if arms are up when live mast is lowered.

8. Using crane setup remote control, fully lower live mast arms.
9. Verify that all mast strap and counterweight strap shipping pins are removed and stored.

CAUTION**Mast Damage!**

Avoid mast or equalizer damage. Do not raise mast until all straps are unpinned from mast strap supports.

10. Perform Mast Pre-Raising Steps before proceeding.
11. Slowly haul in mast hoist wire rope to raise mast until straps are taut.
12. Continue to raise mast while paying out boom hoist wire rope.

NOTE: Operator shall match rate of speed at which mast hoist wire rope is hauled in with rate of speed at which boom hoist wire rope is paid out. Boom hoist wire rope must remain slack until mast nears vertical.
13. As mast nears vertical, tighten boom hoist wire rope as required so mast moves smoothly past vertical to rear.

NOTE: As the fixed mast lowers, use the taglines to guide the counterweight straps and mast stops clear of the live mast. **Damage can occur if this step is not performed.**
14. Continue to slowly haul in mast hoist wire rope and pay out boom hoist wire rope to lower mast to rear.
15. Stop lowering mast when mast stops engage mast stop pins on rotating bed.

NOTE: The MAX-ER mast stop position information screen will not be available with crane software version M002066 or newer.
16. While watching indicator rod on mast stops (View F) or the mast stop position information screen on the main display (View G), **mast up slowly** until:
 - Indicator rods are flush with ends of indicator tubes
 - Indicator arrow (on screen) is in line with green line
17. Move boom hoist equalizer to side so it is clear of boom assembly area.

Take every precaution to protect wire rope from damage. Do not allow wire rope to jump off sheaves (in mast and equalizer) or otherwise become fouled.
18. Install boom (View H). See Install Boom topic in this section for instructions.

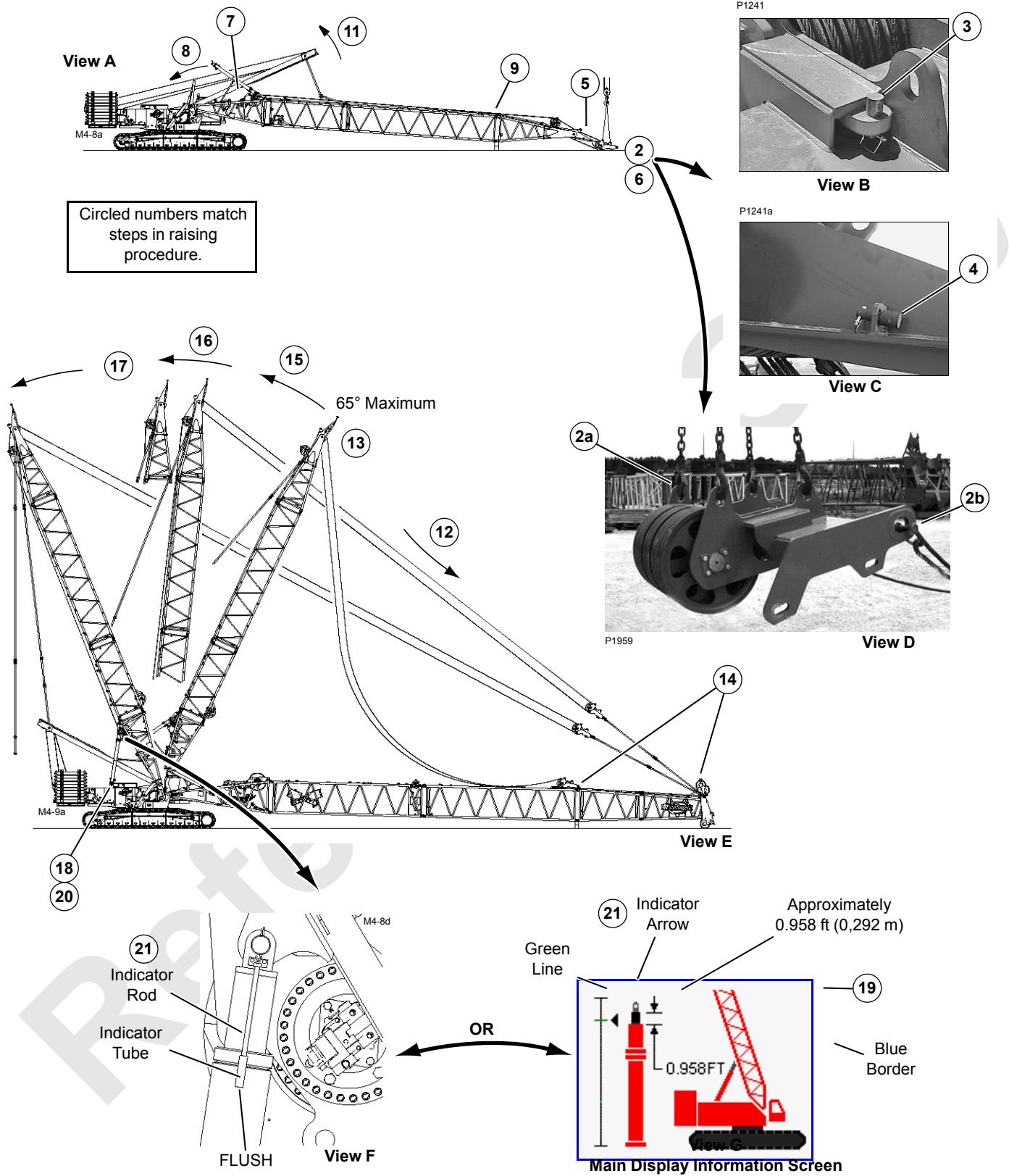


FIGURE 4-12

Raise Mast Using Boom as Holdback

Circled numbers in [Figure 4-12](#) match the following steps.

1. Start crane engine.
2. Attach assist crane to boom hoist equalizer (View D):
 - a. Attach 4-leg chain sling to lifting holes in equalizer.
 - b. Securely attach wire rope slings between equalizer and rotating bed or carbody of assist crane.

CAUTION

Wire Rope Damage!

Boom hoist equalizer will tip if it is not properly supported, possibly resulting in damage to wire rope. Support boom hoist equalizer properly while raising fixed mast.

3. Remove boom hoist equalizer retaining pins (View B) from mast top forks.
4. Store equalizer retaining pins (View C) in mast top lugs (View C).
5. Lift boom hoist equalizer and pull equalizer off forks on end of mast. Pay out boom hoist wire rope as required.
6. Park assist crane so equalizer is **centered with relation to mast to prevent side loading mast**.
7. Connect a 50 ft (15 m) long tagline to the following:
 - End of each counterweight strap nearest the crane
 - Just above the flange on the bottom of each mast stop
8. Using crane setup remote control, fully lower live mast arms.



WARNING

Mast Damage!

Lower live mast arms before raising fixed mast. Mast can collapse if arms are up when live mast is lowered.

9. Verify that all mast strap and counterweight strap shipping pins are removed and stored.

CAUTION

Mast Damage!

Avoid mast or equalizer damage. Do not raise mast until all straps are unpinned from mast strap supports.

10. Perform Mast Pre-Raising Steps before proceeding.
11. Slowly haul in mast hoist wire rope to raise mast until straps are taut.
12. Continue to raise live mast while paying out boom hoist wire rope.

NOTE: Operator shall match rate of speed at which mast hoist wire rope is hauled in with rate of speed at which boom hoist wire rope is paid out. Boom hoist wire rope must remain slack until mast nears vertical.

13. Stop raising mast when it is at 65° maximum (View E).

When fixed mast is at 65°, live mast will be at approximately 75°. The live mast angle can be monitored on the display in the cab.

14. Place equalizer to side so it will not interfere with assembly of boom. Take necessary precaution to prevent damage to boom hoist wire rope.

Turn Drum 5 PARK ON to engage drum pawl.

15. Install desired length of boom. See Install Boom topic in this section for instructions.

Minimum boom length of 137.8 ft (42 m) is required.

CAUTION

Structural Damage!

Do not raise mast until boom hoist equalizer is unpinned from rails and boom straps are unpinned from strap supports.

16. Continue to raise mast while paying out boom hoist wire rope.
17. As mast nears vertical, tighten boom hoist wire rope as required so mast moves smoothly past vertical to rear.

NOTE: As the fixed mast lowers, use the taglines to guide the counterweight straps and mast stops clear of the live mast. **Damage can occur if this step is not performed.**

18. Continue to slowly haul in mast hoist wire rope and pay out boom hoist wire rope to lower mast to rear.
19. Stop lowering mast when mast stops are 2 to 3 in (51 to 76 mm) from engaging mast stop pins on rotating bed.
20. Continue to raise mast until mast stops engage mast stop pins on rotating bed.

NOTE: The MAX-ER mast stop position information screen will not be available with crane software version M002066 or newer.

21. While watching indicator rod on mast stops (View F) or the mast stop position information screen on the main display (View G), **mast up slowly** until:

- Indicator rods are flush with ends of indicator tubes
- Indicator arrow (on display) is in line with green line

Check Mast Stop Pressure

Each mast stop has a hydraulic pressure gauge (Figure 4-13).

Check both gauges WEEKLY. The gauges should read 200-280 psi (13,8-19,3 bar) depending on outside air temperature.

At 70°F (21°C), the gauge should read 230 psi (15,8 bar).

- Pressure increases as temperature increases
- Pressure decreases as temperature decreases

If the proper reading is not indicated at either gauge, determine cause of faulty pressure and take corrective action.



WARNING

Explosion Hazard!

Mast stop cylinders are equipped with nitrogen pre-charged accumulators.

Do not tamper with accumulators unless authorized and trained to do so.



Hydraulic Pressure Gauge
at Base of Both Mast Stops

FIGURE 4-13

Reference Only

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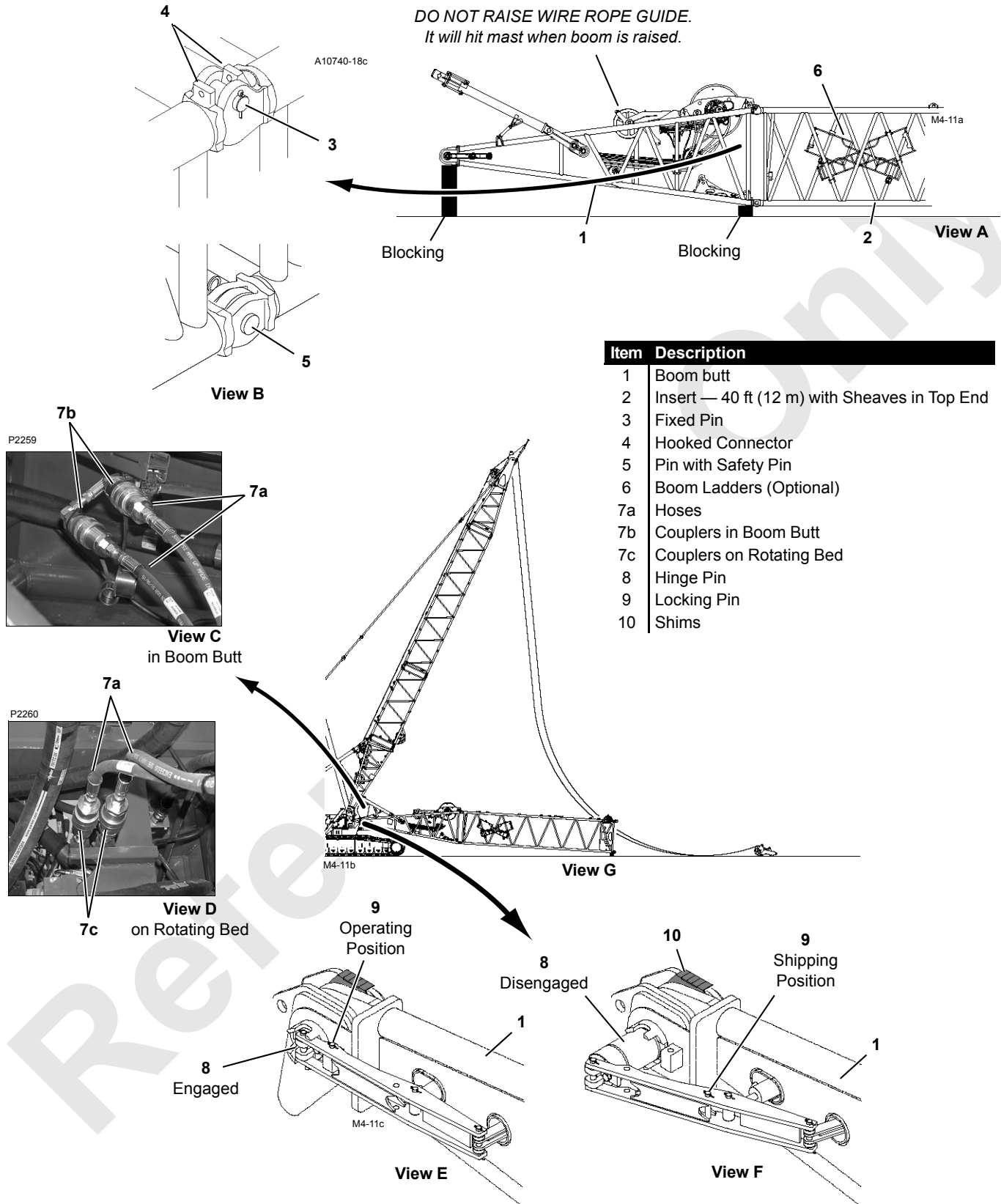


FIGURE 4-14

Install Boom

Assemble Boom Butt and First Insert

See [Figure 4-14](#) for the following procedure.

- Lift boom butt (1) off trailer and place on blocking in front of 16000 as shown in View A.
Lift with slings from assist crane attached to four lifting lugs on butt.
Adjust blocking so top end of butt is square in relation to foundation.
- Disconnect lifting slings.

CAUTION

Wire Rope Guide Damage!

If raised, lower wire rope guide on boom butt (View A). Otherwise, wire rope guide will hit mast when boom is raised.

- Lift insert (2) into position at front of boom butt (1).
Lift with slings attached to four lifting lugs on insert.
- Engage fixed pins (3, View B) in insert with hooked connectors (4) in butt.
- Lower insert until bottom connecting holes line up.
- Install bottom connecting pins (5, View B).
Pins (5) are stored in pockets in the lacings next to the connectors.
- Block under top end of insert.
- Disconnect lifting slings.

Install Boom Butt and First Insert

See [Figure 4-14](#) for the following procedure.

- Attach lifting slings from assist crane to top chords of boom butt and insert.
Adjust position of slings so butt and insert are horizontal when lifted.
- Lift butt and insert into position at connecting holes in front of rotating bed (View F).
- Disconnect hydraulic hoses 7a, View C) from couplers (7b) in boom butt. **Thoroughly clean couplers.**
- Connect hydraulic hoses (7a, View D) to couplers (7c) on left side of rotating bed.

- Using crane setup remote control, disengage boom hinge pins (8, View E).
- Position butt so connecting holes in butt line up with connecting holes in rotating bed.
- Center butt between rotating bed lugs and check side play. If total side play is greater than 5/64 in (2 mm), install shims (10, View F) as follows:
 - Install thickest shim possible between inboard side of butt and rotating bed lug on both sides of crane.
Shim tabs must face inward and rest on rotating bed lugs.
 - Install next thickest shim possible between inboard side of butt and first shim on both sides of crane.
 - If possible, install thinnest shim between inboard side of butt and second shim on both sides of crane.
- Using crane setup remote control, engage boom hinge pins.
- Remove locking pins (9, View E) from shipping position and install in working position.
- Lower end of insert onto blocking (View G).
- Disconnect lifting slings.
- Disconnect hydraulic hoses (7a, View D) from couplers (7c) on rotating bed and connect to couplers (7b, View C) in butt.

See [Figure 4-15](#) for the remaining steps.

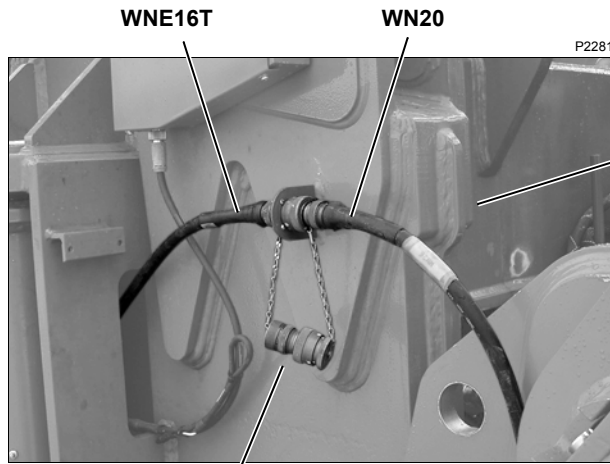
- Connect hydraulic lines from boom butt to crane:
 - Remove dust covers from couplers on boom butt and from couplers and hydraulic hoses on rotating bed. **Thoroughly clean couplers.**
 - Connect hydraulic hoses and couplers on rotating bed to couplers on boom butt as shown in [Figure 4-15](#).

NOTE: These are straight line connections. No hoses will cross when hoses are connected correctly.

On current production cranes, the hoses and couplers between the boom butt and rotating bed have numbered tags. To ensure proper connection, match the numbers on the tags.

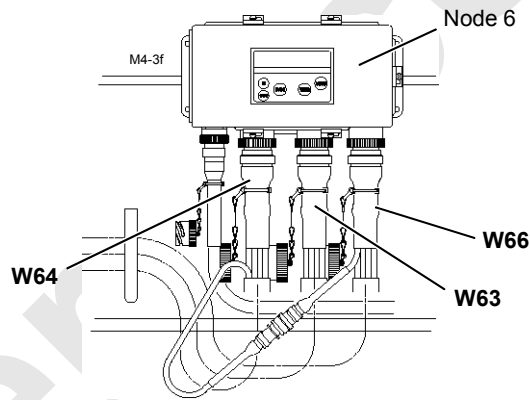
Coupler-assist tool (View C) can be used to connect the large couplers.

Continued on [page 4-31](#).



On Current Production Units, Item (10), Cable (WN20), and Cable (WNE16T) are on Inboard Side of Rotating Bed

View A
Right Side of Rotating Bed



View B
Front of Rotating Bed

Item	Description
10	Terminating Plug with Protective Cap
WNE16T	Electric Cable from Crane
WN20	Electric Cable from Boom Butt
W63	Electric Cable from Drum 3 Boom Butt
W64	Electric Cable from Drum 5 Mast Butt
W66	Electric Cable from Drum 1 Boom Butt

FIGURE 4-15

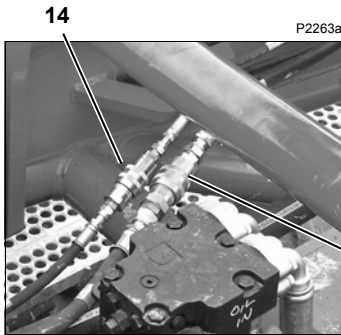


View C

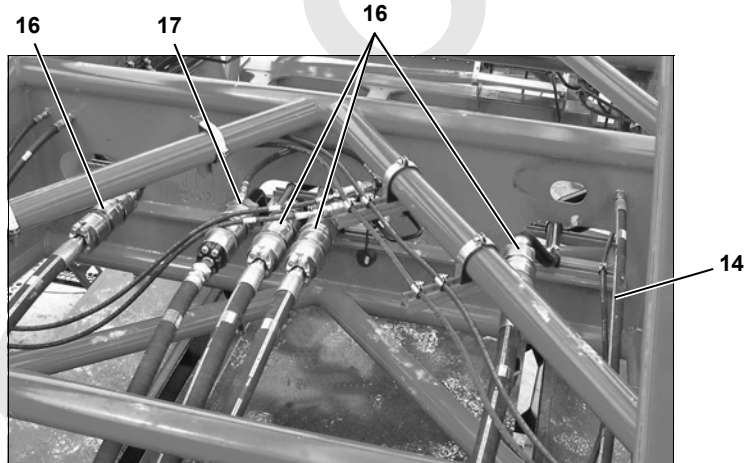
11

Item	Description
11	Coupling Assist Tool
12	Retaining Bar
13	Safety Pin
14	Motor Pilot
15	Anti-Cavitation
16	High Pressure
17	Case Drain

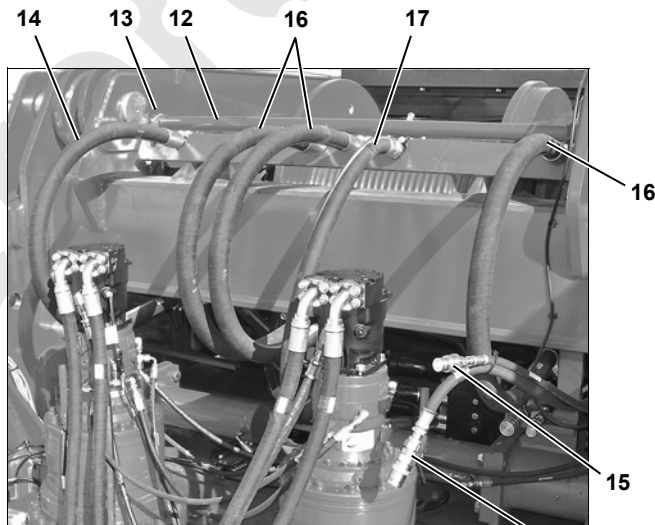
Views D and E are from Crane Looking Forward



View D

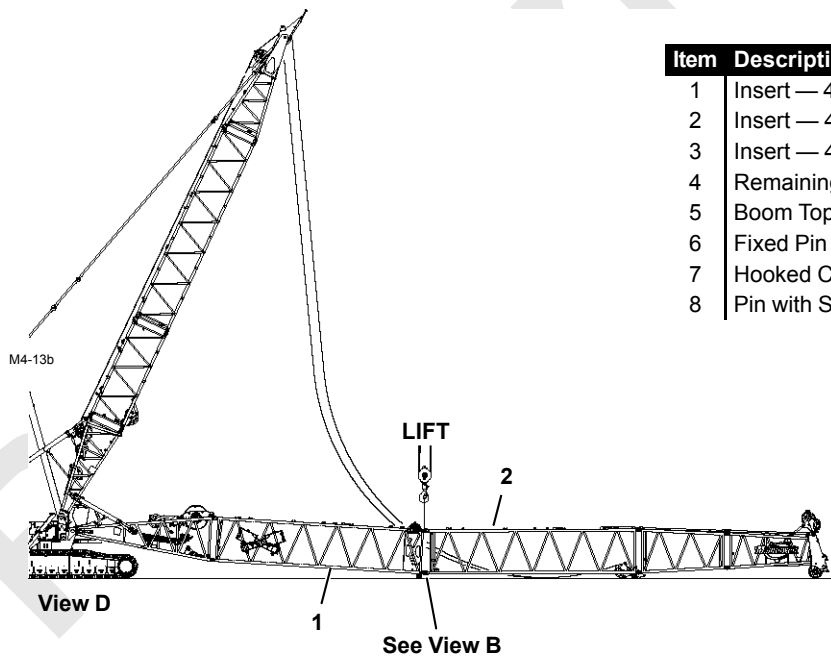
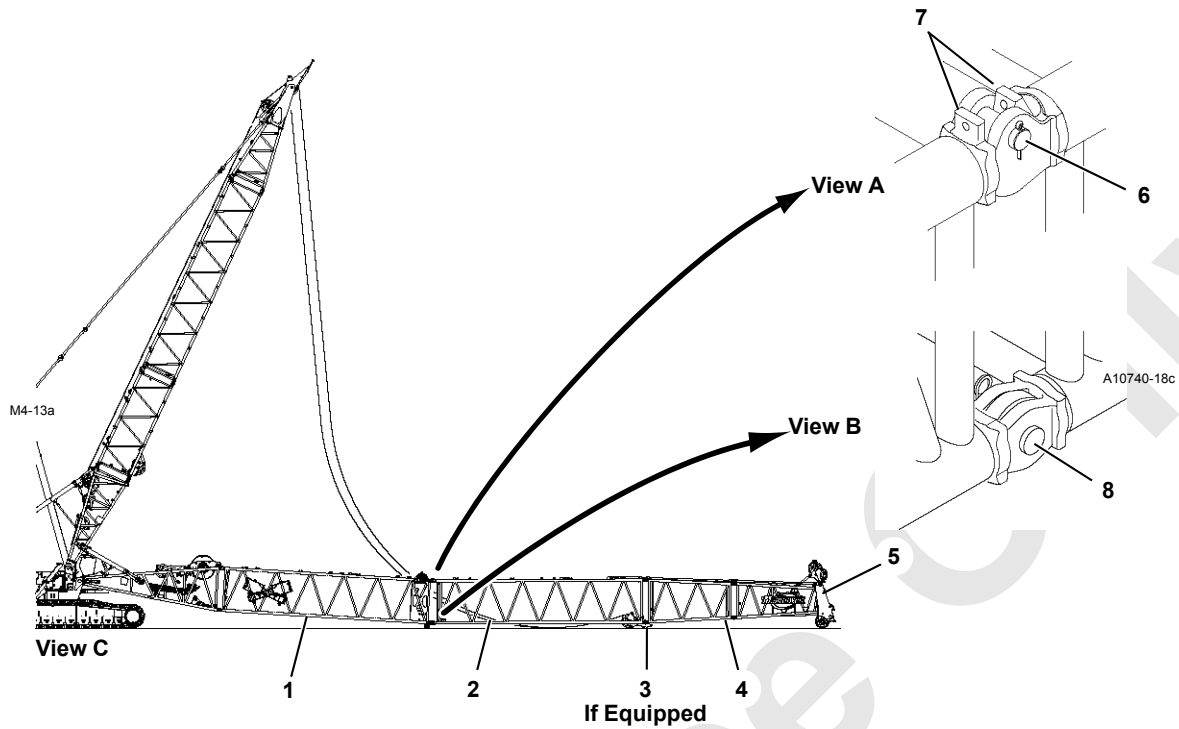


View E



View F
From Front

FIGURE 4-15 continued



Item	Description
1	Insert — 40 ft (12 m) with Sheaves in Top End
2	Insert — 40 ft (12 m) with Equalizer Rail
3	Insert — 40 ft (12 m) HEAVY
4	Remaining Inserts
5	Boom Top
6	Fixed Pin
7	Hooked Connector
8	Pin with Safety Pin

FIGURE 4-16

14. Connect electric cables from boom butt to crane:

See [Figure 4-15](#)

NOTE: For Node-6 electrical connections with Mast Stop Limit Switch, and for cranes with software version M002066 or newer, reference [Figure 4-5](#).

- a. Unplug terminating plug (10, View A) from electric cable (WNE16T) on front of rotating bed.
- b. **Thoroughly clean protective cap** and install it on shorting plug.
- c. Remove protective caps from electric cables (W63, W66, and WN20). **Thoroughly clean connectors**.
- d. Connect electric cable (WN20, View A) to cable (WNE16T).
- e. Connect electric cables (W63 and W66) to Node 6 (View B).

Assemble Remaining Boom Sections

See [Figure 4-16](#)

Boom inserts including heavy insert, if applicable, must be assembled in proper sequence. See Boom Rigging Assembly drawings at the end of this section for assembly sequence.

NOTE: Butt end of HEAVY insert has two tags stamped **H**.

1. Lift insert (2, View C) — insert with equalizer rails — into position in front of insert (1).
Lift with slings from assist crane attached to four lifting lugs on insert.

2. Engage fixed pins (6, View A) in insert with hooked connectors (7) in adjacent insert.
3. Lower insert to horizontal and block under top end of insert.
4. Disconnect slings.

NOTE: On current production units, the equalizer rails on insert (2) are storable so the insert can be used with the #58WA boom on a 16000 Wind Attachment.

If your insert has storable rails, move them from the stored position ([Figure 4-17](#)) to the working position ([Figure 4-18](#)).

5. Repeat steps [1](#) – [4](#) for next insert.
6. Install both bottom connecting pins (8, View B).
7. Repeat steps [5](#) and [6](#) for remaining inserts and for boom top.
8. Join bottom connectors between inserts that are not connected (View D):
 - a. Place blocking under lower boom point sheaves.
 - b. Attach lifting slings from assist crane to chords at top end of insert (1). Crane must have capacity to lift 1/2 the weight of assembled boom.
 - c. Lift insert until bottom connecting holes line up.
 - d. Install both bottom connecting pins (8, View B).
 - e. Disconnect slings.

#58, 12 m (39.4 FT) MAX-ER Insert with Storable Equalizer Rails
CONFIGURED FOR USE WITH 16000 WIND ATTACHMENT

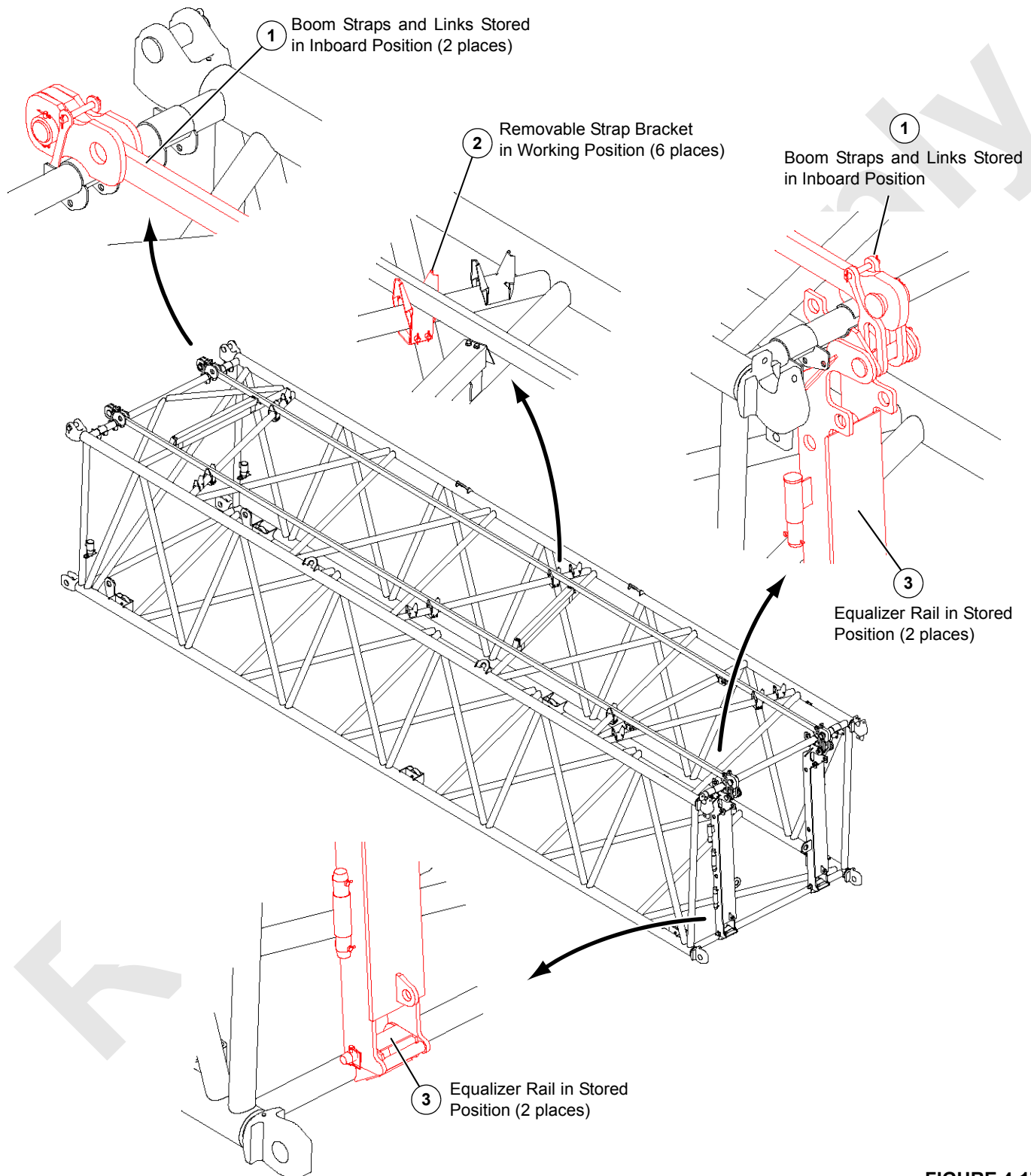


FIGURE 4-17

#58, 12 m (39.4 FT) MAX-ER Insert with Storable Equalizer Rails
CONFIGURED FOR USE WITH MAX-ER ATTACHMENT

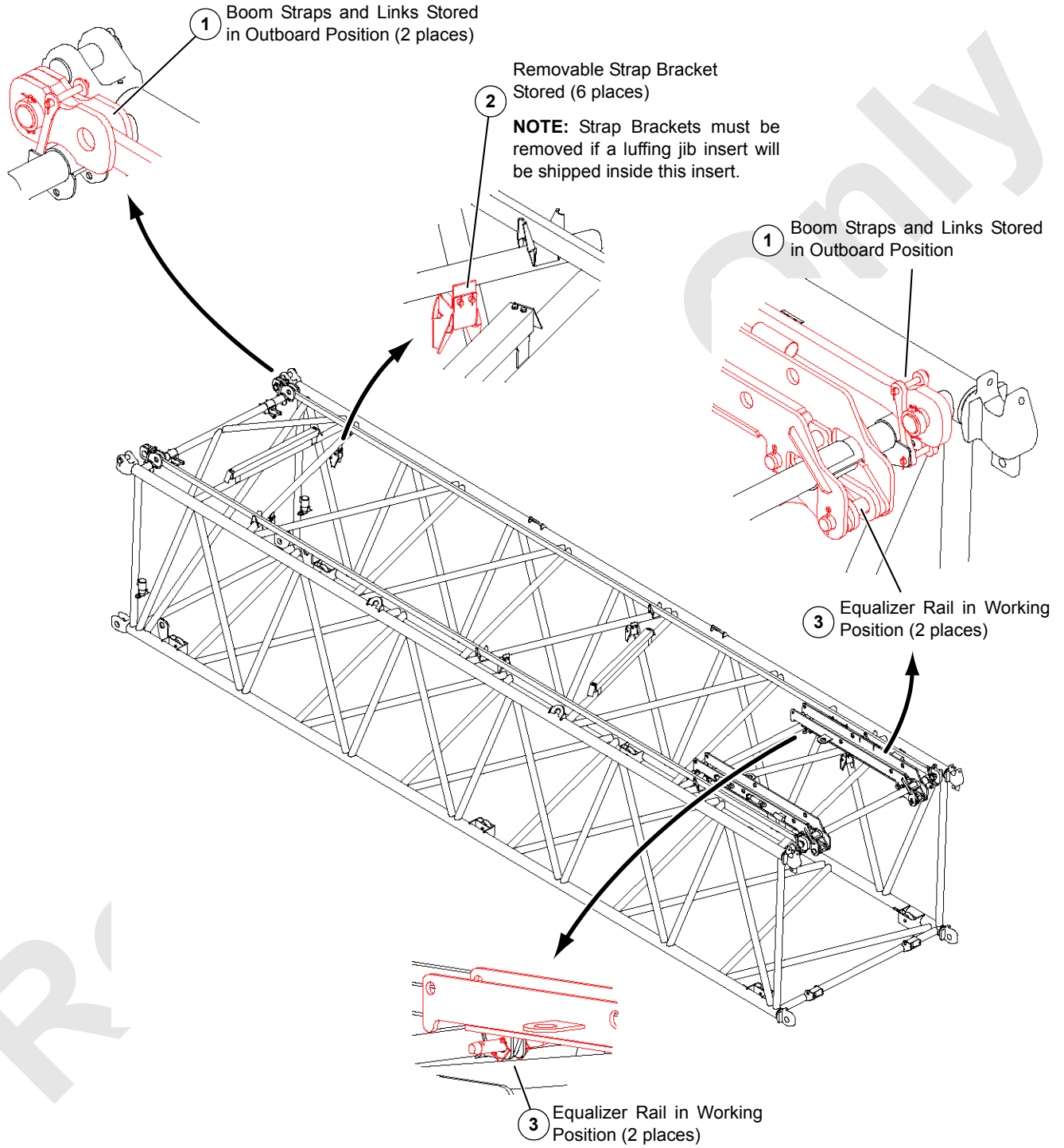


FIGURE 4-18

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A11543

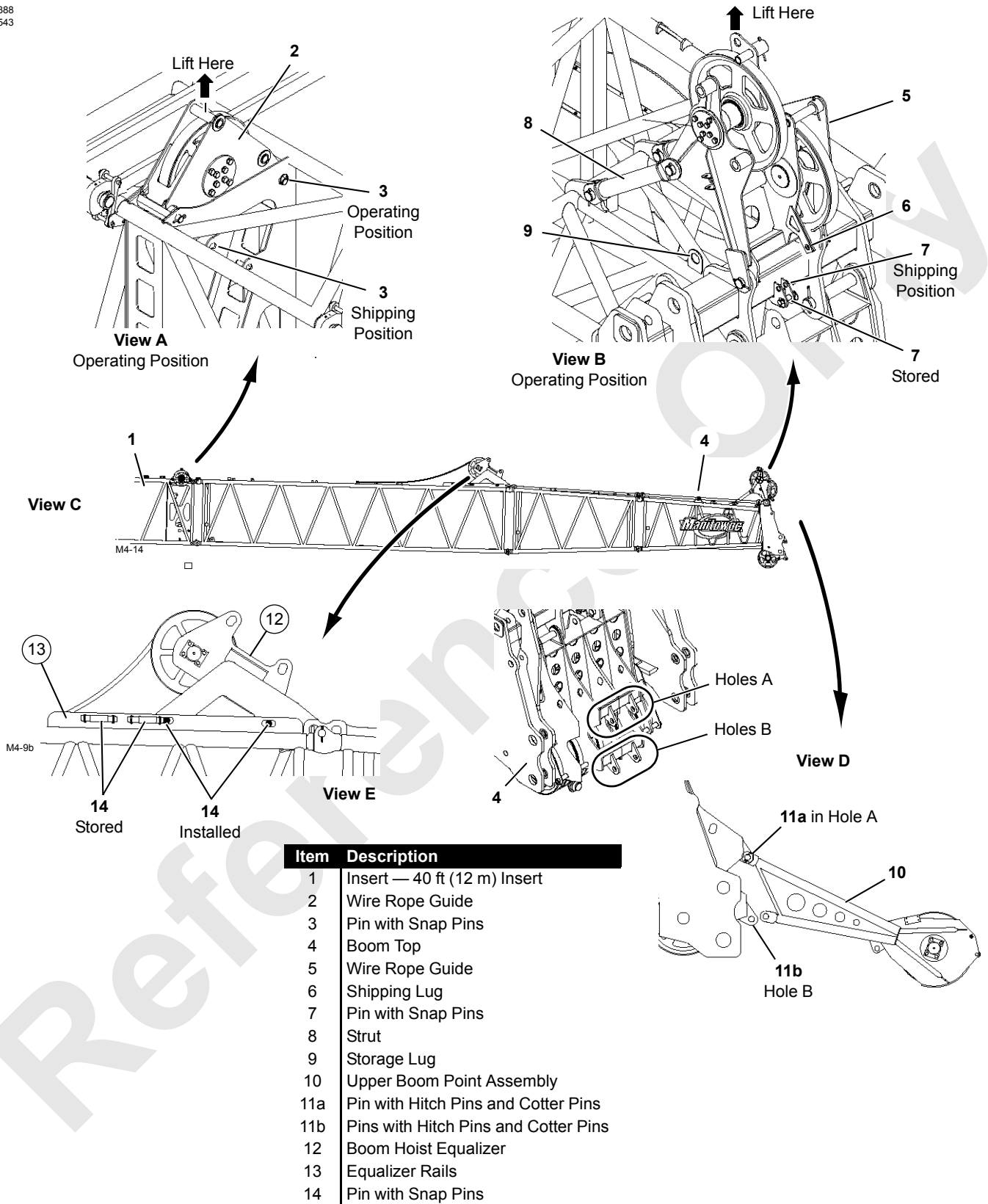


FIGURE 4-19



WARNING
Pinch Point Hazard!

Keep hands clear of openings in wire rope guide frame while raising or lowering wire rope guide in step [9](#).

See [Figure 4-19](#)

9. If required for luffing jib or for auxiliary drum, raise wire rope guide (2, View A) to operating position:
 - a. Attach lifting sling from assist crane to rope guide pin.
 - b. Hoist just enough to support wire rope guide and remove pin (3) from shipping position.
 - c. Raise wire rope guide to operating position and install pin (3).
 - d. Disconnect lifting sling.
10. Raise boom top wire rope guide (5, View B) to operating position:
 - a. Attach lifting sling from assist crane to hole in wire rope guide frame.
 - b. Hoist just enough to support wire rope guide and remove pin (7) from shipping position.

- c. Raise wire rope guide to operating position.
- d. Store pin (7).
- e. Unpin struts (8) from storage lugs (9) and pin to wire rope guide.

11. Install equalizer on rails:

NOTE: On current production units, the equalizer rails are storable so the insert can be used with the #58WA boom on a 16000 Wind Attachment.

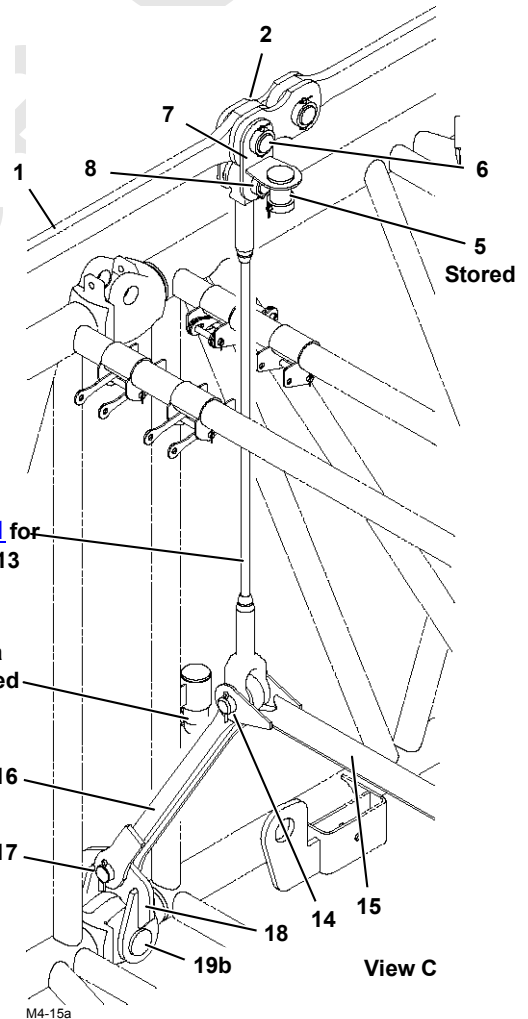
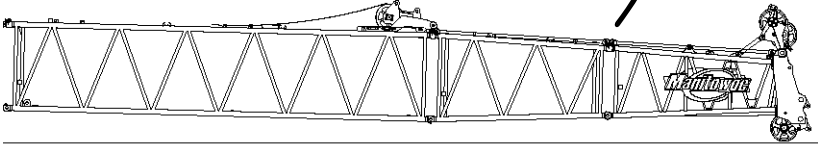
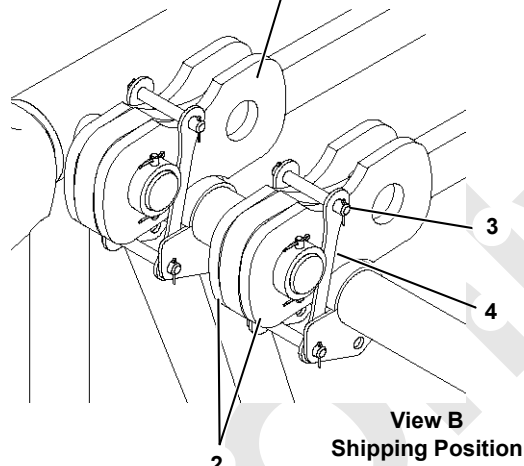
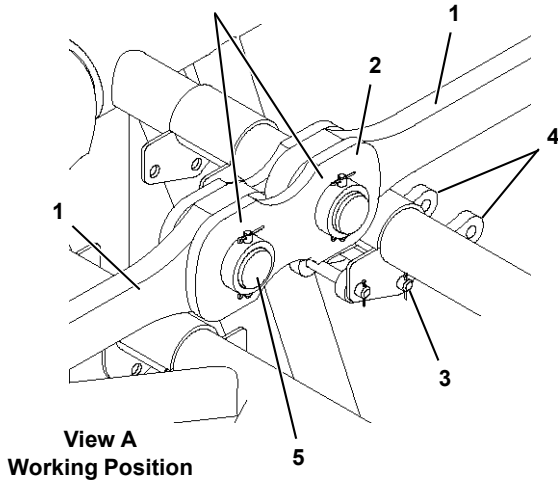
If your insert has storable rails, move them from the stored position ([Figure 4-17](#)) to the working position ([Figure 4-18](#)).

- a. Using slings from assist crane, lift boom hoist equalizer (12, View E) into position on rails (13).
Haul in or pay out wire rope from Drum 5 as needed.
- b. Attach equalizer to holes in equalizer rails with pins (14, View E). **Pins must be installed to prevent equalizer from accidentally sliding back on rails during link assembly.**
- c. Disconnect lifting slings.
- d. Slacken boom hoist wire rope.
- e. Attach strap links from boom to equalizer. See procedure in this section.
- f. Remove and store pins (14) securing equalizer to rails.

A11543-1
A11543-2

Collars Toward Inside of Boom Sections

Luffing Jib Straps, Links, and all Hardware Must be Removed if Luffing Jib is Not Used



Item	Description
1	Strap
2	Link
3	Pin (shipping) with Cotter Pins
4	Link (shipping)
5	Pin (standard) with Collar, Retaining Pin, and Cotter Pins
6	Pin, 2.56 in (65 mm) Diameter x 4.8 in (122 mm) Long, with Collar, Retaining Pin, and Cotter Pins
7	Link (intermediate Suspension)
8	Pin, 2.25 in (57 mm) Diameter x 4.8 in (122 mm) Long, with Collar, Retaining Pin, and Cotter Pins
9	Pendant, 8 ft 9 in (2,7 m) Long
10	Pendant, 4 ft 2 in (1,3 m) Long
11	Pin with Cotter Pin (supplied with item 10)
12	Pin with Cotter Pins
13	Adjustable Link
14	Pin with Cotter Pins
15	Link
16	Link
17	Pin with Cotter Pins
18	Link
19a	Pin (standard) with Safety Pin
19b	Pin, 8.50 in (215 mm) Long, with Safety Pin

FIGURE 4-20

Connect Boom Straps

See [Figure 4-20](#) for the following procedure.

The boom straps and links are shipped on the boom sections as shown in View B.

1. Connect straps (1, View A) at top end of butt and each insert, as follows:
 - a. Remove pins (3, View B) and rotate links (4) to working position (View A).
 - b. Pin links (4, View A) in working position.
 - c. Remove pin (5, View A) from end of strap (1).
 - d. Rotate links (2, View B) rearward and pin to adjacent strap with pin (5, View A).

NOTE: If the boom length in use requires intermediate suspension, see procedure on next page.

Install Intermediate Suspension

See [Figure 4-20](#) and [Figure 4-21](#) for the following procedure.

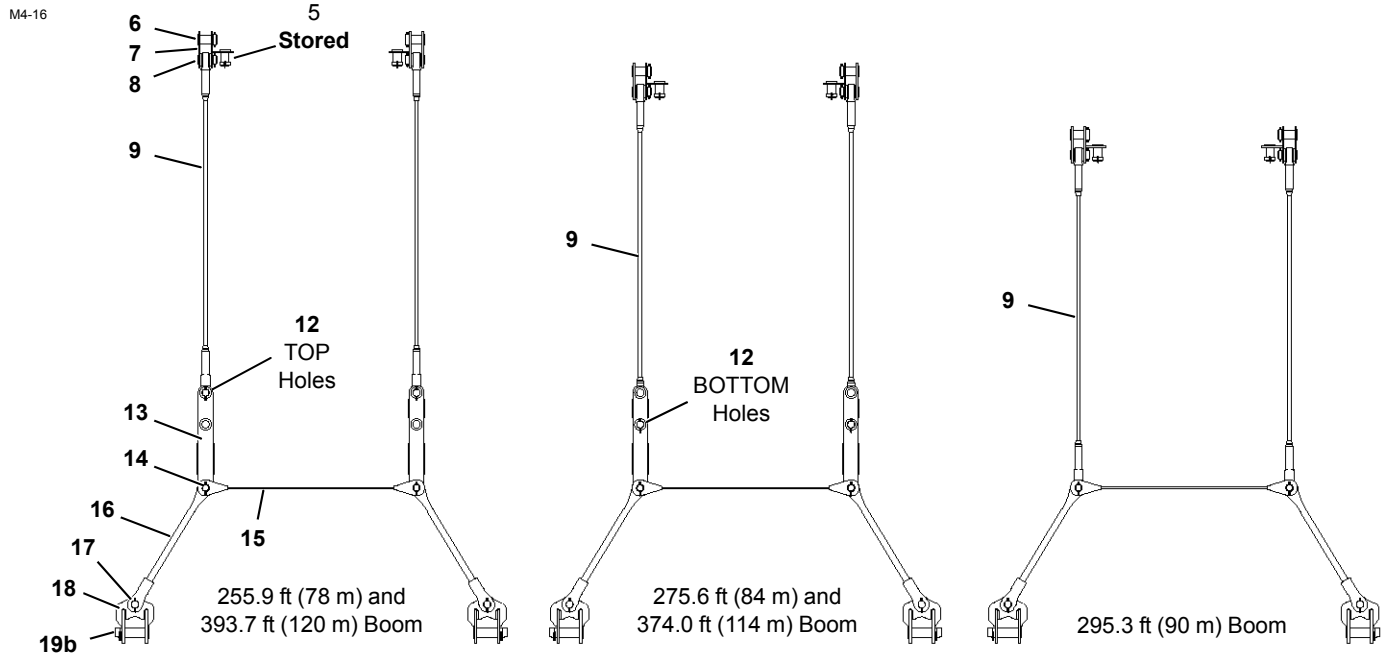
NOTE: See the Boom Assembly Drawing at the end of this section to determine if intermediate suspension is required.

Perform the following steps on both sides of the boom.

1. Remove standard connecting pin (5, View A,) from **rear holes** in links (2) and strap (1).
2. Using pin (6) – stored in lug on intermediate suspension link (7) – pin links (2) and links (7) to strap (1, View C).
3. Store standard connecting pin (5) in lug on link (7, View C).
4. Remove standard connecting pin (19a) from bottom insert connectors (View C) and store pins in pockets on insert.
5. Pin link (18, View C) between inserts with pin (19b).
6. Pin link (16, View C) to link (18).
7. Pin link (15, View C) and link (13) or pendant (9) to link (16).
If links (13) are used, be sure to pin pendants (9) to proper link holes — top or bottom — depending on boom length.
8. If used, pin pendants (10) to pendant (9).
9. Pin pendant (9 or 10) to links (7).

When the boom is raised, the boom straps lift the intermediate suspension into position to support the inserts.

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See [Figure 4-20](#) for List of Item Numbers

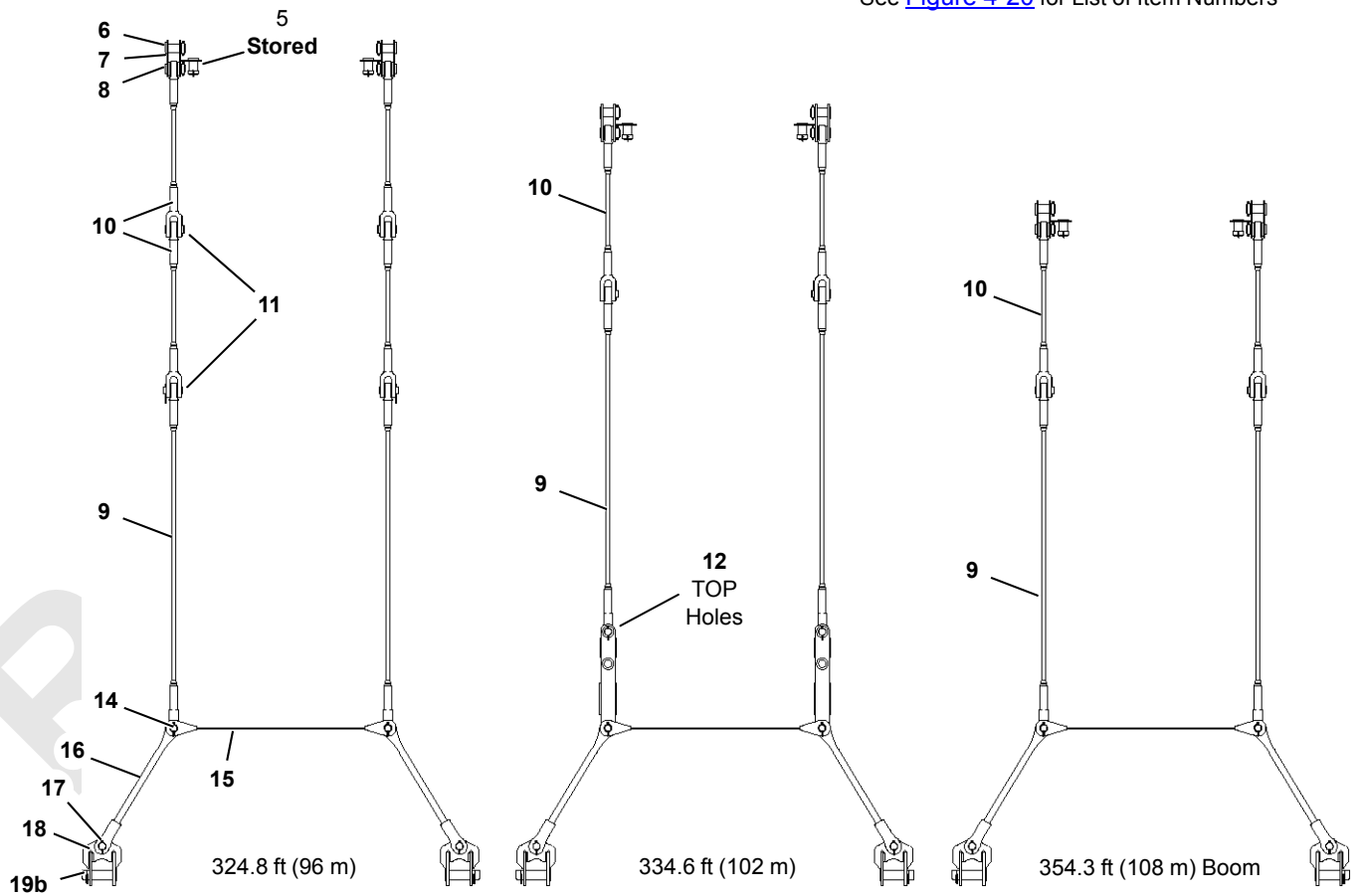
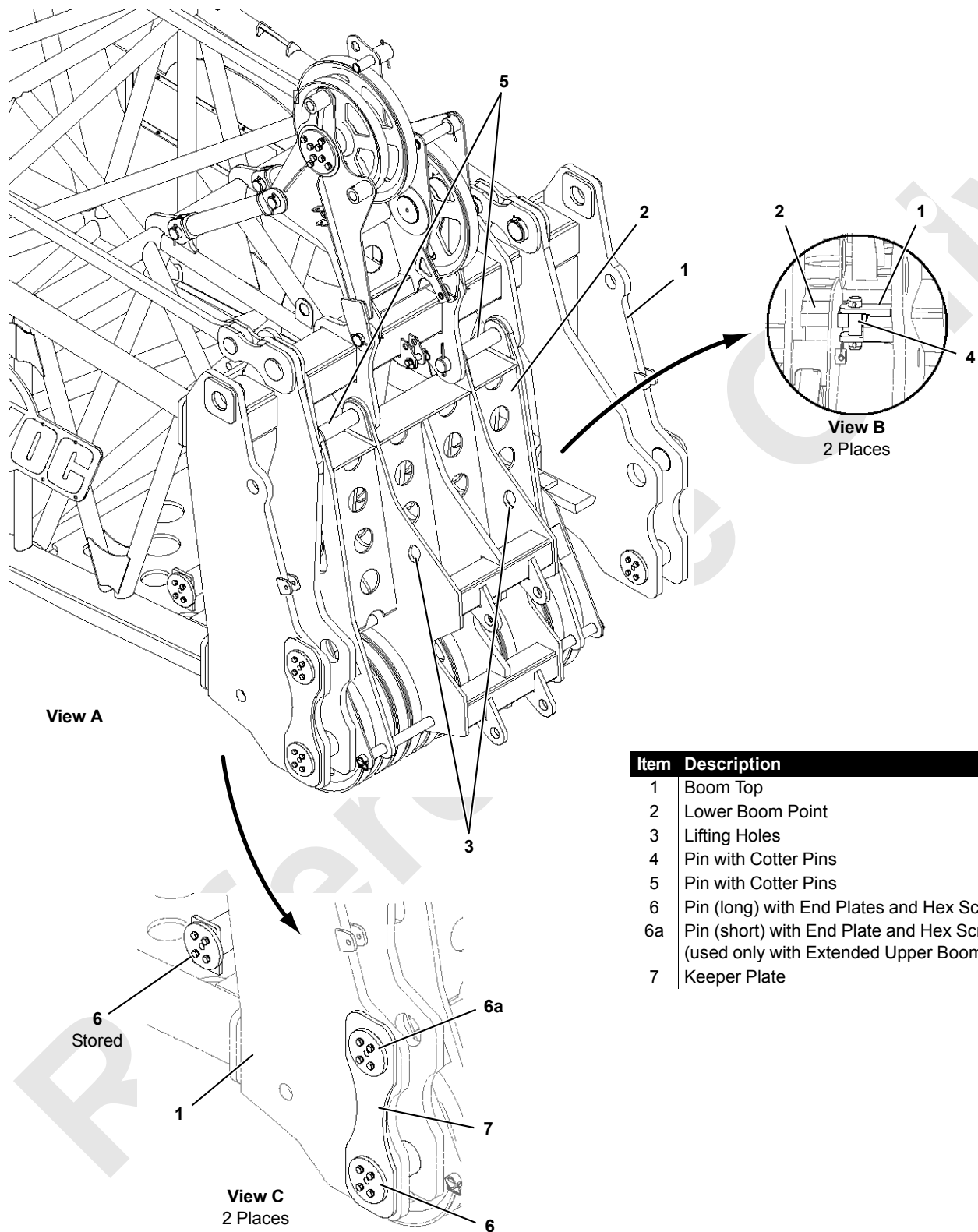


FIGURE 4-21

A11388-4,5,6



Item	Description
1	Boom Top
2	Lower Boom Point
3	Lifting Holes
4	Pin with Cotter Pins
5	Pin with Cotter Pins
6	Pin (long) with End Plates and Hex Screws
6a	Pin (short) with End Plate and Hex Screws (used only with Extended Upper Boom Point)
7	Keeper Plate

FIGURE 4-22

Install Standard Upper Boom Point

See [Figure 4-19](#), View D for the following procedure.

Do not install standard upper boom point if an extended upper boom point or luffing jib will be installed.

1. Using lifting slings from assist crane, lift upper boom point (10) into position at lower boom point.
2. Remove top pin (11a) from holes in upper boom point.
3. Align upper holes (A) and install pins (11a and 11b).
4. Rest upper boom point on foundation.
5. Remove lifting slings.
6. Slowly raise boom until bottom holes (B) are aligned.
7. Install pins (11b) in holes (B).

CAUTION

Avoid Upper Boom Point Damage!

Do not rest weight of entire boom on standard upper boom point. Structural damage will occur.

Install Extended Upper Boom Point

For this procedure, see [Figure 4-22](#) and Extended Upper Boom Point Assembly Drawing at the end of this section.

1. Remove lower boom point, as follows:
 - a. Lower boom until sheaves in lower boom point (2) are just clear of ground.
 - b. Attach hooks from assist crane to lifting holes (3, View A) in lower boom point (2).
 - c. Remove lower pins (4, View B).
 - d. Hoist against lower boom point with assist crane until upper pins (5, View A) are loose and remove upper pins.
 - e. Swing lower boom point away from boom top and store.
 - f. Store pins (4 and 5) in lower boom point holes.
 - g. Lower boom top onto blocking at least 12 in (305 mm) high.
2. If installed, remove pins (6 or 6a, View C) with end plates and keeper plates (7) from boom top (1).

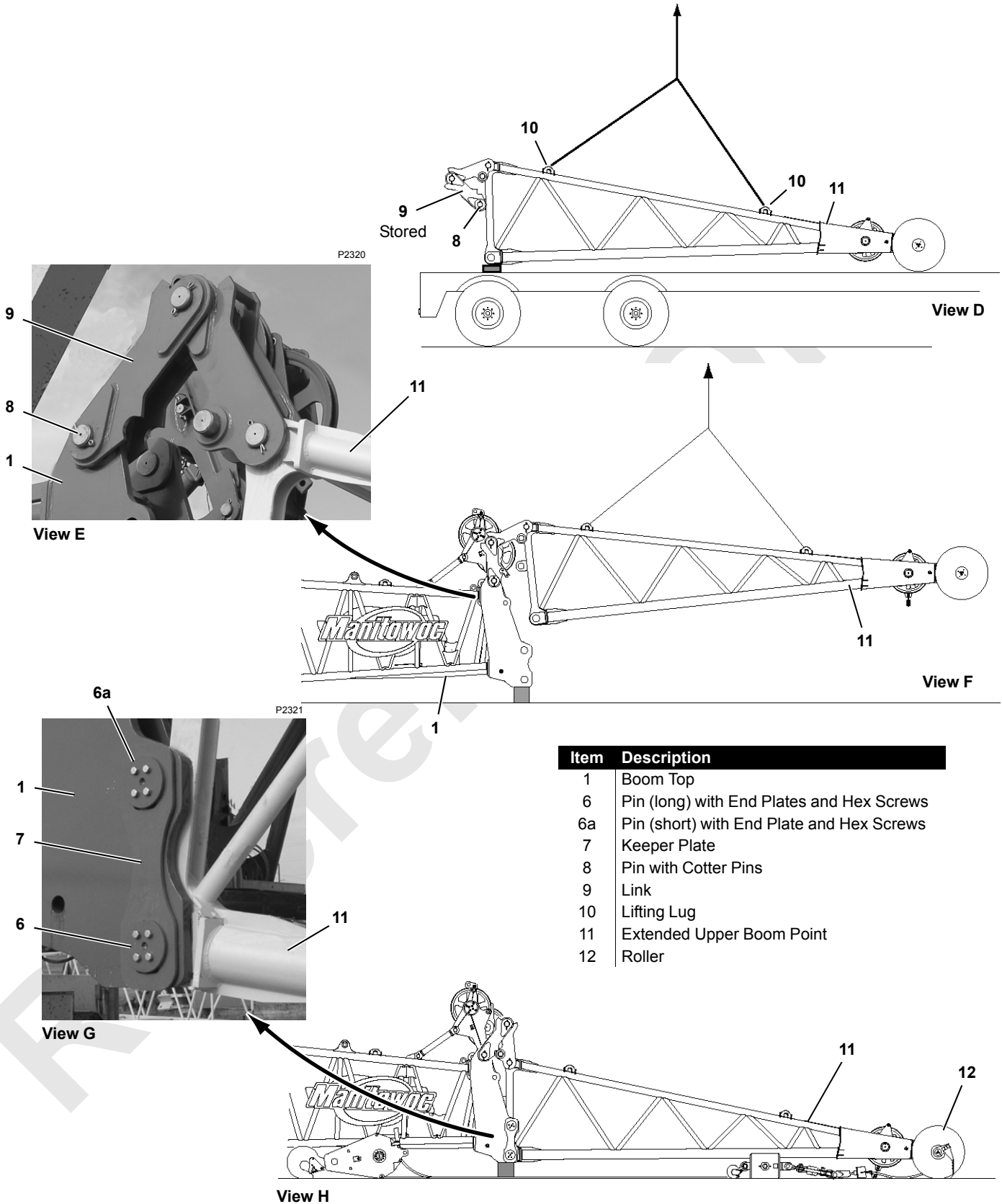


FIGURE 4-23

See [Figure 4-23](#)

3. Remove pins (8, View D) to disconnect links (9) from storage position.
4. Attach equal length slings from assist crane to four lifting lugs (10, View D) on extended upper boom point (11).
5. Lift extended upper boom point (11) off trailer and into position at boom top (1, View F).
6. Align connecting holes in links (9, View E) with boom top (1) and install pins (8).
7. Lower extended upper boom point until bottom holes are aligned.
8. Install bottom pins (6, View G), keeper plates (7) and end plates.
9. Lower upper boom point until rollers (12, View H) are on foundation and disconnect assist crane.
10. If equipped with long top pins (6) in upper holes, store them with end plates (View C).
11. Install short top pins (6a, View G) and outboard end plates.
12. Securely tighten end plate screws for pins (6 and 6a).
13. As boom is raised, extended upper boom point rollers (12) will roll along ground until links unfold. Upper point will then lift off ground as boom is raised.

Make sure roller path is clear of obstructions.



WARNING

Crush Hazard!

Prior to raising boom, warn personnel to stand clear of extended upper boom point rollers.

Install Load Line

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

Install Block-Up Limit Control

Install block-up limit components and connect electric cables from block-up limit switches and wind speed transmitters to proper receptacles on boom and jib node controllers.

See [Figure 4-24](#) and Boom Wiring and Limits Electrical Drawing at the end of this section.

Install wind speed indicator assembly if removed for shipping. Use star washers to attach mounting bracket to jib top to provide a good ground.

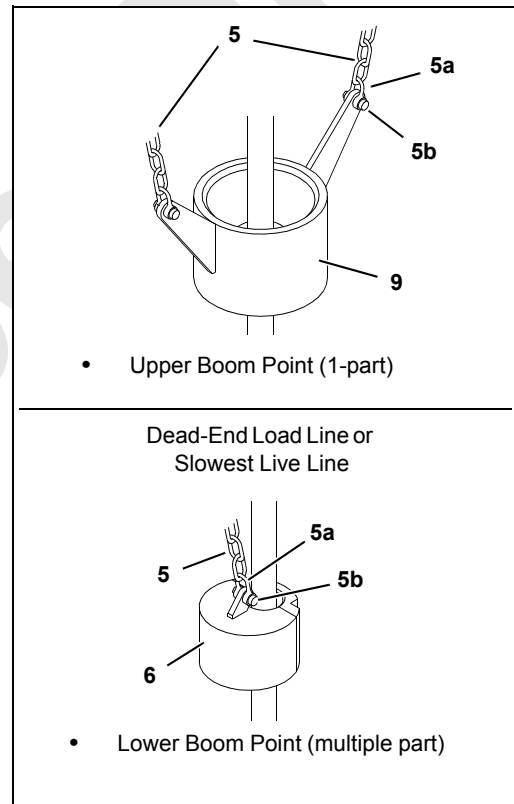
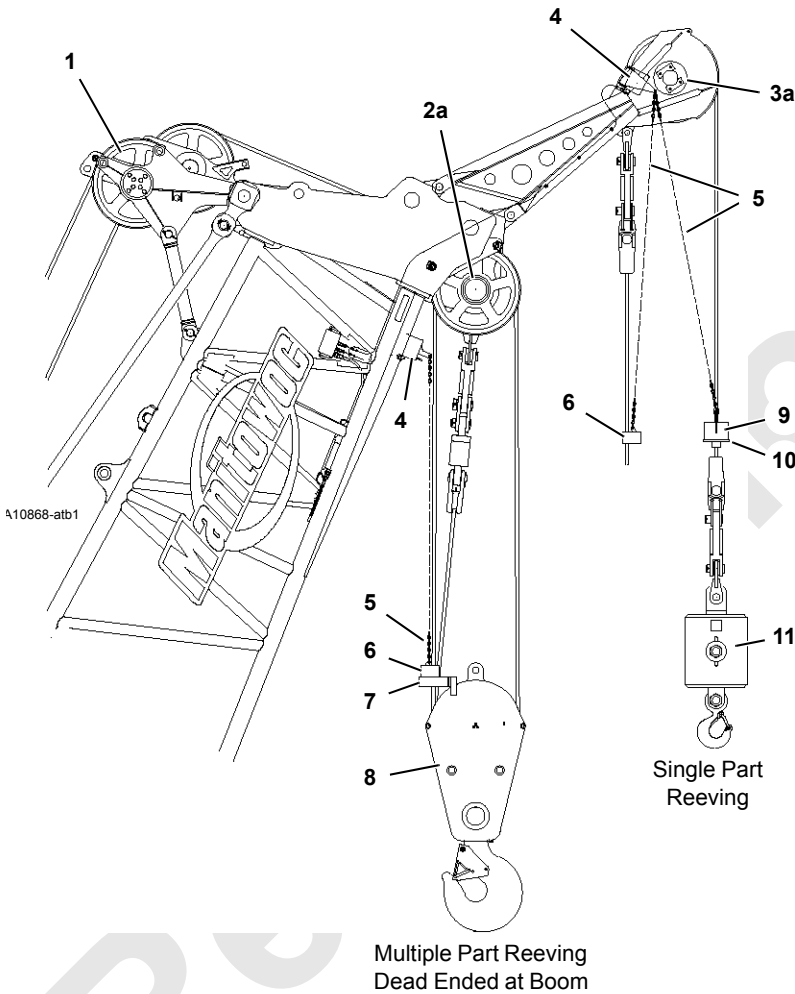
Perform Pre-Raising Checks

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

- o Crane on firm, level surface.
- o Crawlers blocked if required per Capacity Chart.
- o All connecting pins installed and properly retained.
- o Boom inserts installed in proper sequence.
- o Boom straps installed in proper sequence.
- o All jib backstay straps, links, and pins removed from boom sections (if luffing jib will not be used).
- o All insert and strap connecting pins installed and properly retained.
- o Load lines spooled tightly onto drums and engaged with proper sheaves. Load lines securely anchored to sockets at boom points or at load block and weight ball.
- o All blocking, tools, and other items removed from boom.
- o Electronic boom angle indicator properly installed and adjusted.
- o Block-up limit control properly installed and operational.
- o Wind speed indicator installed on jib top.
- o Rated Capacity Indicator/Limiter (RCL) properly installed and operational.
- o Proper liftcrane chart selected in RCL.
- o Automatic boom stop properly installed. Must be adjusted after boom is raised.
- o Crane and attachment properly lubricated.
- o Wind within allowable limits for operation.

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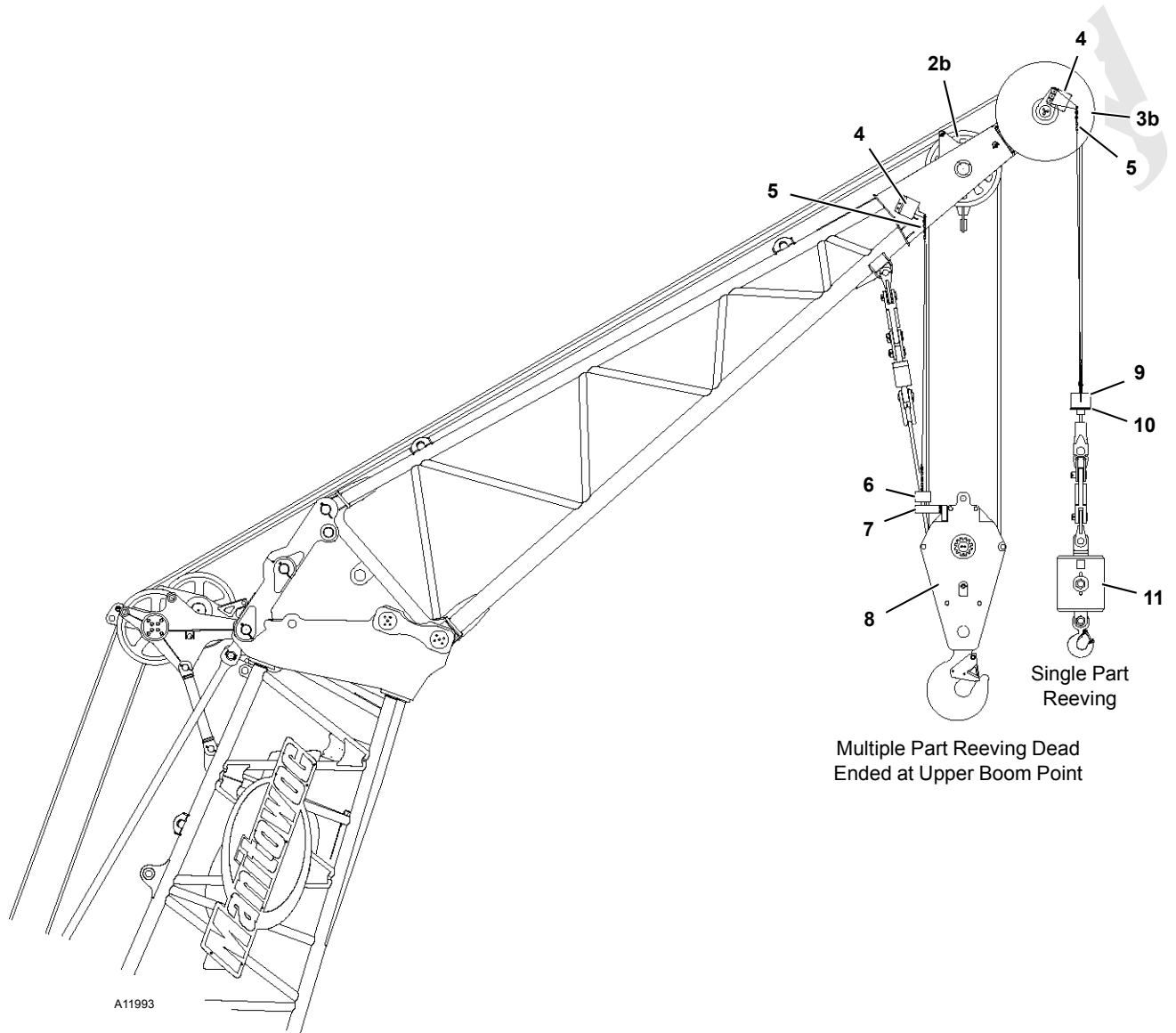
Item	Description	Item	Description
1	Wire Rope Guide	5b	Pin
2a	Lower Boom Point	6	Weight
2b	Extended Upper Boom Point (lower sheaves)	7	Lift Plate
3a	Standard Upper Boom Point	8	Load Block
3b	Extended Upper Boom Point (upper sheave)	9	Weight
4	Block-Up Limit Switch	10	Lift Block
5	Chain	11	Weight Ball
5a	Shackle		



Location of Components at Boom Top Shown
Location of Components at Jib Tops is Similar

See Load Block Reeving Diagrams for
Suggested Location of Weight with
Multiple Part Reeving

FIGURE 4-24



Multiple Part Reeving Dead Ended at Upper Boom Point

Single Part Reeving

FIGURE 4-24 continued

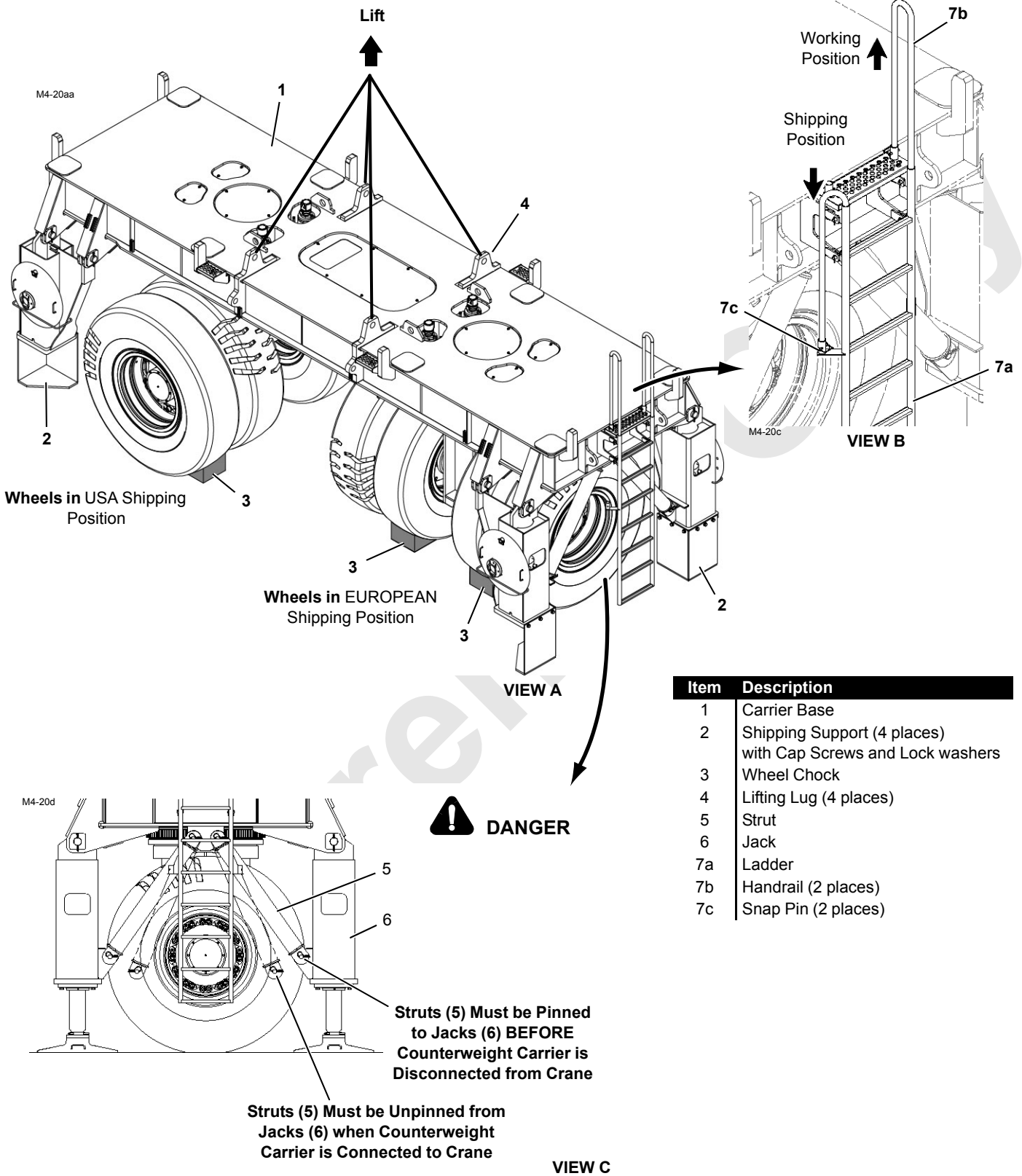


FIGURE 4-25

Assemble and Attach Wheeled Counterweight Carrier

REMINDER — To operate the MAX-ER remote control, the wireless remote mode must be turned on in the MAX-ER Function Mode screen of the Main Display.

Remove Carrier Base from Trailer

The carrier base is shipped in the following configuration from Manitowoc:

- Counterweight boxes removed
- Lifting frame removed
- Shipping supports installed
- For USA shipment: Wheels in line with carrier base

For USA shipment, the carrier base will stand on its own if the shipping supports are not used. The base will tip, however, approximately 3° in either direction

- For EUROPEAN shipment: Wheels perpendicular to carrier base. This position provides the narrowest width for transporting the carrier base on a trailer

For EUROPEAN shipment, the **carrier base will not stand on its own if the shipping supports are not used. It will tip over**



DANGER

Tipping Hazard!

When MAX-ER wheels are in EUROPEAN shipping position and telescopic beam is disconnected from crane:

Carrier base (1, [Figure 4-25](#)) must be supported by shipping supports (2) or by jacks (3) with jack pads installed.

Otherwise, carrier base will tip over.

Owner/user, do not discard shipping supports. They are required each time you ship carrier base.

See [Figure 4-25](#) for the following procedure.

1. To gain access to top of carrier base:
 - Unpin ladder handrails (7b, View B) from shipping position, raise handrails, and pin handrails in working position
2. Attach shackles to lifting lugs (4, View A) on carrier base (1).
3. Attach slings from assist crane to shackles and hoist just enough to support carrier base.



WARNING

Tipping Hazard!

Prevent carrier base from tipping over. Make sure struts (5, View C) are pinned to jacks on both ends of carrier base.

4. Remove all tie-downs securing carrier base to trailer and lift carrier base off trailer.
5. Place carrier base on a firm level foundation in assembly area.
6. Disconnect the lifting slings.

Continued on [page 4-49](#).

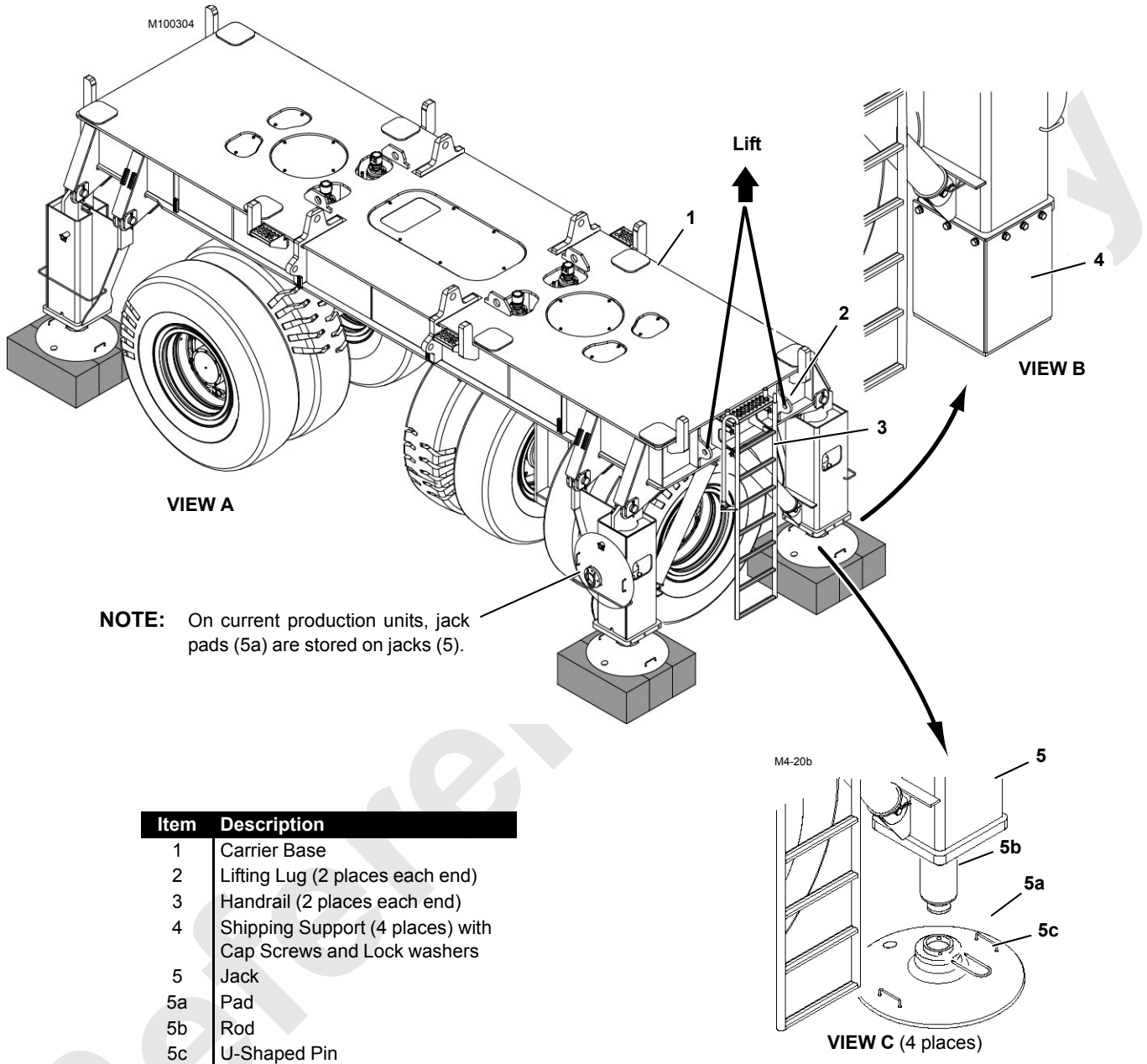


FIGURE 4-26

See [Figure 4-26](#)

7. Lower handrails (3) to prevent damaging them.
8. Perform the following steps at both ends of carrier base (1), one end at a time.
 - a. Attach shackles to lifting lugs (2, View A) on either end of carrier base (1).
 - b. Attach slings from assist crane to shackles and hoist just enough to lift shipping supports (4, View B) clear of ground.
 - c. Remove shipping supports (4, View B) and store them for future use.
 - d. Lift each jack pad (5a, View C) into position so rod (5b) engages saddle in pad.
Jack pads weigh 40 lb (18 kg).
 - e. Install U-shaped pin (5c).
 - f. To maintain stability of carrier base, block under jack pads as shown in View A.

Blocking will be approximately 15 in (381 mm) high.

- g. Adjust blocking so carrier base is level in all directions.
- h. Lower carrier base with assist crane so jack pads are resting firmly on blocking.



DANGER
Tipping Hazard!

For EUROPEAN shipment, do not disconnect lifting slings until jack pads are installed (so that carrier base is supported on foundation). Otherwise, tires will roll and base will tip over.

- i. Disconnect lifting slings and remove shackles.
9. Repeat above steps at other end of carrier base.
10. Make sure carrier base is level in all directions.
11. Raise handrails (3).

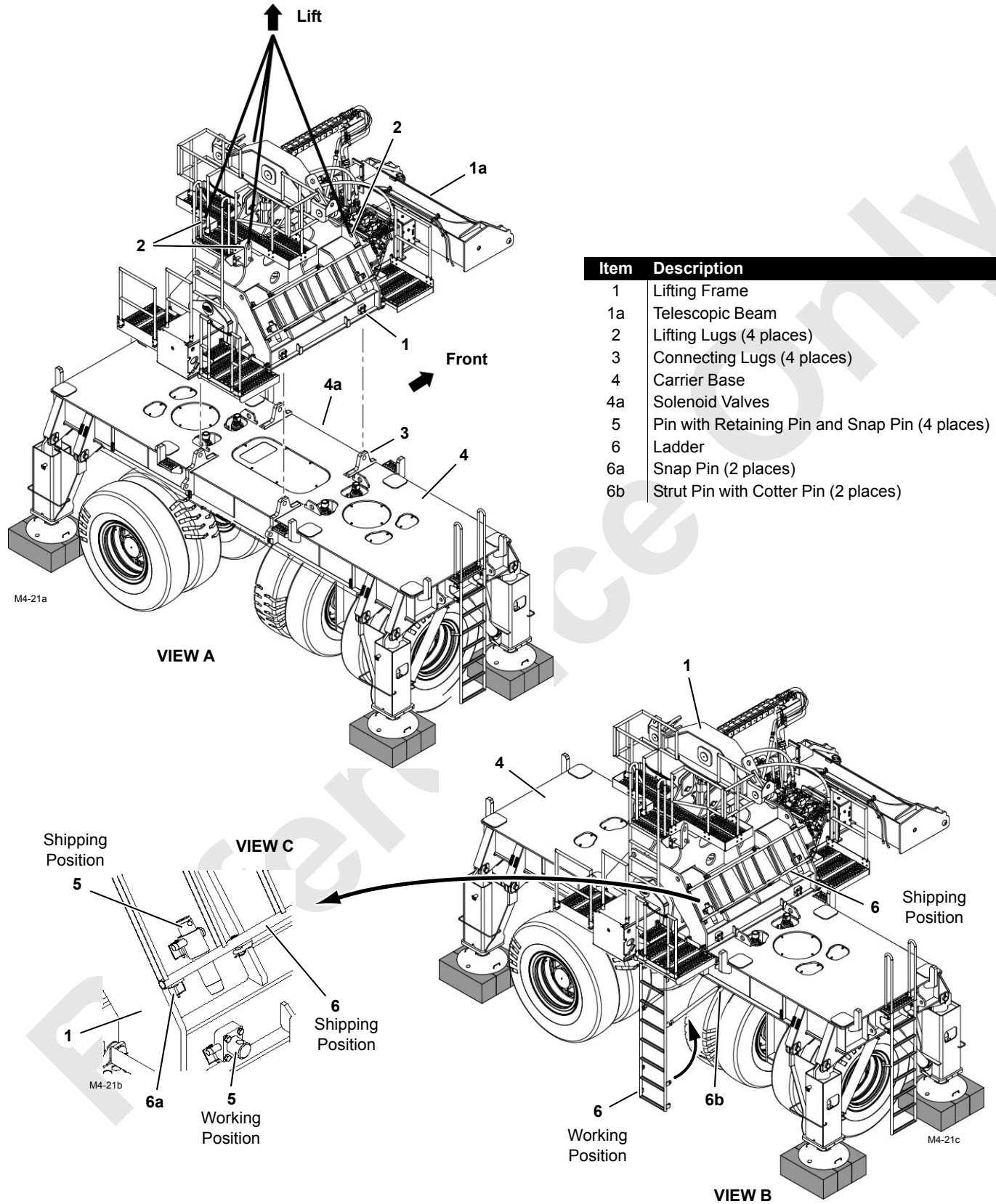


FIGURE 4-27

Install Lifting Frame on Base

See [Figure 4-27](#) for the following procedure.

1. Attach shackles to lifting lugs (2, View A) on lifting frame (1).
2. Attach slings from assist crane to shackles.
3. Adjust length of slings so lifting frame is level when lifted.
4. Remove all tie-downs securing lifting frame to trailer and lift lifting frame off trailer.
5. Position lifting frame in position over connecting lugs (3, View A) on carrier base (4).

Telescopic beam (1a) on front of lifting frame must be over solenoid valves (4a) on front of carrier base.

6. Lower lifting frame onto carrier base. Connecting lugs will guide the frame into position (View B).
7. Remove pins (5, View C) from shipping position and install in working position.
8. Disconnect lifting slings and remove shackles.
9. Remove ladder (6, View B) from shipping position on lifting frame.

The ladder is retained by snap pins (6a, View C) on one end and by hooks on the other end. Reinstall snap pins in holes on lifting frame once ladder is removed.

10. Install ladder (6, View B) in working position.
 - a. Hook top end of ladder into slots in bottom of platform.
 - b. Unpin struts (6b) from ladder.
 - c. Pins struts to lugs under carrier base.

Connect Hydraulic Hoses from Carrier Base to Lifting Frame

See [Figure 4-28](#) for the following procedure.

1. Pass hydraulic lines (1) from solenoid valve on front of carrier base through opening (2) in right-front platform on lifting frame.
2. Remove protective caps and **thoroughly clean couplers**.
3. Connect hoses (1) to couplers (3) on lifting frame (they can be connected one way only).

Item	Description
1	Hydraulic Hoses from Carrier Base
2	Opening in Right Front Platform
3	Couplers on Lifting Frame Valve Assembly

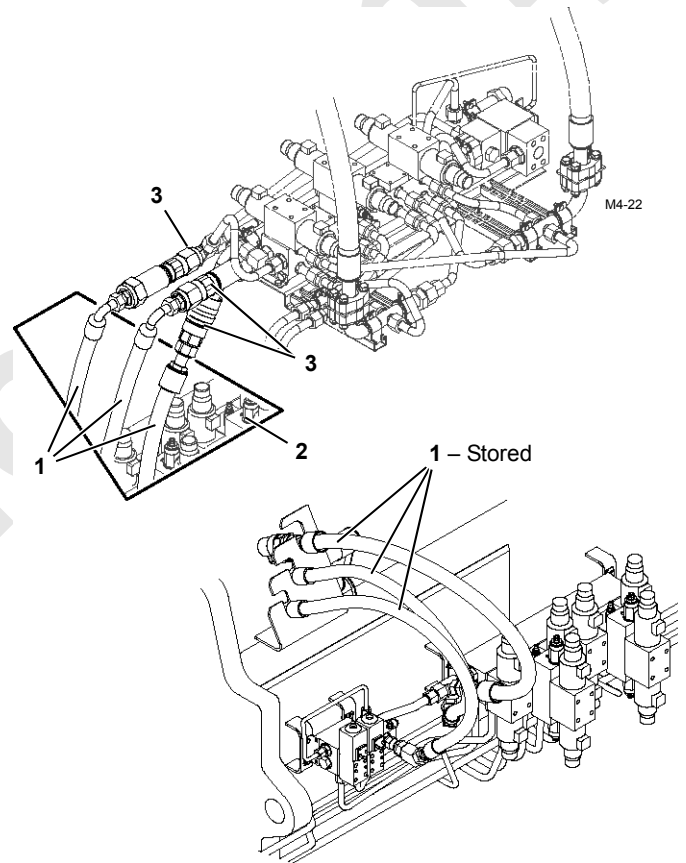


FIGURE 4-28

Item	Description
1	Telescopic Beam
2	Hydraulic Hoses from Lifting Frame
3	Couplers on Rotating Bed
4	Rotating Bed
5	Bracket
WN22	Electric Cable on Rotating Bed
WNE56	Electric Cable from Telescopic Beam
WNE20	Electric Cable on Rotating Bed
WNE56	Electric Cable from Telescopic Beam

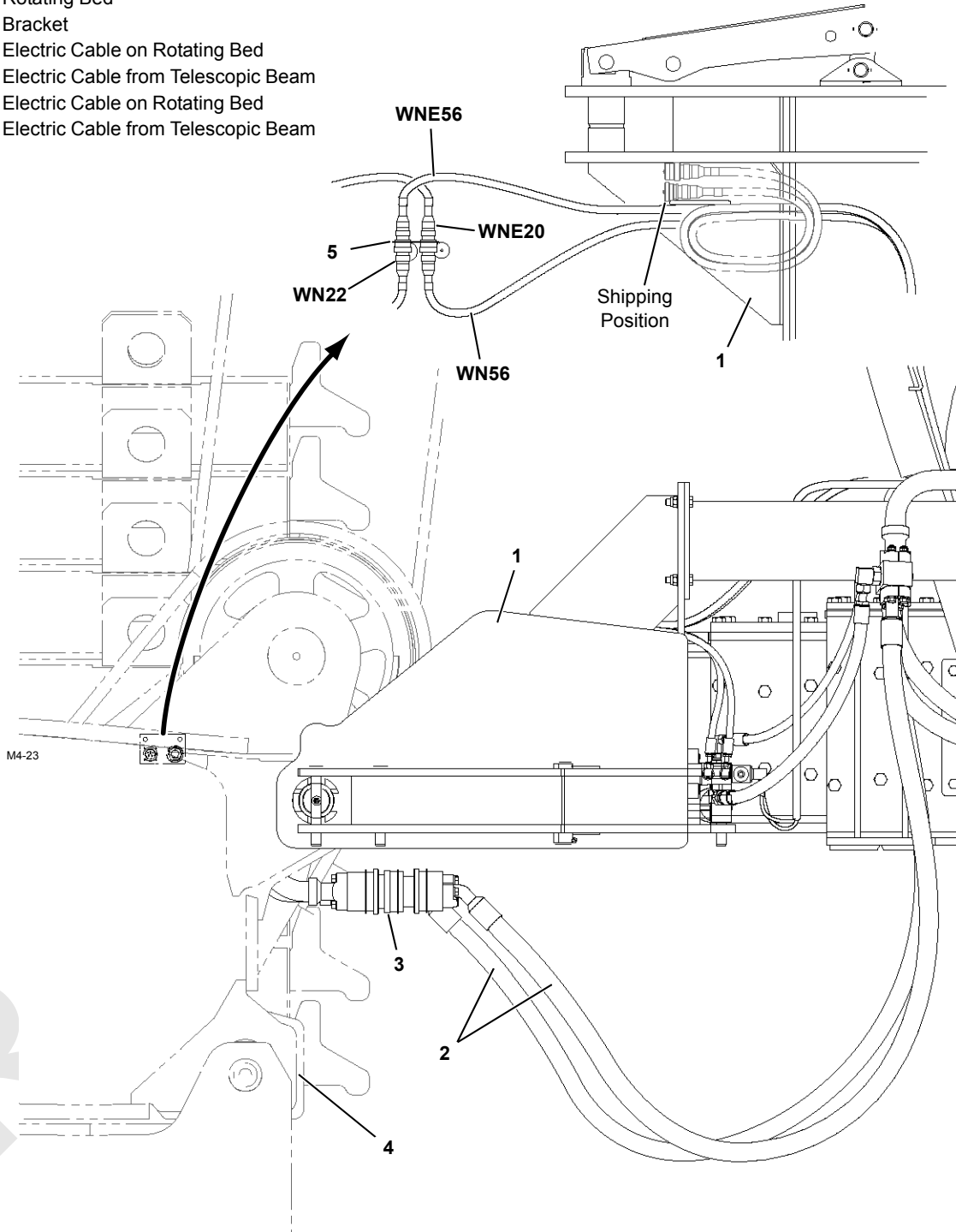


FIGURE 4-29

Connect Electric Cables from Carrier Base to Lifting Frame

See [Figure 4-30](#)

- a. Go under center of carrier base and open sliding door in cover.
- b. Uncoil electric cables from left side of telescopic beam (View A).
- c. Unscrew protective caps from cables and from receptacles on Node 7 inside carrier base. **Thoroughly clean connectors.**
- d. Route cables through sliding door opening.
- e. Connect cables to corresponding receptacles on Node 7 (View B).

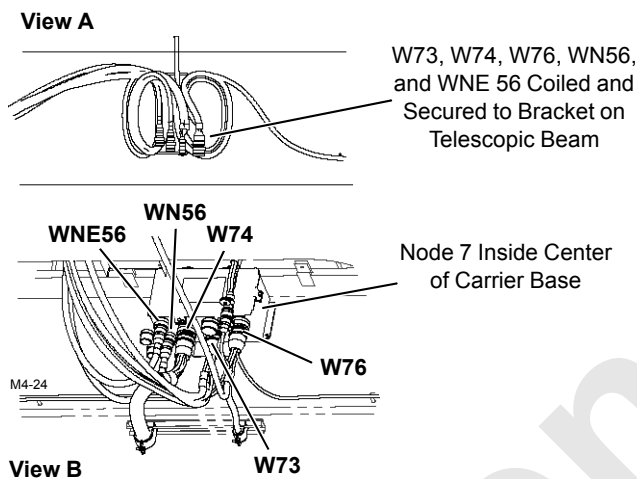


FIGURE 4-30

Connect Telescopic Beam to Crane

WARNING Tipping Hazard!

Use extreme care not to hit wheeled counterweight assembly when backing crane into position. Wheeled counterweight assembly will tip over.

See [Figure 4-29](#) for steps 1 - 3

1. Position rear of crane in line with and as close to telescopic beam (1) as possible.
2. Connect hydraulic hoses:
 - a. Remove protective caps and **thoroughly clean couplers.**
 - b. Connect hoses (2) to couplers (3) on rotating bed (4).
3. Connect electric cables:
 - a. Uncoil electric cables WN56 and WNE56 from storage on telescopic beam (1).
 - b. Unscrew protective caps from cables and from receptacles on rotating bed bracket (5). **Thoroughly clean connectors.**
 - c. Connect cables to corresponding receptacles on rotating bed bracket.

Continued on [page 4-55](#).

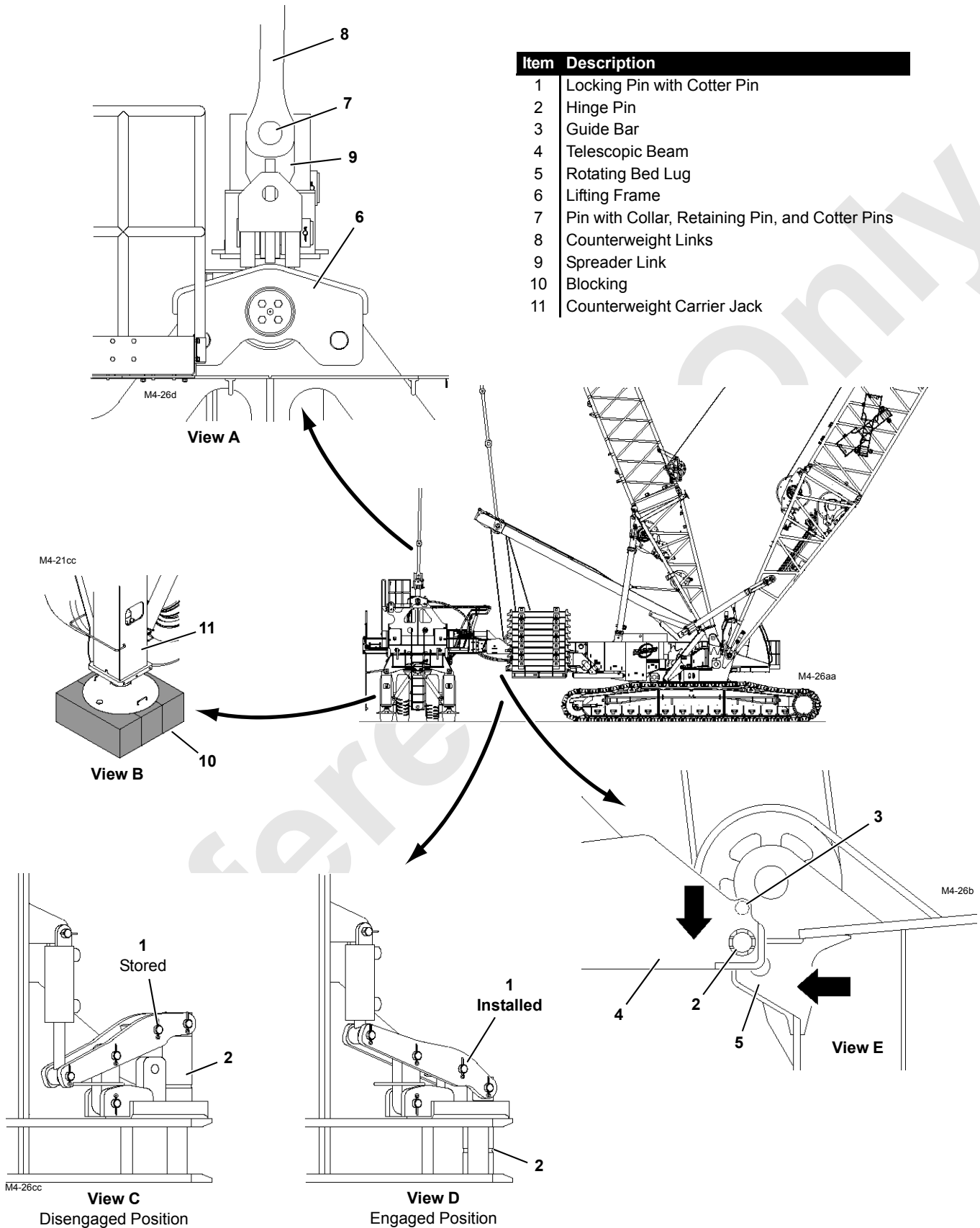


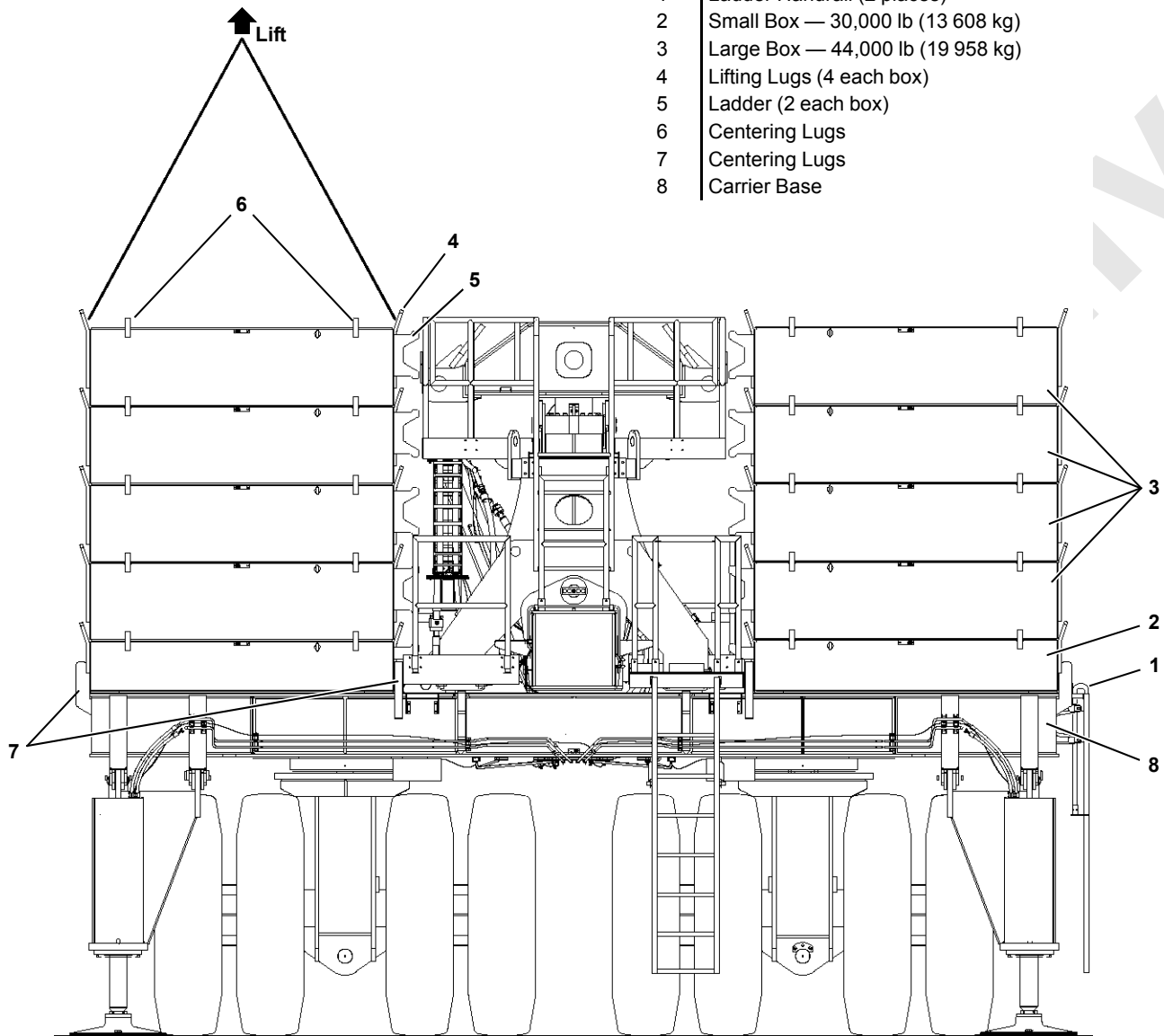
FIGURE 4-31

See [Figure 4-31](#)

4. Remove locking pins (1, View D) from engaged position and store (View C).
5. Disengage hinge pins (2, View C) using MAX-ER remote control.
6. Extend counterweight carrier jacks using MAX-ER remote control so guide bars (3, View E) on telescopic beam (4) are above lugs (5) on rear of rotating bed.
7. Slowly back crane into position to align holes in lugs (5) vertically with hinge pins (2).
8. Retract jacks only enough to align hinge pins (2) horizontally with holes in lugs (5) — guide bars (3) lightly contacting lugs (5).
9. Engage hinge pins (2, View D) and install locking pins.
10. Remove blocking from under counterweight carrier jacks:
 - a. Extend all of the jacks about 1 in (25,4 mm).
 - b. At any one corner of counterweight carrier, remove blocking (10, View B) from under jack (11).
 - c. Extend jack (11) until it firmly contacts ground.
 - d. Repeat steps [10b](#) and [10c](#) at each jack.
11. Connect counterweight links on both sides of lifting frame (6, View A):
 - a. Remove pins (7) from counterweight links (8).
 - b. Extend lifting cylinder as needed with MAX-ER remote control to align connecting holes in counterweight links with holes in spreader link (9) — one counterweight link (8) on each side of spreader link (9).
 - c. Reinstall pins (7).
12. Fully retract counterweight carrier jacks using MAX-ER remote control.
13. Unpin struts from counterweight carrier jacks ([Figure 4-25](#), View C, [page 4-46](#)) after jacks are retracted.

If you fail to perform this step, struts and jacks can be damaged.

Item	Description
1	Ladder Handrail (2 places)
2	Small Box — 30,000 lb (13 608 kg)
3	Large Box — 44,000 lb (19 958 kg)
4	Lifting Lugs (4 each box)
5	Ladder (2 each box)
6	Centering Lugs
7	Centering Lugs
8	Carrier Base



M4-25a

Wheeled Counterweight with MANITOWOC FURNISHED BOXES

4 Arrangements, Depending on Load Handling Requirements —

- 0 lb (0 kg) — Wheeled Counterweight Assembly Removed *
- 159,400 lb (72 303 kg) — 1 Small Box each Side
- 335,400 lb (152 135 kg) — 1 Small Box, 2 Large Boxes each Side *
- 511,400 lb (231 967 kg) — 1 Small Box, 4 Large Boxes each Side *

* Also Used for Luffing Jib with MAX-ER Attachment.

FIGURE 4-32

Install Counterweight Boxes

! WARNING
Tipping Hazard!

Do not install counterweight boxes until wheeled counterweight assembly is pinned to rear of crane. Wheeled counterweight assembly could tip over.

See [Figure 4-32](#) for the following procedure.

1. Lower ladder handrails (1) to shipping position (see View B, [Figure 4-25](#)).
2. Stack required counterweight boxes (2 and 3) one box at a time alternating from side to side.

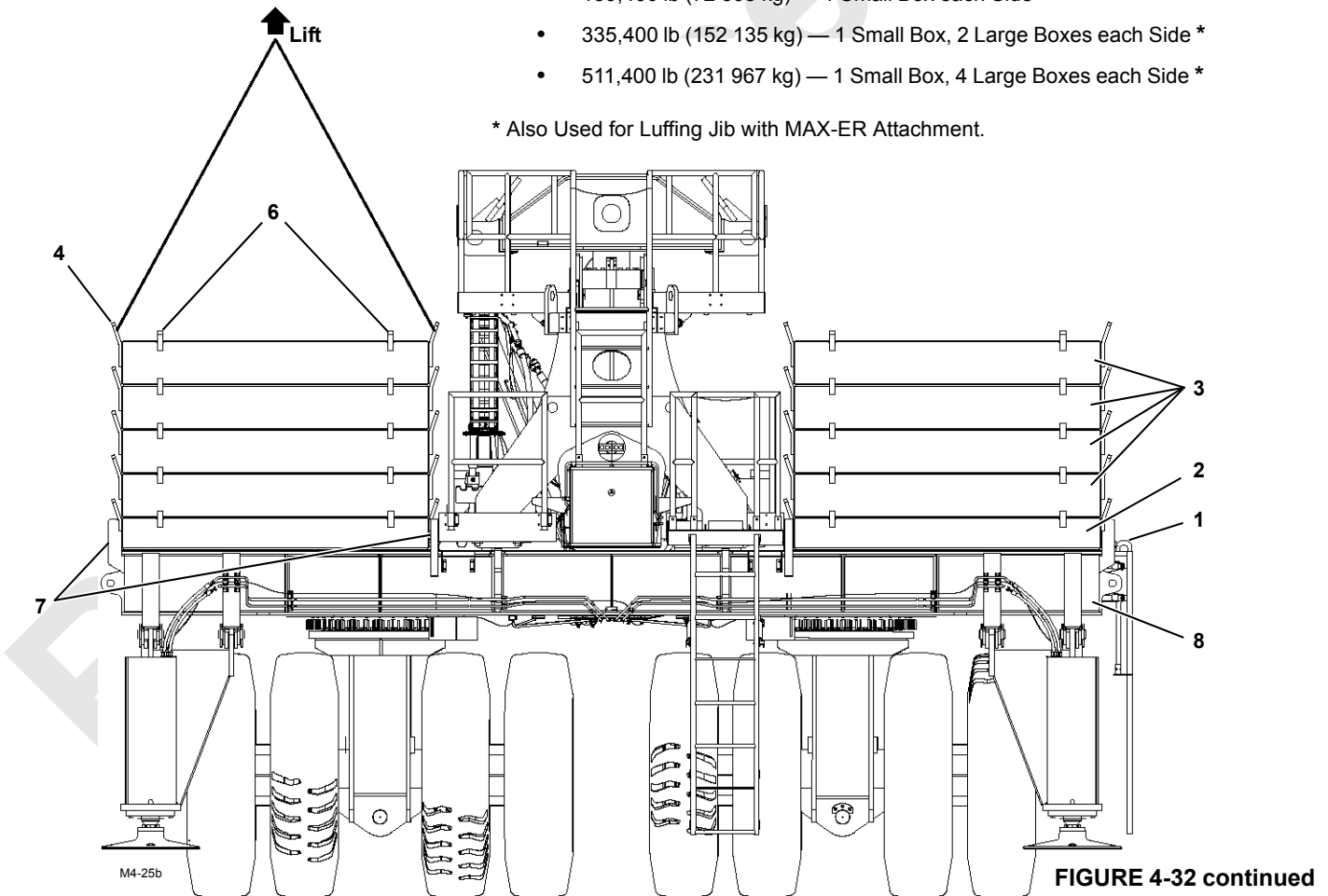
- Lift boxes at four lifting lugs (4)
- Ladders (5) on boxes must face inward.
 - Current production cranes the ladder rung must be pinned into the operating position during assembly and pinned back into the shipping position during disassembly. See decal on counterweight assembly for detailed information
- Small boxes (2) must be installed first
- Lugs (7) will center boxes on carrier base (8)
- Lifting lugs (4) and lugs (6) will center adjacent boxes

Wheeled Counterweight with OWNER FURNISHED STEEL BOXES

4 Arrangements, Depending on Load Handling Requirements —

- 0 lb (0 kg) — Wheeled Counterweight Assembly Removed *
- 159,400 lb (72 303 kg) — 1 Small Box each Side
- 335,400 lb (152 135 kg) — 1 Small Box, 2 Large Boxes each Side *
- 511,400 lb (231 967 kg) — 1 Small Box, 4 Large Boxes each Side *

* Also Used for Luffing Jib with MAX-ER Attachment.



READY CRANE FOR OPERATION

MAX-ER attachment is now ready for operation.

1. If required, lower boom onto blocking at ground level and perform the following steps:
 - a. Lengthen boom (add inserts).
 - b. Install upper boom point.
2. Install load lines.
3. **Disconnect struts at counterweight carrier jacks** ([Figure 4-25](#), View C).
4. Rotate wheels to desired position. See Section 3 for detailed instructions.

CALIBRATION AND ADJUSTMENT

Perform the calibration and adjustment procedures given in Section 6. **Damage can occur if components are not properly calibrated or adjusted.**

MAX-ER OPERATION

See Section 3 for operating precautions and a description of the MAX-ER Operating Controls.

To operate with the MAX-ER attachment the proper capacity chart must be selected in Rated Capacity Indicator/Limiter. See MAX-ER Operating Mode topic in Section 3.

Reference Only

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DISCONNECTING WHEELED COUNTERWEIGHT ASSEMBLY FOR JOB SITE STORAGE

To perform the following procedure:

- The 16000 must not be equipped with any more boom than can be raised with 0 lb (0 kg) of wheeled counterweight installed (See MAX-ER Capacity Charts)
- The counterweight boxes can remain installed on the wheeled counterweight assembly for job site storage

Prepare Crane

Position the crane on a firm and level foundation.



DANGER

Tipping Hazard!

Do not disconnect wheeled counterweight assembly from rear of crane until telescopic beam is fully retracted to 36 ft 1 in (11 m) position. Wheeled counterweight assembly can tip over if this step is not performed.

Disconnect Wheeled Counterweight Assembly

REMINDER — To operate the MAX-ER remote control, the wireless remote mode must be turned on in the MAX-ER Function Mode screen of the Main Display.

1. Fully retract telescopic beam to 36 ft 1 in (11 m) position. ***Wheeled counterweight assembly can tip over when it is disconnected from crane if this step is not performed.***
2. Pin struts (5) to jacks (6, [Figure 4-25](#), View C, [page 4-46](#)).
3. Install jack pads (5a, [Figure 4-26](#), View C, [page 4-48](#)).
4. Unpin counterweight links (8, [Figure 4-31](#), View A, [page 4-54](#)) from spreader links (9). Extend lifting cylinder with MAX-ER remote control as required to loosen pins.
Store pins (7) in holes in links (8).
5. Disconnect telescopic beam from crane as follows:
 - a. Extend jacks as required and disengage hinge pins (2) using MAX-ER remote control ([Figure 4-31](#), Views C and D, [page 4-54](#)).
 - b. Slowly travel crane until it is just clear of wheeled counterweight assembly.

- c. Extend jacks so wheeled counterweight assembly is level in all directions.
- d. Disconnect hydraulic hoses and electric cables between telescopic beam and rear of crane ([Figure 4-29](#), [page 4-52](#)). ***Clean all connectors and install protective caps.***

REMOVING MAX-ER ATTACHMENT FOR SHIPPING

Prepare Crane

Position the crane on a firm and level foundation.

Disassemble and Disconnect Wheeled Counterweight Assembly

The 16000 must be traveled and swung to disconnect the wheeled counterweight assembly from the crane.

If another crane is used to disassemble wheeled counterweight assembly, disconnect the wheeled counterweight assembly from the 16000 after the fixed mast and boom are removed so the 16000 can be traveled and swung.

If 16000 is used to disassemble wheeled counterweight assembly, it must not be equipped with any more boom than can be raised with 0 lb (0 kg) of wheeled counterweight installed (See MAX-ER Capacity Charts).



DANGER

Read Capacity Charts!

Before you disconnect wheeled counterweight assembly from crane, read Capacity Charts to determine the following requirements:

- Are blocked crawlers required to raise and lower boom and jib (if equipped)?
- Is wheeled counterweight required to lower boom and jib (if equipped)?

If required per Capacity Chart, make sure crawlers are blocked and counterweight carrier and required counterweight is installed before lowering boom and jib to ground.

Failing to observe this precaution will result in tipping and possible collapse of boom and jib.

Tipping Hazard!

Do not disconnect wheeled counterweight assembly from rear of crane until telescopic beam is fully retracted to 36 ft 1 in (11 m) position. Wheeled counterweight assembly can tip over if this step is not performed.

REMINDER — To operate the MAX-ER remote control, the wireless remote mode must be turned on in the MAX-ER Function Mode screen of the Main Display.

Remove Counterweight Boxes

1. Fully retract telescopic beam to 36 ft 1 in (11 m) position. **Wheeled counterweight assembly can tip over when it is disconnected from crane if this step is not performed.**
2. Reverse the installation procedure on [page 4-57](#) to remove the counterweight boxes with an assist crane.

Prepare Carrier Base/Disconnect Telescopic Beam

1. Pin struts (5) to jacks (6,) [Figure 4-25](#), View C, [page 4-46](#)).
2. Install jack pads (5a, [Figure 4-26](#), View C, [page 4-48](#)).
3. Rotate wheels to proper shipping position ([Figure 4-25](#), View A, [page 4-46](#)):
 - For USA shipment, wheels in line with carrier base.
 - For EUROPEAN shipment, wheels perpendicular to carrier base.
4. Unpin counterweight links (8, [Figure 4-31](#), View A, [page 4-54](#)) from spreader links (9). Extend lifting cylinder with MAX-ER remote control as required to loosen pins.

Store pins (7) in holes of counterweight links (8).
5. Fully retract lifting cylinder with MAX-ER remote control.
6. Fully retract jacks.
7. Block (10) under jack pads as shown in [Figure 4-31](#), View B, [page 4-54](#).

Adjust blocking so carrier base is level from end to end.
8. Disconnect telescopic beam from crane as follows:
 - a. Disengage hinge pins using MAX-ER remote control ([Figure 4-31](#), Views C and D, [page 4-54](#)).
 - b. Slowly travel crane until it is just clear of wheeled counterweight assembly.
 - c. Engage hinge pins (2) using MAX-ER remote control ([Figure 4-31](#), Views C and D, [page 4-54](#)). This step must be performed to meet shipping width.
 - d. Disconnect hydraulic hoses and electric cables between telescopic beam and rear of crane ([Figure 4-29](#), [page 4-52](#)). **Clean all connectors and install protective caps.**

Remove Lifting Frame from Base

1. Disconnect hydraulic hoses ([Figure 4-28](#), [page 4-51](#)) and electric cables ([Figure 4-30](#), [page 4-53](#)) between base and lifting frame. **Clean all couplers and connectors and install protective caps.**
2. Store hoses (1) as shown in ([Figure 4-28](#), [page 4-51](#)).

See [Figure 4-27](#), [page 4-50](#)

3. Remove ladder (6, View C) from working position on lifting frame.
 - a. Unpin struts from base and pin to ladder with pins (6b).
 - b. Unhook ladder from slots in bottom of platform.
4. Install ladder (6, View B) in shipping position.

The ladder is retained by hooks on one end and snap pins (6a, View C) on the other end.
5. Attach shackles to lifting lugs (2, View A) on lifting frame (1).
6. Attach slings from assist crane to shackles.
7. Remove pins (5, View C) from working position and install in shipping position.
8. Remove lifting frame from trailer and either store it on job site or place it on transport trailer.
9. Securely attach lifting frame to transport trailer.
10. Disconnect lifting slings and remove shackles.

Install Shipping Supports

See [Figure 4-26](#) on [page 4-48](#)

Perform the following steps at both ends of carrier base (1), one end at a time.

1. Lower handrails (3) to prevent damaging them.
2. Attach shackles to lifting lugs (2, View A) on either end of carrier base (1).
3. Attach slings from assist crane to shackles and hoist just enough to lift jack pads (5a, View A) off blocking.
4. Remove both jack pads (5a, View C) and store them as shown in View A.
5. Remove blocking and store for future use.
6. Securely attach shipping supports (4, View B) to jacks.
7. Lower carrier base with assist crane so shipping supports are resting firmly on foundation.

**DANGER****Tipping Hazard!**

For EUROPEAN shipment, do not disconnect lifting slings until shipping supports are installed (so that carrier base is supported on foundation). Otherwise, tires will roll and base will tip over.

8. Disconnect lifting slings and remove shackles.
9. Repeat above steps at other end of carrier base.

Place Carrier Base on Transport Trailer

See [Figure 4-25](#) on [page 4-46](#) for the following procedure.

1. To gain access to top of carrier base:
 - Unpin ladder handrails (7b, View B) from shipping position, raise handrails, and pin handrails in working position
2. Attach shackles to lifting lugs (4, View A) on carrier base (1).
3. Attach slings from assist crane to shackles.
4. Lift and position carrier base on transport trailer.
5. Securely chock tires.
6. Securely attach carrier base to transport trailer.
7. Disconnect assist crane.
8. Lower and pin ladder handrails (7b, View B) in shipping position.

Remove Boom

Boom removal is the reverse of installation.

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

Prevent crane from tipping. Block ends of crawlers, if required per capacity chart, before lowering boom to foundation.

**WARNING****Crushing Injury Hazard!**

Boom inserts can collapse when connecting pins are removed. Block both ends of each boom insert before removing connecting pins.

Never work under or inside boom inserts that are not securely blocked.

Do not use top of boom as a walkway.

1. Prepare crane and boom as follows:
 - a. Position crane in disassembly area.
 - b. If required per capacity chart, travel front crawler rollers onto blocking (at boom end of crane).
See Crawler Blocking Diagram in Capacity Chart Manual for blocking requirements.
2. Lower boom to ground as follows:
 - **If equipped with a fixed or luffing jib**, see Jib Rigging Guide for procedure.
 - **If equipped with a standard upper boom point**, remove it (reverse assembly steps) before upper point contacts ground. Upper point cannot support weight of boom.
 - **If equipped with an extended upper boom point**, make sure foundation is clear of obstructions so upper point rollers can roll freely as boom is lowered.

CAUTION**Pendant Damage!**

Use extreme care while lowering boom equipped with intermediate suspension. Boom straps can land on and crush intermediate suspension pendants.

**WARNING****Crushing Injury Hazard!**

Do not attempt to unpin straps until they are resting firmly in strap brackets and equalizer is pinned to equalizer rails.

3. Continue to lower boom onto blocking until boom straps are resting in brackets on boom inserts and equalizer is resting on and pinned to boom rails ([Figure 4-19](#), View E, [page 4-34](#)).

Push intermediate suspension pendants to inner side of boom as boom is lowered.

NOTE: If the boom will be used as the holdback to lower the fixed mast do not disassemble the boom until after the mast is lowered to 65°. See procedure for lowering the fixed mast.

4. Remove and store intermediate suspension pendants, links and pins. Block under inserts before removing lower connecting pins.
5. Store insert straps (1) and links (2, [Figure 4-20](#), [page 4-36](#)).

NOTE: It is not necessary to remove the boom straps. The straps can be left on the inserts for shipping.

6. Lift boom hoist equalizer off equalizer rails and move it to the side so it is clear of boom disassembly area.

Take every precaution to protect wire rope from damage.

Do not allow wire rope to jump off sheaves (in mast and equalizer) or otherwise become fouled.

7. Disconnect electric cables between boom and jib points and connect to proper receptacles on boom and jib nodes. **Clean all connectors and install protective caps.**
8. Remove and store wind speed indicator assemblies so they cannot be damaged during shipping.
9. Disconnect load lines from load block and weight ball and spool load lines onto load drums.
10. Remove fixed jib or luffing jib if installed.
11. Remove extended upper boom point if installed (reverse assembly steps).
12. Store boom top wire rope guide (2, [Figure 4-19](#), View B, [page 4-34](#)):
 - a. Attach a sling from assist crane to hole in wire rope guide (5).

- b. Support wire rope guide (5) with assist crane.
- c. Unpin struts (8) from wire rope guide and pin to storage lugs (9).
- d. Lower wire rope guide (5) to shipping position.
- e. Using pin (7), pin lug (6) to boom top (4).

 **WARNING**
Pinch Point Hazard!

Keep hands clear of openings in wire rope guide frame while lowering wire rope guide in step [13](#).

13. Store wire rope guide in 40 ft (12 m) insert ([Figure 4-19](#), View A, [page 4-34](#)):
 - a. Attach a sling from assist crane to rope guide pin.
 - b. Support wire rope guide (2) with assist crane and remove pin (3) from operating position.
 - c. Lower wire rope guide to shipping position and install pin (3).
14. Disassemble boom sections.
15. Disconnect electric cables and hydraulic hoses between boom butt and crane ([Figure 4-15](#), [page 4-28](#)). **Clean all connectors and couplers and install protective caps.**

NOTE: Allow hydraulic hoses for boom to hang down at front of rotating bed. Do not store hoses ([Figure 4-15](#), View F) until boom and mast have both been removed.

Hoses will be damaged when mast is lowered if you store hoses now.

16. Remove protective cap from terminating plug (11, [Figure 4-4](#), [page 4-6](#)). Connect terminating plug (11) to receptacle for cable (WNE16T).
17. Disconnect boom butt from crane. Reverse assembly steps.

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Lower Fixed Mast

NOTE: No counterweight — carbody or crane — is required to raise the fixed mast.

General

A hold-back force is required to lower the fixed mast. Either an assist crane or the crane’s own boom can be used.

- If an assist crane is used, it must provide the forces given in [Table 4-2](#). Letters in [Figure 4-33](#), View B correspond to letters in the table
- If crane’s own boom is used, a minimum boom length of 137.8 ft (42 m) is required

REMINDER — the MAX-ER Mast Configuration must be selected in the RCL to enable simultaneous operation of Drum 4 (mast hoist on rear of rotating bed) and Drum 5 (boom hoist in mast butt).

The following controls are used to lower the mast:

- Drum 4 (mast hoist) on left console

- Drum 5 (boom hoist) on right console
- Drum park switches

A qualified operator is required to lower the mast. The operator shall be experienced with the 16000 and thoroughly familiar with its operation.

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

Table 4-2 Mast Holdback Requirements

Mast	A From End of Crawler	B Horizontal	C Vertical
98 ft (30 m)	105 ft (32 m) (see Note)	30,000 lbf (133 kN)	25,000 lbf (111 kN)

NOTE: Assist crane and equalizer must be traveled to dimension A once mast is out of way.

Reference

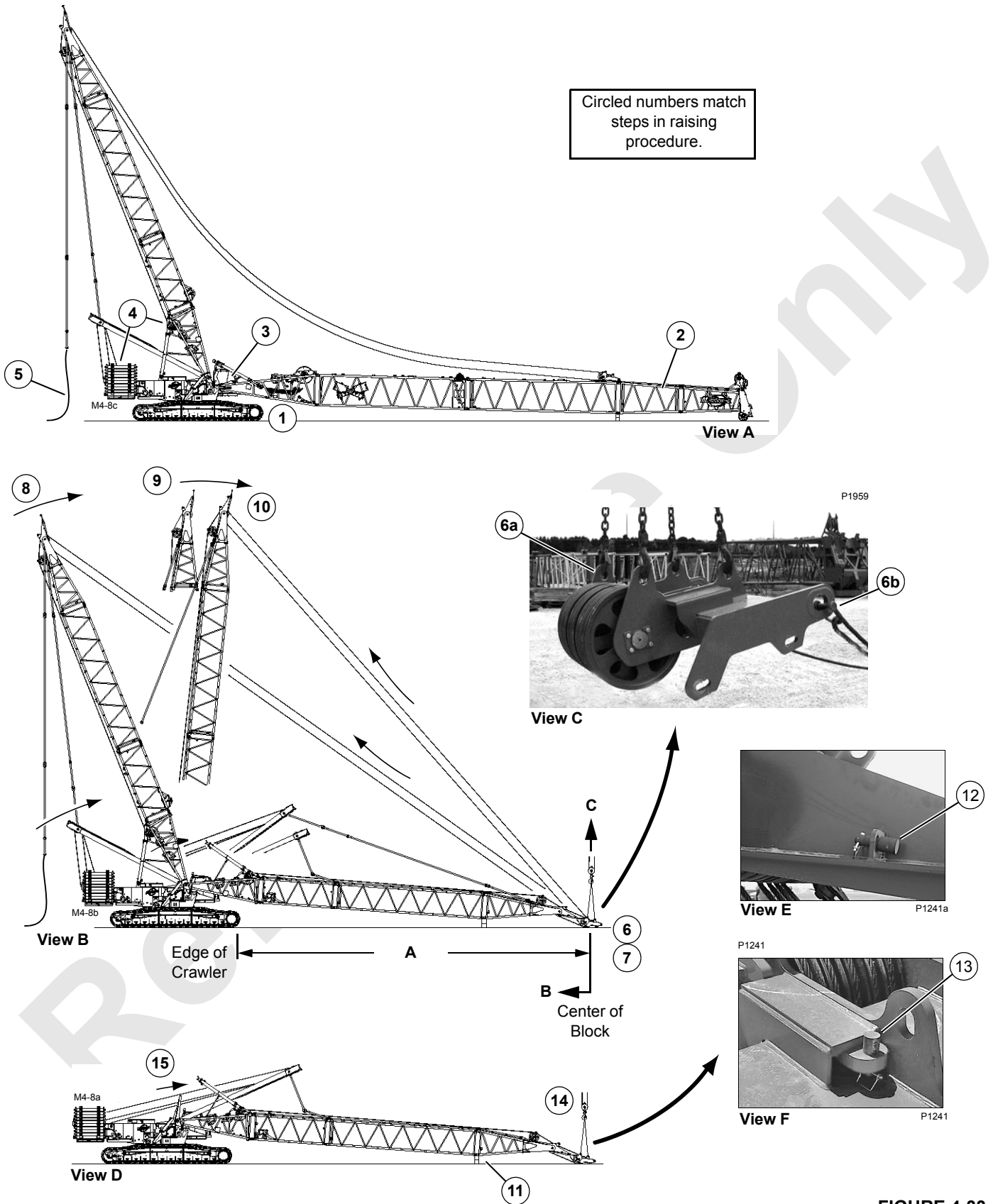


FIGURE 4-33

Lower Fixed Mast Using Assist Crane as Hold-Back

Circled numbers in [Figure 4-33](#) match the following steps.

1. Position crane on a firm, level surface.
2. Lower boom onto foundation (View A) and remove boom (see procedure in this section).
3. Select **MAX-ER Mast Configuration** on RCL.
4. Make sure mast hoist and boom hoist wire rope is spooled properly on drums.
5. Connect a 50 ft (15 m) long tagline to end of each counterweight strap.
6. Attach assist crane to boom hoist equalizer (View C):
 - a. Attach slings to lifting holes in equalizer.
 - b. Securely attach wire rope slings between equalizer and rotating bed or carbody of assist crane.

CAUTION**Wire Rope Damage!**

Boom hoist equalizer will tip if it is not properly supported, possibly resulting in damage to wire rope. Support boom hoist equalizer properly while lowering mast.

7. Park assist crane so equalizer is at Dimension A from end of crawlers (View B, and [Table 4-2](#)). **Equalizer must be centered with relation to mast to prevent side loading mast.**

Assist crane must provide specified hold-back forces (B and C, View B and [Table 4-2](#)).

8. Slowly haul in boom hoist wire rope and pay out mast hoist wire rope to raise mast toward vertical.

NOTE: Using taglines, guide counterweight straps clear of live mast and mast stops as fixed mast rises.

9. As mast nears vertical, tighten mast hoist wire rope as required so mast moves smoothly forward past vertical.
10. Continue to lower mast by slowly paying out mast hoist wire rope and hauling in boom hoist wire rope.

NOTE: Operator shall match rate of speed at which boom hoist wire rope is hauled in with rate of speed at which mast hoist wire rope is paid out.

11. Stop lowering mast when bottom connectors between mast insert and mast top are approximately 3-1/2 ft (1,1 m) from ground.

Place 3 ft (0,9 m) of blocking under bottom connectors between mast insert and mast top. Lower mast onto blocking.

12. Remove boom hoist equalizer retaining pins from mast top pockets (View E).

13. Using assist crane, lift boom hoist equalizer into position on forks at end of mast top (View F) and install retaining pins.

14. Disconnect assist crane from equalizer.

15. Raise live mast arms using crane set-up remote control.

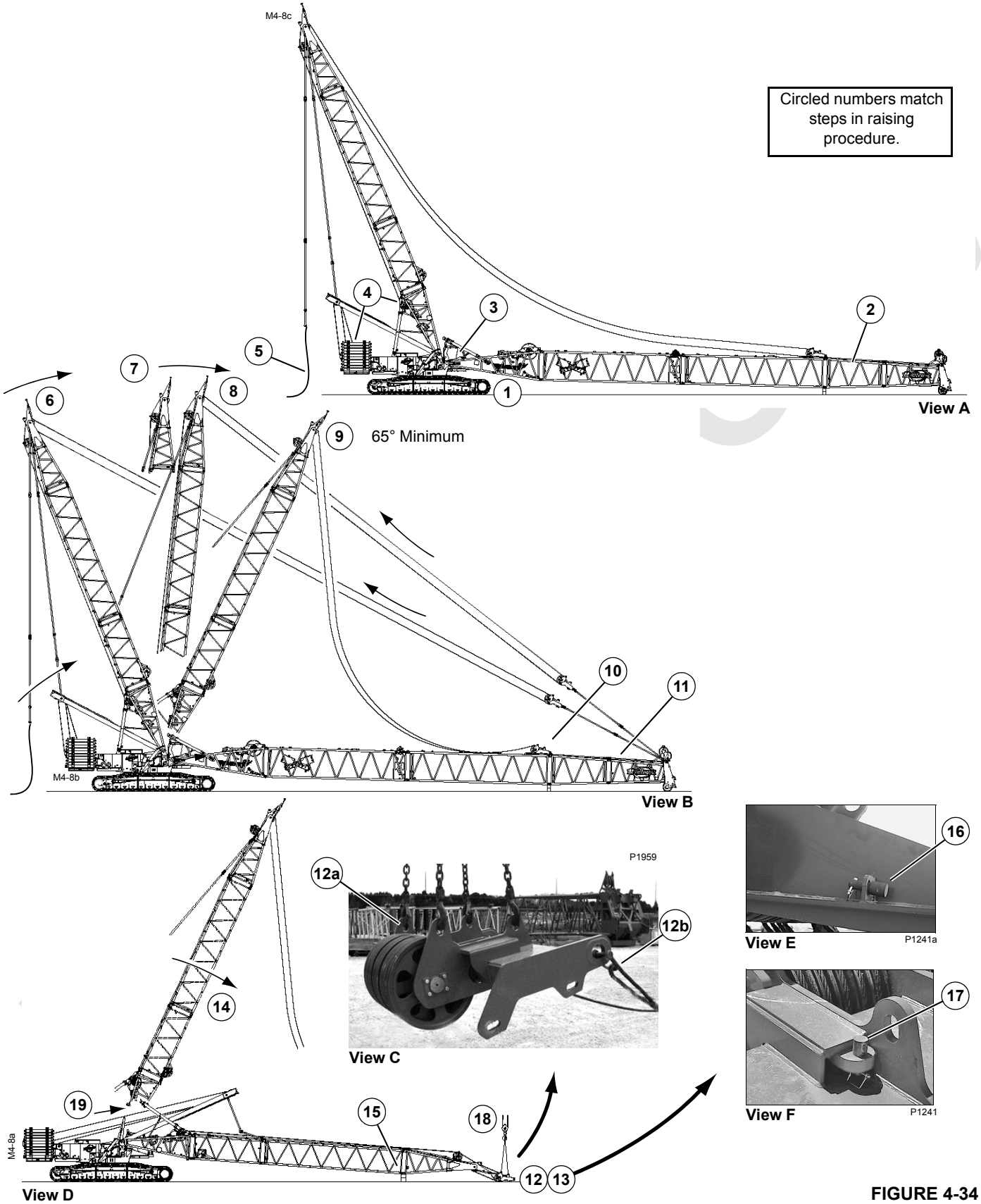


FIGURE 4-34

Lower Fixed Mast Using Boom as Hold-Back

Circled numbers in [Figure 4-34](#) match the following steps.

1. Position crane on a firm, level surface.
2. Lower boom onto foundation (View A).
3. Select **MAX-ER Mast Configuration** on RCL.
4. Make sure mast hoist and boom hoist wire rope is spooled properly on drums.
5. Connect a 50 ft (15 m) long tagline to end of each counterweight strap.
6. Slowly haul in boom hoist wire rope and pay out mast hoist wire rope to raise mast toward vertical.

NOTE: Using taglines, guide counterweight straps clear of live mast and mast stops as mast rises.

7. As mast nears vertical, tighten mast hoist wire rope as required so mast moves smoothly forward past vertical.
8. Continue to lower mast by slowly paying out mast hoist wire rope and hauling in boom hoist wire rope.

NOTE: Operator shall match rate of speed at which boom hoist wire rope is hauled in with rate of speed at which mast hoist wire rope is paid out.

9. Stop lowering mast when it is at 65° minimum angle. Turn Drum 5 PARK ON to engage drum pawl.
10. Boom down until boom hoist equalizer is resting on equalizer rails.
11. Remove boom. See procedure in this section.
12. Attach assist crane to boom hoist equalizer (View C):

- a. Attach slings to lifting holes in equalizer.
- b. Securely attach wire rope slings between equalizer and rotating bed or carbody of assist crane.

CAUTION**Wire Rope Damage!**

Boom hoist equalizer will tip if it is not properly supported, possibly resulting in damage to wire rope. Support boom hoist equalizer properly while lowering mast.

13. Park assist crane so equalizer is in line with mast and a minimum of 105 ft (32 m) from end of 16000 crawlers.
14. Continue to lower live mast by slowly paying out mast hoist wire rope and hauling in boom hoist wire rope.
15. Stop lowering mast when bottom connectors between mast insert and mast top are approximately 3-1/2 ft (1,1 m) from ground.
Place 3 ft (0,9 m) of blocking under bottom connectors between mast insert and mast top. Lower mast onto blocking.
16. Remove boom hoist equalizer retaining pins from mast top pockets (View E).
17. Using assist crane, lift boom hoist equalizer into position on forks at end of mast top (View F) and install retaining pins.
18. Disconnect assist crane from equalizer.
19. Raise live mast arms using crane set-up remote control.

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Remove Fixed Mast

Disconnect and Store Mast and Counterweight Straps

See [Figure 4-9](#) on [page 4-16](#) for the following procedure.

1. Store counterweight links (11) **on both sides of mast** as shown at **LOCATION C**.
2. Disconnect and store straps and links in shipping position at **LOCATION B on both sides of mast**:
 - a. Attach a sling from assist crane to links (6, View B1). Hoist just enough to support links so they cannot fall off insert.



WARNING

Falling Mast Hazard!

Do not use limit bypass to lower live mast below 156°. Mast will fall suddenly. **Connect an assist crane to end of live mast when it is necessary to lower it below 156°.**

- b. Lower live mast to 156° and STOP.
- c. On right side of live mast, disconnect electric cable (W37, View B3), from load pin and from cable on

live mast. **Thoroughly clean connectors and install protective caps.**

- d. Remove pins (9a and 9b) and raise live mast out of way.
 - e. Store pins (9a and 9b) in holes in links (6).
 - f. Unpin links (6, View B2) from straps (1) on adjacent insert and slide links (6) into storage position.
 - g. Lower links (6) into brackets (8) and install pin (3, View B1).
 - h. Unpin link (7, View B1) from storage position and rotate to shipping position between links (6). Install pins (5).
3. Disconnect and store straps and links in shipping position (View A1) at **LOCATION A on both sides of mast**.

Raise Wire Rope Guide to Shipping Position

Reverse Lower Wire Rope Guide steps on [page 4-15](#) to raise wire rope guide (5, [Figure 4-8](#), View B) to shipping position.

Lower Mast Stops

Reverse Raise Mast Stop steps on [page 4-15](#) to lower mast stops (1, [Figure 4-8](#), View A) to shipping position.

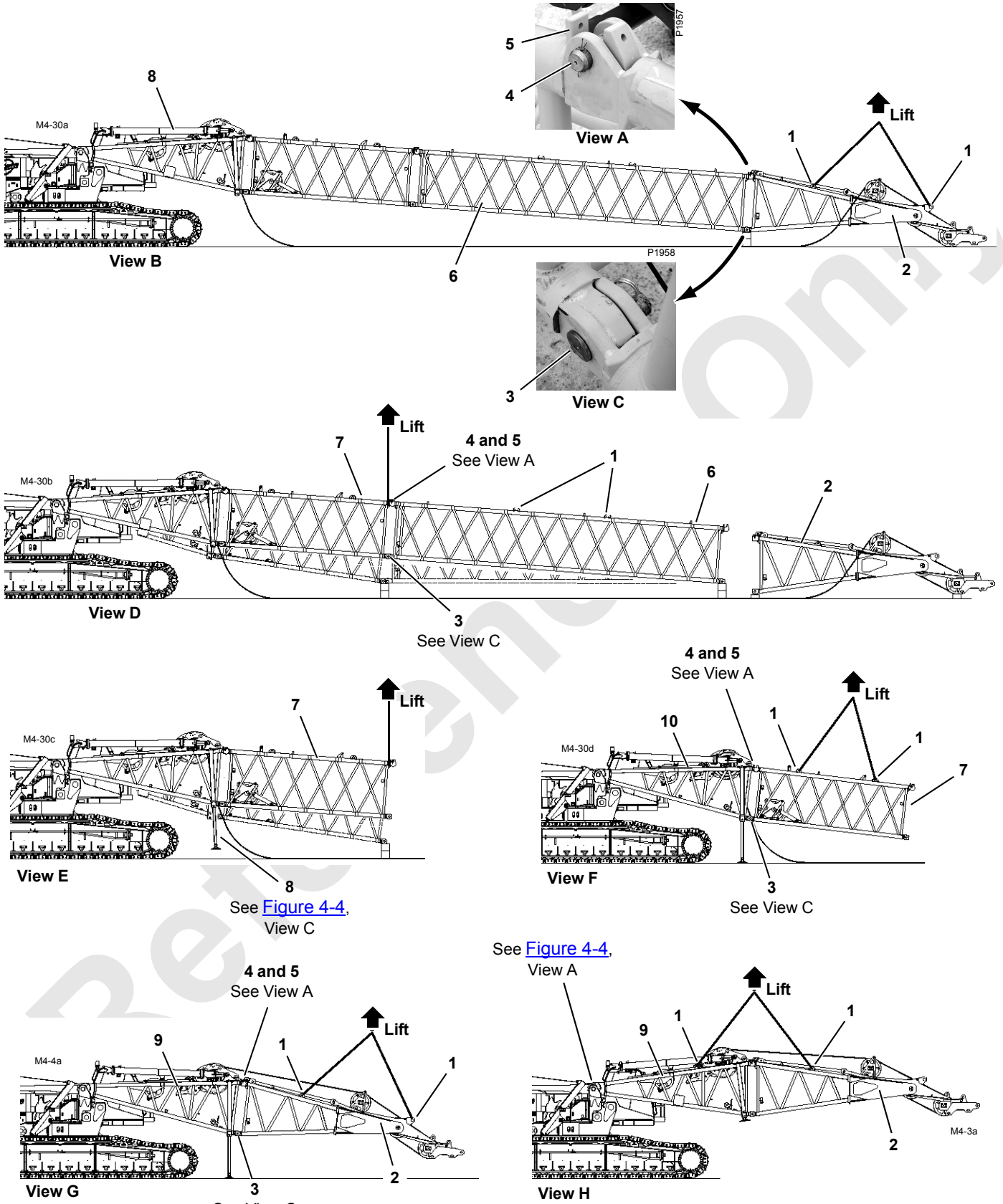


FIGURE 4-35

Legend for [Figure 4-35](#)

Item	Description	Item	Description	Item	Description
1	Lifting Lugs	4	Fixed Pin (2 places)	7	Insert — 20 ft (6 m)
2	Mast Top	5	Hooked Connector	8	Mast Support
3	Pin with Safety Pin (2 places)	6	Insert — 40 ft (12 m)	9	Mast Butt

Remove Mast Inserts

See [Figure 4-35](#) for the following procedure.

1. Disconnect mast top:
 - a. Attach lifting slings from assist to lifting lugs (1, View B) on mast top (2).
 - b. Lift just enough to support mast top and remove pins (3, View C).
 - c. Lift mast top (2) clear of insert (6) and place on blocking in front of insert (View D). Pay out wire rope from Drum 5, as required.
 - d. Disconnect lifting slings.
 2. Remove insert (6):
 - a. Attach lifting slings to top chords directly behind connectors at top end of insert (7, View D).
 - b. Lift just enough to support insert (7) and remove pins (3, View C) between inserts (6 and 7).
Store pins (3) in pockets in the lacings next to the connectors.
 - c. Lower inserts onto blocking (View D) and disconnect lifting slings.
 - d. Attach lifting slings to lifting lugs (8, View D) on insert (6).
 - e. Lift insert (6) clear of insert (7) and store insert on job site or place on transport trailer.
 - f. Disconnect lifting slings.
 3. Remove insert (7):
 - a. Attach lifting slings to top chords directly behind connectors at top end of insert (7, View E).
 - b. Lower mast supports (8, View B). Perform step [6](#) under Install Mast Butt and Top topic on [page 4-7](#).
 - c. Lower boom butt (10) onto mast supports.
 - d. Attach lifting slings to lifting lugs (1, View F) on insert (7).
 - e. Lift just enough to support insert (7) and remove pins (3, View C) between insert (7) and butt (9).
Store pins (3) in pockets in the lacings next to the connectors.
 4. Install mast top (2):
 - a. Check that retaining pins (17, [Figure 4-34](#), View F) are installed in equalizer forks so boom hoist equalizer cannot fall off forks while performing step [4c](#).
 - b. Attach lifting slings from assist crane to lifting lugs (1, View G) on mast top (2).
 - c. Lift mast top into position at end of mast butt so fixed pins (4, View A) in top engage hooked connectors (5) in butt.
Haul in wire rope on Drum 5 while performing step [4c](#).
 - d. Lower mast top until bottom connecting holes line up and install pins (3, View C).
 - e. Slacken lifting slings.
 5. Remove mast butt (9) and top (2):
 - a. Attach lifting slings from assist crane to lifting lugs (1, View H) on mast top (2) and mast butt (9).
 - b. Raise mast top and butt to horizontal (View H).
 - c. Disconnect electric cable (W64) and hydraulic lines between butt and crane ([Figure 4-4](#), View D and E). **Clean connector and couplers and install protective caps.**
- NOTE:** For Node-6 electrical connections with Mast Stop Limit Switch, reference [Figure 4-5](#) for cranes with software version M002066 or newer.
- d. Store mast supports. Perform step [6](#) under topic Install 20 ft (6 m) Insert on [page 4-11](#).
 - e. Remove retaining pins (4) from end of mast butt ([Figure 4-4](#), View A, [page 4-6](#)).
 - f. Lift mast butt and top clear of crane and store on job site or place on transport trailer.
 - g. Store pins in end of mast butt.

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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.

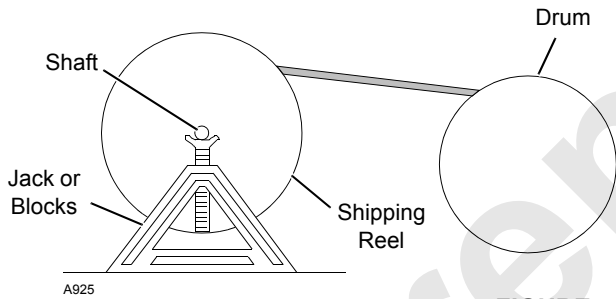


FIGURE 4-36

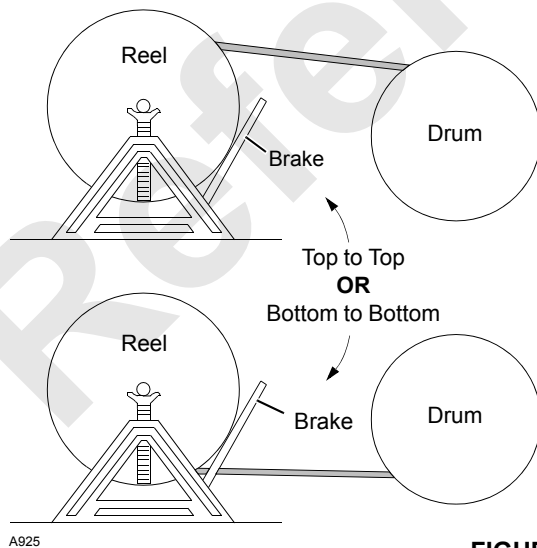
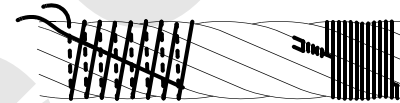


FIGURE 4-37

1. Mount wire rope shipping reel on a shaft supported at both ends by jacks or blocks as shown in [Figure 4-36](#).
2. Provide a brake at shipping reel ([Figure 4-37](#)) so wire rope can be wound tightly onto drum.
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 4-37](#).
4. Avoid dragging wire rope in dirt or around objects that can scrape, nick, cut, or crush wire rope.

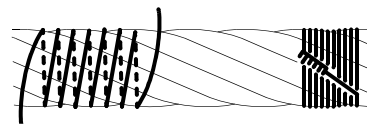
Wire Rope Type	Seizings Required
Preformed	1
Non-preformed	3

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 1in (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 4-38

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 4-38](#) 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

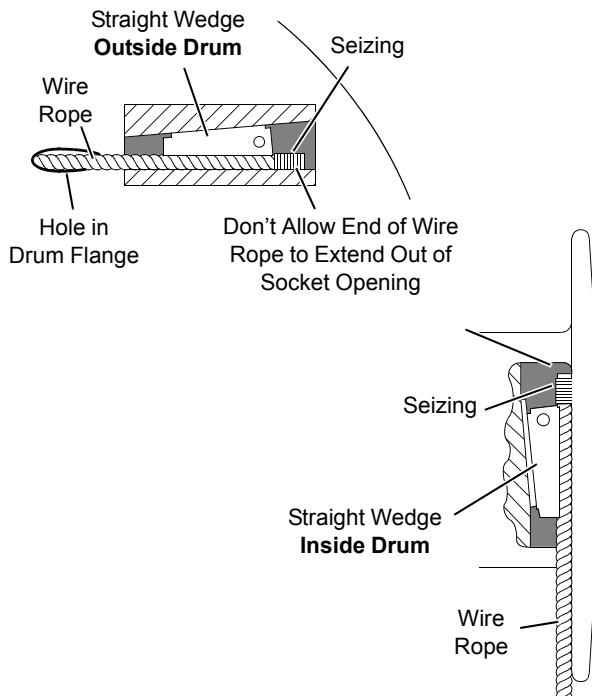


FIGURE 4-39

Anchoring Wire Rope to Drum

See [Figure 4-39](#) for the 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.



WARNING!

Falling Load Hazard!

Wire rope can be pulled out of drum if the 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

1. Assemble wire rope and wedge to drum socket.
2. Tighten wedge, rapping back of wedge with a brass drift pin and hammer.

Drum Guards

The drums are equipped with guards which cover the dead-end sockets on the outside of the drum flanges.



WARNING

Moving Machinery Hazard!

Guards must be secured to drums during crane operation.

When guards are removed for wire rope installation, use extreme care to prevent injury from a moving dead-end socket.

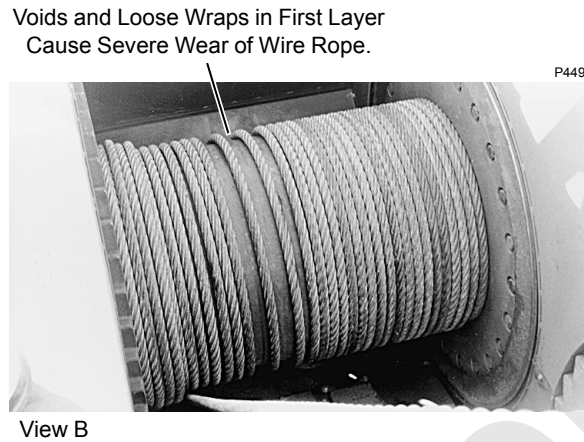
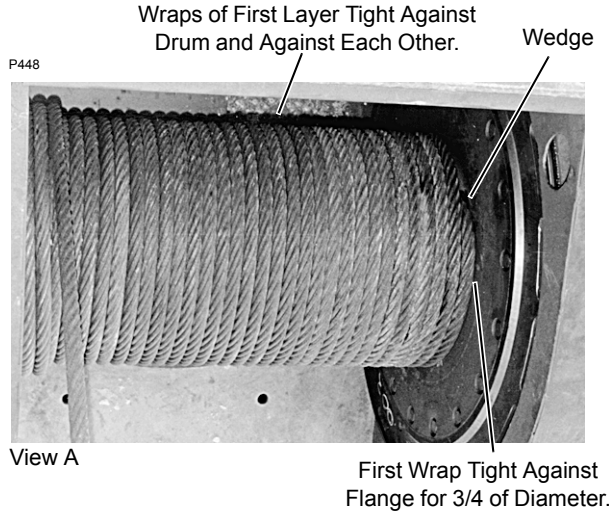


FIGURE 4-40

CAUTION!

Wire Rope Damage!

Voids or spaced wraps in first layer (Figure 4-40, 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.

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 Assembly Drawing at the 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.
2. 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 (Figure 4-40).

3. 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.

Anchoring Wire Rope to Button Socket

See Figure 4-41 for the 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.

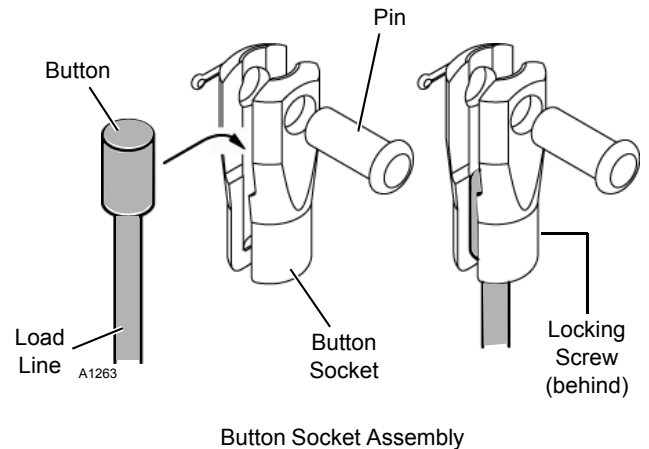
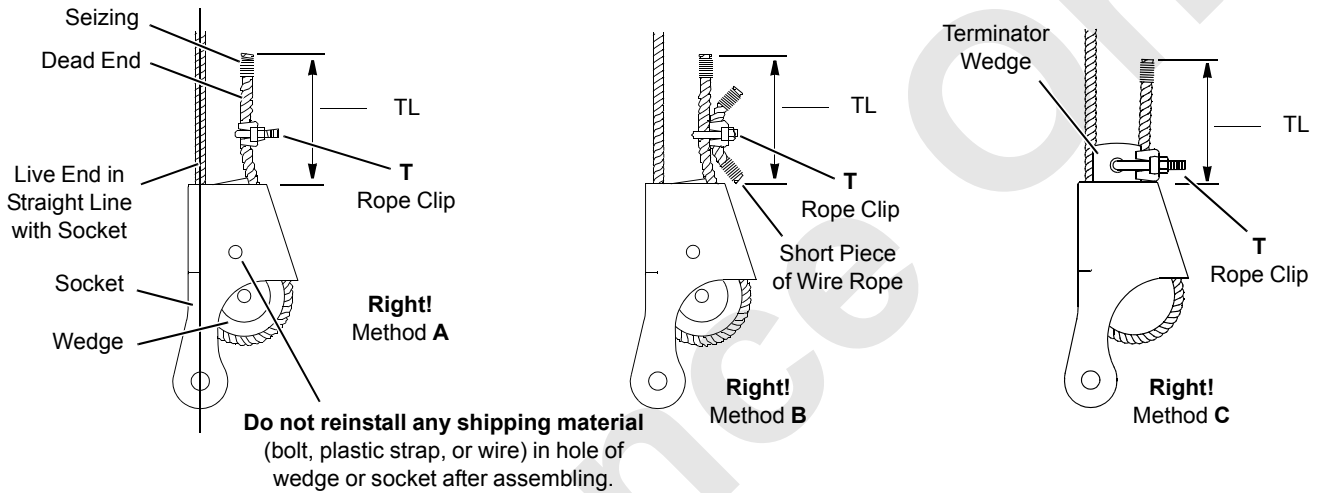


FIGURE 4-41

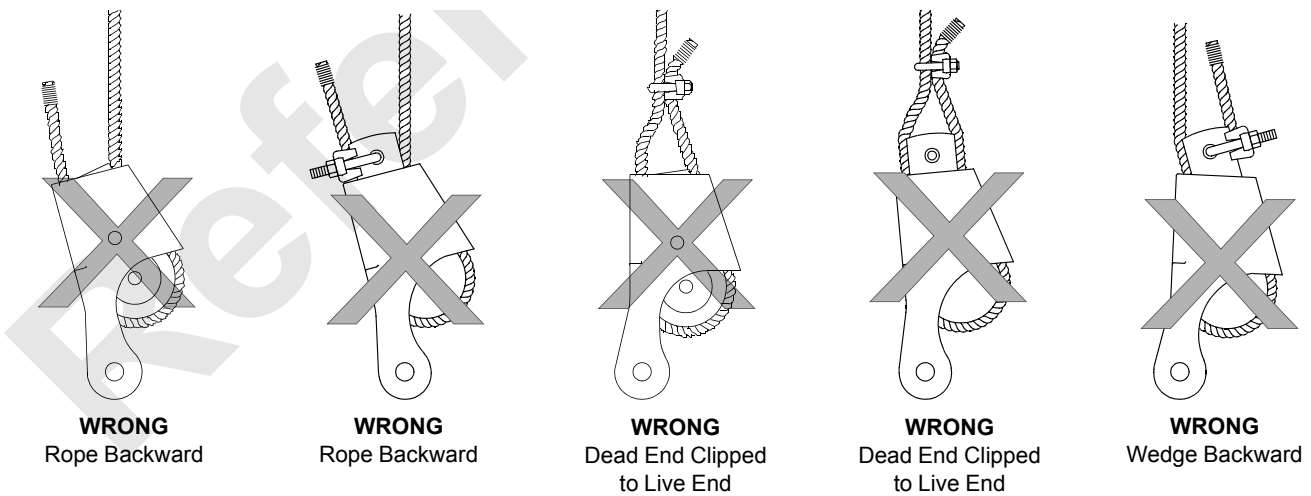
TL (Tail Length)
Standard 6 to 8 Strand Wire Rope
Minimum of 6 rope diameters, but not less than 6 in (152 mm).
Rotation Resistant Wire Rope
Minimum of 20 rope diameters, but not less than 6 in (152 mm).

T (Rope Clip Nut Torque)				
	Wire Rope/Clip Size			
inch (mm)	7/8 (22,23)	1 (25,4)	1-1/8 (28,58)	1-1/4 (31,75)
	Torque			
* ft/lbs (kN/m)	225 (0,30)	225 (0,30)	225 (0,30)	360 (0,49)

* Tightening torque values shown are based on threads being clean, dry and free of lubrication.



ALL ARE DANGEROUS AND PROHIBITED!



A925

FIGURE 4-42

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 4-42](#) for the following procedure.

1. 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.*
2. Allow dead end of wire rope to extend past end of socket amount shown.
3. Allow wire rope to assume its natural lay.
4. 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.



WARNING

Falling Load Hazard!

Wire rope can break if the 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.
5. 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.

6. After socket is pinned in place, hoist load slowly so wedge seats tight. Do not shock load socket and wedge.

Breaking in Wire Rope

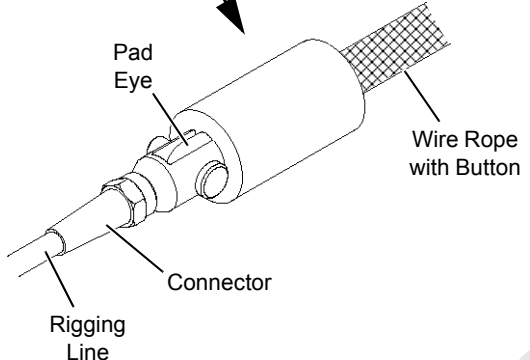
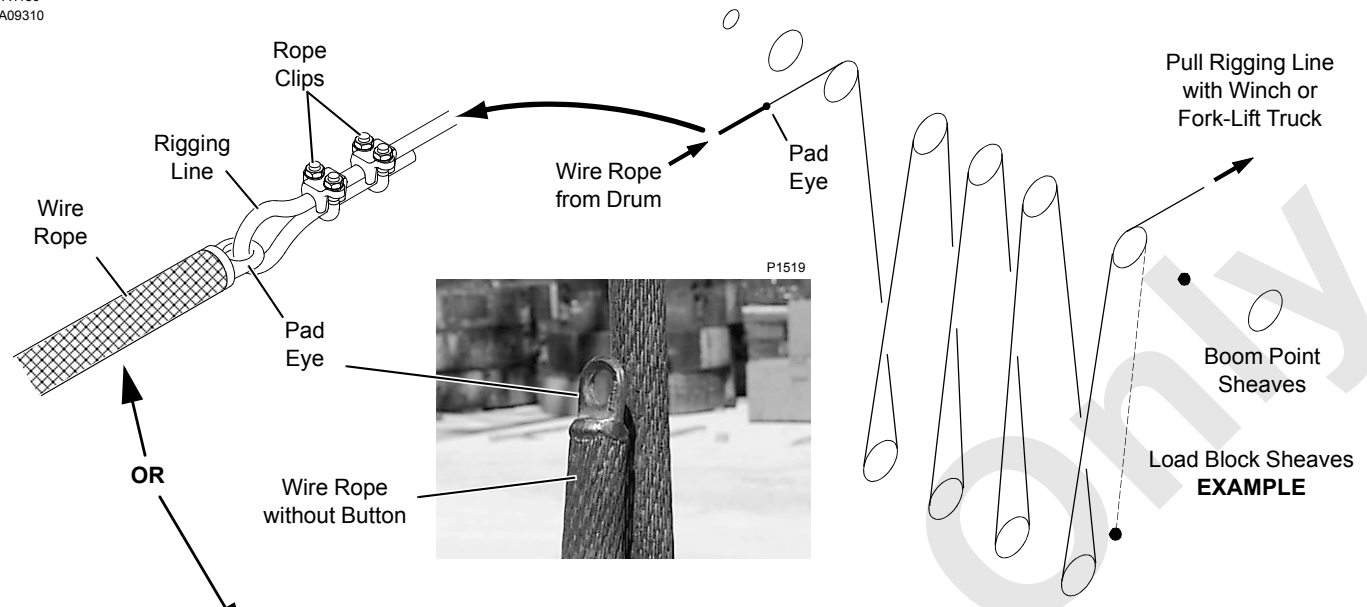
After installing a new wire rope, break it in by operating it several times under light load and at reduced speed. This practice allows the wire rope to form its natural lay and the strands to seat properly.

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.

A1189
A09310



No. 1.5 Pad Eye			
Item	Inch	mm	
Approximate Capacity 1220 lbs. (553 kg)			
A	5/8	16,00	
B	1/4	6,35	
C	1	25,40	
D	7/16	11,18	
E	1-1/8	28,70	
F	1/16	4,06	
G	1-5/16	33,27	

No. 1 Pad Eye			
Item	Inch	mm	
Approximate Capacity 1220 lbs. (553 kg)			
A	3/8	9,65	
B	1/4	6,35	
C	7/8	22,40	
D	13/32	10,40	
E	7/8	22,40	
F	1/8	3,30	
G	1-1/32	25,40	

No. 2 Pad Eye			
Item	Inch	mm	
Approximate Capacity 2600 lbs. (1179 kg)			
A	3/4	19,05	
B	3/8	9,65	
C	1-1/16	26,92	
D	1/2	12,70	
E	1-1/2	38,10	
F	3/16	4,83	
G	1-5/8	41,26	

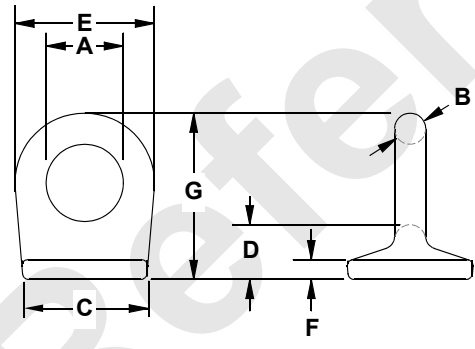


FIGURE 4-43

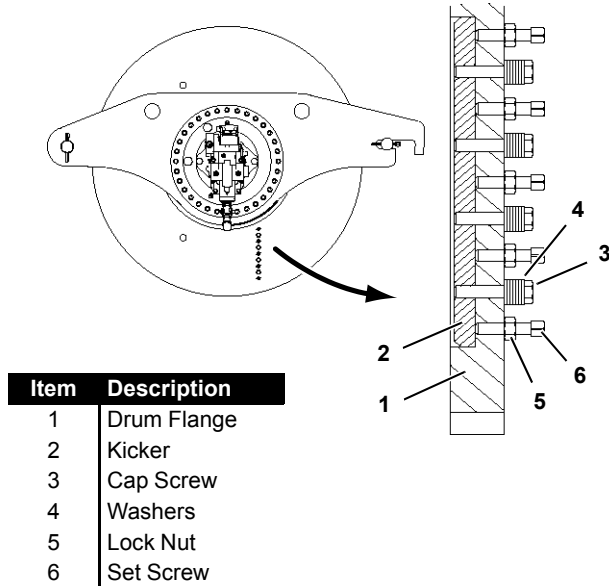


FIGURE 4-44

DRUM KICKER ADJUSTMENT

General

A drum kicker is provided on both flanges of the main load drum (in boom butt) to improve wire rope spooling for long boom lengths with small fleet angles where the wire rope might stack up along either drum flange.

Observe the wire rope during initial break-in and periodically during operation. If the rope stacks up at either end of the drum, adjust the drum kickers.

Adjustment

See [Figure 4-44](#) for the following procedure.

To move drum kickers (2) into the drum (take up space), proceed as follows:

1. Remove drum guard from both ends of drum.
2. Remove an equal number of washers (4) from both sides of kicker (2), one side at a time. Each washer allows kicker to move 0.098 in (2,5 mm).
3. Loosely reinstall cap screws (3) and remaining washers (4).

4. Loosen lock nuts (5) and adjust set screws (6) to move kickers (1) into drum.
5. Repeat steps 1-3 only enough to improve spooling. **Moving drum kickers in too far can cause premature wire rope wear.**
6. Securely tighten set screws (6) and lock nuts (5).
7. Reinstall drum guards.

PAD EYE USAGE FOR WIRE ROPE REEVING

See [Figure 4-43](#) for the following procedure.

General

Some rotation-resistant wire rope supplied by Manitowoc is equipped with a pad eye welded to the leading end of the wire rope or to the button on the end of the wire rope.

A rigging line can be attached to the pad eye to make it easier to reeve the load block.

Safety

1. Do not exceed approximate capacities listed in [Figure 4-43](#).
2. Make sure rigging line and attaching hardware (clips and rope connectors) are rated for the approximate capacities shown in [Figure 4-43](#).
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.

RIGGING WINCH OPERATION

If your crane is equipped with the optional rigging winch (Drum 0) see the Rigging Winch Assembly drawing at the end of this section for wire rope routing.

Selecting Rigging Winch Mode

See [Figure 4-45](#) and [Figure 4-46](#) for the following procedure.

TO TURN RIGGING WINCH MODE ON —

1. Go to Function Mode screen in main display.
2. In **level 2**, use the select buttons to enter selected drum screen options. Select rigging winch data box ([Figure 4-45](#)).

NOTE: The rigging winch data box will only appear if this feature is available.

3. In **level 3**, enter data box and use the select buttons to **turn ON** rigging winch.
4. The yellow box with “I” icon appears when winch is ON.

Rigging Winch Mode

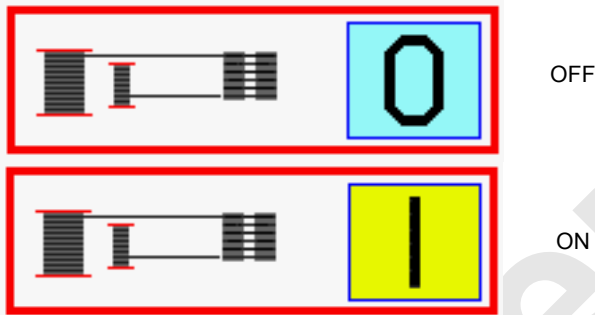


FIGURE 4-45

5. Drum 4 handle (boom hoist) will now control the rigging winch (Drum 0). “0” will appear in the indicator at the boom hoist handle.

TO TURN RIGGING WINCH MODE OFF —

1. Go to Function Mode screen in main display.
2. In **level 2**, use the select buttons to enter selected drum options screen. Select rigging winch data box ([Figure 4-45](#)).
3. In **level 3**, enter data box and use the select buttons to **turn OFF** rigging winch.

NOTE: The rigging mode will automatically turn OFF when power to the control system is turned off.

Operating Rigging Winch

Free-Wheel Operation

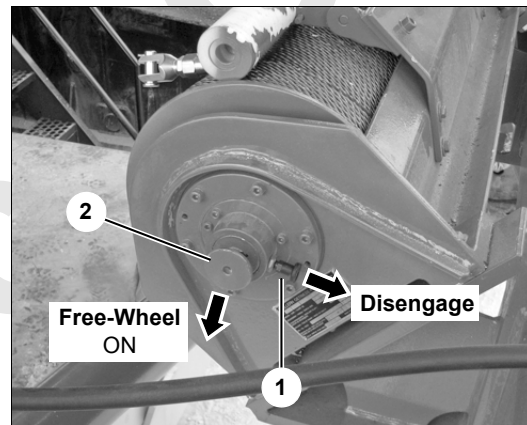
The winch has a free-wheel clutch which allows the drum barrel to be disconnected from the drive mechanism. This position allows the drum to be turned by hand.

TO TURN FREE-WHEEL ON —

1. Pull out locking pin (1) and hold.
2. Pull out knob (2).
3. Release locking pin (1).

TO TURN FREE-WHEEL OFF —

1. Pull out locking pin (1) and hold.
2. Push knob (2) in.
3. Release locking pin (1).



P2314

Legend

Item	Description
1	Locking Pin
2	Knob

FIGURE 4-46

Power Operation

1. Engage free-wheel feature.
2. Turn on rigging winch mode.
3. Pay out rigging line by moving Drum 0 control handle forward.
4. Reeve rigging line through block and boom point and connect to desired load line as shown in Rigging Winch Assembly drawing at the end of this section.
5. Use engine throttle to snug up rigging line prior to paying out load line from selected load drum. Faulty operation will result if there is slack in rigging line before engaging automatic part of operation.

NOTE: Use engine throttle to increase and decrease rigging winch line pull.

6. Use engine throttle speed to control line slack at rigging winch.
7. Move Drum 0 control handle to off and push corresponding load drum control handle forward to pay out load line. Rigging winch will haul in rigging line automatically.

NOTE: The stall line pull of the rigging winch is regulated with a proportional relief valve controlled by the crane's programmable controller.

CAUTION!

Avoid Rigging Winch or Wire Rope Damage!

Rigging winch will not automatically pay out line if selected load drum control handle is pulled back to hoist position.

Structural damage to winch or rigging line will occur!

If it is necessary to haul in load line on load drum when load line is connected to rigging line, proceed as follows:

- Pay out rigging line with Drum 0 control handle while hauling in load line with load drum control handle
- Keep rigging line slacker than load line with engine throttle



WARNING Flying Object Hazard!

Do not attempt to disconnect rigging line from load line until lines are slack.

Lines could fly apart with explosive force and strike personnel.

8. Once load line is reeved through block and boom point:
 - a. Move load drum control handle to off.
 - b. Pay out rigging line to slacken load line by pushing Drum 0 handle forward.
 - c. Disconnect rigging line from load line.
 - d. Haul in rigging line for storage on rigging winch by pulling Drum 0 control handle back.
 - e. Secure end of rigging line to boom for storage.
 - f. Connect load line to dead-end socket. See instructions in this section.
 - g. Turn OFF rigging winch mode.

REEVING – LOAD BLOCK

Load Block Identification

See the Boom Assembly Drawing at the end of this section for a complete list of load blocks and weight balls available for this crane.



WARNING Falling Load Hazard!

Use only a load block with a capacity equal to or greater than load to be handled.

Avoid overloading load block sheave bearings. Attach load to duplex hook so load hangs straight.

Load block can fail if overloaded, allowing load to fall.

Wire Rope Specifications

See Wire Rope Specifications chart in Capacity Chart Manual for the following load block reeving information:

- Parts of line required to handle desired load
- Wire rope length required for various boom lengths and parts of line
- Maximum spooling capacity of load hoists

Wire Rope Installation

See Wire Rope Installation in this section for instructions:

- Installing wire rope on drums
- Anchoring wire rope to drums

See Wire Rope Lubrication topic in Section 5.



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.

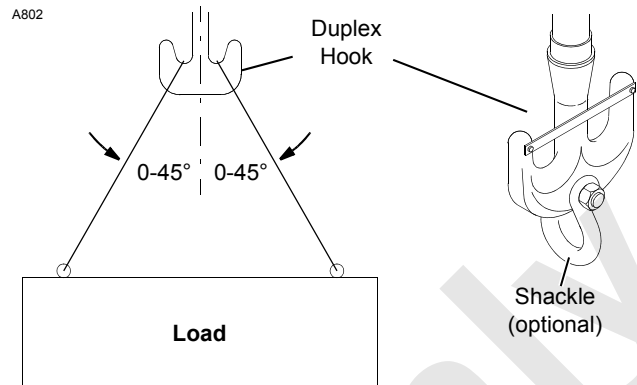


FIGURE 4-47

Duplex Hook

Attach the load so it is balanced equally on the hook. Lifting slings must be within angles given in [Figure 4-47](#) to achieve maximum hook capacity. The duplex hook has a hole to which an optional shackle can be attached as shown in [Figure 4-47](#).

Guide Sheaves and Drums

See [Figure 4-48](#) for identification of the load drums and guide sheaves.

Once wire rope is routed through the guide sheaves, be sure to install rope guard pins, bars, and rollers to retain the wire rope on the sheaves. **Wire rope and sheaves can be damaged if rope is not properly retained on sheaves.**

Load Block Reeving

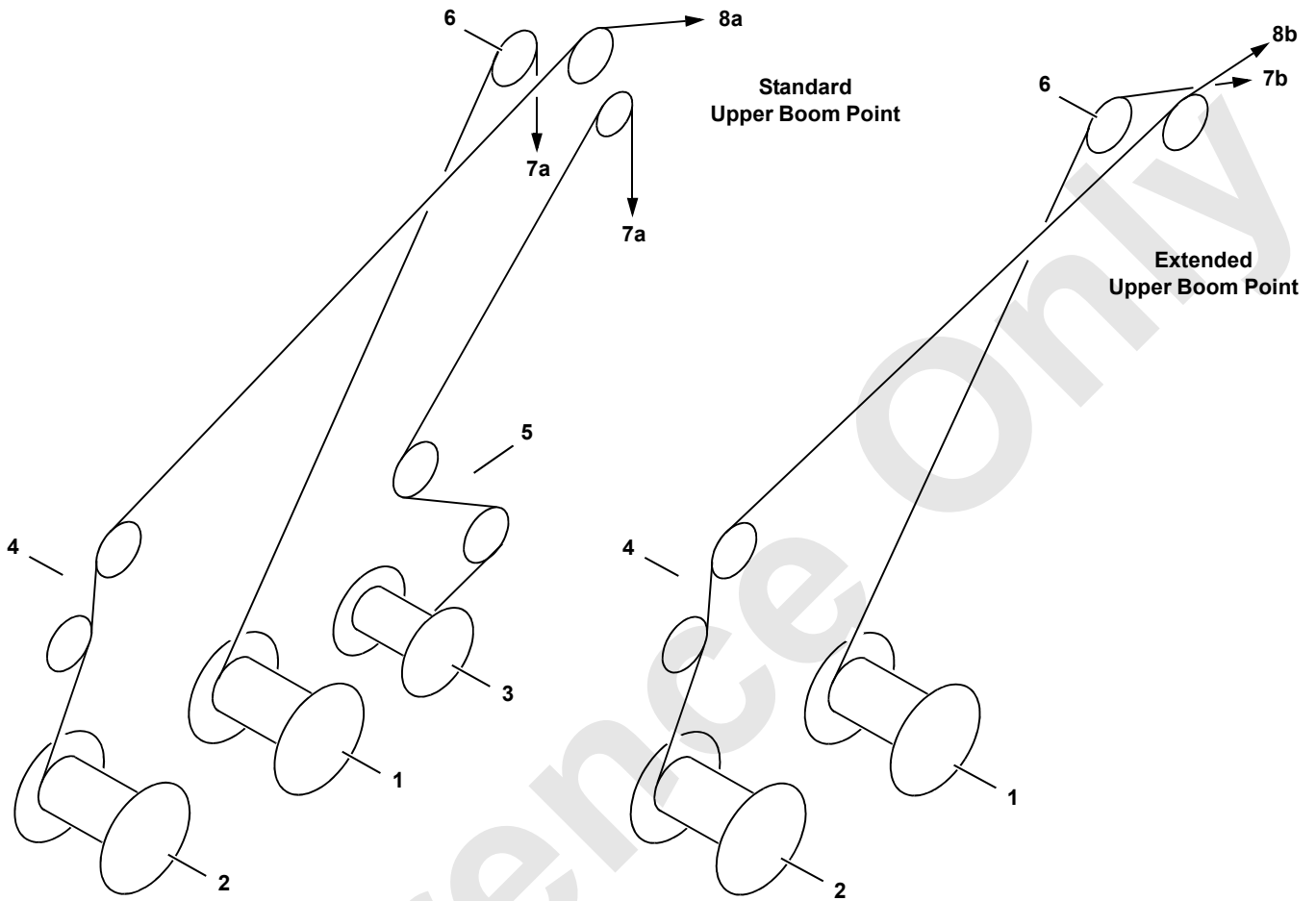
See [Figure 4-49](#) and [Figure 4-50](#) for dead-end locations and components in the lower and upper boom points.

See [Figure 4-51](#) and [Figure 4-52](#) for load block reeving. Reeving the load block in any manner other than shown can result in excessive block twist.

CAUTION

Wire Rope Damage!

Do not hoist load block closer to boom point than shown on Range Diagram in Capacity Chart Manual. Improper fleet angle or contact with other parts can damage wire rope.



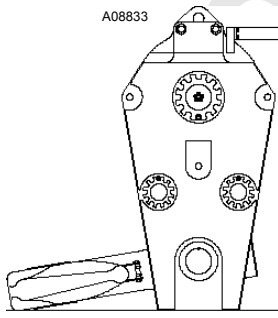
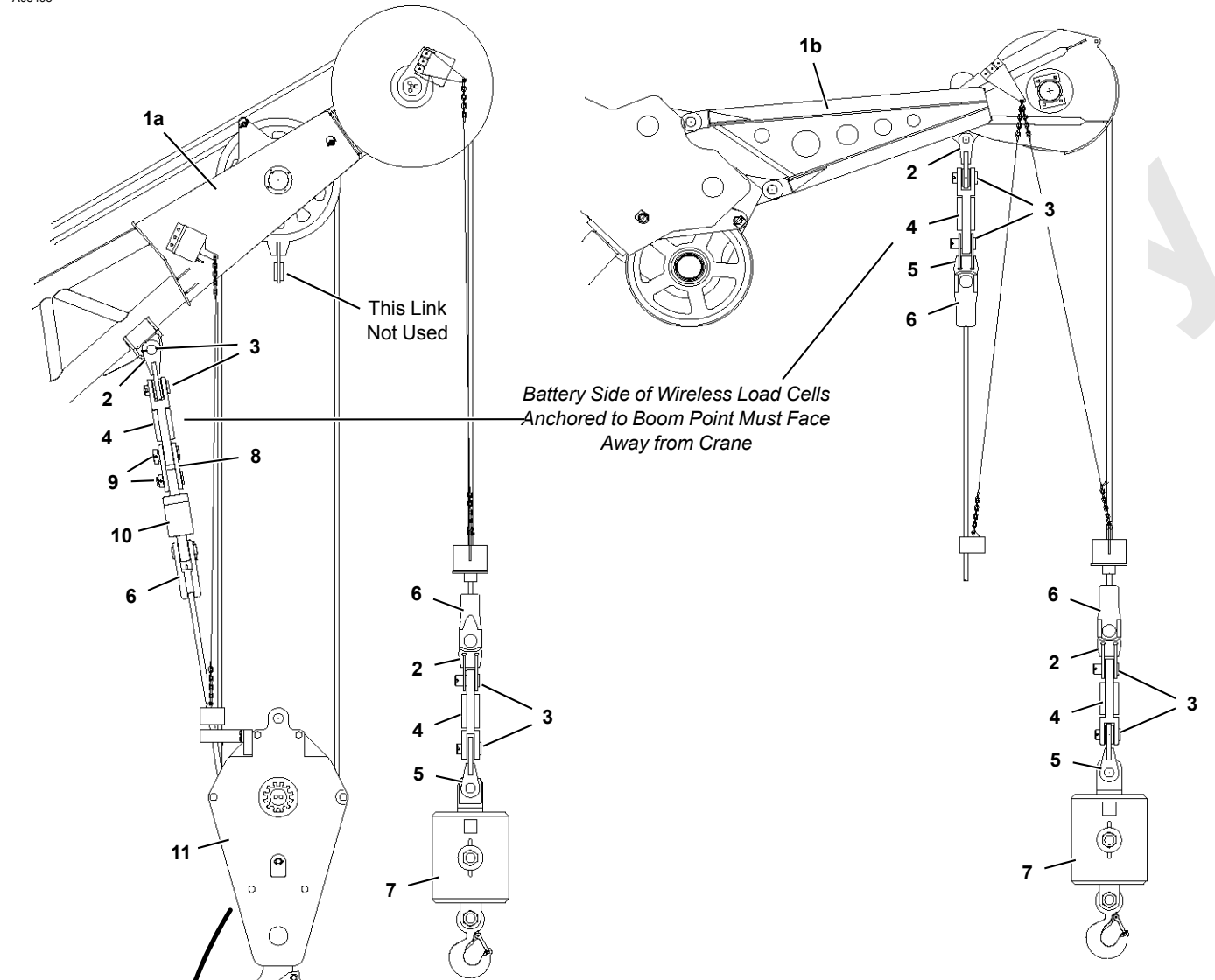
Item	Description
1	Main Hoist (Drum 1 in boom butt)
2	Whip Hoist (Drum 2 in crane)
3	Auxiliary Hoist (Drum 3 in boom butt)
4	Wire Rope Guides (in mast butt)
5	Wire Rope Guides (in insert)
6	Wire Rope Guide (on boom top)
7a	To Lower Boom Point
7b	To Extended Upper Boom Point (lower sheaves)
8a	To Standard Upper Boom Point
8b	To Extended Upper Boom Point (upper sheave)

NOTE: See Wire Rope Specifications Chart for line pull of drums. Drums 2 and 3 do not have same line pull as Drum 1.

Drum 2 has a high-speed option. This option does not increase line pull – only speed. High-speed is approximately 80% faster than standard speed (depending on load and layer).

FIGURE 4-48

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! WARNING

Avoid Death or Serious Injury!

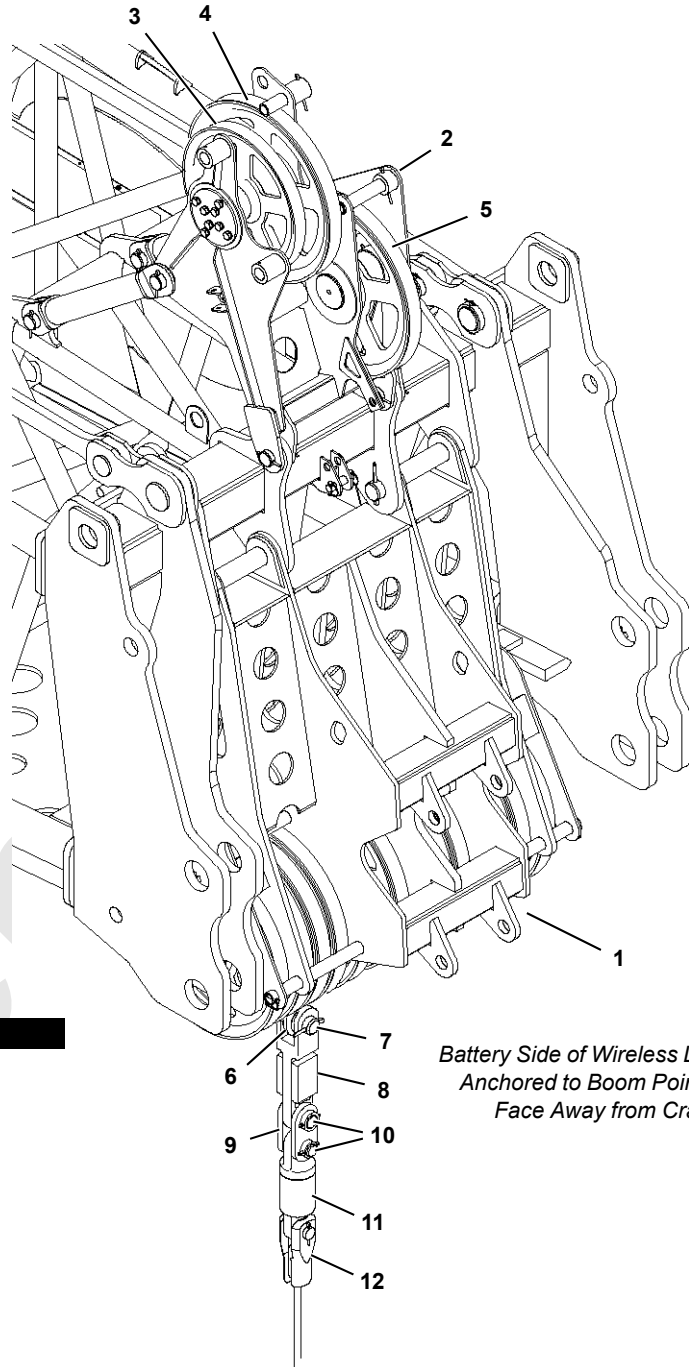
Exercise care when block is standing in vertical position, as the potential for tipping exists. Potential causes of tipping are unstable work area, boom movement and the reeving process.

If work area is unstable, lay block flat on side plate.

Item	Description
1a	Extended Upper Boom Point
1b	Standard Upper Boom Point
2	Link with Pin with Cotter Pin
3	Pin with Cotter Pin
4	Load Cell – 35,000 lb (13 063 kg)
5	Link
6	Button Socket – 1-1/8 in (28 mm) with Pin and Cotter Pin
7	Weight Ball
8	Links
9	Pin with Collar, Retaining Pin, and Cotter Pins
10	Swivel
11	Load Block

FIGURE 4-49

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4

Item	Description
1	Lower Boom Point
2	Wire Rope Guide (on boom top)
3	Luffing Hoist Guide Sheave
4	Whip Hoist Guide Sheave
5	Main Hoist Guide Sheave
6	Dead-End Link
7	Pin with Cotter Pin
8	Load Cell – 35,000 lb (13 063 kg)
9	Links
10	Pin with Collar, Retaining Pin, and Cotter Pins
11	Swivel
12	Button Socket – 1-1/8 in (28 mm) with Pin and Cotter Pin

*Battery Side of Wireless Load Cell
Anchored to Boom Point Must
Face Away from Crane*

FIGURE 4-50

Reeving_1

LOWER BOOM POINT REEVING

Item	Description
1	Boom Top Guide Sheaves
2	Lower Boom Point
3	Load Block
4	Standard Upper Boom Point
●	Dead-End Socket
■	Two-Block Weight

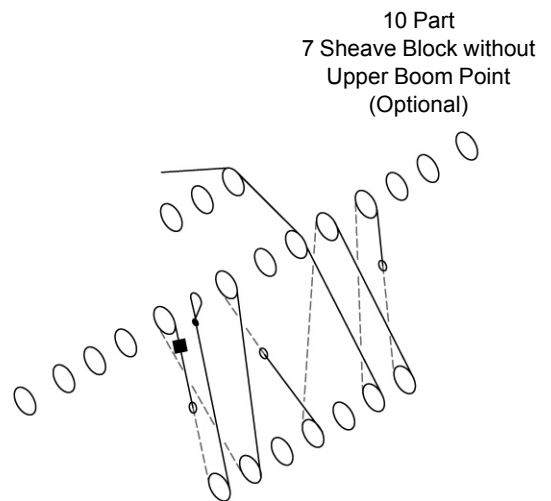
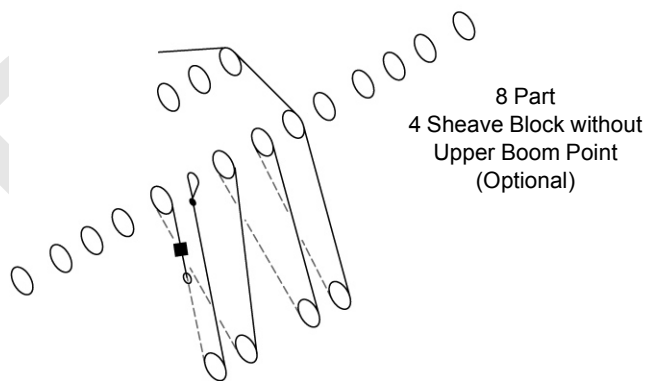
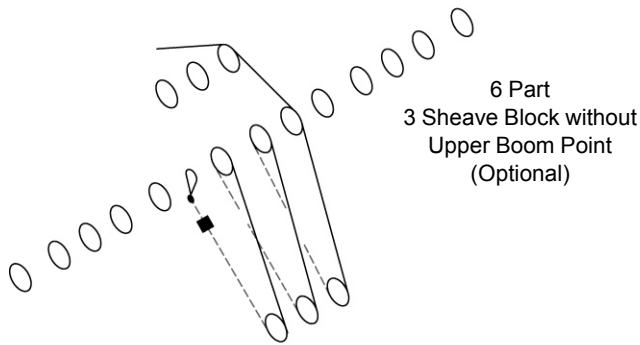
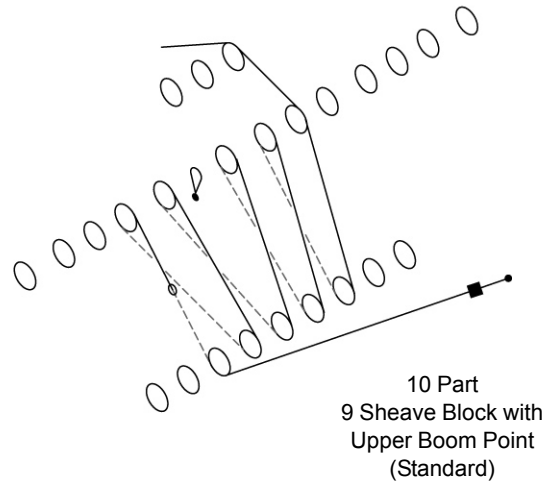
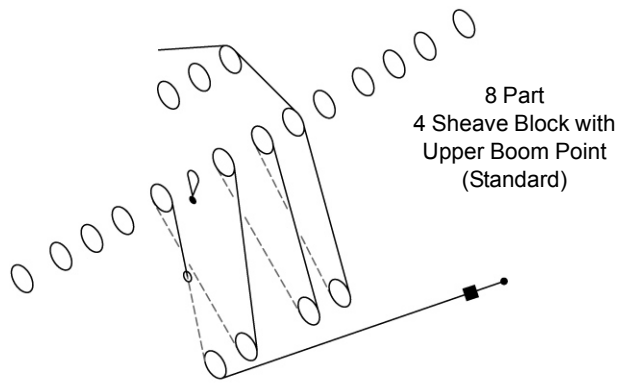
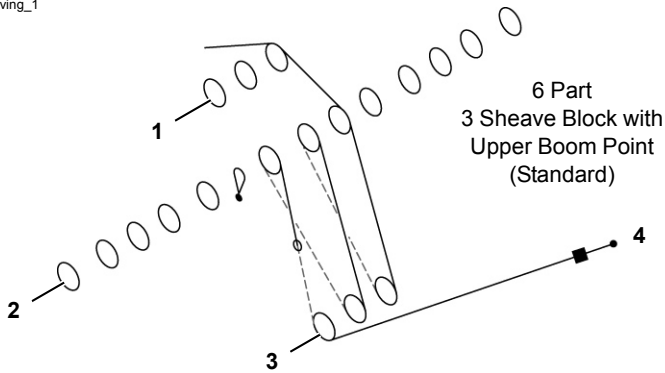


FIGURE 4-51

Reeving_2

**LOWER BOOM
POINT REEVING**

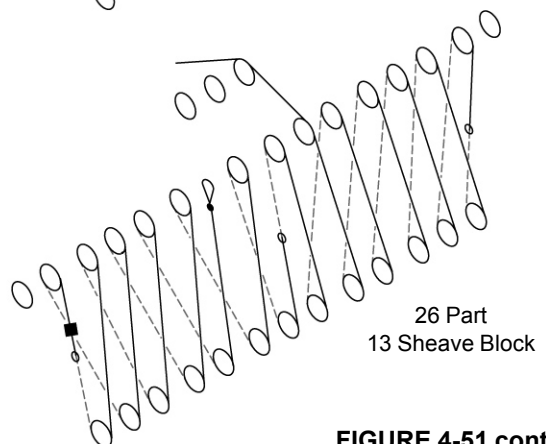
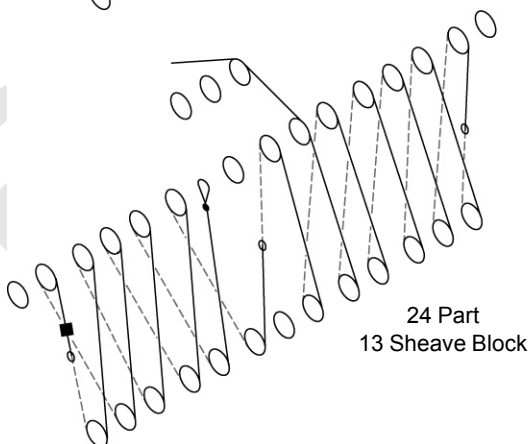
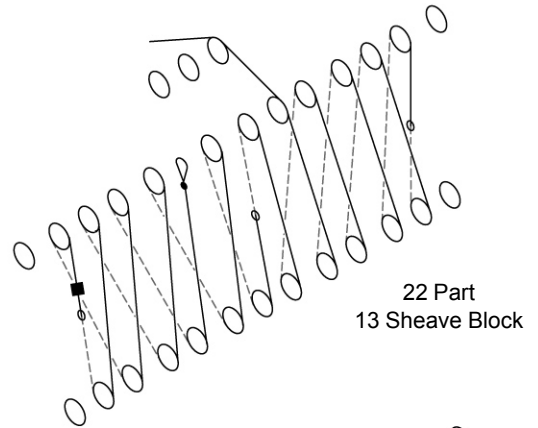
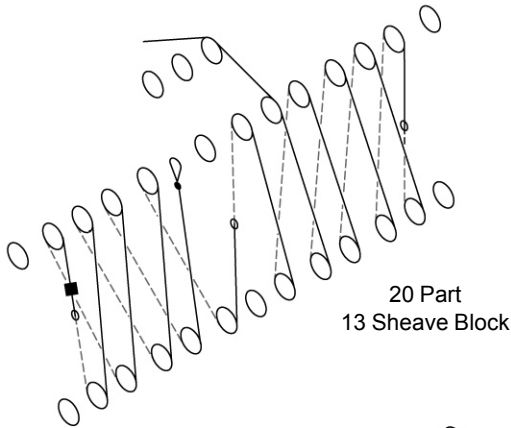
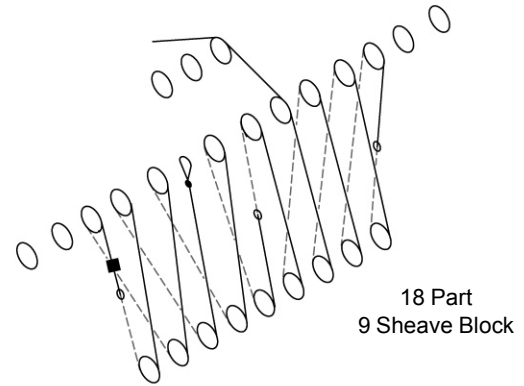
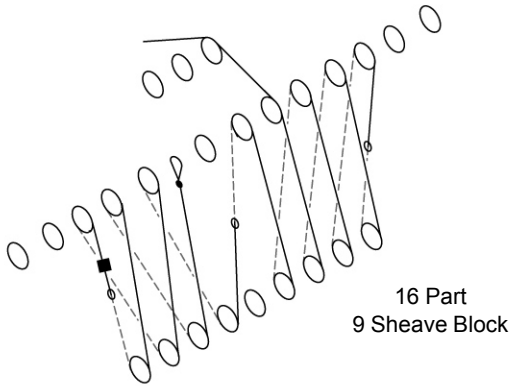
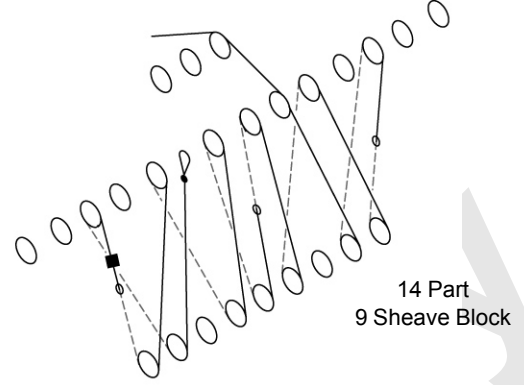
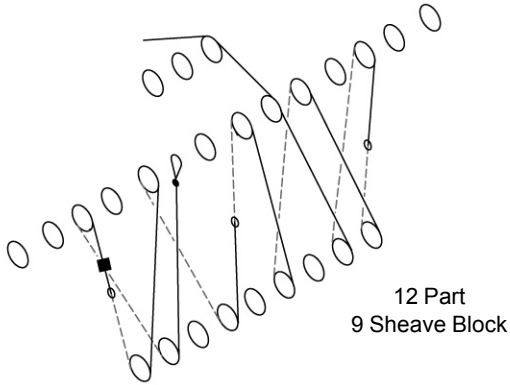


FIGURE 4-51 continued

Item	Description
1	Boom Top Guide Sheaves
2	Extended Upper Boom Point (lower sheaves)
3	Load Block
●	Dead-End Socket
■	Two-Block Weight

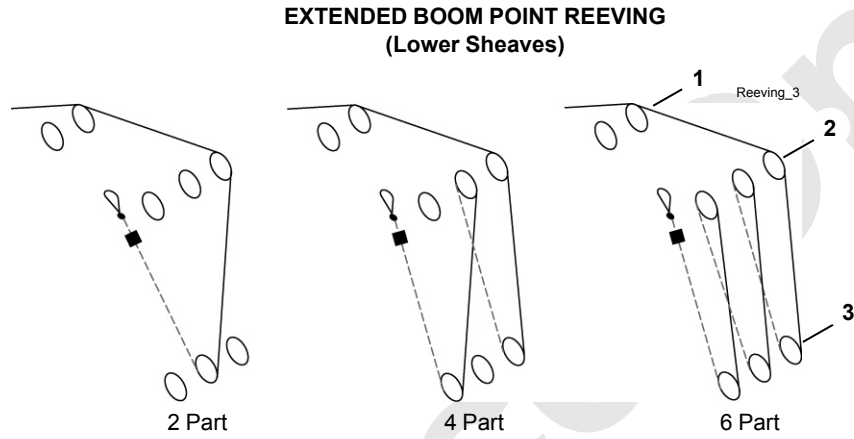


FIGURE 4-52

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SECTION 5 LUBRICATION

LUBRICATION

See F2109 at the end of this section.

LUBE AND COOLANT PRODUCT GUIDE

See the publication at the end of this section.

Reference Only

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SECTION 6 MAINTENANCE

GENERAL

This section contains maintenance and adjustment instructions for the sensors (encoders) and limit devices provided with the MAX-ER 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

Continued on Next Page

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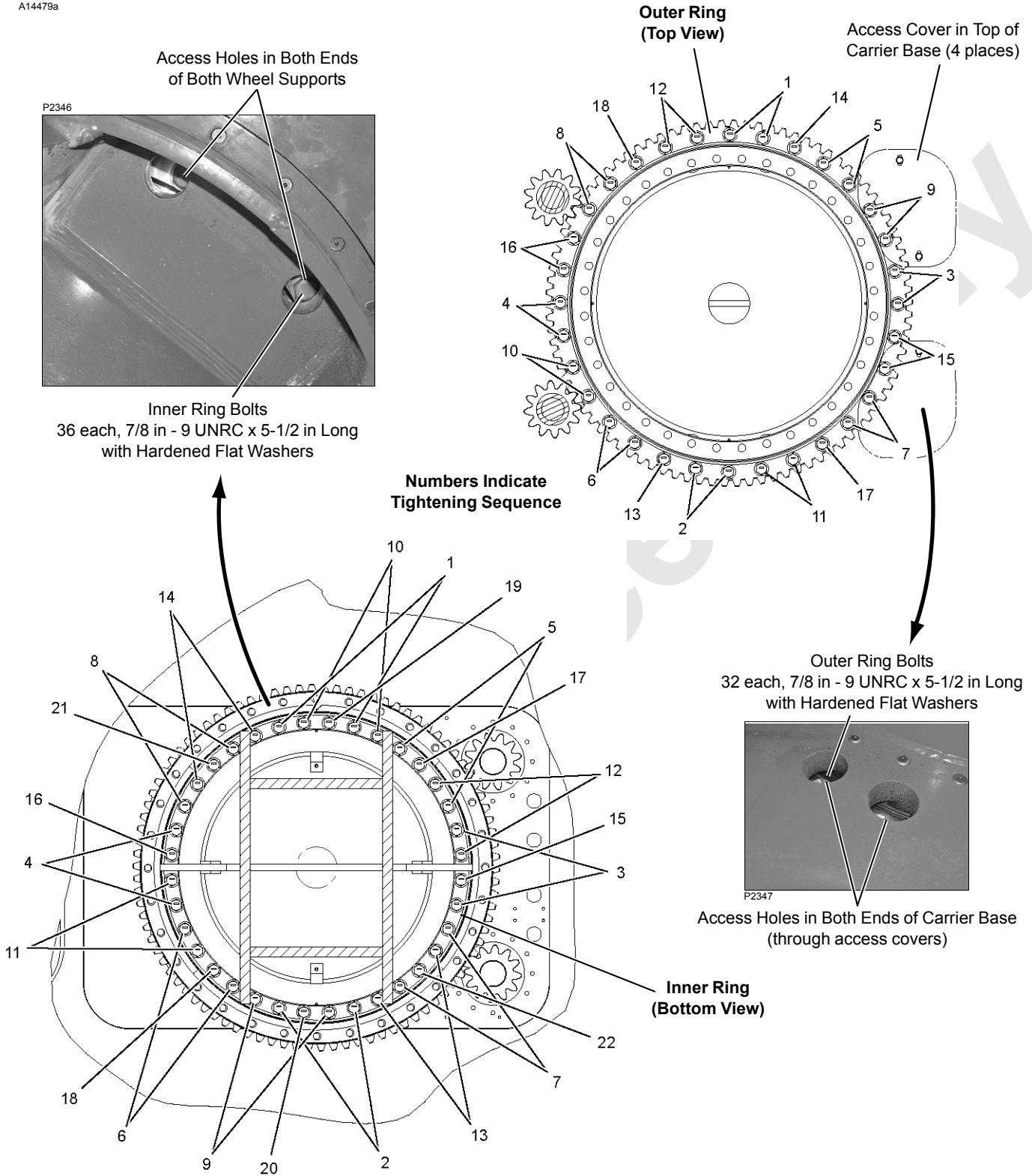


FIGURE 6-1

WHEEL SUPPORT BEARING BOLT TORQUE



WARNING

Bolt Failure!

Loose or improperly torqued bolts can cause bolts or bearing to fail, possibly allowing MAX-ER counterweights to break away from wheels.

General

The wheeled counterweight assembly is equipped with two bearings, one between each wheel support and the base. To gain access to the bolts in the inner ring of the bearings, the counterweight boxes must be removed.

The instructions in this section apply to both bearings.

Lubrication

Before installing the bearing bolts, apply Never-Seez (MCC No. 361010) or an equivalent anti-seizing lubricant to the bolt threads, the underside of each bolt head, and both sides of each washers.

Torque Values

Torque the bolts in two steps:

- First to 200 ft-lb (270 Nm)

- Then to 650 ft-lb (880 Nm)

Torque Sequence

Torque the bolts in the numbered sequence given in [Figure 6-1](#).

Torque Intervals

Initial Operation

Retorque all bolts to the specified value after the first 50 hours of operation.

Yearly or Every 2,000 Hours of Operation (whichever comes first)

Retorque 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 519 ft-lb (704 Nm), replace each loose bolt. Also, replace the bolt on each side of each loose bolt.

If at the yearly inspection interval six or more bolts in the outer ring or seven or more bolts in the inner ring are found to be torqued to less than 519 ft-lb (704 Nm), replace all of the bolts in the corresponding ring.

Replace all of the bolts each time a new bearing is installed.

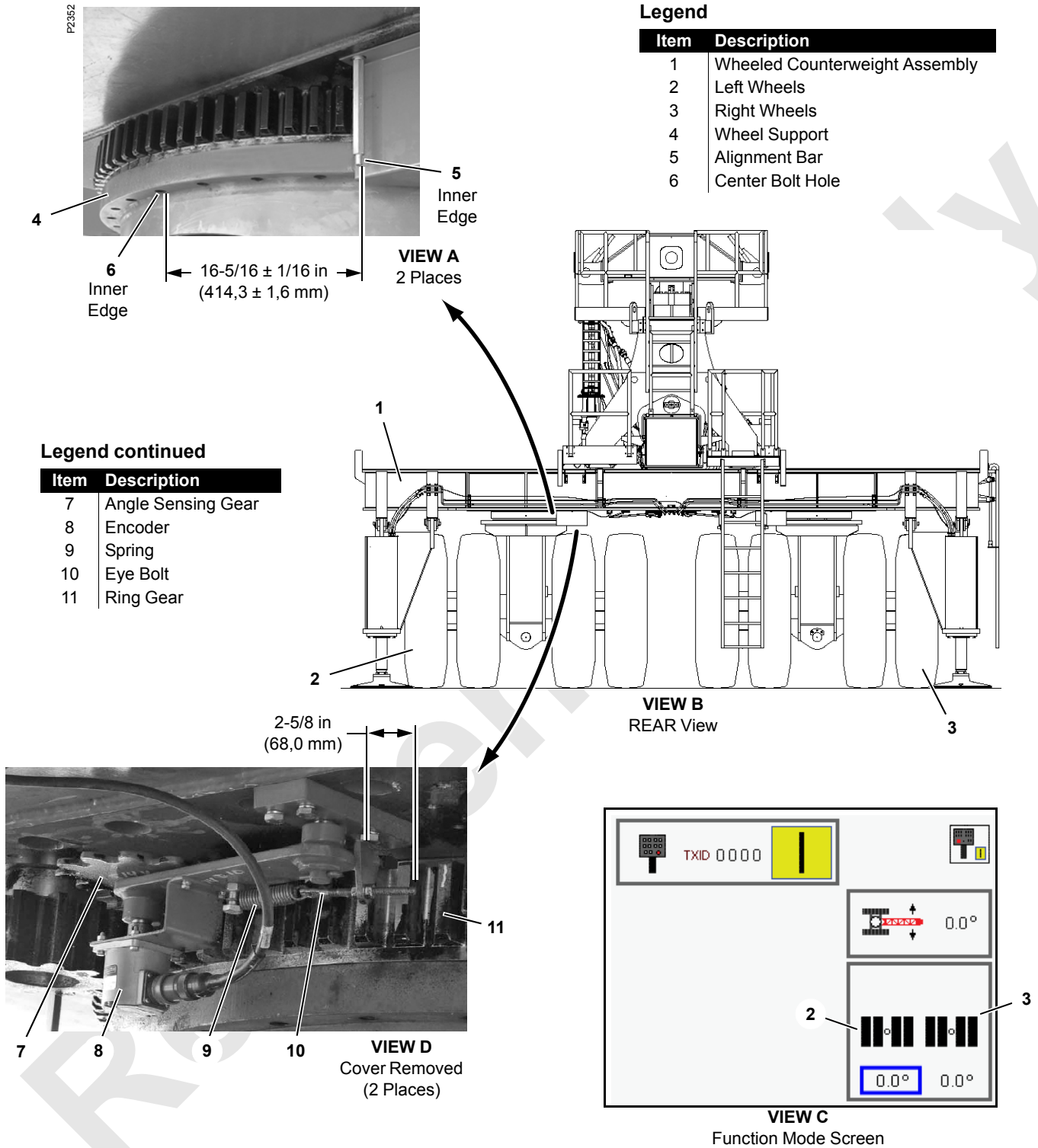


FIGURE 6-2

WHEEL POSITION ENCODER CALIBRATION

See [Figure 6-2](#) for the following procedure.

Check wheel position encoder calibration at the following intervals:

- The first time the wheeled counterweight assembly is attached to a 16000
- Anytime angle sensing encoder parts are replaced
- When the wheeled counterweight assembly is attached to a different 16000

Perform the following steps at both wheel assemblies once wheeled counterweight assembly (1, View B) is attached to the 16000.

The following steps require two people: an operator in the cab to observe the main display and a technician to perform the calibration steps.

NOTE: The appropriate MAX-ER capacity chart must be selected in the Rated Capacity Indicator/Limiter display. Wheel position encoder calibration cannot be performed with a setup chart selected.

1. Switch to the main display once the appropriate MAX-ER capacity chart is selected.
2. Turn on the MAX-ER remote control.
3. Using the MAX-ER remote control, extend the jacks as necessary until the bulge is out of the tires and rotate left wheels (2, View B) to the straight position.

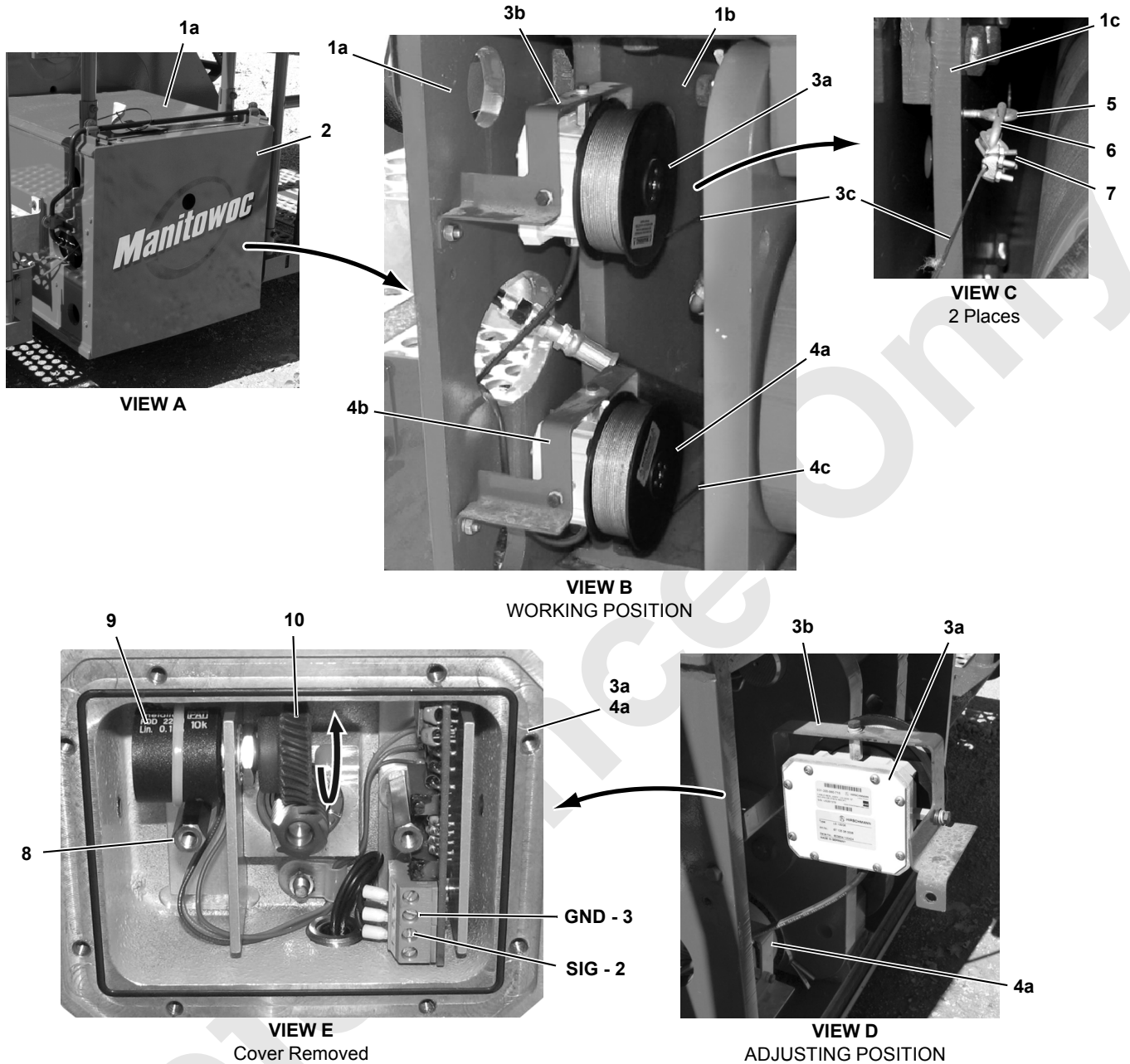
4. Using a tape measure, measure the distance from the inside edge of alignment bar (5, View A) to the inside edge of center bolt hole (6) in left wheel support frame (4).
5. Using the MAX-ER remote control, reposition the left wheels, as required, to the specified dimension.
6. In the operator's cab scroll to and select the icon for left wheels (2, View C) in the MAX-ER function mode screen.
7. Press the confirm switch at the display. The display will read 0.0°.
8. Repeat the steps for right wheels (3, View B).

WHEEL POSITION ENCODER SPRING TENSION

See [Figure 6-2](#), View D for the following procedure.

Spring tension is adjusted at the factory and should not require period adjustment. Check spring tension if you are getting erratic signals to the main display.

Adjust eye bolt (10) to the initial dimension given [Figure 6-2](#). The spring must apply enough force to hold angle sensing gear (7) against ring gear (11).



Legend

Item	Description	Item	Description
1a	Outer Telescopic Beam	4b	Top Cable Reel Bracket
1b	Intermediate Telescopic Beam	4c	Top Cable
1c	Inner Telescopic Beam	5	Eyebolt
2	Cover	6	Threaded Link
3a	Top Cable Reel	7	Thimble with Cable Clamps
3b	Top Cable Reel Bracket	8	Hex Nut
3c	Top Cable	9	Potentiometer
4a	Top Cable Reel	10	Worm Wheel

FIGURE 6-3

CABLE REEL LENGTH POTENTIOMETER CALIBRATION

See [Figure 6-3](#) for the following procedure.

Check cable reel length potentiometer calibration at the following intervals:

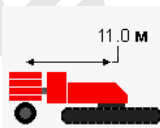
- The first time the wheeled counterweight assembly is attached to a 16000
- Anytime cable reel parts are replaced
- When the wheeled counterweight assembly is attached to a different 16000

Perform the following steps at both cable reels once the wheeled counterweight assembly is attached to the 16000. The telescopic beams must be fully retracted.

The following steps require two people: an operator in the cab to observe the main display and a technician to perform the inspection and calibration steps.

Inspection Steps

1. Remove cover (2, View A) from the rear of outer telescopic beam (1a).
2. Inspect cables (3c and 4c, View B).
 - a. If the cables are taut (no sag), go to inspection step 3.
 - b. If there is sag in either cable, go to calibration step 1.
3. Start the crane engine and scroll either to the MAX-ER information screen or to the MAX-ER diagnostic screen.
 - a. If the length icon indicates 11 m (36.1 ft), calibration is not required. Reinstall cover (2, View A) and resume operation.
 - b. If the length icon does not indicate 11 m (36.1 ft), calibration is required. Go to calibration step 1.



Calibration Steps

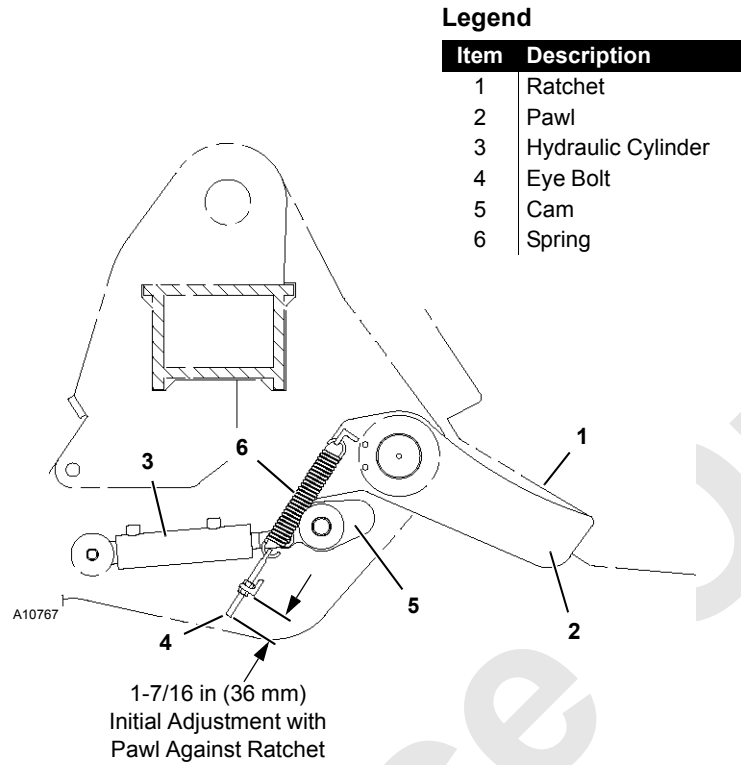
1. Remove cover (2, View A) from the rear of outer telescopic beam (1a).
2. Hold top cable reel (3a, View B) so it cannot fall and remove the screws attaching top cable reel bracket (3b) to the outer telescopic beam.
3. Reattach top cable reel bracket (3b) to the end of the outer telescopic beam as shown in View D.
4. If necessary, perform the following steps to tension top cable (3c).

- a. Disconnect top cable (3c, View C) from eyebolt (5, View C).
- b. Wrap the cable onto the cable reel drum and allow the drum to rotate counterclockwise until it stops (no pretension).
- c. Remove the cover from top cable reel (3a, View E).
- d. Loosen hex nut (8, View E) and slide potentiometer (9) up so worm wheel (10) can be rotated by hand.
- e. Rotate the worm wheel fully clockwise (direction of arrow in View E) until it stops.
- f. Rotate the cable reel drum clockwise four full turns to pretension the internal return spring. Don't allow the reel to unwind.
- g. Make sure the cable is spooled properly on the drum (no cross wraps) and reconnect the cable to rod eye (5, View C) with link (6). Be sure to fully tighten the nut on the link.

5. Calibrate the potentiometer as follows:
 - a. If not already done, remove the cover from top cable reel (3a, View E).
 - b. If not already done, loosen hex nut (8, View E) and slide potentiometer (9) up so it can be rotated by hand.
 - c. Start the crane engine and scroll either to the MAX-ER information screen or to the MAX-ER diagnostic screen.
6. Rotate worm wheel (10, View E) in the required direction until the length icon indicates 11 m (36.1 ft).

ALTERNATE METHOD: Connect leads from a multimeter to SIG and GND screws (2 and 3, View E). The reading should be 1.824 plus or minus 0.004 volts

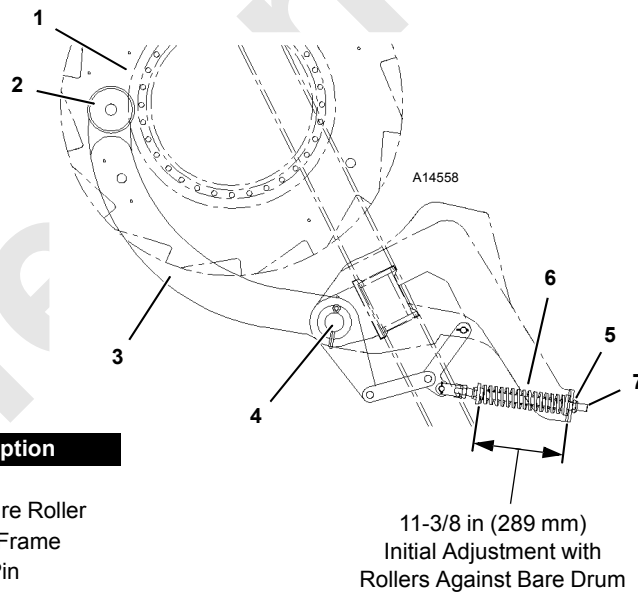
 - a. STOP ENGINE.
 - b. Slide potentiometer (9) down so worm wheel (10) is engaged with the worm shaft.
 - c. Securely tighten hex nut (8).
 - d. Reinstall the cover on top cable reel (3a, View D).
7. Reattach top cable reel (3a) to the working position inside telescopic beam (1a, View B).
8. Repeat the inspection steps. Readjust the cable reel if needed.
9. Perform the inspection and calibration steps for bottom cable reel (4a).
10. Install cover (2, View A) on the rear of outer telescopic beam (1a).



Legend

Item	Description
1	Ratchet
2	Pawl
3	Hydraulic Cylinder
4	Eye Bolt
5	Cam
6	Spring

FIGURE 6-4



Legend

Item	Description
1	Drum
2	Pressure Roller
3	Roller Frame
4	Pivot Pin
5	Lock Nut
6	Spring
7	Spring Guide

FIGURE 6-5

BOOM ANGLE INDICATOR CALIBRATION

An angle sensor is located inside the node controller mounted on the boom top and on the luffing jib top.

The boom and luffing jib angles are calibrated automatically by the crane's programmable controller as part of the rated capacity indicator's calibration procedure. See Rated Capacity Indicator/Limiter (RCL) Operation Guide located in Operator Information Manual in operator's cab.

BOOM HOIST PAWL ADJUSTMENT

General

The boom hoist (Drum 5) has a drum pawl ([Figure 6-4](#)) which is a positive locking device. When engaged, the pawl prevents the boom hoist drum from turning in the down direction.

The pawl is controlled by Drum 5 park switch in the operator's cab:

- When park is turned ON, the pawl engages. The hydraulic cylinder extends and spring force rotates the pawl into engagement with the ratchet.
- When park is turned OFF, the pawl disengages. The hydraulic cylinder retracts, and the cam rotates to disengage the pawl from the ratchet.

It may be necessary to hoist slightly to fully disengage the pawl from the ratchet.

Maintenance

The only maintenance required is to visually check the pawl for proper operation. This should be done daily when the boom hoist is in use.

If necessary, adjust the eye bolt so the spring has sufficient tension to fully engage the pawl with the ratchet.

In some cases, the pawl may come to rest on the top of a ratchet tooth. There must be enough spring tension to pull the pawl into the root of a ratchet tooth if the drum starts to turn in the down direction.

BOOM HOIST DRUM PRESSURE ROLLER ADJUSTMENT

General

The pressure roller is spring loaded to assist in maintaining proper wire rope spooling by firmly holding the wire rope firmly in place on the boom hoist drum.



The roller is spring loaded. Stop drum and turn off engine before adjusting.

Maintenance

The only maintenance required is for the operator to visually monitor drum spooling during daily during operation.

If the wire rope jumps layers or does not wind smoothly onto the drum, perform the adjustment step.

Adjustment

See [Figure 6-5](#) for the following procedure.

1. Hold spring guide (7) wrench flats.
2. Tighten lock nut (5) to increase spring tension.

BOOM HOIST SPEED SENSOR ADJUSTMENT

NOTE: The motor speed sensor is located on the same side of the boom hoist as the oil drain. Adjustment should only be necessary when replacing.

1. Loosen speed sensor lock nut.
2. Turn speed sensor clockwise by hand until bottom end gently touches the speed ring inside the motor.
3. Back speed sensor out counterclockwise 1 turn. Continue to back out until the sensor orientation notch is $180 \pm 15^\circ$ to the motor shaft centerline.
4. Hold sensor from moving and tighten lock nut. Torque to 10 ft/lbs.

AUTOMATIC BOOM STOP ADJUSTMENT

Maximum Boom Angle

Boom stop limit switch (5, [Figure 6-7](#)) automatically stops the boom and applies the boom hoist brake when the boom is raised to **Angle A** shown in [Figure 6-6](#) and listed in [Table 6-1](#).

Operation

See [Figure 6-7](#) for the following description.

When the boom is below the maximum angle, limit switch (5) is closed and its LED (light-emitting diode) is ON (View B). The boom hoist can be operated.

When the boom is raised to the maximum angle, boom butt (1) pushes adjusting rod (2a or 2b) in and actuator rod (11, View A) opens limit switch (5). The LED then goes OFF. Boom hoist operation stops automatically because the open limit switch turns off power to the boom hoist electric circuit. The boom hoist pump shifts to neutral and the brake applies to stop boom movement.

WARNING

Falling Attachment Hazard!

If boom fails to stop for any reason, stop engine immediately. Troubleshoot system to determine problem.

Do not resume operation until problem has been corrected.

Maintenance

At least once weekly, check that the automatic boom stop stops the boom at the specified maximum angle. If not, replace any worn or damaged parts and/or adjust the boom stop.

Once the automatic boom stop is properly adjusted, it should not require periodic adjustment. Adjustment is required, however, when:

- The luffing jib is installed or removed
- Parts are replaced



WARNING

Falling Attachment Hazard!

Do not operate crane unless automatic boom stop is properly adjusted and operational. Do not adjust maximum operating angle higher than specified. Boom could be pulled over backwards or collapse, causing death or serious injury.

Table 6-1 — Automatic Boom Stop Angles

Angle A (see Figure 6-6)	
83° — #58 Boom without Luffing Jib 87° — #58 Boom with #59 Luffing Jib	For Cranes with a Boom Up Limit that Can be Bypassed
84° — #58 Boom without Luffing Jib 88° — #58 Boom with #59 Luffing Jib	For Cranes with a Boom Up Limit that Cannot be Bypassed

* To determine if the boom up limit on your crane can be bypassed or not, perform Bypass Limit Test given on [page 6-11](#).

Bypass Limit Test

Perform the following test to determine if the boom up limit on your crane can be bypassed or not.

! WARNING
Crush Hazard!

Maintain constant communication between operator and assistant during following steps.

Stay clear of moving parts.

1. Lower the boom onto blocking at ground level.
2. Have an assistant push the adjusting rod (Figure 6-7) in to trip the boom stop limit switch open.
3. Rotate the limit bypass key (in crane cab) to the bypass position and hold.
4. Try to boom up — do not raise the boom any higher than necessary to perform the test:
 - a. If the boom rises, your boom up limit **can be bypassed**.
 - b. If the boom does not rise, your boom up limit **cannot be bypassed**.
5. The test is complete. Release the limit bypass key and the adjusting rod to the normal operating positions.

Legend

Item	Description
1	Boom Butt
2	Switch Assembly

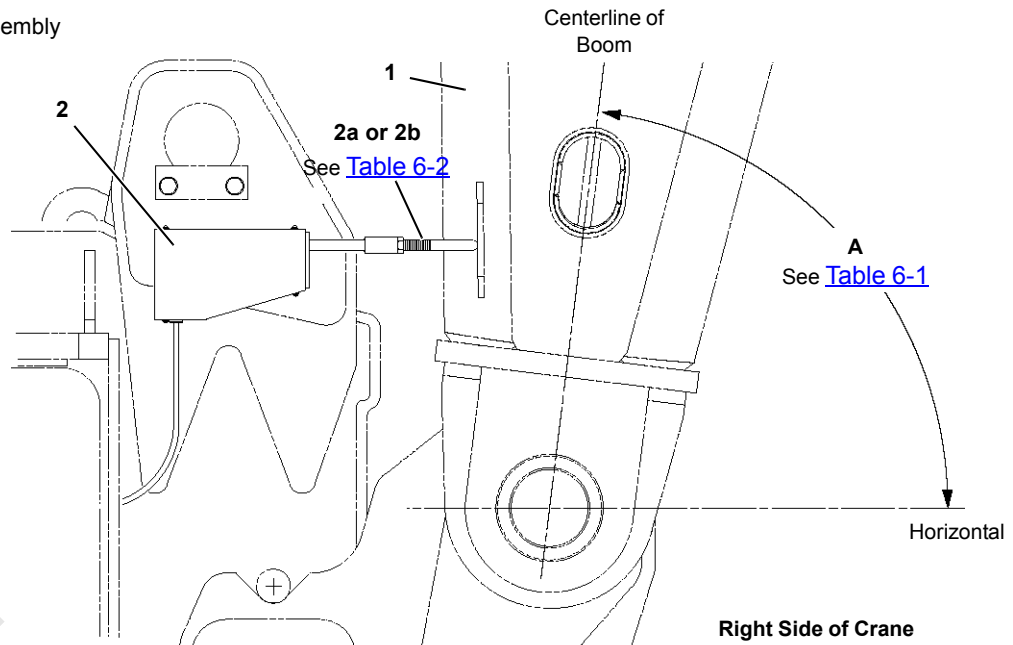


Table 6-2 — Adjusting Rods

Adjusting Rod and Length	
2a	2b
Boom Only	With Luffing Jib
145471 7 in (178 mm)	A18794 6-1/8 in (156 mm)

FIGURE 6-6

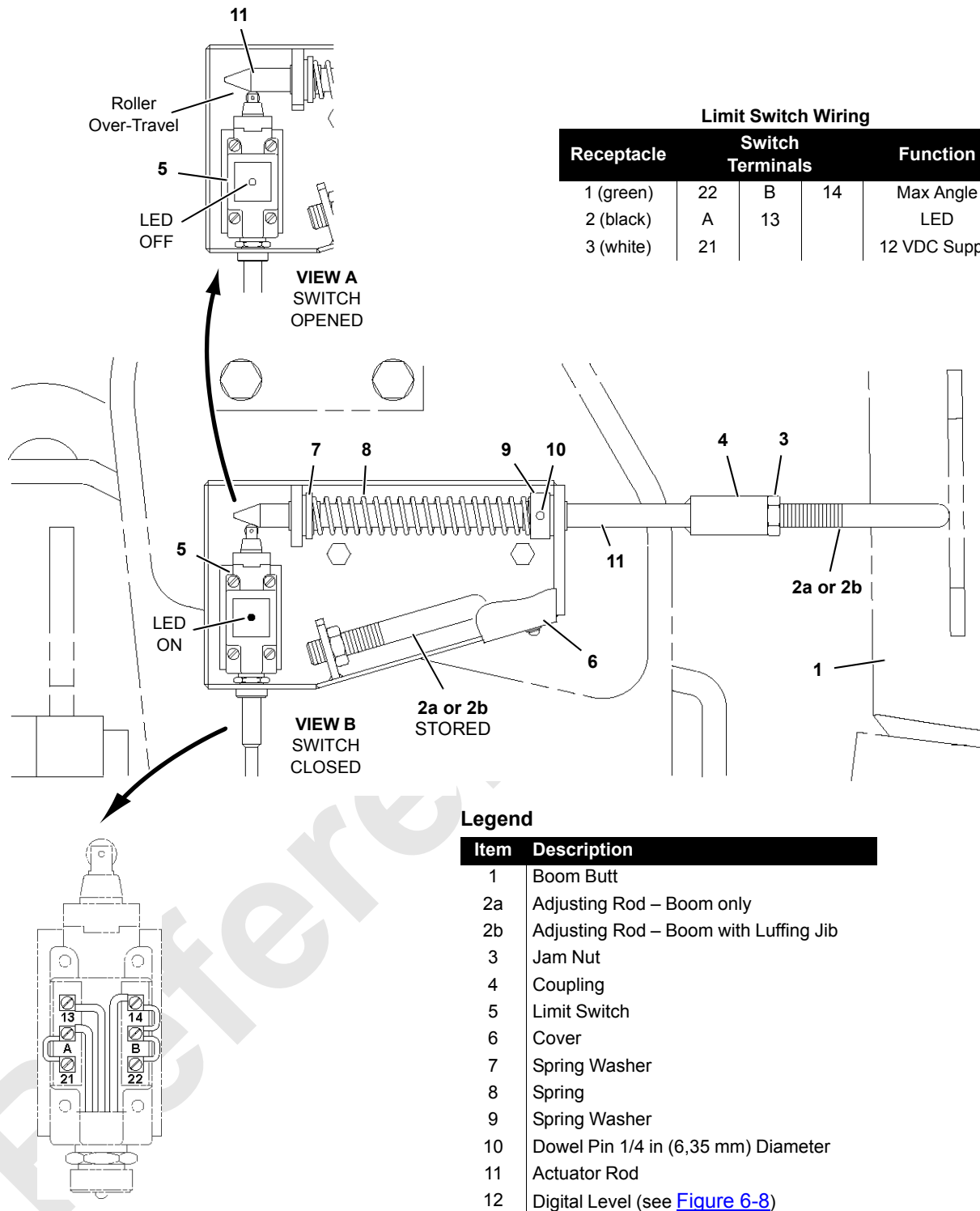


FIGURE 6-7

Angle A	Digital Level Angle
83°	75.3°
84°	76.3°
87°	79.3°
88°	80.3°

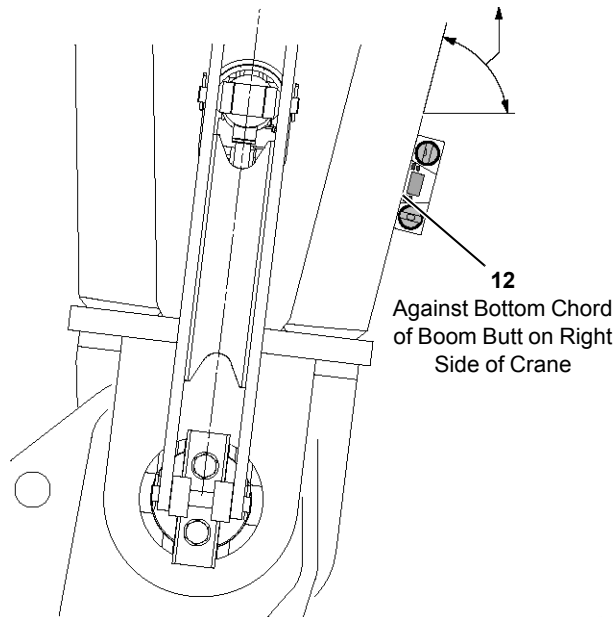


FIGURE 6-8

Adjustment

- Park the crane on a firm level surface or level the crane by blocking under the crawlers.
- Make sure the proper adjusting rod is installed (see [Table 6-2](#) in [Figure 6-6](#)):
- Raise the boom to specified **Angle A** ([Figure 6-6](#)) while monitoring the angle on the mechanical indicator or on the operating conditions screen of the front-console display.
- Verify that the boom is at proper Angle A:
 - Place an accurate digital level (12) on the boom butt as shown in [Figure 6-8](#). The corresponding **Digital Level Angle** should appear on the digital level.
 - Raise or lower the boom as necessary.
- If the boom stops at the specified angle, further adjustment is not needed.
 - If the boom stops before reaching the specified angle, go to step 6.
 - If the boom reaches the specified angle before it stops, go to step 7.

See [Figure 6-7](#) for the remaining steps.

- Loosen jam nut (3, View B).
 - Turn adjusting rod (2a or 2b) all the way into coupling (4).
 - Boom up slowly until the boom reaches the specified angle.
 - Turn adjusting rod (2a or 2b) out against boom butt (1) until limit switch (5) “clicks” open and the LED is OFF (View A).
 - Tighten jam nut (3).
- If the boom reaches the specified angle before it stops:
 - Loosen jam nut (3, View B).
 - Turn adjusting rod (2a or 2b) out against boom butt (1) until limit switch (5) “clicks” open and the LED is OFF (View A).
 - Tighten jam nut (3).
 - Check that actuator rod (11) over-travels the limit switch as shown in View A.
 - Test the adjustment as follows:
 - Lower the boom several degrees below specified Angle A.
 - Slowly raise the boom.
 - Boom must stop at specified Angle A.** If the boom does not stop at the specified angle:
 - Stop raising the boom (move control handle to off)
 - Lower the boom several degrees below the specified angle
 - Repeat adjustment steps [2](#) through [9](#).

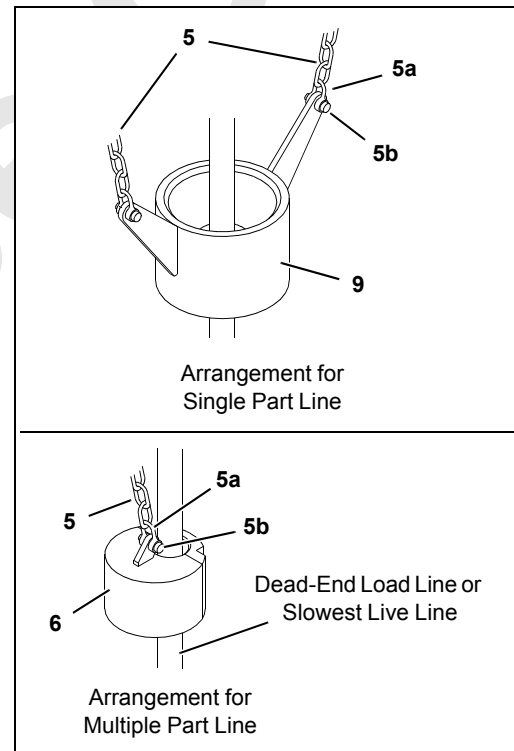
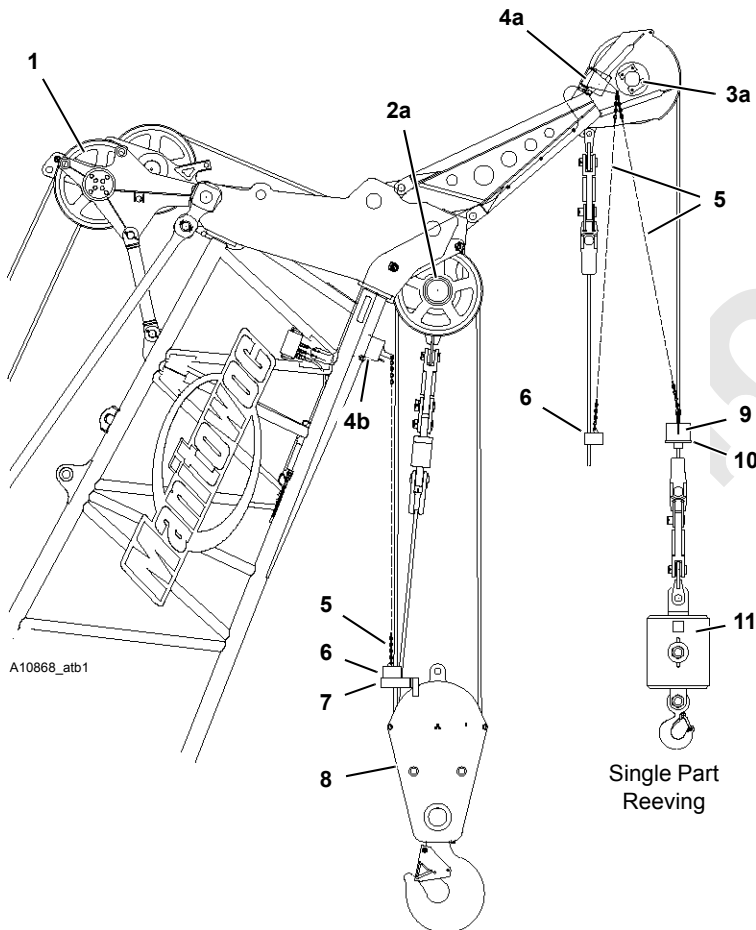
Actuator Rod Replacement

See [Figure 6-7](#), View B for the following procedure.

- Remove damaged actuator rod (11).
- Slide spring washers (7 and 9) and spring (8) over new actuator rod (11) while sliding the actuator rod into the bracket assembly.
- Position actuator rod (11) so the tapered end just touches the roller of limit switch (5, View B). The actuator rod must not depress the limit switch roller.
- Drill a 1/4 in (6,35 mm) hole through spring washer (9) and actuator rod (11).
- Install dowel pin (10).
- Install proper adjusting rod (2a or 2b).
- Adjust the boom stop.

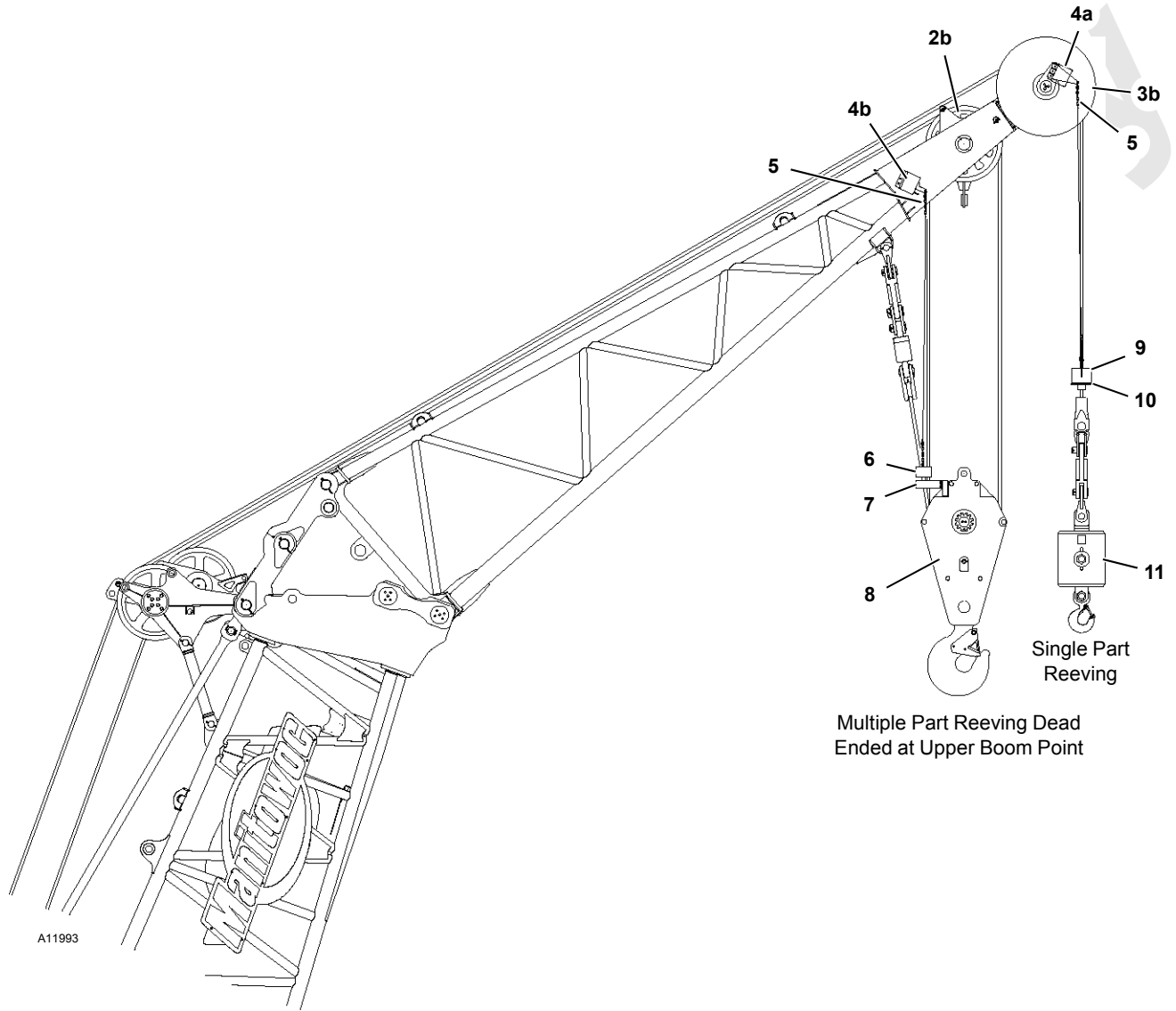
Legend

Item	Description	Item	Description
1	Wire Rope Guide	5a	Shackle
2a	Lower Boom Point	5b	Pin
2b	Extended Upper Boom Point (lower sheaves)	6	Weight
3a	Standard Upper Boom Point	7	Lift Plate
3b	Extended Upper Boom Point (upper sheave)	8	Load Block
4a	Block-Up Limit Switch (left hand)	9	Weight
4b	Block-Up Limit Switch (right hand)	10	Lift Block
5	Chain	11	Weight Ball



Multiple Part Reeving
Dead Ended at Boom

FIGURE 6-9



A11993

FIGURE 6-9 continued

BLOCK-UP LIMIT CONTROL

General

A block-up limit (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 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 may not prevent two-blocking when load is hoisted at maximum single line speed. Operator shall determine fastest line speed that allows block-up limit to function properly and, thereafter, not exceed that line speed.

The block-up limit system consists of the following components ([Figure 6-9](#)):

1. Normally closed limit switch assembly fastened at the following locations:
 - a. Lower boom point
 - b. Upper boom point
2. Weight freely suspended by chain from each limit switch actuating lever (weight encircles load line as shown).
3. Lift block fastened to load line or lift plates fastened to load block.

Operation

See [Figure 6-9](#) and [Figure 6-10](#) for component identification.

For a complete wiring diagram of the system, see Boom Wiring and Limits Drawing in Section 3.

Block-Up Limit Control Deactivated

During normal operation, the weight overcomes 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/mast hoist pumps stroke to off. At the same time, load drum and boom parking brakes apply to stop load drum from hoisting and boom from lowering.

Maintenance

Inspect and test the block-up limits **weekly or every 40 hours of operation**, as follows:

CAUTION

Avoid Machinery Damage!

To prevent two-blocking from occurring, do not operate crane until cause for improper operation and all hazardous conditions have been found and corrected.

1. Lower the boom 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 the actuating lever; wipe away any excess grease.
 - b. Inspect each weight for freedom of movement on the load line.
 - c. Inspect each weight, chain, shackle and connecting pin for excessive or abnormal wear. Make sure cotter pins for shackles are installed and spread.
 - d. Inspect entire length of each electric cable for damage.
 - e. Check that electric cables are clear of all moving parts on boom and that cables are securely fastened to boom with nylon straps.
 - f. Check that all plugs are securely fastened.
2. Test block-up limits 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/mast 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/mast hoist should not operate in LOWER direction.

CAUTION

Avoid Sheave Damage!

Use extreme care when testing block-up limits when boom is raised. If a block-up limit fails to stop load, immediately stop load by moving drum control handle to off; otherwise, two-blocking may occur.

Adjustment

See [Figure 6-10](#) for the 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.
2. Loosen setscrew in limit switch lever so lever is free to rotate.
3. Manually lift weight to allow actuating lever to rotate 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 COUNTERCLOCKWISE (for right hand) or CLOCKWISE (for left hand) **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 topic); repeat adjustment steps until limit switch operates properly.

Legend

Item	Description
1	Elbow with Cord Gripper
2	Setscrew
3	Spring
4	Enclosure
5	Adjusting Screw (Spring Tension)
6	Grease Fitting
7	Actuating Lever
8	Roller
9	Limit Switch Lever
10	Shaft
11	Cover

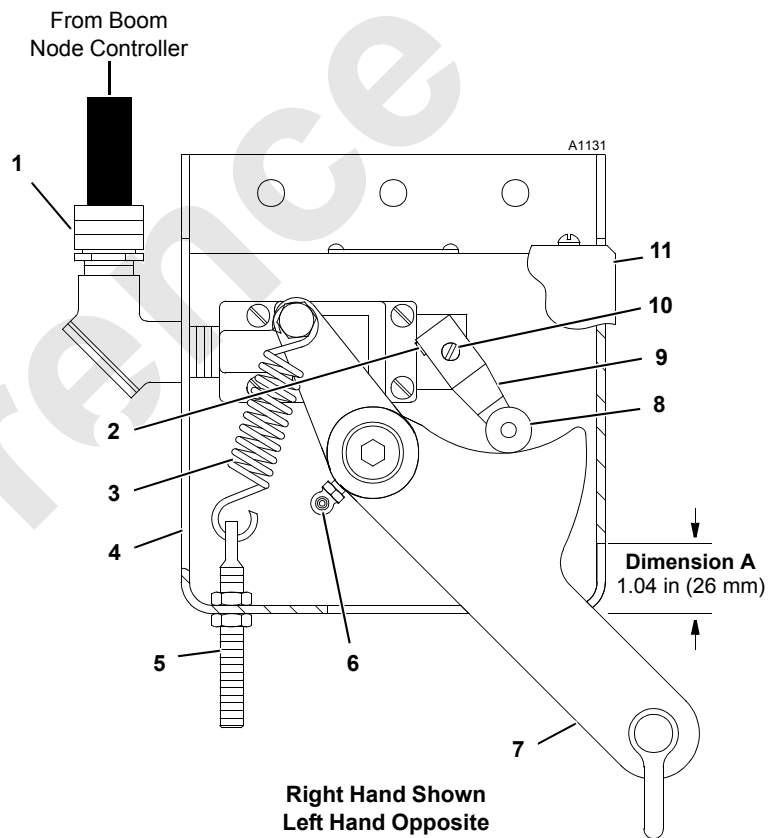


FIGURE 6-10

MAST STOP LIMIT SWITCH

See [Figure 6-12](#) for the following procedure.

NOTE: Mast Stop Limit Switch procedures apply to crane software version M002066 and newer.

Maintenance

Software Confirmation

NOTE: Contact Manitowoc Crane Care Lattice Team for questions regarding the software verification procedure.

1. Verify on crane display the mast stop cylinder position information screen is not available.
2. Make sure the crane is not in MAX-ER mode and unplug P9 W64 connector from the MAX-ER limit switch cable receptacle (3a).
3. Verify Fault #27 is active on the crane display.
4. Reconnect P9 W64 connection to the MAX-ER limit switch.

Limit Switch Inspection

NOTE: Inspect and test the mast stop limit switch during MAX-ER setup.

1. Inspect limit switch lever and actuating lever for freedom of movement.
2. Confirm Fault #27 is active on the crane display when the mast stop limit switch is tripped at 26°.

Adjustment

It should only be necessary to perform this procedure when parts are replaced or the limit switch does not operate properly.

NOTE: Mast stop limit switch to switch when the cylinder is 80% retracted.

1. When replacing the limit switch, mount the fixed limit switch arm (9) at 90° with respect to the cylinder centerline. Reference the switch free position view (2c) in figure 2.
2. Confirm the limit switch bracket (7) clears the outer diameter of the cylinder head.
3. The limit switch arm must rotate 26° to trip the switch, view (2d).
4. Adjust the switch mounting to ensure that the limit switch arm travels greater than 60° from the free position when the cylinder is fully extended confirming the positive opening of the normally closed contacts at 55°
5. Confirm the maximum limit switch arm travel is no greater than 85°

Mast Stop Limit Switch Electrical Wiring

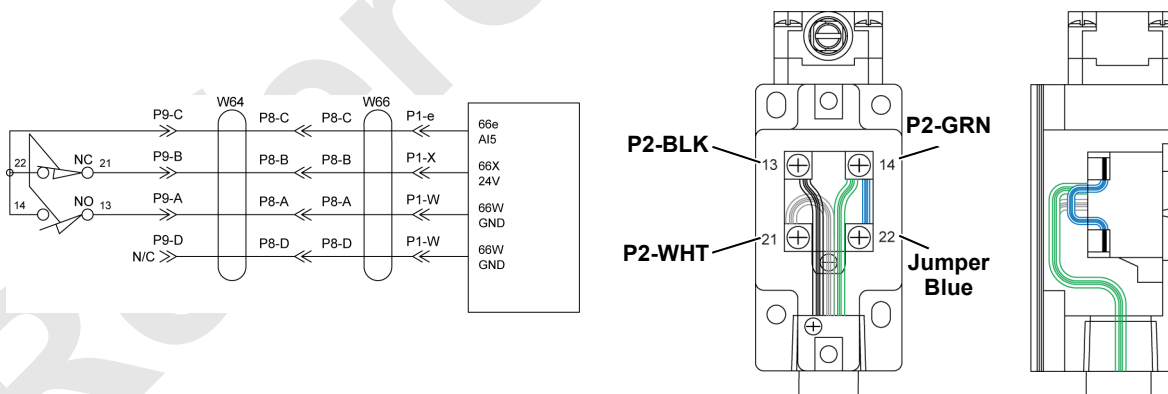
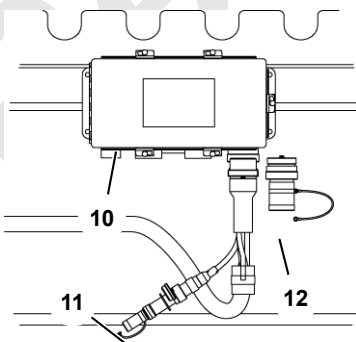
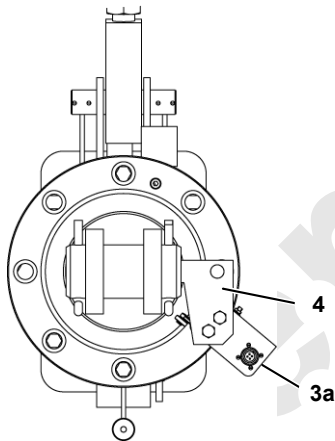
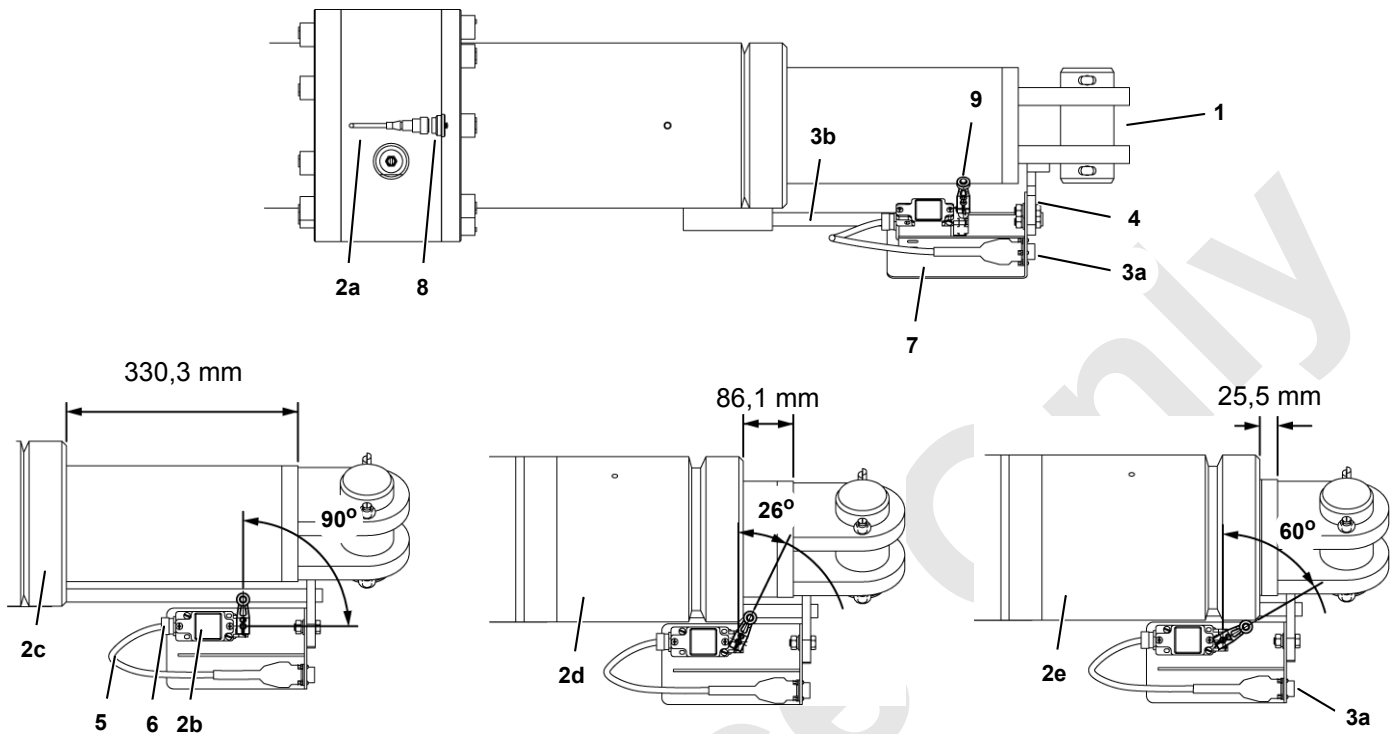


FIGURE 6-11

Mast Stop Limit Switch Component Overview



Legend

Item	Component	Description
1	Cylinder	Right Hand MAX-ER Mast Stop
2a	Position Sensor	
2b	Limit Switch	
2c	Cylinder Fully Extended	Switch in Free Position (90°)
2d	Cylinder Retracted 80%	Switched Position (26°)
2e	Cylinder Retracted 100%	Switch at Full Travel (60°)
3a	Limit Switch Cable Receptacle	Mast Stop Position
3b	Indicator Rod (part of item 4)	
4	Bracket (part of item 3b)	Indicator Rod Mounting
5	Mast Stop Cylinder Position Cable	Limit Switch Electrical Wiring
6	Cord Grip	
7	Bracket	Limit Switch Mounting
8	Cap	Dust Cap
9	Arm	Limit Switch Fixed Arm
10	Node	Node 6 on Front of Rotating Bed
11	W66P8 Shorting Terminator	Limit Switch Shorting Bypass
12	W66 Shorting Terminator	Node 6 Shorting Bypass

FIGURE 6-12

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