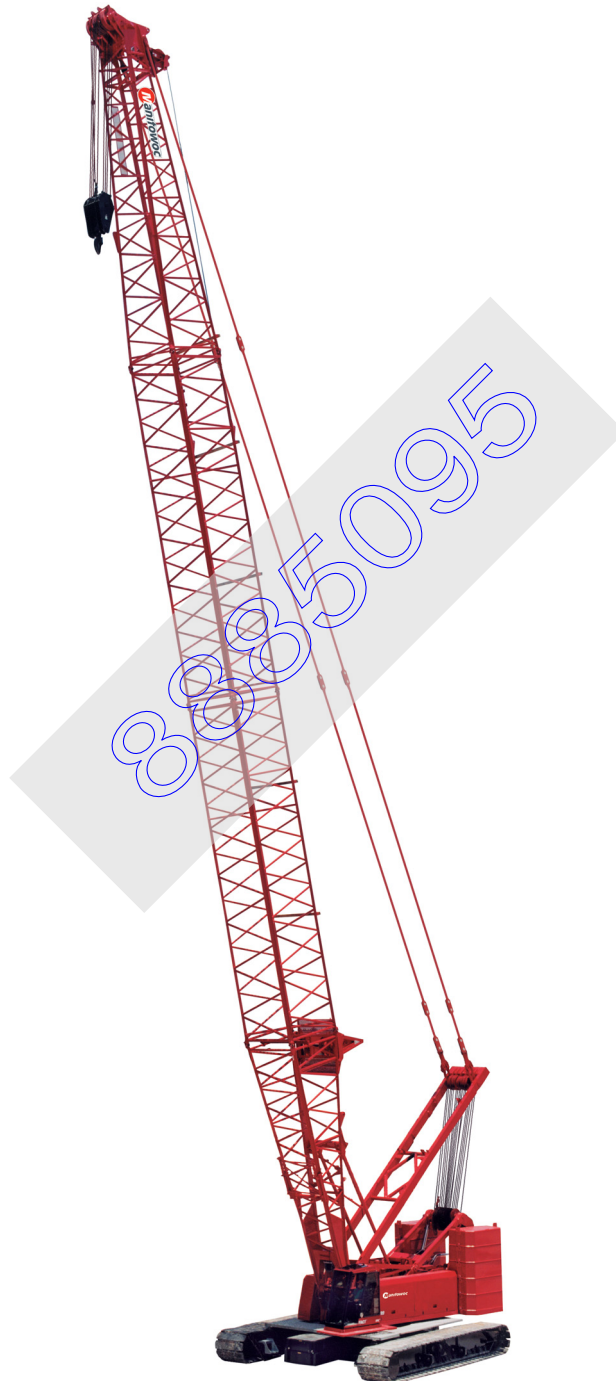


Manitowoc 14000

Operator Manual Luffing Jib Attachment





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

Batteries, battery posts, terminals, and related accessories can expose you to chemicals, including lead and lead compounds, which are known to the State of California to cause cancer and birth defects or other reproductive harm. Wash hands after handling. For more information, go to www.P65warnings.ca.gov



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.



OPERATOR MANUAL

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

14000

Model Number

14005Ref

Luffing Jib 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 PROCEDURES

NOTICE

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

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

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

	! 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. If Operator Information Manual or Service Manual is missing from cab, contact your Manitowoc dealer for a new one.



THE ORIGINAL LANGUAGE OF THIS PUBLICATION IS ENGLISH

8885095

See end of this manual for Alphabetical Index

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SECTION 1 INTRODUCTION

CRANE DATA

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

- Basic Specifications
- EC Declaration (if applicable)

CRANE WEIGHTS

See the end of this section for crane weights.

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 jibs) available for this crane.

The crane or attachment model and serial number are etched into 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.

CHANGE OF OWNERSHIP REGISTRATION

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

1. Go to www.manitowoc.com
2. Go to SUPPOR>SERVICES>CHANGE OF OWNERSHIP.
3. Complete the form.

MANITOWOC DEALER

For questions about this manual or the 14000 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.manitowoc.com
2. Click on the red FIND A DEALER button.
3. Follow the on-screen prompts to locate your Manitowoc dealer.

CRANE ORIENTATION

The terms RIGHT, LEFT, FRONT, REAR used in this manual refer to the 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.



FIGURE 1-1

IDENTIFICATION AND LOCATION OF COMPONENTS

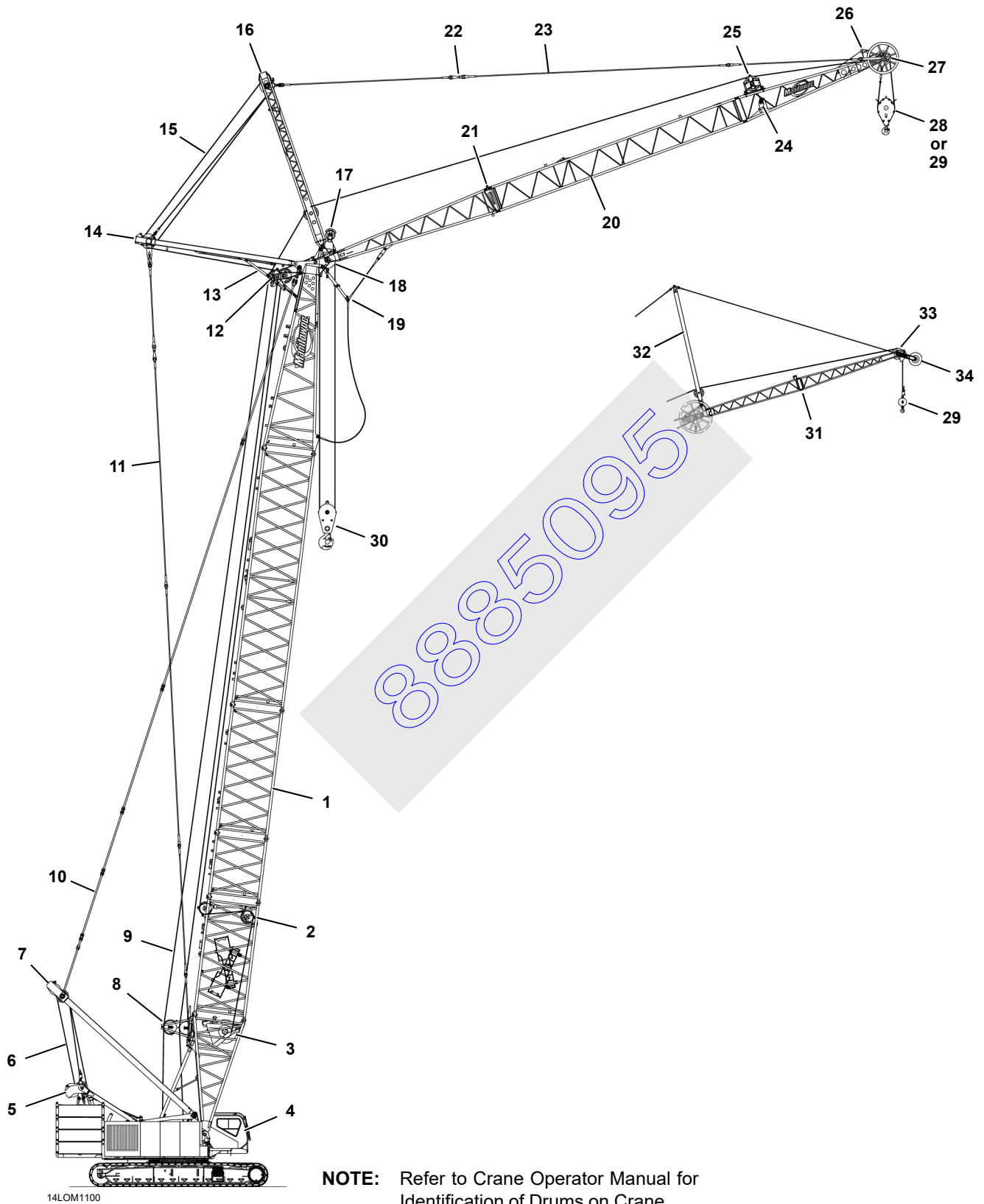


FIGURE 1-2

Legend for [Figure 1-2](#)

Item	Description
1	#76 Boom
2	Wire Rope Guides (Luffing Hoist)
3	Luffing Hoist (Drum 3)
4	Model 14000 Operator Cab
5	Gantry
6	Boom Hoist Wire Rope (See Note)
7	Live Mast
8	Wire Rope Guide (Load Lines)
9	Load Lines (See Note)
10	Boom Straps
11	Jib Backstay Straps
12	Wire Rope Guide
13	Main Strut Stops
14	Main Strut
15	Luffing Hoist Wire Rope
16	Jib Strut
17	Wire Rope Guide (Fold-Under Luffing Jib)
18	Lower Boom Point
19	Jib Stop (Physical)
20	#135 Luffing Jib
21	Adapter Frame
22	Pendant Link
23	Jib Pendants
24	Wire Rope Guide Winch (Fold-Under Luffing Jib)
25	Wire Rope Guide (Load Lines)
26	Jib Stop Winch
27	Jib Point with Rollers
28	Load Block (1 or 2 Sheaves)
29	Hook and Weight Ball
30	Load Block
31	#138 Fix Jib
32	Strut
33	Jib Point
34	Wheel

ENGLISH AND METRIC CONVERSIONS

Inverse Conversion

Direct Conversion

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

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

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

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

To Convert	Symbol	Application	To	Symbol	Multiply By
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	Nmm	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
VOLUME (LIQUID)					

To Convert	Symbol	Application	To	Symbol	Multiply By
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
Ton (2,000 lb.)	USt	Load Ratings	Metric Ton	t	0.9072
Ton (2,000 lb.)	USt		Kilogram	kg	907.1847



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SAFETY INFORMATION

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SECTION 2

SAFETY INFORMATION



WARNING

California Proposition 65

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- 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.

Batteries, battery posts, terminals, and related accessories can expose you to chemicals, including lead and lead compounds, which are known to the State of California to cause cancer and birth defects or other reproductive harm. Wash hands after handling. For more information go to www.P65warnings.ca.gov.

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 Manitowoc Product Support.

NAMEPLATES AND DECALS

See the 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 on page 2-2](#) and [Table 2-2 on page 2-3](#).

Table 2-1 Common Safety Symbols





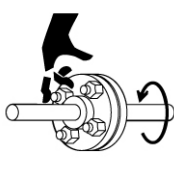


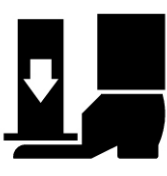




















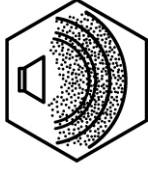

Cut or Crush Hazards					Cut Hazard
 M100090	 M100091	 M100066	 M100065	 M100069	 M100067
Crush Hazards					Fire Extinguisher
 M100070	 M100071	 M100072	 M100073	 M100074	 M100082
Fall Hazards			Falling Boom (Crush) Hazards	Explosion Hazard	
 M100083	 M100084	 M100085	 M100068	 M100075	 M100080
Falling 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 2-1 Common Safety Symbols











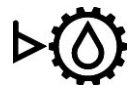

Emergency Cab Exit	Lift	Do Not Lift	Prohibited
 <p>M102486</p>	 <p>M104626</p>	 <p>M104627</p>	 <p>M104628</p>

Table 2-2 Miscellaneous Symbols

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

SAFETY AND INFORMATION SIGNS

Maintaining Signs

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

Ordering Signs

Order replacement safety and information signs from your Manitowoc dealer.

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

CRANE ACCESS POINTS



WARNING

Crush Hazard!

The upperworks can swing into and crush personnel climbing on or off the crane.

Moving crawlers can crush personnel climbing on or off the crane.

To prevent death or serious injury:

- Barricade all accessible areas to the crane so personnel cannot be struck or crushed when the upperworks is swung.
- Do not climb onto or off the crane while the upperworks is being swung or the crane is being traveled.
- Signal the operator for permission to climb onto/off the crane.
- Operator: do not swing or travel while personnel are climbing onto or off the crane. Stop the swing and travel motions. Apply the swing brake and turn on travel park.
- Operator: Always sound the 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 a ladder, steps, platforms, and catwalks at the locations shown in

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

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 the crane. Store clothing and other personal belongings so they do not interfere with controls in operator cab or with operation of the 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 operator 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 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 Maniowoc.

GETTING ON OR OFF CRANE

Personnel getting on and off the crane shall do so only:

- a. at the steps or ladders provided,
- b. while crane is parked and not moving,
- c. with the operator's or qualified person's permission,
- d. if the performance of their duties requires them to do so.

When personnel use the steps and 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 shall be lifted into place with a hand line or hoist.

Always maintain a three-point contact with the ladder: two feet and one hand or two hands and one foot.

Item	Description
1	Platforms (removable)
2a	Enclosure Panel (hinged)
2b	Enclosure Panel (removable)
3	Step (both crawlers)
4	Step (operator's cab)
5	Catwalk (operator's cab)
6	Carbody Counterweight (has non-skid surface)
7	Step (both Carbody counterweights)
8	Platform (between drums)
9	Steps (behind enclosure panel)
10	Ladder (rotating bed)
11	Counterweight Boxes and Tray (have non-skid surface)
12	Catwalk (boom butt)
13	Platforms (boom butt)

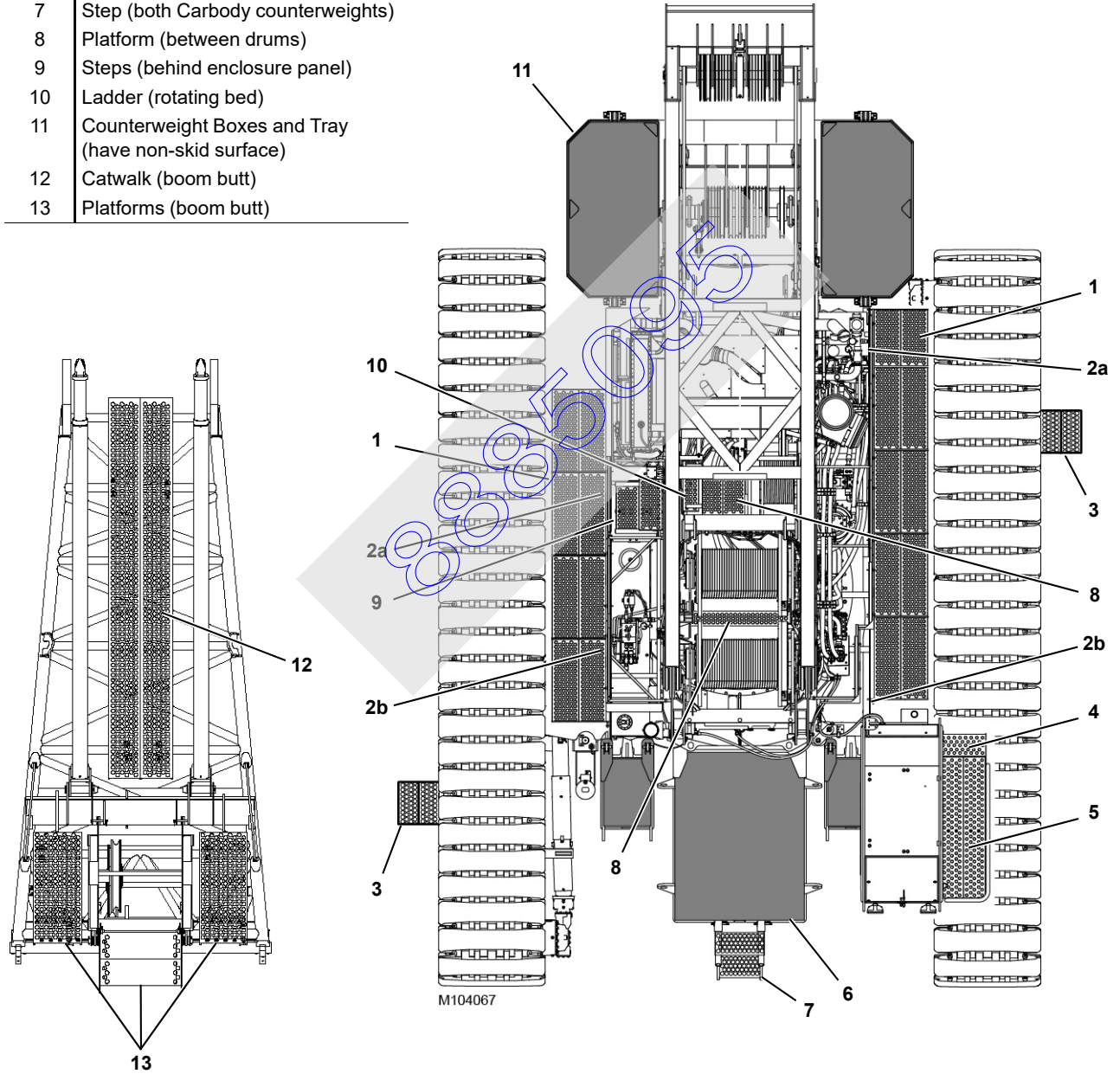


Figure 2-1. Crane Access Points

PERSONAL FALL-PROTECTION

It is the crane owner/user's responsibility to provide assembly/maintenance personnel with appropriate fall-protection equipment.

WARNING Fall Hazard!

To prevent falling from any height during crane assembly and disassembly, personnel shall appropriate wear fall-protection equipment.

OPERATOR MANUAL/CAPACITY CHART STORAGE

General

Manitowoc provides the following manuals and other important literature with your crane:

- 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 cab (Operator Manual, Capacity Charts, Maintenance Checks and Lube Guide, and RCL Operation) are supplied in an OPERATOR INFORMATION binder.

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. **Using any other manual or capacity chart is prohibited.**

The crane model and serial number are located on the Crane Identification Plate on the crane cab.

If the serial numbers of your manuals and capacity charts do not match the serial numbers of the crane, contact your Manitowoc dealer for the proper manual or capacity charts.

Do not operate the crane if the proper Capacity Chart is not in the cab.

Storing Manuals in Standard Cab

See [Figure 2-2](#).

Store the Operator Information Manuals for the crane and applicable attachment in the holders provided in the operator's cab

Attach the chain from the each manual to the link on the holder.

An extra holder is located behind the seat

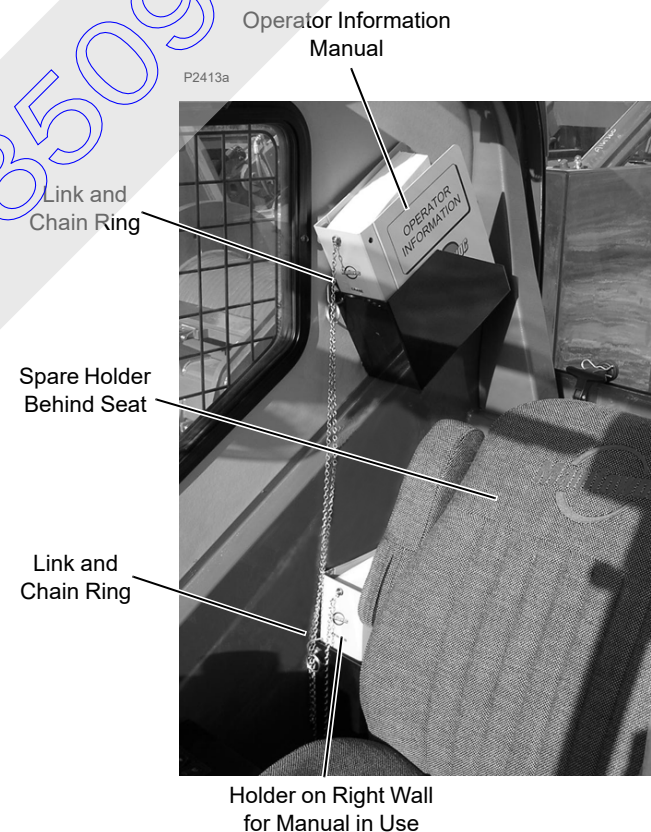


Figure 2-2.

Storing Manuals in Vision Cab

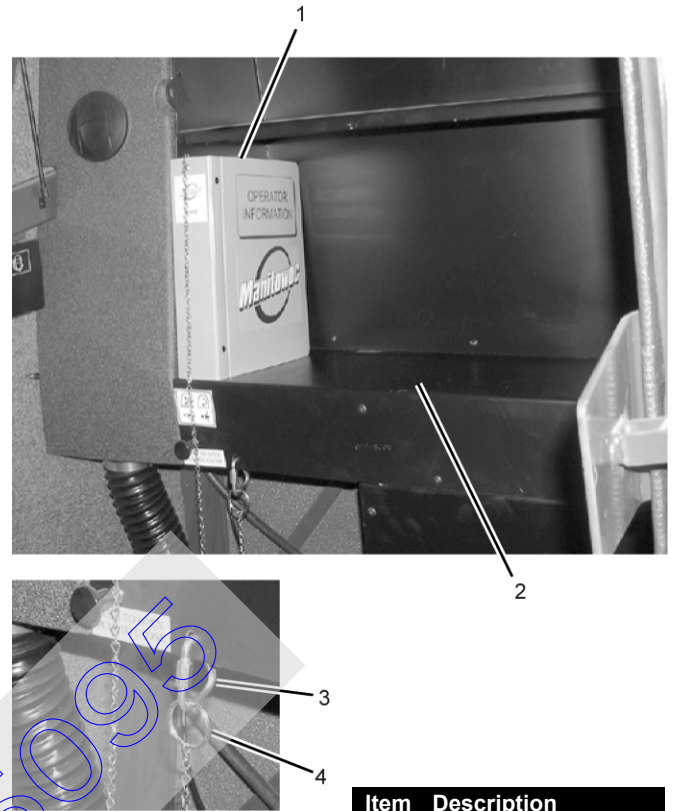
See [Figure 2-3](#).

Store the Operator Information binder in the holder (3) located behind the seat (1) in the left rear corner of the operator cab.

Attach the chain from the manual to the link (4) on the holder.

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

Additional storage is provided on the storage shelves (2).



Item	Description
1	Operator Information Manual
2	Bookshelf Behind Operator Seat
3	Link
4	Chain Ring

Figure 2-3.

SWING RADIUS BARRIER

Manitowoc's optional swing radius barrier is shown in [Figure 2-4](#).

WARNING Crush Hazard!

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

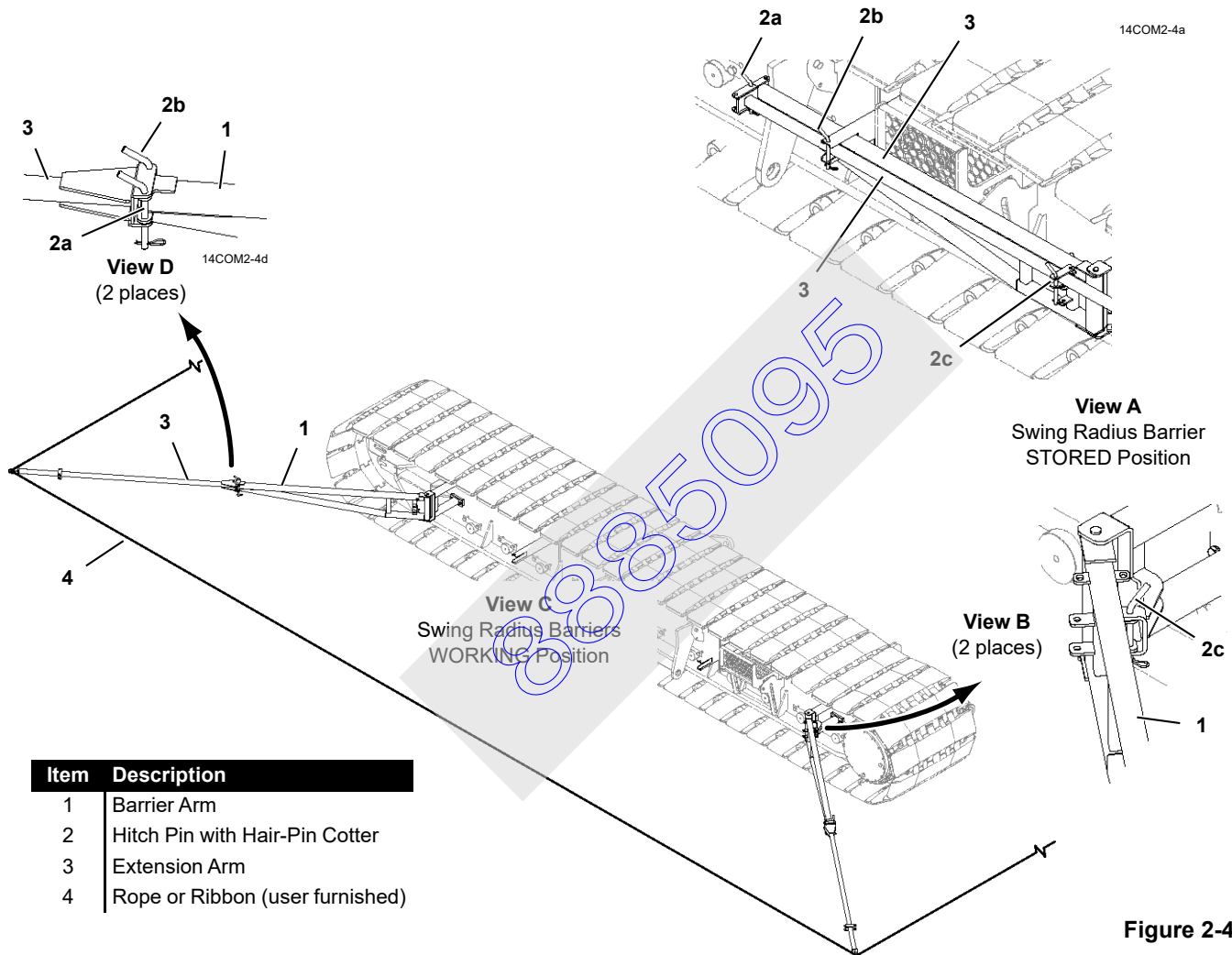


Figure 2-4.

Deploying Swing Radius Barrier

1. Remove pins (2b and 2c, View A) from stored position.
2. Unfold extension arms (3) and rotate barrier arms (1) outward to working position (View C).
3. Install pins (2b, View D and 2c, View B) to secure arms in working position.
4. Form a safety perimeter by attaching user supplied high visibility rope or ribbon (4) to hooked ends of extension arms (3, View C).

Storing Swing Radius Barrier

1. Remove rope or ribbon (4) from hooked ends of extension arms (3).
2. Remove pins (2b, View D and 2c, View B) from working position.
3. Fold extension arms (3) and rotate barrier arms (1) inward against crawler frame.
4. Install pins (2b and 2c, View A) in stored 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.

Work Area Control

Personnel within the swing radius of the crane and fall zone of the crane's boom and/or load are subject to hazards if the crane is not operated per the requirements of the manufacturer and industry recognized safe operating practices.

To minimize the risk of harm, training of personnel on jobsite hazard recognition and prevention is required. Additionally, restricting access to the swing radius and fall zone during specific work conditions is required. The U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) regulations for Construction provides requirements in 29CFR1926.1417 Operation, 29CFR1926.1424 Work area control, 29CFR1926.1425 Keeping clear of the load and 29CFR1926.1426 Free fall and controlled load lowering.

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 must be read and completely understood by each person responsible for assembly, disassembly, operation, and maintenance of the crane.

The Operator Manual must be read to personnel who cannot 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 or Manitowoc Product Support.

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 the crane or enter 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 can 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 the 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 the crane in no way substitutes for or lessens requirement that operator knowledge, experience, and judgment are required to ensure safe operation of the 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 Section 3 of the MLC100-1 Operator Manual.

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 must 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 cab for any reason:

- a. Park the crane and position upperworks so the 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 on [page 2-10](#).

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 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 16 m/s (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.
2. The ratings given in the Capacity Chart are developed based on “Freely suspended loads” and specified operating conditions. When cranes are used for service other than lifting service and/or special lifting operations, Manitowoc or a qualified person shall establish the ratings, operating limitations, maintenance, testing, and inspection requirements. Please reference Special Application/Service later in this section.

NOTE “*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 load to allow for the dynamic effects of swinging, hoisting, or lowering, and adverse weather conditions to include wind.

3. 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% — 0,3 m (1ft) rise or fall in 30,5 m (100 ft) 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.manitowoc.com
 - b. The load is secured and properly balanced in the slings or the lifting device before lifting the load more than 76 to 152 mm (3 to 6 in).
 - 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 76 to 152 mm (3 to 6 in) 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 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. When lifting, any non-vertical loads applied to the crane from dynamics, multi-crane lifts or environmental factors must be minimized or eliminated. The load must remain under the lifting point at all times.
 - d. 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.
 - e. Use taglines or other restraints to control the load when necessary.
 - f. Do not exceed any swing limitations (areas of operation) given in the Capacity Chart.
 - g. Do not allow the load, boom, or any other part of the crane to contact obstructions.
 - h. Do not use the crane to drag a load.
 - i. Do not hoist, lower, or swing the load while personnel are on the load or the hook. See Personnel Handling in this section.
 - j. 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.

- k. 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.

- l. Fully retract and lock the jacks and the outrigger beams so they cannot extend when not in use.
- m. Do not lower the load or the boom to a point where less than three full wraps of wire rope remain 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 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 must 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.

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 must 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 must be in accordance with the standard signals shown in Section 3, unless communications equipment (telephone, radio, etc.) is used.
3. All signals must 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 must be agreed upon in advance by the operator and the signal person. The signals used must 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 must 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 the 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 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 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 the 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.

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 he/she 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 (visible from operator 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 6 m (20 ft) 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 the crane, boom, and load be kept at least 6 m (20 ft) away from all electrical power lines and equipment less than 350 kV.

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



WARNING

Electrocution Hazard!

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

1. Keep all personnel and their personal belongings (clothing, water coolers, lunch boxes, etc.) away from

the crane if it is being operated near electrical power lines or equipment.

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

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

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

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

3. Crane operation is dangerous when close to an energized electrical power source. Exercise extreme caution and prudent 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 6 m (20 ft) 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.

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 shall attempt to come close to the crane or load until the power has been turned off.

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

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

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

REFUELING

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

FIRE EXTINGUISHERS

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

ACCIDENTS

If this crane becomes involved in a property damage and/or personal injury accident, immediately contact 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. Accident reporting forms can be found at www.manitowoc.com.

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

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

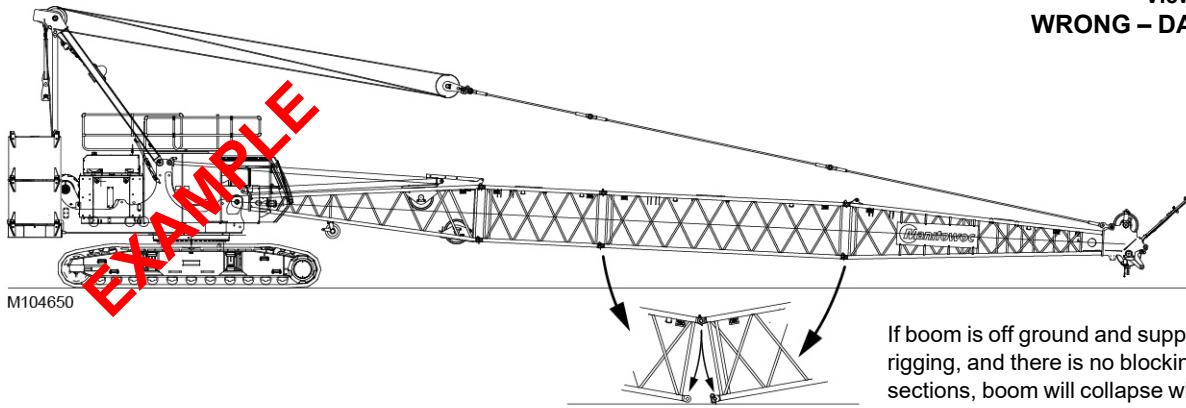
Potentially harmful waste used in Manitowoc cranes includes — but is not limited to — oil, fuel, grease, coolant, air conditioning refrigerant, filters, batteries, and cloths which have come into contact with these environmentally harmful substances.

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

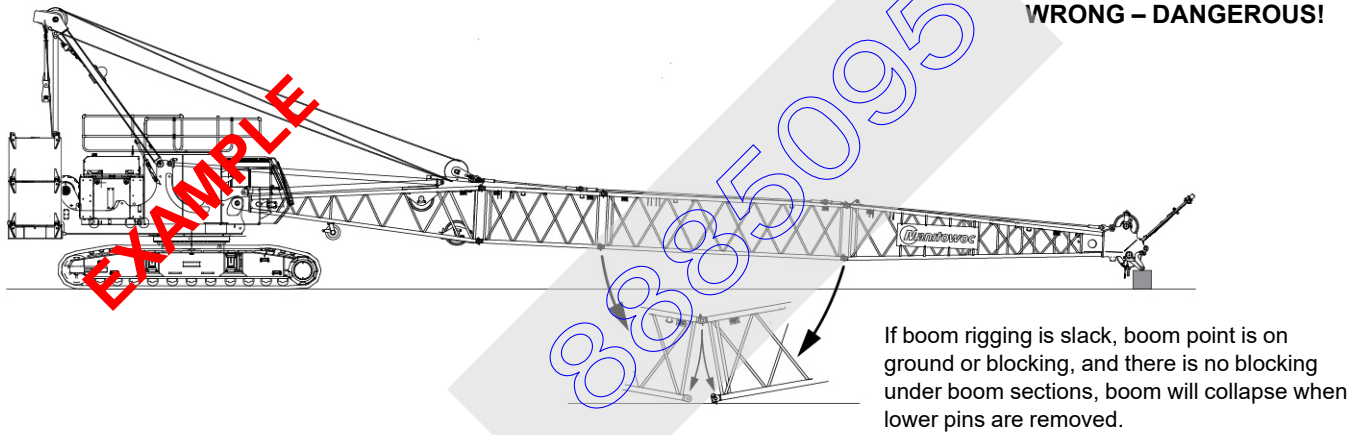
When filling and draining crane components: do not pour waste fluids onto the ground, down any drain, or into any source of water.

- 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.

**View A
WRONG – DANGEROUS!**



**View B
WRONG – DANGEROUS!**



**View C
RIGHT – SAFE**

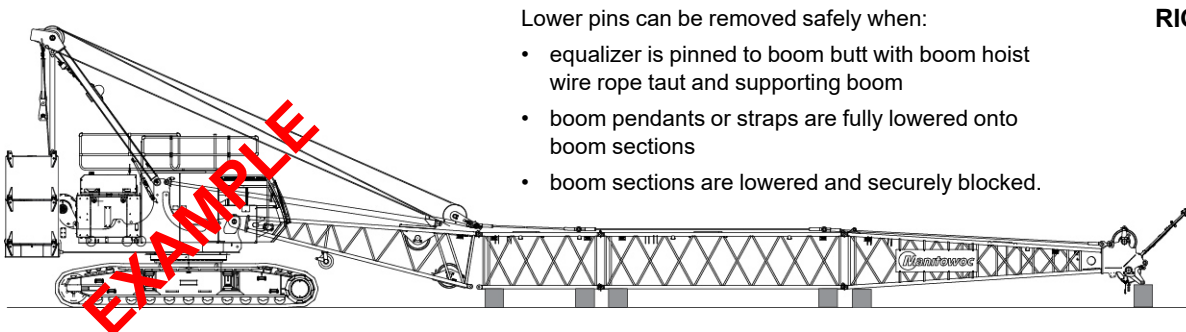


Figure 2-5. Boom Disassembly

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 2-6) 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 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.**

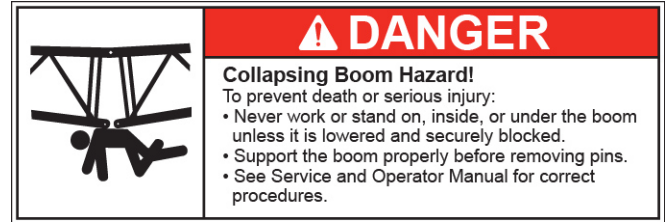
Location

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.



M101904

Figure 2-6. Safety Decal

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 pendants as shown in Figure 2-5, View A.
- Do not remove pendant connecting pins until pendants are fully lowered onto boom sections as shown in Figure 2-5, View C.
- Do not remove bottom connecting pins from any boom section when boom point is resting on ground or blocking and boom rigging is slack as shown in Figure 2-5, View B.
- Never work or stand inside boom unless it is lowered and securely blocked as shown in Figure 2-5, View C.
- Do not stand or walk on top of the boom.



DANGER **Falling Boom Hazard!**

Crane can tip or the boom can collapse if excess boom is cantilevered. Never cantilever more boom than allowed in rigging drawing or capacity chart.

SPECIAL APPLICATION/SERVICE

Special Application/Service is defined as anything other than normal lifting activities or normal lifting operation.

As identified in ASME B30.5, cranes are sometimes used for service other than lifting service and/or special lifting operations. In such cases Manitowoc or a qualified person shall review the service to be performed and jobsite conditions prior to operation. If appropriate, Manitowoc or a qualified person shall determine and establish a reduction in rated capacity, operating limitations, maintenance, testing and inspection requirements based on the job site conditions/limitations.

Because Manitowoc is not aware of all job site conditions/limitations we cannot provide further guidance until the intended service is understood, and a review of the conditions/limitations is complete.

Manitowoc cannot foresee all hazards that will arise in the field related to the special applications/services below; therefore, safety remains the responsibility of the qualified lifting personnel involved in the crane operations and owners.

Additional resources, training and experience may exist in the crane industry to provide guidance of risk assessments and hazard avoidance regarding special applications/service.

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, 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 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 must 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 (for example, personal fall-protection system).
- 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 6 m (20 ft) of a power line that is up to 350 kV or within 15 m (50 ft) 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.

In 2016, **The International Crane Stakeholder Assembly** published a guidance document titled *Lifting of Persons with Mobile Cranes*. This document may assist crane owners and lifting personnel in the risk assessment of personnel handling.

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 the operator that the crane's capacity has been exceeded. When the capacity of a pedestal mounted crane is exceeded, the hook rollers or other structural components may break, before the load lines fail, causing the crane to separate from the 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. The crane user shall verify that the barge is capable of limiting crane list and/or dynamics to the maximum allowable specified in the Capacity Charts. If the specified crane list and/or dynamic conditions are exceeded, the crane's capacity may be exceeded; the hook rollers or other structural components may break, causing the crane to separate from the pedestal.

! WARNING

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

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

Pedestal Mounted Crane

Also see ASME publication B30.8-2015, 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 2-7).

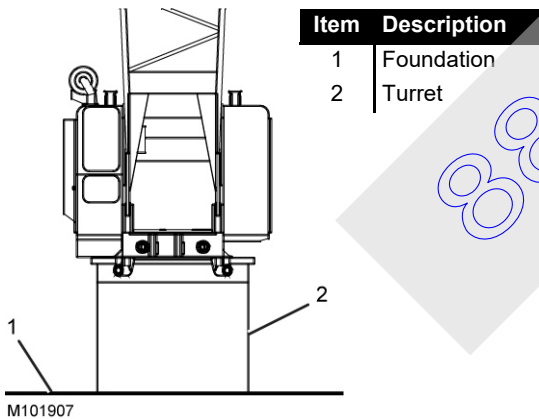


Figure 2-7. Turret-Mounted Crane

2. Crane rotating bed mounted on a carbody (crawlers removed) which is securely fastened to the foundation (Figure 2-8).

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

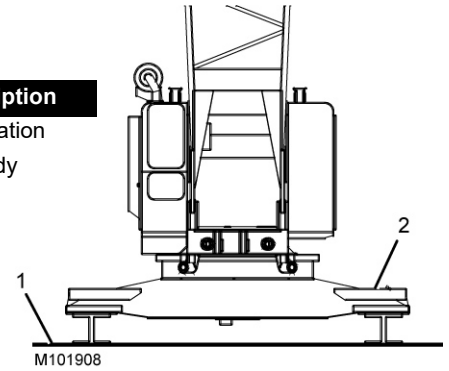


Figure 2-8. Carbody-Mounted Crane

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 the carbody anchored with tie-downs to the foundation (Figure 2-9).

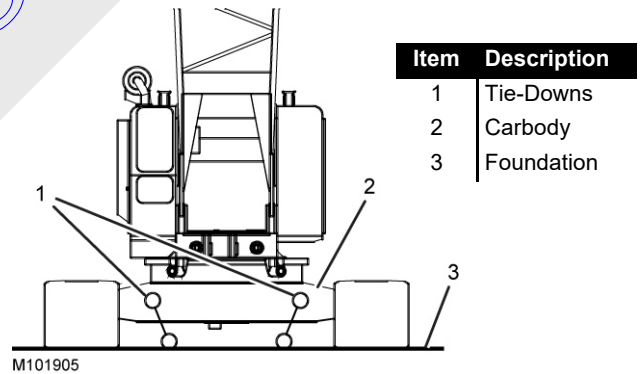


Figure 2-9. Crawler-Mounted Crane

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 2-10). 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 on a barge deck with load.

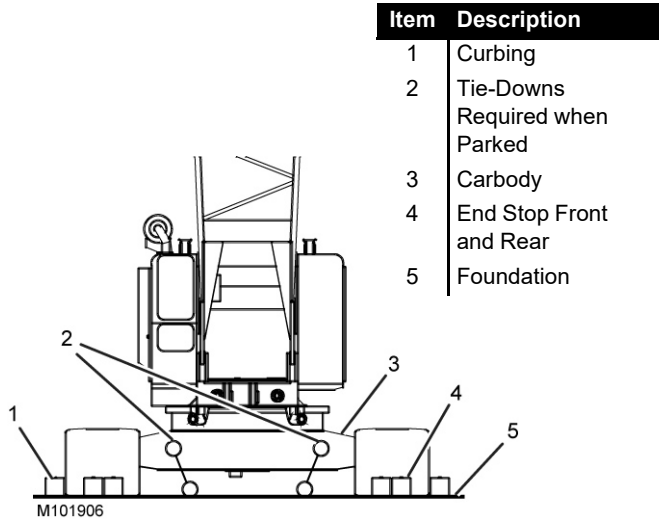


Figure 2-10. Crawler-Mounted Crane

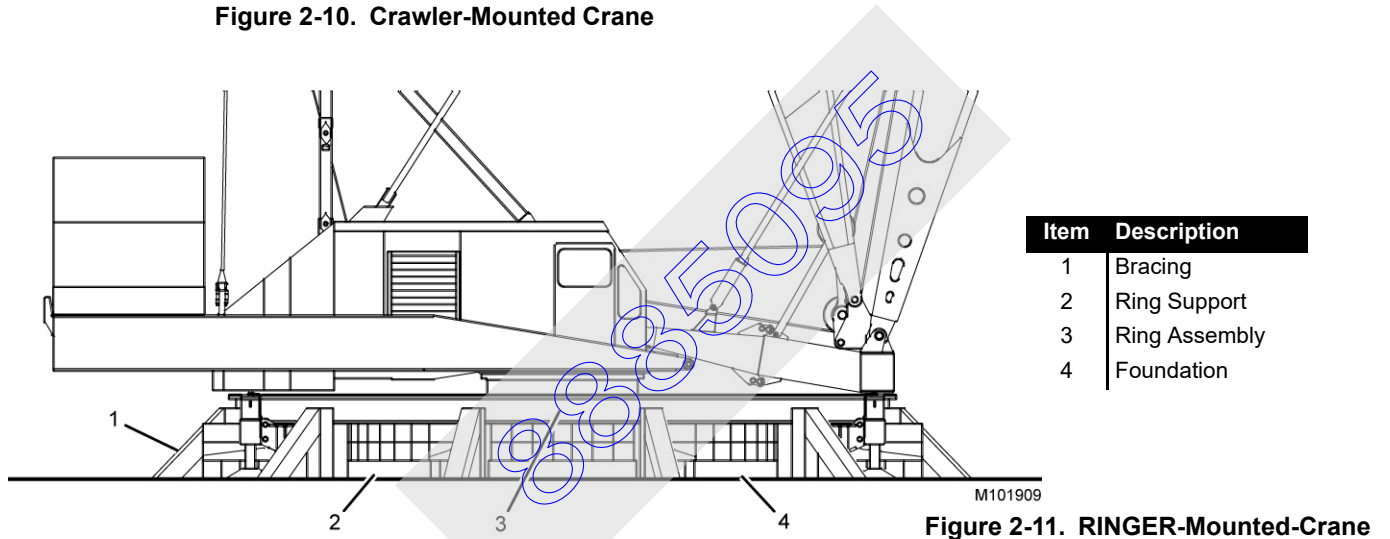
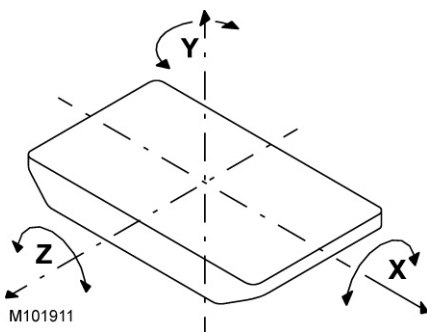


Figure 2-11. RINGER-Mounted-Crane



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 2-12. Barge Dynamics

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 2-11).

NOTE RINGERS must be equipped with hook rollers on the boom carrier and the counterweight carrier.

4. RINGER (platform mounted) which has the ring braced and fastened directly to the foundation in such a manner as to prevent movement.

Capacity Charts for Barge Mounted Crane

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 the 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 Caused by Barge Dynamics

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 2-12](#) illustrates the dynamic conditions of the barge which influence crane capacity.

CAUTION

Structural Damage Hazard!

If the crane's boom or structure is shock loaded during operation, or there is any indication of shock loading, all structural components of the crane must 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

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

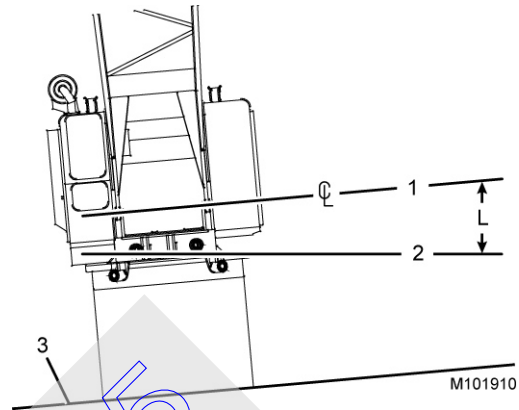
Tipping Crane Hazard!

Tie-downs which only prevent the 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, a ship or a floating platform, the crane user shall verify that correct the Capacity Chart is being used — pedestal mounted, barge mounted, 0°, 1°, 2° or 3° list or dynamic Capacity Chart.

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

Barge Mount 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 2-13](#)). This out-of-level condition creates side load and affects the crane's lifting capacity.



Item	Description
1	Centerline through Boom Hinge Pins
2	Horizontal
3	Barge Deck
	Degrees of Machine List (Maximum allowable is specified in Capacity Chart)

Figure 2-13. Machine List

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

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

3. Barge List and Machine List are not 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.

Inspection of Barge-Mounted Crane

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.

PILE DRIVING AND EXTRACTING

Introduction

By operating within the following guidelines, pile driving is an approved application for Manitowoc brand mobile crawler cranes. Because pile driving and extracting presents many variables and unknowns, Manitowoc crane owners shall exercise discretion when considering the use of a crane for this application.

It is not our intention to recommend specific types or makes of pile driving and extracting equipment but rather to advise crane owners of our operational requirements to help avoid pile driving and extracting from having any detrimental effect on the crane and invalidating the new machine warranty. The following are the operating requirements that must be used during pile driving and extracting with a Manitowoc crawler crane. These notes are in addition to any guidelines published on the crane's capacity charts.

Operation of Pile Driving and Extracting Equipment

1. The combined weight of the drive or extractor, piling, leads, attachments, etc., must not exceed the published load chart values. A qualified person shall determine if additional capacity reductions are necessary.
2. The pile driver or pile extractor must be kept clear of the boom top at all times.
3. The crane operator shall ensure that the crane is not subject to impact loading or vibration being induced into the boom and crane structure by meeting the rate of descent of the driver and piling.
4. Pile driving or extracting must be restricted to the boom. A qualified person shall determine an appropriate configuration.
5. Pile Extraction is only permitted when using extraction devices that do not transmit vibration or shock loading into the crane. All possible precautionary measures must be taken to prevent shock loads or vibration from being imposed on crane components, either directly through the hoist cable or indirectly from ground borne vibration. Do not exceed load capacity.
6. The crane operator and other personnel associated with the pile driving and pile extraction operation shall have read and understood all safety standards applicable to crane operations as well as being thoroughly trained in the safe operation of pile driving and extracting equipment.
7. The load lines must be kept vertical at all times during pile driving and pile extraction operations.

Crane Equipment

1. Manitowoc recommends that hoist cable length be reduced to operate on the first layer for optimal spooling.
2. Crane must be assembled per applicable rigging drawing and operator manual.
3. All hoist hooks must be equipped with a positive locking latch.
4. Refer to the specific hook block or headache ball manufacturer website for additional guidelines on usage in pile driving applications.

Crane Inspection

1. In addition to the crane's frequent and periodic inspections, dated daily records must be maintained showing inspections were performed on the crane during the time it was used for pile driving or extraction.
2. The "40 Hours of Operation or Weekly" boom related inspection intervals published in the crane's *Inspection*

and *Maintenance Checklist* must be increased to 8 hour or daily intervals for the duration of pile driving operations.

3. The hoist cable must be inspected daily to ensure no abrasion or wear is occurring.

In 2014, **FEM**, a member of **The International Crane Stakeholder Assembly** published a guidance document titled *Using Mobile Cranes for Pile Driving/Extraction*. Additionally, ASSE A 10.19 Safety Requirements for Pile Installation and Extraction Operations may assist crane owners and lifting personnel in the risk assessment related to pile driving/extraction.

ELECTROCUTION HAZARD DEVICES

The use of insulated links, insulated boom cages/guards, or proximity warning devices does not assure that electrical contact will not occur. Therefore, Manitowoc does not endorse their use. When insulated links, insulated boom cages/guards, or proximity warning devices are installed on the crane as required by Regulations, Industry Codes, or company policies, the crane owner is responsible for ensuring that:

- a. The device manufacturer is contacted and provides instructions for storage, inspection, maintenance, and use of the devices.
- b. The device manufacturer provides all limitations and restrictions of the device.
- c. The documentation provided by the device manufacturer is maintained on the crane and available to the crane operator at all times.

Further, when insulated links, insulated boom cages/guards, or proximity warning devices are installed on the crane, a pre-operational meeting is to be held and a review of the instructions, limitations and restrictions related to the device(s) will be communicated to all personnel that are to work on or around the crane.

Even if the crane is equipped with these devices, failure to follow the rules, limitations and precautions outlined in this manual and provided by the device manufacturer at all times may result in serious injury or death.

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, the condition of the ground, the magnitude of the voltage/current present, and numerous other factors.

MULTIPLE LOAD LINE OPERATION

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 load 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 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 the 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, jib, and sheaves:
 - The load lines must hang as close to vertical as possible to minimize side and forward loads.
 - 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. To minimize the angle of the load transmitted into the boom and/or jib, 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.

9. 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).
10. 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.
11. Load shift when lifting with two hooks may be more unpredictable than typical one hook lifting.

MULTIPLE CRANE LIFTS

Operate with extreme caution when using more than one crane to lift the same load. Any lift that requires more than one crane to lift the same load must be precisely planned and coordinated by a qualified person due to new and different hazards.

The following additional precautions must be taken if it is necessary for more than one crane to lift the load:

- a. Secure the services of a qualified person to analyze and plan the lift.
- b. Verify proper controls are in place to prevent overload such as the necessity to reduce crane ratings, load position, boom position, ground support, and speed of movements. These controls must be in accordance with the qualified person's

decision and all other requirements identified in the operator manual.

- c. Ensure the lift director coordinates and instructs all personnel involved in the lift plan, to include but limited to, proper rigging and positioning of the load and all movements to be made prior to beginning the lift.
- d. Make sure all signals are coordinated through the lift director.
- e. A qualified person must direct the lift.
- f. Maintain communication between all parties throughout the entire lift. If possible, provide approved radio equipment for voice communication between all parties engaged in the lift.
- g. Ensure the load lines are directly over the attach points to avoid side loading, forward loading, and transfer of loading from one crane to the other.

In 2016, **The International Crane Stakeholder Assembly** published a guidance document titled *Lifting A Load With Several Mobile Cranes (Multiple Crane or Tandem Lifting)*. This document may assist crane owners and lifting personnel in the risk assessment of multiple crane lifts.

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SECTION 3

OPERATING CONTROLS AND PROCEDURES

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SECTION 3 OPERATING CONTROLS AND PROCEDURES


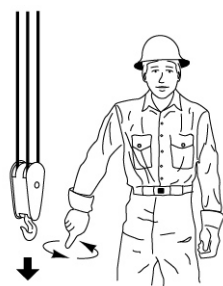

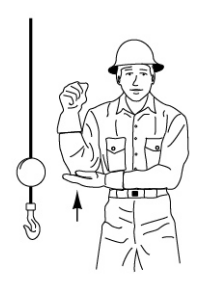



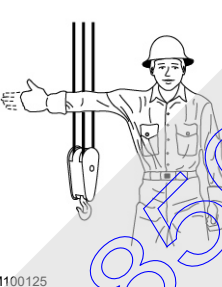
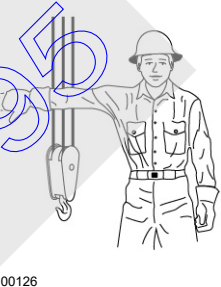
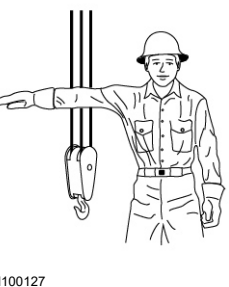
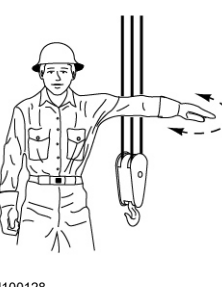
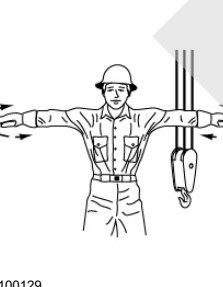
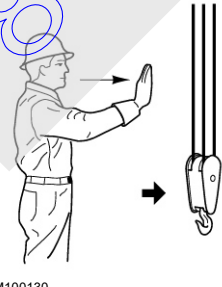

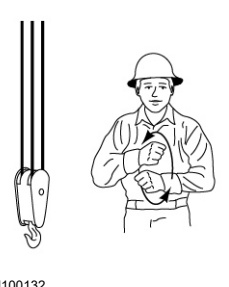
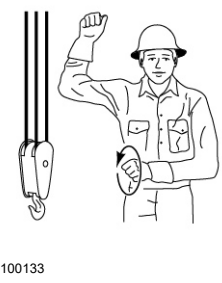
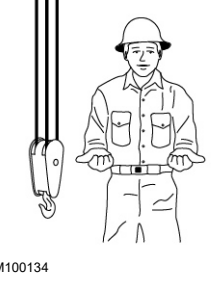
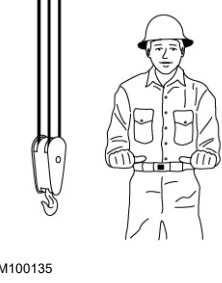
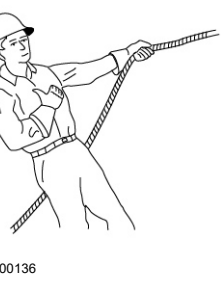

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STANDARD HAND SIGNALS FOR CONTROLLING CRANE OPERATIONS

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

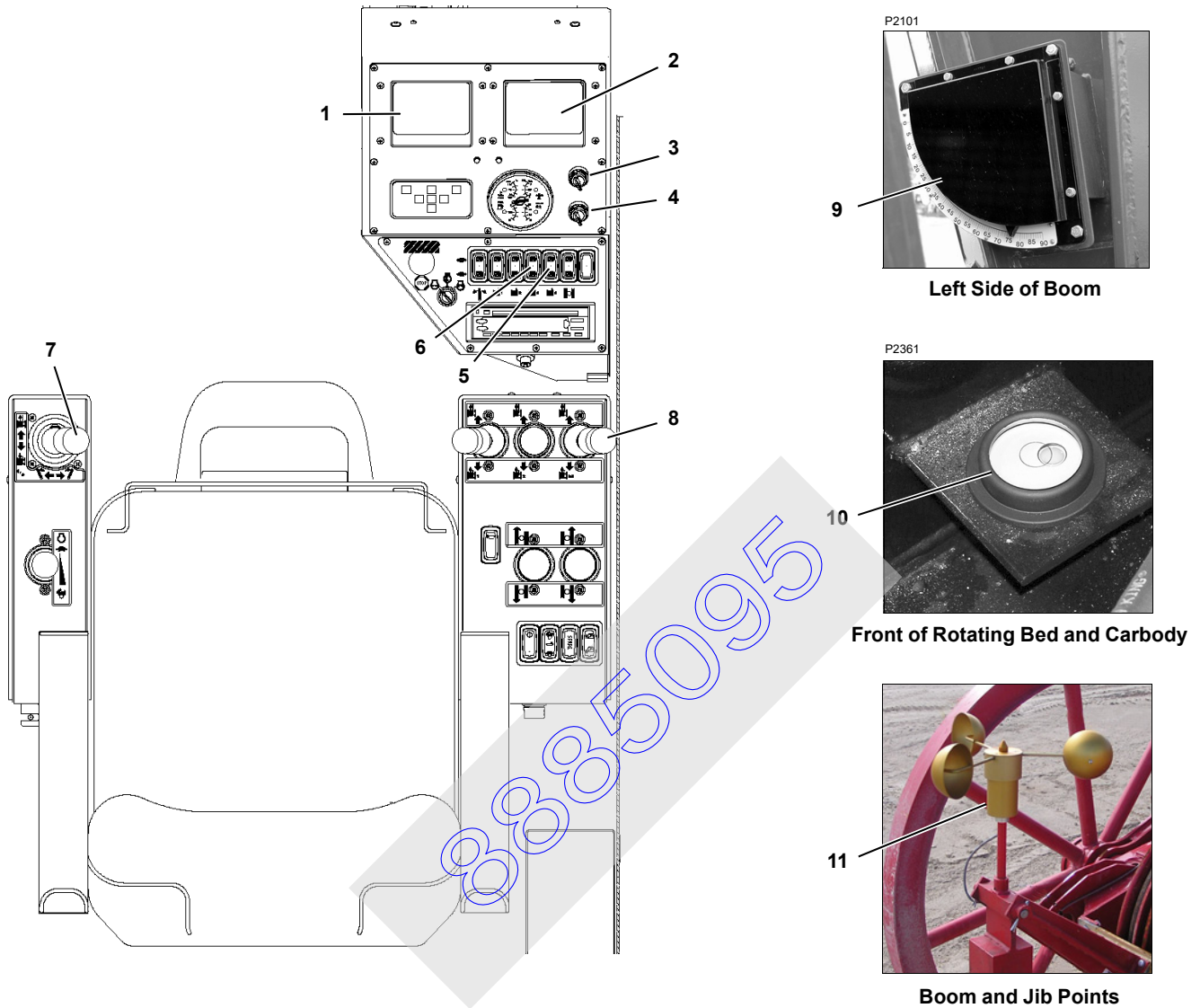
Table 3-1 Standard Hand Signals For Controlling Crane Operations

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<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.

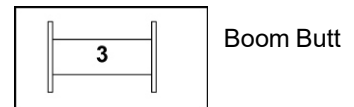
14COM3-4



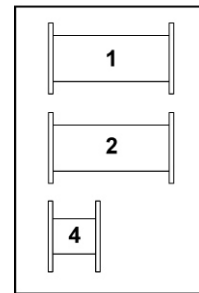
Item	Identification
1	RCL Display
2	Main Display
3	Luffing Jib Limit Bypass Switch (past production only)
4	Limit Bypass Switch
5	Boom Hoist Park Switch
6	Luffing Hoist Park Switch
7	Luffing Hoist Control (in luffing jib mode)
8	Boom Hoist Control (in luffing jib mode)
9	Mechanical Boom Angle Indicator
10	Mechanical Level
11	Wind Speed Transmitter

Drum Identification

Item	Description
1	Main Hoist
2	Auxiliary Hoist
3	Luffing Hoist
4	Boom Hoist



Boom Butt



Crane

M101859

FIGURE 3-1

GENERAL OPERATION

The instructions in this section supplement the operating control instructions in the Operator Manual. This section has two purposes:

- To familiarize qualified operators with the location of the controls used for luffing jib operation
- To alert operators to important safety information



WARNING

Prevent death or serious injury to personnel!

Luffing jib attachment must be installed and operated by experienced personnel trained in erection and operation of construction cranes. These personnel shall read, understand, and comply with instructions in this manual, in Luffing Jib Assembly Drawings and Capacity Charts, in Crane Operator Manual.

LUFFING JIB OPERATING CONTROLS

See [Figure 3-1](#) for Location of Controls.

1 – RCL (Rated Capacity Limiter) Display

Read and become thoroughly familiar with Rated Capacity Indicator/Limiter Operation Guide — publication F2128 located in Operator Information Manual in operator's cab.

To operate the LUFFING JIB, the operator shall select the correct luffing jib capacity in the RCL Display.

When selected, chart number (1a, [Figure 3-2](#)) will appear in the working screen of the display. See Luffing Jib Operator Information Manual in the cab for a complete list of luffing jib capacity charts for your crane.

The RCL working screen shows all capacity related information required to operate the crane, to include:

Boom Angle

Refer to item 1b, [Figure 3-2](#).

Angle between center line of boom and horizontal (see [Figure 3-3](#)). Monitor this angle when raising boom to operating angle.

Luffing Jib Angle

Refer to item 1c, [Figure 3-2](#).

Angle between center line of jib and horizontal (see [Figure 3-3](#)). Monitor this angle when raising and lowering jib during operation.

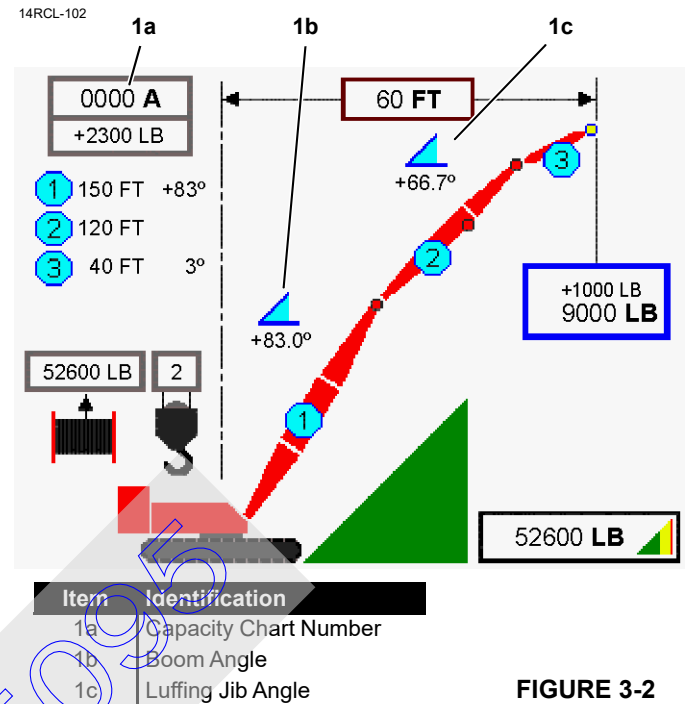


FIGURE 3-2

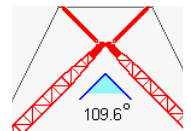
2 – Main Display

Read and become thoroughly familiar with Main Display instructions in Section 3 of Operator Manual located in operator's cab.

The main display information screen shows information required to operate the crane and luffing jib, to include:

Boom to Luffing Jib Angle

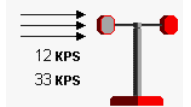
Shows the angle between the center line of the boom and the center line of the luffing jib (see [Figure 3-3](#)).



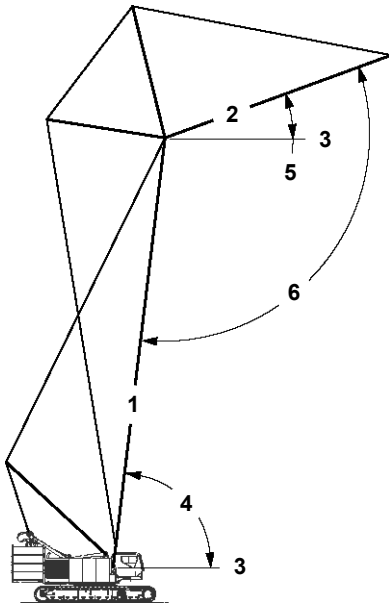
Monitor this angle when raising and lowering the boom and jib from and to the ground.

Wind Speed

Shows the steady wind speed and the maximum gust wind speed at the luffing jib point. See Wind Conditions topic later in this section for allowable wind speeds during operation.



14LOM3101



Item	Identification
1	Centerline of Boom
2	Centerline of Luffing Jib
3	Horizontal
4	Boom Angle
5	Luffing Jib Angle
6	Boom to Luffing Jib Angle

FIGURE 3-3

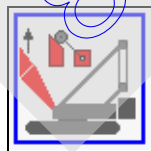
The main display information screen also shows faults that may occur during operation, including:

Boom Maximum Up Limit

Stops the boom hoist when the boom is raised to the maximum angle.

- 88.5° when equipped with luffing jib.
- 84° when luffing jib is removed.

To correct the fault, lower the boom.



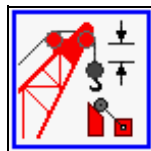
! WARNING

Falling Boom/Jib Hazard!

Do not raise boom above specified maximum angle. Boom and jib could be pulled over backwards.

Block-Up Limit

Stops the boom and luffing hoists in the down direction and the load hoists in the up direction if a load is hoisted to close to either jib point.



To correct the fault, the boom and luffing hoists can be operated in the up direction and load hoists can be operated in the down direction.

The appropriate limit bypass switch must be turned to the bypass position before a load can be hoisted above the limit.

! WARNING

Two-Blocking Hazard!

If it is necessary to hoist a load above block-up limit, do so slowly with extreme caution to prevent two-blocking.

Do not hoist load above minimum block clearance given in Range Diagram (see Capacity Chart Manual).

Do not use limit bypass switch to lower boom or luffing jib after block-up limit is contacted; two-blocking could occur, causing load to fall.

Luffing Jib Down Limits

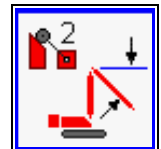
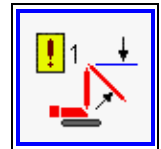
! WARNING

Falling Boom/Jib Hazard!

Do not lower luffing jib below maximum down limit 2. Structural damage will result, possibly causing boom and luffing jib to collapse.

Two luffing jib down limits stops are provided:

- **JIB DOWN 1:** turns on the fault alarm to alert the operator that the jib is near maximum down limit 2 (occurs when boom to jib angle is 60° regardless of jib type — layout or fold-under).
- **JIB MAXIMUM DOWN 2:** automatically stops the luffing jib when the boom to jib angle is:
 - 57° for layout luffing jib
 - 10° for fold-under luffing jib



This limit **cannot** be bypassed for cranes meeting 2010 European requirements (CE).

Non-CE machines can be bypassed if handle returns to neutral while bypass is held.

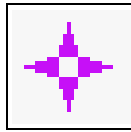
The luffing jib can be raised after the limit is contacted.

NOTE: For current production cranes meeting 2010 European Requirements the luffing jib cannot be raised after JIB MAXIMUM DOWN 2 limit is contacted until the limit switch is reset.

When the limit is contacted, operation will stop and the jib down prompt (shown to right) will appear on the main display.



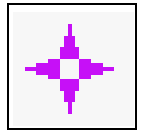
Once the prompt appears, release the control handle to off and press the confirm button (shown to right) to reset the limit switch. The luffing jib can then be raised.



When the limit is contacted, operation will stop and the jib up prompt (shown to right) will appear on the main display.



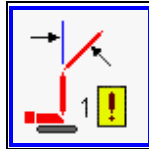
Once the prompt appears, release the control handle to off and press the confirm button (shown to right) to reset the limit switch. The luffing jib can then be lowered.



Luffing Jib Up Limits

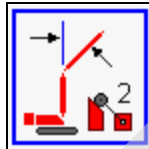
Two luffing jib up limits stops are provided:

- **JIB MAXIMUM UP 1** (max working angle): automatically stops the luffing jib when the boom to jib angle is 168°.



The appropriate limit bypass switch must be turned to the bypass position to allow the jib to be raised an additional 3° to JIB MAXIMUM UP 2 limit.

- **JIB MAXIMUM UP 2** (max angle): automatically stops the luffing jib when the boom to jib angle is 171°.



On past production cranes, this limit can be bypassed only when the boom is below 50° (such as when boom and luffing jib are being raised and lowered from and to ground).

This limit **cannot** be bypassed on cranes meeting 2010 European requirements (CE). See [Table 3-2](#) for bypassable limit identification.

The luffing jib can be lowered after either limit is contacted.

NOTE: For current production cranes meeting 2010 European Requirements the luffing jib cannot be lowered after JIB MAXIMUM UP 2 limit is contacted until the limit switch is reset.

! WARNING

Falling Boom/Jib Hazard!

Do not raise luffing jib above Maximum Up 2 limit. Boom and luffing jib could be pulled over backwards.

Make sure luffing jib limits are enabled for normal operation (bypass switches turned counterclockwise).

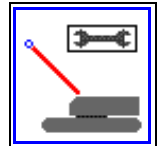
3 – Luffing Jib Limit Bypass Switch

NOTE: This switch is not provided on current production cranes.

This switch bypasses the limits identified in [Table 3-2](#).

Use this switch only when boom and luffing jib are being raised and lowered from and to ground.

When the key is turned to the bypass position, the fault alarm is turned on (beep, beep, beep...) and the setup mode fault icon is displayed in the information screen.



4 – Limit Bypass Switch

This switch bypasses the limits identified in [Table 3-2](#) and [Table 3-3](#).

Table 3-2 Bypassable Limit Identification — Past Production

This table applies to cranes with Luffing Jib Limit Bypass Switch (3, [Figure 3-1](#)).

Limit	Past Production Console	
	Limit Bypass Switch (4) (momentary)	Luffing Jib Limit Bypass Switch (3) ¹ (maintained)
Boom Maximum Up	No	No
Boom Down (optional)	Yes	No
Block-Up (each drum)	Yes	Yes
Bail, Max and Min (each drum)	Yes	No
Luffing Jib Maximum UP 1	Yes	Yes
Luffing Jib Maximum UP 2	Yes ²	Yes ²
Luffing Jib Maximum Down 1	Yes	No
Luffing Jib Maximum Down 2	No	No
Rated Capacity Limiter	Yes	Yes
Mast Too Far Forward	No	No

¹ Fault 6 alarm will remain on when this switch is in bypass position.

² Only when boom is below 50°

Table 3-3 Bypassable Limit Identification — Current Production

This table applies only to cranes without Luffing Jib Limit Bypass Switch (3, Figure 3-1)

Limit	Limit Bypass Switch (4) (momentary key switch)		Limit Bypass Switch (4) (momentary key switch) Luffing Jib Setup Mode On ¹		External Override Switch ²
	Non-CE	CE ³	Non-CE	CE ³	CE ³
Boom Up	No	No	No	No	No
Block Up (each drum)	Yes	Yes ⁶	Yes	Yes	No
Minimum Bail (each drum)	Yes	No	No	No	No
Luffing Jib Maximum Up 1	Yes	No	Yes	Yes	No
Luffing Jib Maximum Up 2	Yes	No	Yes ⁴	Yes ⁴	No
Luffing Jib Maximum Down 1	Yes	No	Yes	Yes	No
Luffing Jib Maximum Down 2	Yes ⁵	No	Yes ⁵	No	No
Mast Too Far Forward	No	No	No	No	No
Gantry Down	Yes	Yes	No	No	No
Boom Limiter ⁸	Yes	Yes	No	No	No
Swing Limiter ⁸	No	No	No	No	No
Rated Capacity Indicator/Limiter	Yes	Yes ⁶	Yes	Yes ⁶	Yes ⁷

- ¹ Use only for rigging. See procedure described on [page 3-10](#) for enabling Luffing Jib Setup Mode.
- ² Cranes meeting 2010 European requirements are equipped an RCI/RCL External Override Switch located outside the operator's cab. See Rated Capacity Indicator/Limiter Operation Manual.
- ³ CE = Cranes that comply with 2010 European requirements (see NOTE below)
- ⁴ Only when boom is below 50°
- ⁵ When this limit is contacted, operation will stop and you will not be able to continue lowering luffing jib. See Luffing Jib Max Down 2 on [page 3-6](#) for detailed instructions.
- ⁶ Only if boom or luffing jib is below allowable angle given in Capacity Chart (while raising or lowering boom and luffing jib from or to ground level)
- ⁷ When the external bypass is in override, the speed of the crane functions are limited to 15% of their maximum speed for movements that increase load.
- ⁸ Cranes equipped with boom or swing motion limiter



- 5 – Drum 4 (Boom Hoist) Park Switch
- 6 – Drum 3 (Luffing Hoist) Park Switch
- 7 – Luffing Hoist Control
- 8 – Boom Hoist Control

See Operating Controls topic in this section for operation of these controls.

9 – Mechanical Boom Angle Indicator

Shows the angle of the boom in degrees above horizontal (visible through right cab window)

The boom’s angle is also shown on the RCL working screen (1b, [Figure 3-2](#)).

10 – Mechanical Level

See [Figure 3-4](#).

Shows crane levelness from front to rear and from side to side.

! WARNING
Tipping Hazard!

Unless otherwise specified on capacity chart, all crane operations must be performed with crane **level** to within 1% of grade in all directions – 1 ft in 100 ft (0.3 m in 30 m); otherwise, the crane could tip.

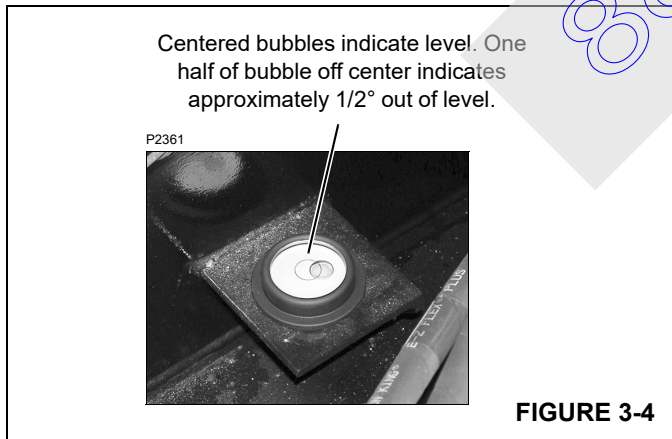


FIGURE 3-4

11 – Wind Speed Transmitter

Sends wind speed information from the jib points to the main display information screen.

LUFFING JIB SETUP MODE

For current production cranes not equipped with a luffing jib limit bypass switch, the Luffing Jib Setup Mode must be

turned on before the limits identified in [Table 3-3, page 3-9](#) can be bypassed.

1. Enter the function mode in the main display ([Figure 3-5](#)).

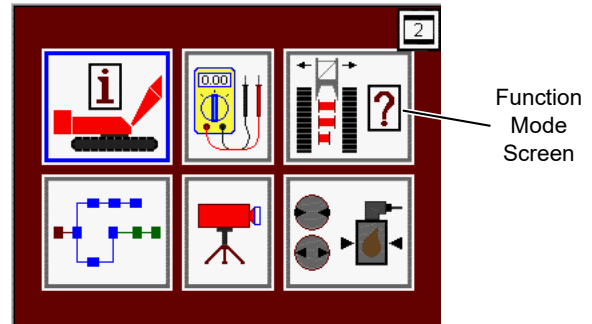


FIGURE 3-5

2. Scroll to and enter the setup mode screen ([Figure 3-6](#)).

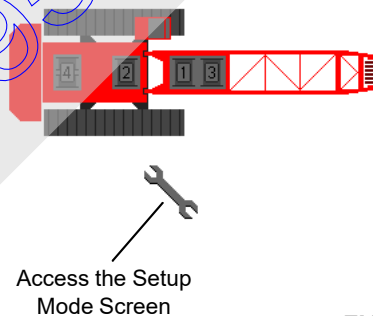


FIGURE 3-6

3. The screen shown in [Figure 3-7](#) will appear on the display.

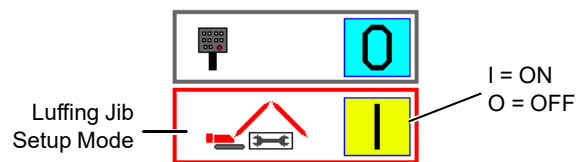


FIGURE 3-7

4. Turn the luffing jib setup mode on (or off when done with luffing jib setup).
5. Rotate limit bypass switch (D4) clockwise and release. The limits will remain bypassed for 10 seconds.
6. Move the desired control handle (luffing hoist, boom hoist, load drum) in the required direction. The limits will remain bypassed for as long as the handle is moved in either direction.

- The limits will remain bypassed for 10 seconds after the control handle(s) is returned to off.

NOTE: When the luffing jib setup mode is on, the crane setup fault is turned on and the alarm in the cab sounds intermittently.

OPERATING PRECAUTIONS

- Read and comply with instructions in Liftcrane Luffing Jib Capacity Charts provided with luffing jib attachment. Do not operate beyond limits given in capacity charts.
Make sure proper counterweight is installed on the crane.
- Read and comply with instructions in this manual and in Operator Manual.
- Read and comply with Maximum Allowable Travel Specifications in Luffing Jib Capacity Chart Manual.
- Make sure luffing jib attachment is installed properly. Read and comply with instructions in Section 4 of this manual.
- Make sure all safety devices — block-up limits, boom angle indicator, boom and jib stops, RCL — are installed and operating properly. See Section 6 of this manual and separate RCL Operation Guide.
- Make sure proper luffing jib capacity chart is selected to operate luffing jib.
- Raise and lower attachment as instructed in Section 4 of this manual.
- Perform all operations with the crane on a firm, level, uniformly supporting surface.
- Operate all crane functions slowly and smoothly. Avoid sudden starts and stops which could side load or shock load attachment.
- Do not operate, including raising boom and luffing jib from ground level, if wind exceeds allowable limits given in Capacity Charts provided with crane and luffing jib. Contact your local weather station for wind velocity.

LEAVING CRANE UNATTENDED

When the crane is left unattended, it must be parked as instructed in Section 3 of the Crane Operator Manual.

WIND CONDITIONS

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.



WARNING

Tippling Crane Hazard!

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

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

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

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

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

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

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

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SECTION 4

SET-UP AND INSTALLATION

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SECTION 4

SETUP AND INSTALLATION



WARNING

Avoid Death or Serious injury!

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

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 SETUP AND INSTALLATION

This section contains installation and removal instructions for the #135 luffing jib on the Model 14000.

The #135 luffing jib used on Model 888 or 999 can be used on the Model 14000 with the following exceptions:

- Intermediate fall from Model 888 cannot be used on Model 14000.
- Long jib stop pendants from Model 888 or 999 cannot be used on Model 14000.
- Backstay pendants from Model 888 or 999 cannot be used on Model 14000.



WARNING

Avoid Two-Block Struts!

Do not use backstay pendants from Models 888 or 999 on Model 14000.

Jib strut could two-block with main strut when luffing jib is raised.

Structural damage might occur, possibly causing boom and luffing jib to collapse.

The luffing jib or fixed jib must be installed, operated, and removed by experienced personnel trained in the operation and erection of construction cranes. These personnel shall read, understand, and comply with the instructions in this section, in the Luffing Jib Assembly Drawing, and in the Liftcrane Luffing Jib Capacity Charts provided with the attachment.

Contact your Manitowoc dealer for a detailed explanation of any procedure not fully understood.

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

Level = 1% of grade or 1 ft (0,3 m) in 100 ft (30,5 m).

The area selected must be large enough to accommodate the crane, selected boom and jib length, and movement of an assist crane.

See the Luffing Jib Assembly Drawing at the end of this section for:

- Maximum combined boom and luffing jib length
- Minimum boom length for use with luffing jib

CRANE ORIENTATION

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

ACCESSING PARTS

Many parts of the crane, boom, luffing jib, and fixed jib cannot be reached from the ground. Take the necessary precautions to prevent falling off the crane, boom, or jib during installation and removal.

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

Optional boom ladders (stored in the boom butt) are available from Manitowoc. If your crane has ladders, see Section 4 in Operator Manual provided with the crane.

CRANE WEIGHTS

Crane Operator Manual

OPERATING CONTROLS

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

COUNTERWEIGHT REQUIREMENT

See applicable Luffing Jib Capacity Charts and Raising Procedure Charts for counterweight requirements when operating with the luffing jib.



WARNING

Tipping Hazard!

Prevent the crane from tipping. Do not operate the crane until proper counterweight is installed.

BLOCKED CRAWLERS

To prevent the crane from tipping or structural damage to attachment, **some boom and jib combinations must be raised and lowered over blocked crawlers**. See Luffing Jib Capacity Charts and Raising Procedure Charts for blocked crawler requirements. Also see Crawler Blocking Diagram in Luffing Jib Capacity Chart Manual for instructions.



DANGER

Tipping Hazard!

Prevent the crane from tipping or structural damage to attachment. Do not attempt to raise or lower the boom and jib from or to the ground until crawlers are blocked.

JIB ASSEMBLY DRAWINGS

See the end of this section for the Jib Assembly Drawings that apply to your crane.

The boom and luffing jib components (butts, inserts, tops, pendants, straps) must be assembled in the proper sequence according to the rigging drawings.

LUFFING JIB RAISING PROCEDURE

See the end of this section for the Luffing Jib Raising (and Lowering) Procedure Chart.

IDENTIFYING JIB COMPONENTS

Jib sections are marked for proper identification as shown in Views A and B, [Figure 4-1](#).

Jib pendants are marked for proper identification as shown in View C, [Figure 4-1](#).

Jib straps and links are marked for proper identification as shown in View D, [Figure 4-1](#).

NOTE: The markings shown in [Figure 4-1](#) can vary depending on when your crane was produced and the original equipment manufacturer.

HANDLING COMPONENTS

Handle boom and jib components with care to avoid damaging lacings and chords. *Lift against chords only, never against lacings.*

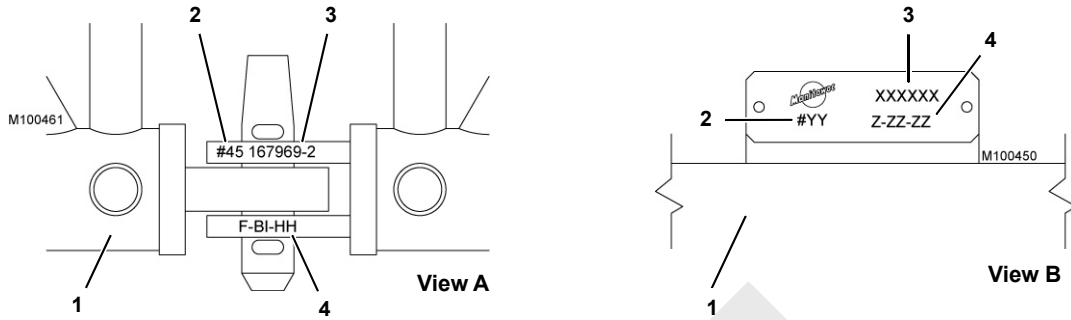
Nylon slings should be used to handle components. If wire rope or chain slings are used, protective covering (such as sections of rubber tire) must be used between the slings and the component.

RETAINING CONNECTING PINS

Connecting pins are retained in various ways:

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

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



Item	Description
1	Boom or Jib Chord
2	Boom or Jib Number
3	Manitowoc Part Number
4	Manitowoc Manufacturing Code
5	Pendant
5a	Aluminum Tag (if equipped)
6	Manitowoc Purchase Order Number
7	Manufacturer's Number
8	Wire Rope Type
9	Diameter
10	Length
11	Set Number
12	Strap or Link

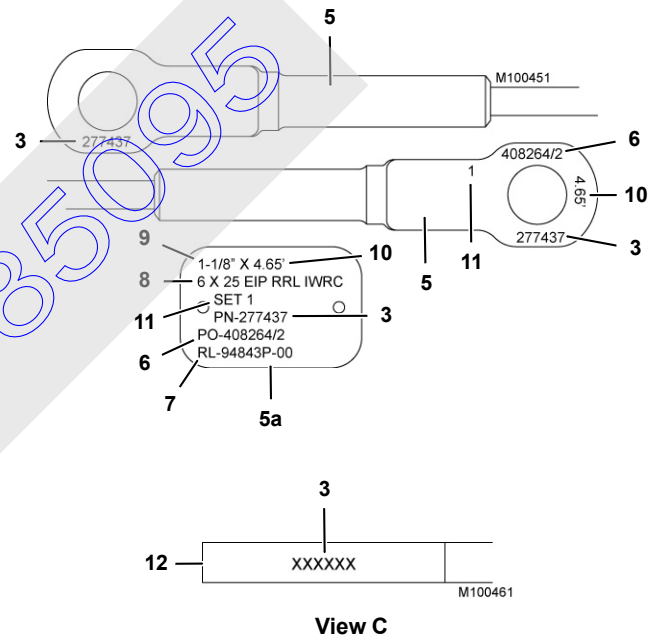


FIGURE 4-1

ASSIST CRANE REQUIREMENTS

An assist crane is required for jib installation and removal.

The jib butt and struts are shipped as an assembled unit. This assembly weighs approximately 9,870 lb (4 477 kg) and is the heaviest weight to be lifted. Size the assist crane accordingly.

SHIPPING CRANE COMPONENTS

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 [Figure 4-2](#), 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 [Figure 4-2](#), View B.

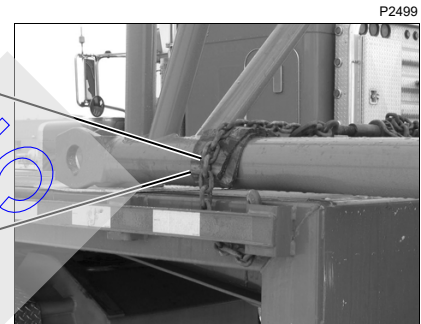
When securing boom sections, wrap tie-downs over chords — never over lacings. Keep tie-downs as close

to blocking as possible (View A) to prevent bending the chords.



Nylon Tie-Down
Wrapped Over
Boom or Jib Chord

View A



Chain Tie-Down
Wrapped Over
Boom or Jib Chord

Protective
Covering
(section of
rubber tire)

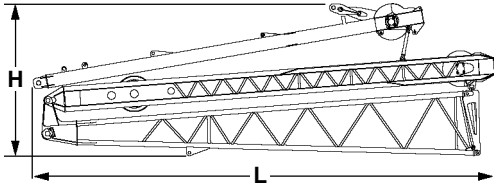
View B

FIGURE 4-2

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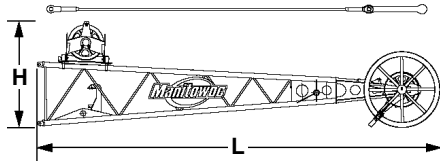
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SHIPPING DATA



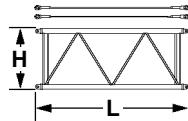
No. 135 Luffing Jib 27 ft (8,2m) Butt & Struts

Length	28 ft 11 in	8,81 m
Width	5 ft 3 in	1,60 m
Height	9 ft 7 in	2,92 m
Weight	9,870 lb	4 477 kg



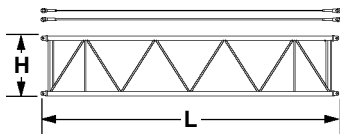
No. 135 Luffing Jib Top 23 ft (7,0 m), Roller & Pendants

Length	25 ft 7 in	7,80 m
Width	5 ft 3 in	1,60 m
Height	6 ft 8 in	2,03 m
Weight	4,375 lb	1 984 kg



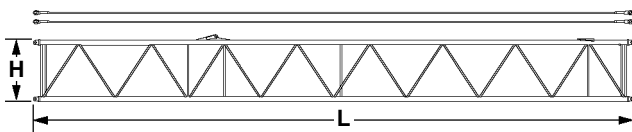
No. 135 Luffing Jib Insert 10 ft (3,0 m) & Pendants

Length	10 ft 4 in	3,15 m
Width	5 ft 3 in	1,60 m
Height	4 ft 5 in	1,35 m
Weight	840 lb	381 kg



No. 135 Luffing Jib Insert 20 ft (6,0 m) & Pendants

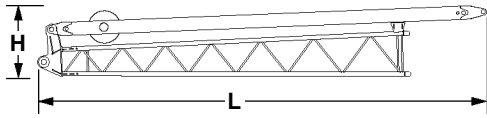
Length	20 ft 4 in	6,20 m
Width	5 ft 3 in	1,60 m
Height	4 ft 5 in	1,35 m
Weight	1,350 lb	612 kg



No. 135 Luffing Jib Insert 40 ft (12,0 m) & Pendants

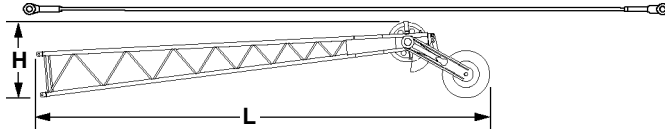
Length	40 ft 4 in	12,30 m
Width	5 ft 3 in	1,60 m
Height	4 ft 5 in	1,35 m
Weight	2,315 lb	1 050 kg

FIGURE 4-3



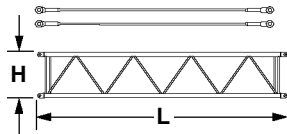
No. 138 Fixed Jib 15 ft (4,6 m) Butt & Strut

Length	18 ft 7 in	5,66 m
Width	2 ft 6 in	0,76 m
Height	2 ft 10 in	0,86 m
Weight	775 lb	352 kg



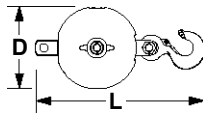
No. 138 Fixed Jib 15 ft (4,6 m) Top, Wheel & Pendants

Length	18 ft 5 in	5,61 m
Width	2 ft 6 in	0,76 m
Height	3 ft 1 in	0,94 m
Weight	817 lb	371 kg



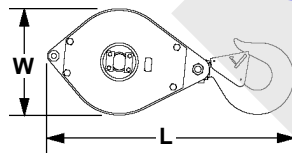
No. 138 Fixed Jib 10 ft (3 m) Insert & Pendants

Length	10 ft 2 in	3,10 m
Width	2 ft 6 in	0,76 m
Height	1 ft 11 in	0,58 m
Weight	215 lb	98 kg



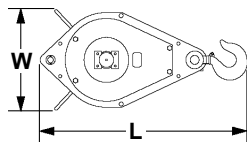
15 US t (13.6 t) Hook and Weight Ball

Length	3 ft 9 in	1,14 m
Diameter	1 ft 10 in	0,56 m
Weight	1,310 lb	594 kg



60 US t (55 t) Load Block

Length	6 ft 3 in	1,91 m
Width	2 ft 8 in	0,81 m
Depth	1 ft 5 in	0,43 m
Weight	2,825 lb	1 281 kg



30 US t (27 t) Load Block

Length	5 ft 11 in	1,80 m
Width	2 ft 10 in	0,86 m
Depth	1 ft 0 in	0,30 m
Weight	2,000 lb	907 kg

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FIGURE 4-3 continued

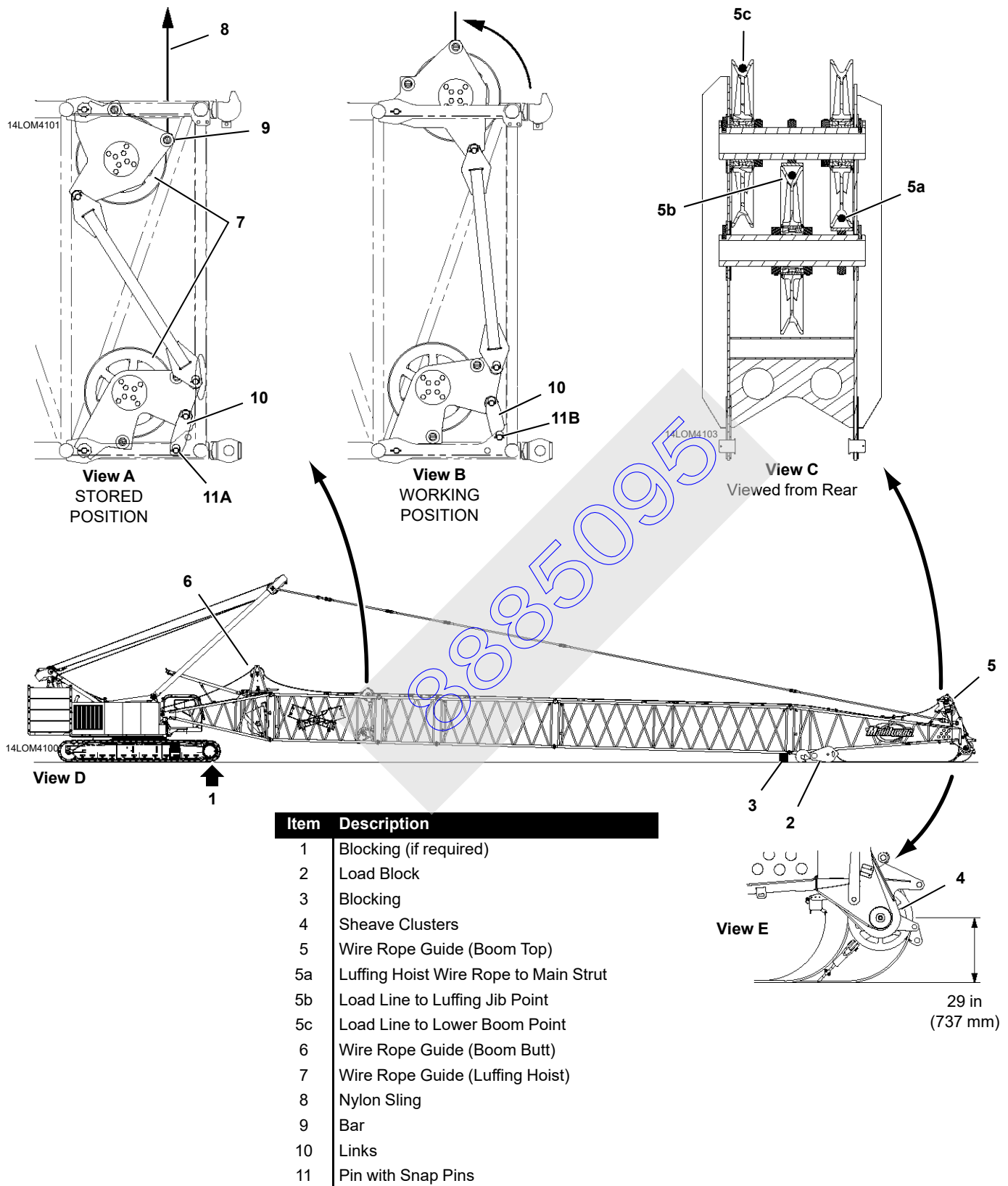


FIGURE 4-4

PREPARING CRANE FOR LUFFING JIB

The instructions in this section assume that the crane and boom are already fully assembled.

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

Lower Boom

1. If required per capacity chart, travel front crawler roller and tumbler at boom end of the crane onto blocking (1).
See Crawler Blocking Diagram in Capacity Chart Manual for blocking requirements.

! WARNING
Tipping Hazard!

Prevent the crane from tipping.

- Block crawlers if required per capacity chart before raising or lowering the boom.

2. Swing the crane slightly to either side and lower load block (2) and hook and weight ball onto the ground.
3. Swing boom in-line with crawlers and lower boom onto blocking (3) so distance from centerline of lower boom point to ground is 29 in (737 mm) as shown in View E.

Prepare Boom for Jib

1. Disconnect required load lines and remove and store hook and weight ball and/or load block from boom point.
2. Remove fixed jib or upper boom point, if equipped. See procedures in this section.
3. Change boom length as necessary to meet job requirements.
4. Check that all inserts and pendants are assembled in the proper sequence according to the Boom Assembly Drawing in Section 4 of Crane Operator Manual.
5. Remove sheave clusters (4), as required, from lower boom point and replace them with spacers. See procedure in Section 4 of Crane Operator Manual.

For luffing jib operation with the lower boom point completely removed, the bolt and all spacers must also be removed.

! WARNING
Tipping Crane Hazard!

Do not attempt to raise more boom than specified when lower boom point sheave clusters are installed. Rear of the crane will tip forward.

6. Raise boom top wire rope guide (5) to operating position. See Section 4 of Crane Operator Manual for the procedure.

NOTE The boom top wire rope guide sheaves must be positioned as shown in View C.

7. Raise luffing hoist wire rope guide to operating position:
 - a. Attach nylon sling (8, View A) from assist crane to bar (9) in upper wire rope guide.
 - b. Hoist just enough with assist crane so pin (11, View A) is loose.
 - c. Remove pin (11) from holes (A).
 - d. Slowly hoist with assist crane to rotate wire rope guide (7) to working position (View B).
 - e. Pin links (10, View B) to holes (B).
8. The fold-under luffing jib is identical to the layout luffing jib with the following exceptions, which allow the jib to be folded under the boom:
 - a. Wire rope guide on jib top is foldable to provide folding clearance.
 - b. Jib butt adapter has lever-operated pins which allow inserts to connect during jib raising and lowering.
 - c. Wire rope guide rollers on boom point which guide luffing jib hoist wire rope during jib raising and lowering.
9. For fold-under luffing jib, install wire rope guide roller assembly on boom top with pins and snap pins ([Figure 4-5](#)). **This wire rope guide must be removed for operation with layout luffing jib.**

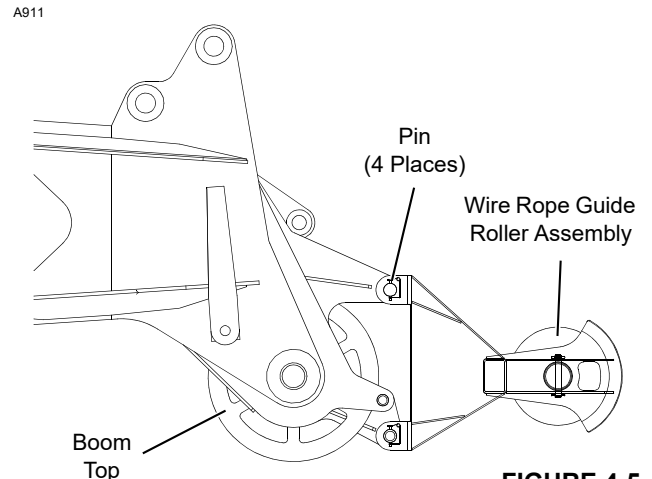


FIGURE 4-5

10. Add or remove crane counterweight to comply with applicable capacity chart.

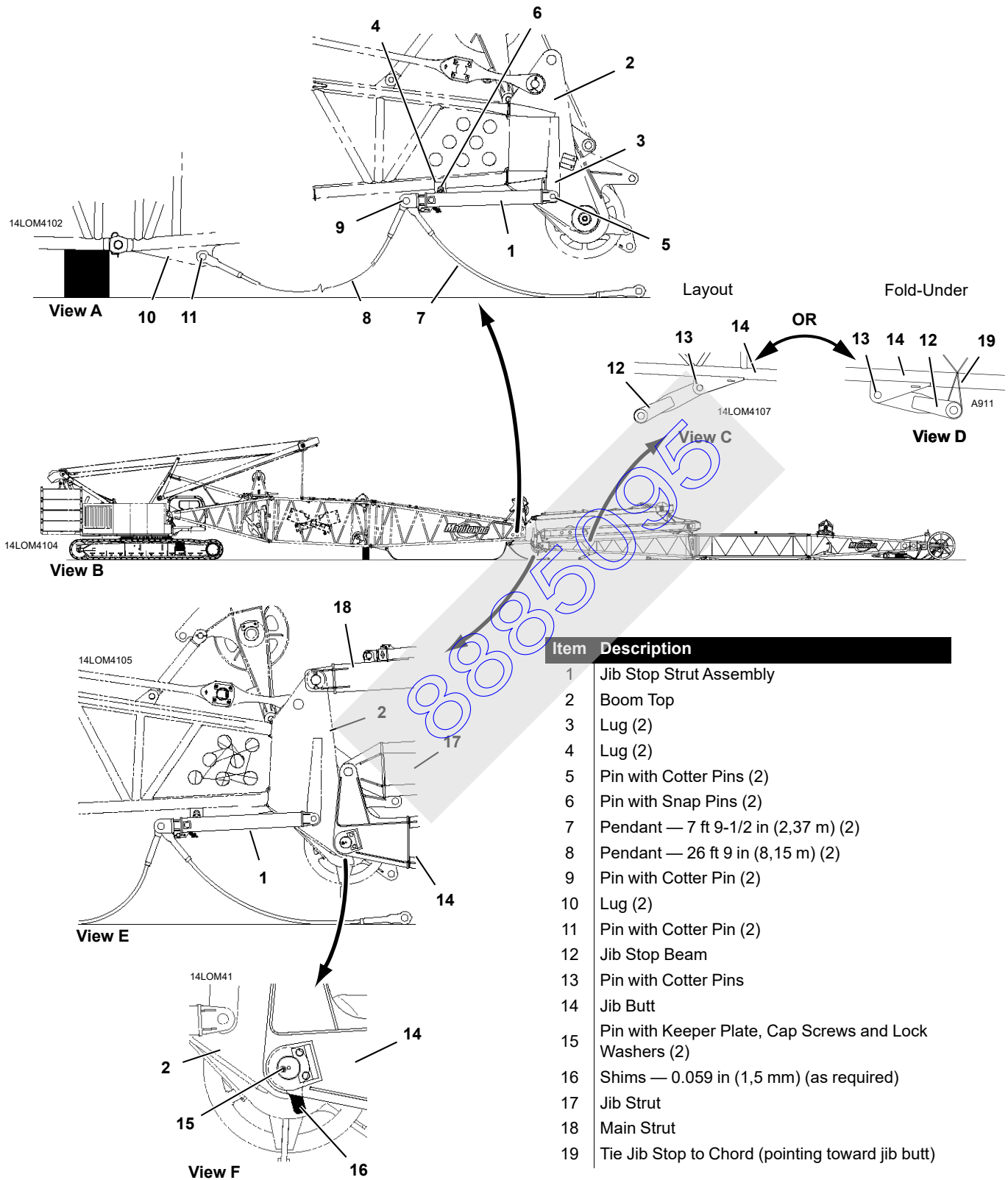


FIGURE 4-6

INSTALLING LAYOUT LUFFING JIB

Install Jib Stop Strut Assembly

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

1. Lift jib stop strut assembly (1) into position under boom top (2). A fork-lift truck can be used.
2. Pin jib stop strut assembly to boom top lugs (3 and 4) with pins (5 and 6).

NOTE For fold-under luffing jib, disregard steps 3 through 5.

3. Pin pendants (7 and 8) to jib stop strut with pins (9).
4. Pin other end of pendants (8) to lugs (10) on underside of boom top with pins (11).

NOTE Long jib stop pendants (8) from Model 888 or 999 cannot be used on Model 14000.

5. Stretch pendants (7) along ground toward jib butt. These pendants will be connected to jib stop beam (12, View C) when jib is raised.

Install Jib Butt

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

NOTE The jib butt, adapter frame, and jib strut are shipped as an assembled unit.

1. If not already installed, pin jib stop beam (12, View C) to jib butt (14).

For fold-under luffing jib, position jib stop beam (12, View D) toward jib butt adapter and tie to chord (19).

2. Lift the jib butt (14) into position at end of boom top (2).
3. Pin the jib butt to boom top lugs with pins (15) and keeper plates (View F).

As pins are installed, install an equal amount of shims (16, View F) on outboard side of both boom top lugs **so jib butt is centered on boom top**.

4. Lower the jib butt onto blocking.
5. Apply several shots of grease to both pins (15).

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Item	Description
1	Jib Butt
2	Jib Insert — 20 ft (6,1 m) Shown
3	Jib Adapter (ships attached to jib butt)
4	Pin with Cotter Pins
5	Jib Top

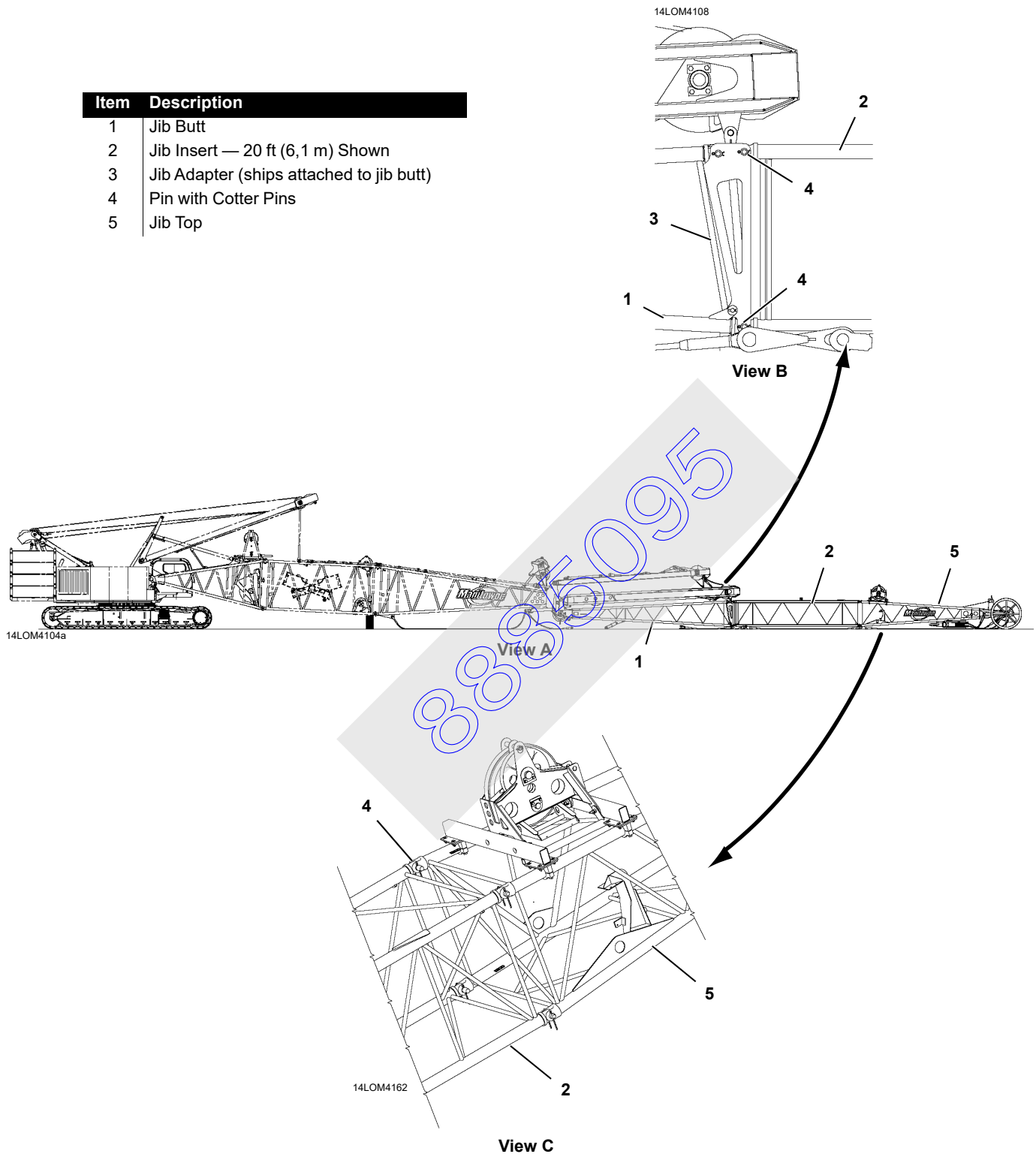


FIGURE 4-7

Install Jib Inserts and Top

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

1. Determine jib length required for lift to be made.
2. Pin inserts and jib top to butt *in the proper sequence — shortest inserts nearest butt* (see Luffing Jib Assembly drawing).

Long tapered end of pins (4) must be pointed in.

Connect Jib Stop Control Cable

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

1. Using hand winch on the jib top (View A), pay out control cable (3).
2. Connect control cable (3) from hand winch to cable extension (5) from the jib butt with shackle (4, View B).
3. Route cable (5) through sheave (6).
4. Pay out control cable until it is resting on bottom of jib sections.
5. Jib stop pins are spring engaged automatically.

Item	Description
1	Hand Winch
2	Hand Winch Pawl
3	Cable from Winch
4	Shackle
5	Cable from Jib Butt
6	Sheave
7	Cable to Jib Stop

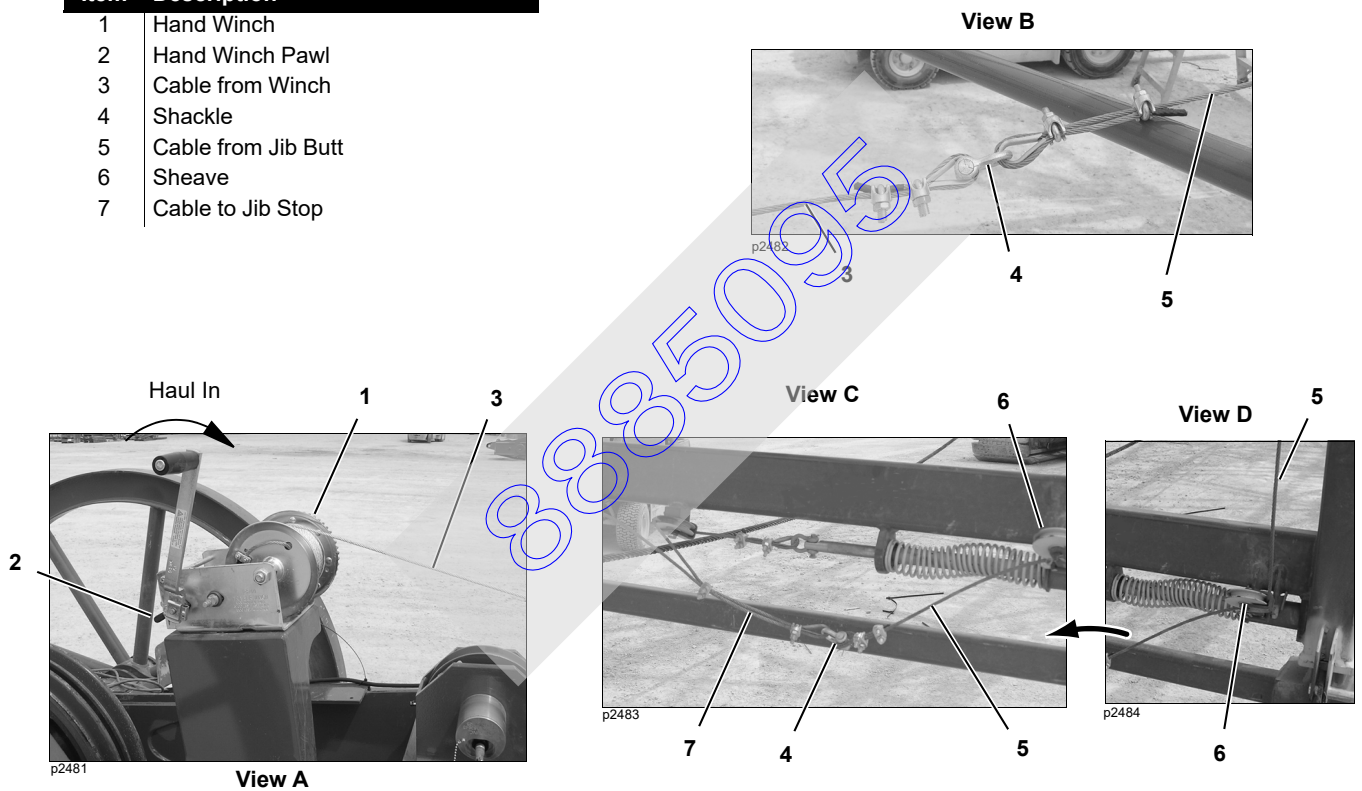


FIGURE 4-8

Item	Description
1	Basic Jib Pendants
2	Pendant Link
3	Main Strut
4	Jib Strut
5	Socket and Wedge
6a	Strut Support (erecting)
6b	Strut Support (stored)
7	Strut Support Pins
8	Jib Insert Pendant (install with jib inserts)
9	Jib Insert Pendant Link
10	Jib Butt
11	Main Strut Pin
12	Boom Top
13	Backstay Lug
14	Backstay Pendant
15	Boom Butt Wire Rope Guide
16	Jib Top
17	Pendant Link Pin
18	Pendant Link
19	Jib Top Pendant
20	Basic Backstay Pendant

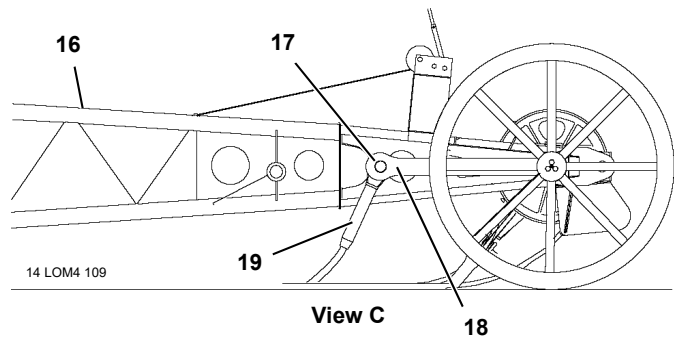
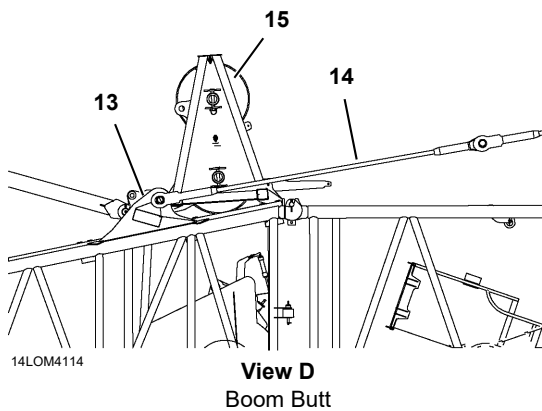
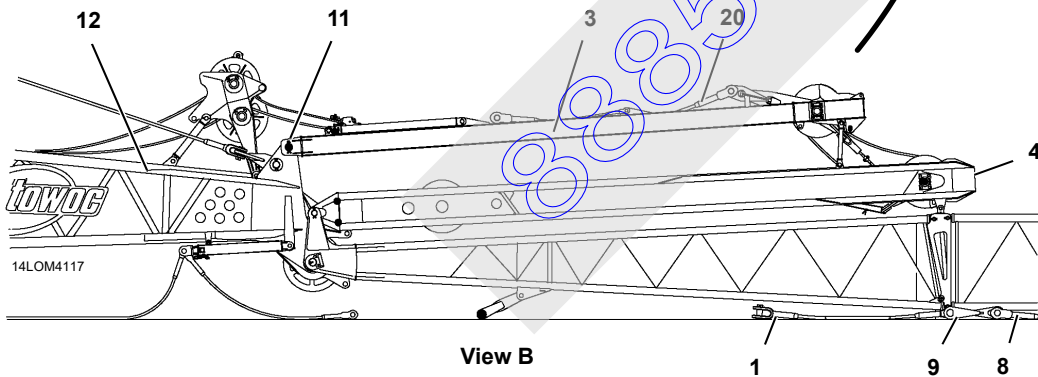
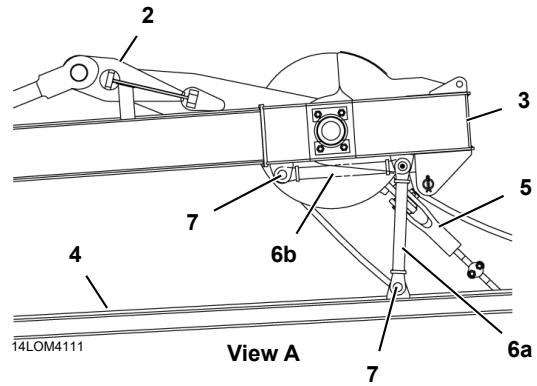


FIGURE 4-9

Install Main Strut

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

1. Make sure main strut is positioned so pendant link (2, View A) faces up.
2. Pin main strut (3) to lugs on the boom top (12, View B).
3. Attach main strut to jib strut with strut supports (6a, View A).

Install Jib Pendants

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

NOTE Either non-stowable pendants or stowable pendants can be used to assemble the jib.

Stowable pendants are slightly longer than non-stowable pendants. When disassembling the jib, stowable pendants can be disconnected and left on top of the sections for shipping. This arrangement allows the jib to be reassembled faster.

It is the owner/user's responsibility to securely attach stowable pendants to jib sections so that pendants cannot fall off jib sections during shipment.



WARNING Falling Jib Hazard!

Pendants must be installed in the same sequence as inserts (shortest inserts and pendants nearest butt). Pendants are furnished in matched sets of two and must be installed in matched sets — pendant on one side of the jib insert must match pendant on opposite side of insert. Do not mix stowable pendants with non-stowable pendants. ***Failing to observe this precaution will cause jib to twist excessively when boom is raised. Structural damage to jib will occur.***

1. Pin basic jib pendants (19) to pendant links (18, View C) on jib top.
2. Continue to assemble and pin all required jib pendants on the ground alongside the jib, working toward jib butt.
3. Install pendant links (9) between last set of insert pendants (8) and basic jib pendants (1, View B).

NOTE Pendant links (9) are required only for jib lengths 70 to 100 ft (21,34 to 30,48 m).

Install Backstay Pendants

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



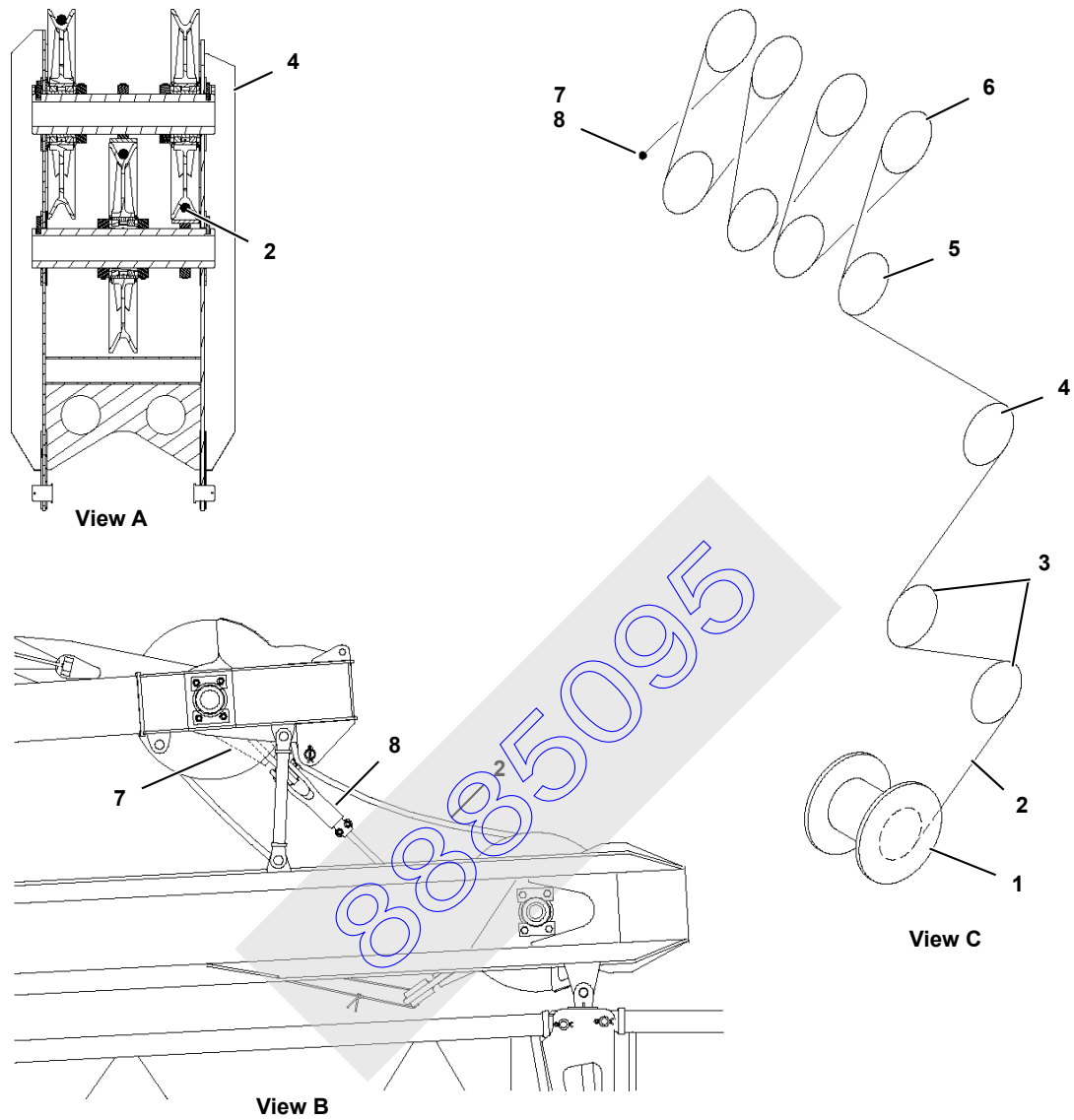
WARNING Falling Boom Hazard!

Backstay pendants and links must be installed in the sequence shown in Luffing Jib Assembly Drawing at the end of this section.

Pendants are furnished in matched sets of two and must be installed in matched sets — pendant on one side of boom insert must match pendant on opposite side of boom insert. Do not mix stowable pendants with non-stowable pendants. ***Failing to observe this precaution will cause jib struts to twist excessively when the boom is raised. Structural damage to the jib or boom will occur.***

1. Assemble backstay pendants (14) and links in the proper sequence starting at backstay lugs (13, View D) on the jib butt.
2. Lay pendants along top of the boom while working toward boom top. Pull pendants as tight as possible along the boom.

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Item	Description
1	Luffing Hoist (in boom butt)
2	Luffing Hoist Wire Rope
3	Sheave Assembly (boom insert)
4	Wire Rope Guide (boom top)
5	Main Strut Sheaves
6	Jib Strut Sheaves
7	Main Strut Dead-End Link (left side)
8	Terminator Socket and Wedge

FIGURE 4-10

Install Luffing Hoist Wire Rope

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

1. Reeve luffing hoist wire rope from luffing hoist through guide sheaves on the boom, through main strut sheaves, and through jib strut sheaves as shown in [Figure 4-10](#).
2. Route wire rope through bottom of guide sheave (4, View A) in upper wire rope guide on the boom top.
3. Anchor free end of luffing hoist wire rope to left side dead-end link (7) on main strut with socket and wedge (8, View B).

Manitowoc recommends the following wire ropes:

- For luffing jib use only — MCC #719276, 770 ft (235 m) long, 1 in (26 mm), 6x26, Right Hand Lang Lay, Minimum Breaking Strength 103,000 lb (458 kN)
- For luffing jib or auxiliary drum use — MCC #719436 770 ft (235 m) long, 1 in (26 mm), Dyform 34 Max, Right Hand Lang Lay, Minimum Breaking Strength 153,800 lb (684 kN)

See Wire Rope Installation topic in this section for instructions on installing wire rope on drum and for anchoring it to a socket and wedge.

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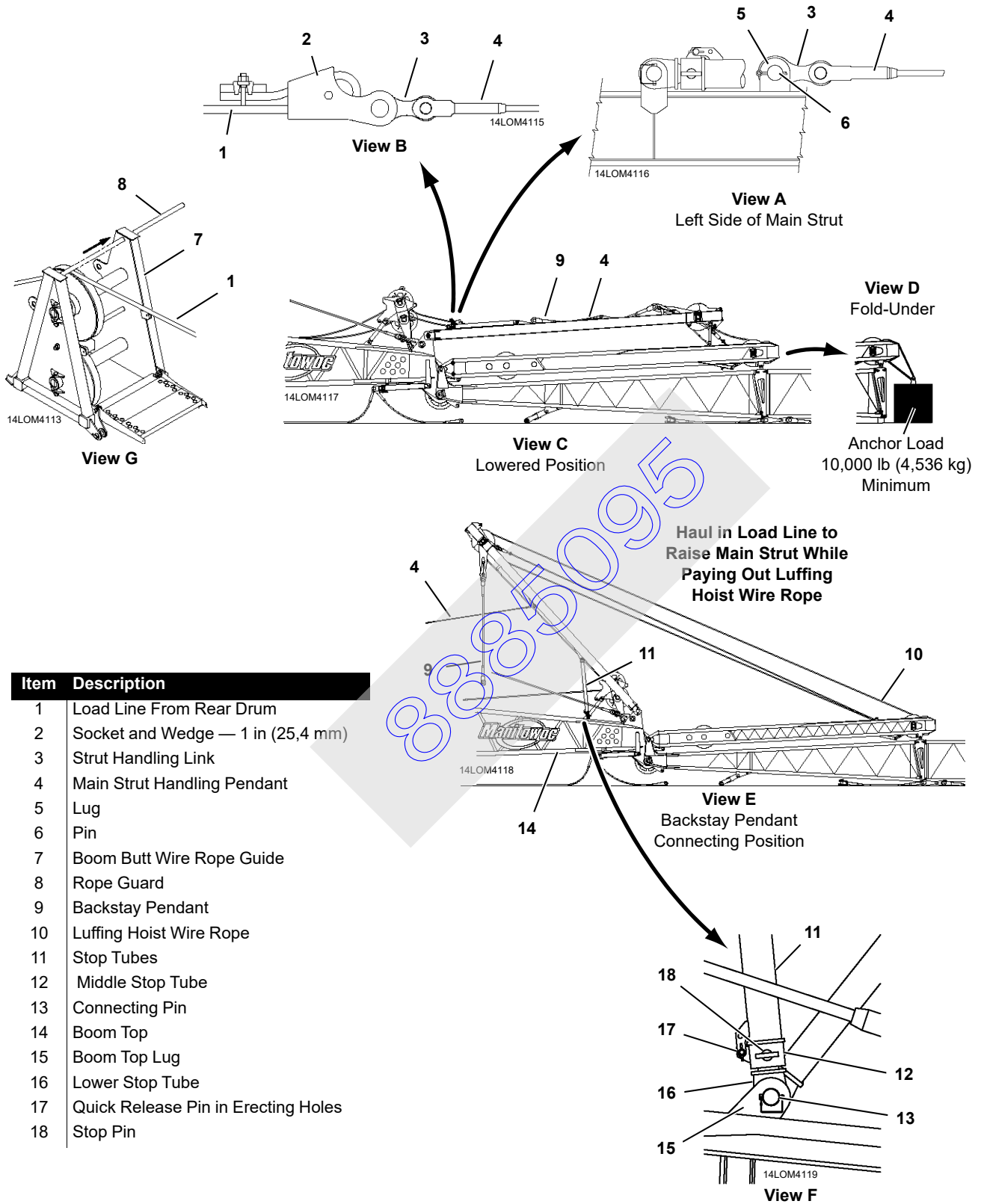


FIGURE 4-11

Raise Main Strut and Connect Backstay Pendants

See [Figure 4-11](#) for the following procedure.



WARNING

Moving Part Hazard!

Do not stand on the boom top or jib butt while main strut is being raised or lowered.

Wait until main strut is stopped and supported by load line or luffing hoist wire rope before climbing onto the boom top or jib butt when connecting and disconnecting strut stop tubes.

NOTE For fold-under luffing jib, prevent the jib strut and jib butt from raising during main strut raising procedure by anchoring jib strut to a minimum load of 10,000 lb (4 536 kg) as shown in View D.

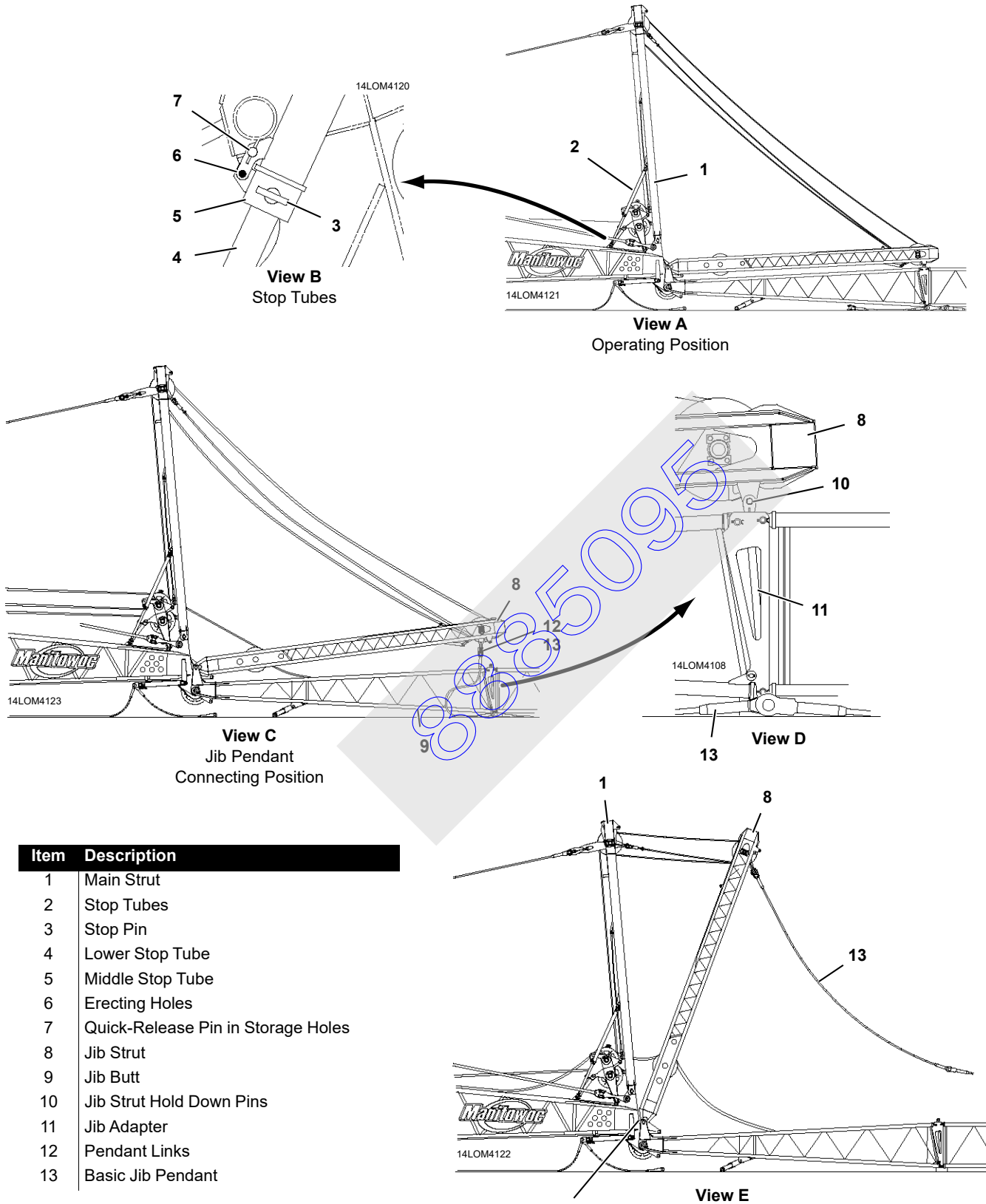
1. Unpin strut handling link (3, View A) from storage lugs (5) on main strut.
2. Guide load line (1, View G) from rear drum over upper sheave in wire rope guide (7) on boom butt.
3. **Temporarily remove rope guard (8) or it will be damaged.**
4. Continue to guide load line over center of upper shaft in boom top wire rope guide.
5. Connect socket and wedge (2, View B) to load line (1) from rear drum (this is the same socket and wedge used to anchor load line at jib point).
6. Pin socket and wedge to strut handling link (3, View B).
7. Haul in load line just enough to support main strut. Then, unpin strut supports from the jib strut and pin supports in storage position ([Figure 4-9](#), View A).
8. Slowly haul in load line while paying out luffing hoist wire rope to raise main strut.

CAUTION

Jib Strut Damage!

Do not allow luffing hoist wire rope to go into tension until main strut is near vertical. Jib strut could be damaged.

9. Tighten luffing hoist wire rope as main strut nears vertical so strut moves smoothly past vertical.
10. Continue to haul in load line and pay out luffing hoist wire rope to lower main strut to rear (View E).
Keep load line slacker than luffing hoist wire rope so the jib strut is not over tensioned.
11. Stop lowering main strut when holes in lower stop tubes (16, View F) line up with holes in lugs (15) on the boom top.
12. Pin lower stop tubes to lugs on the boom top.
13. Unpin socket and wedge from strut handling link and pin link and pendant to storage lugs on main strut (View A).
14. Remove socket and wedge from rear drum load line and reinstall at the jib point.
15. Pin basic backstay pendants (9, View E) from main strut to backstay pendants or links on the boom top (see Luffing Jib Assembly Drawing at the end of this section for details).
16. Leave quick-release pins (17, View F) in erecting holes.
17. Remove stop pin (18, View F) from both middle stop tubes (12).



Item	Description
1	Main Strut
2	Stop Tubes
3	Stop Pin
4	Lower Stop Tube
5	Middle Stop Tube
6	Erecting Holes
7	Quick-Release Pin in Storage Holes
8	Jib Strut
9	Jib Butt
10	Jib Strut Hold Down Pins
11	Jib Adapter
12	Pendant Links
13	Basic Jib Pendant

Do not Allow Jib Strut to Contact Boom Top

FIGURE 4-12

See [Figure 4-12](#), View B for the following steps.

18. Slowly haul in luffing hoist wire rope until holes in both middle stop tubes (5) line up with upper holes in both lower stop tubes (4).
19. Install stop pin (3) in both middle stop tubes (5).
20. Remove quick-release pins (7) from erecting holes (6) and install them in storage holes.

Connect Jib Pendants to Jib Strut

See [Figure 4-12](#) for the following procedure.

1. Luff up or down as required, to loosen hold-down pins (10, View D) in hold-down lugs.
2. Remove hold-down pins (10).
3. Luff up until the jib strut (8, View C) is approximately 3 ft (1 m) above the jib butt.

4. Store hold down pins (10) in hold-down lugs on adapter (11).
5. Lower pendant links (12, View C) to working position.
6. Pin basic jib pendants (13, View C) to pendant links (12) on the jib strut.
7. Luff up to raise the jib strut until jib pendants are just slightly above top of jib (View C), and stop luffing up.
Guide pendants while luffing up to assure pendants and connectors do not strike side of jib.

CAUTION

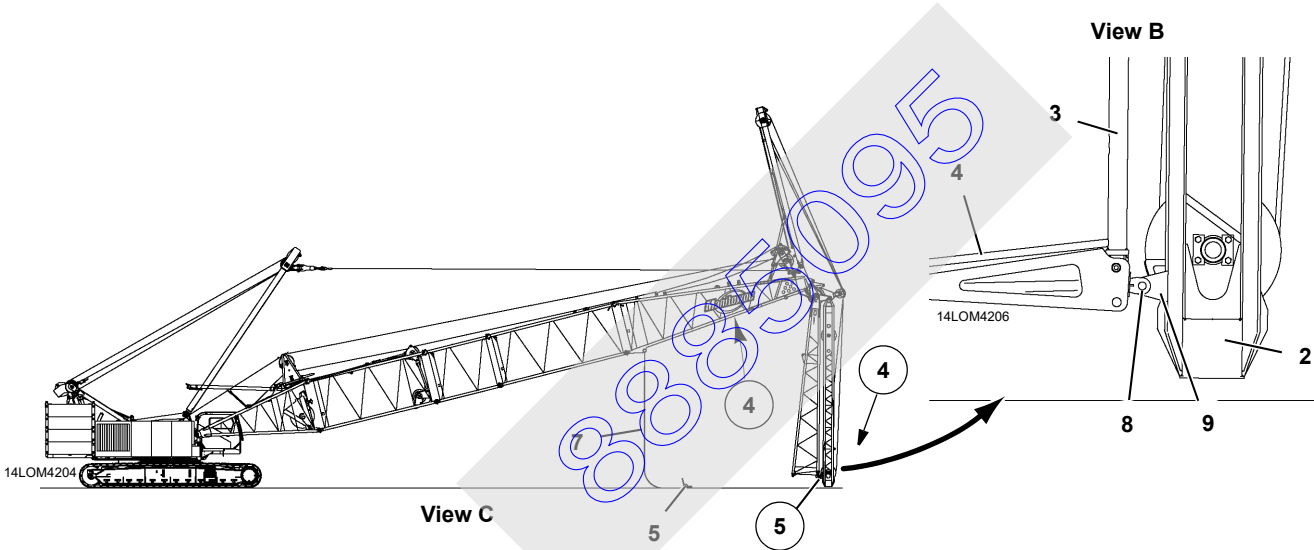
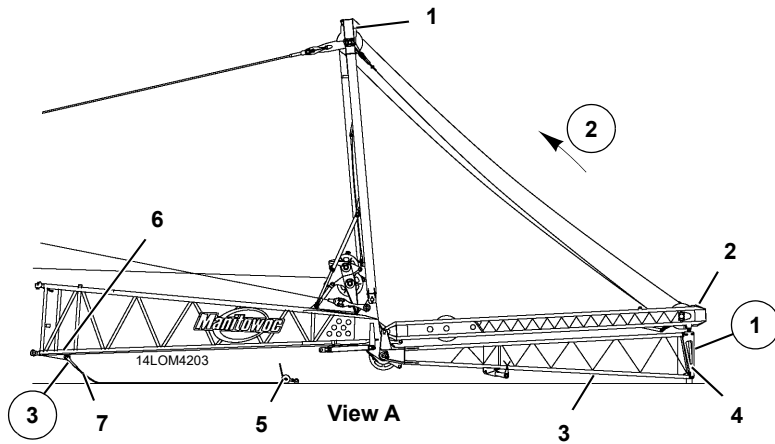
Jib Strut Damage!

Do not allow the jib strut to come into contact with the boom top when luffing up. Jib strut damage could occur.

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Circled Item Numbers Correspond to Fold-Under Raising Procedure Steps

Item	Description
1	Main Strut
2	Jib Strut
3	Jib Butt
4	Jib Butt Adapter
5	Lever Operated Hoist
6	Jib Stop Anchor Lugs
7	Chain
8	Hold Down Pins
9	Hold Down Lugs



CAUTION

Avoid Jib Strut Damage!

Do not allow jib strut to contact wire rope roller guide.

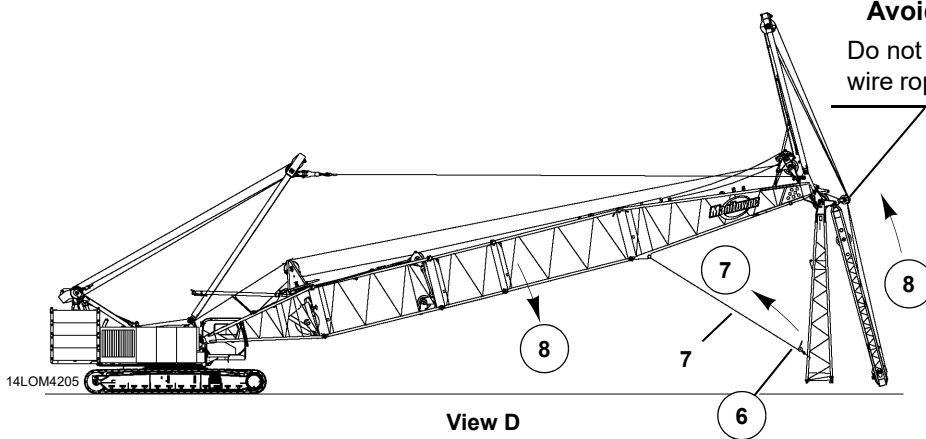


FIGURE 4-13

INSTALLING FOLD-UNDER LUFFING JIB

Raise Main Strut and Connect Backstay Pendants

Raise main strut per layout steps 1 through 20, starting on [page 4-19](#).

Fold Jib Butt Under Boom Top

See [Figure 4-13](#) in the following procedure.

NOTE Following procedure uses a lever-operated hoist to lift jib butt into position under boom top.

Total height that the jib butt must be lifted is 24 ft (7,3 m).

Any other suitable hoisting method may be used. Hoisting method selected must be strong enough to handle weight of jib butt — 2,275 lb (1 032 kg).

Circled numbered steps in the following procedure apply to item numbers in [Figure 4-13](#).

1. Make sure the jib strut (2) is still pinned to the jib butt (3, View B).
2. Luff up until luffing hoist wire rope just starts to go into tension and stop. **Do not attempt to lift the jib strut and butt during this step.**
3. Connect chain (7) from lever-operated hoist (5) to jib stop anchor lug (6, View A) on bottom of the boom.

Other end of hoist will be connected to jib butt chord after the jib is hanging vertically.

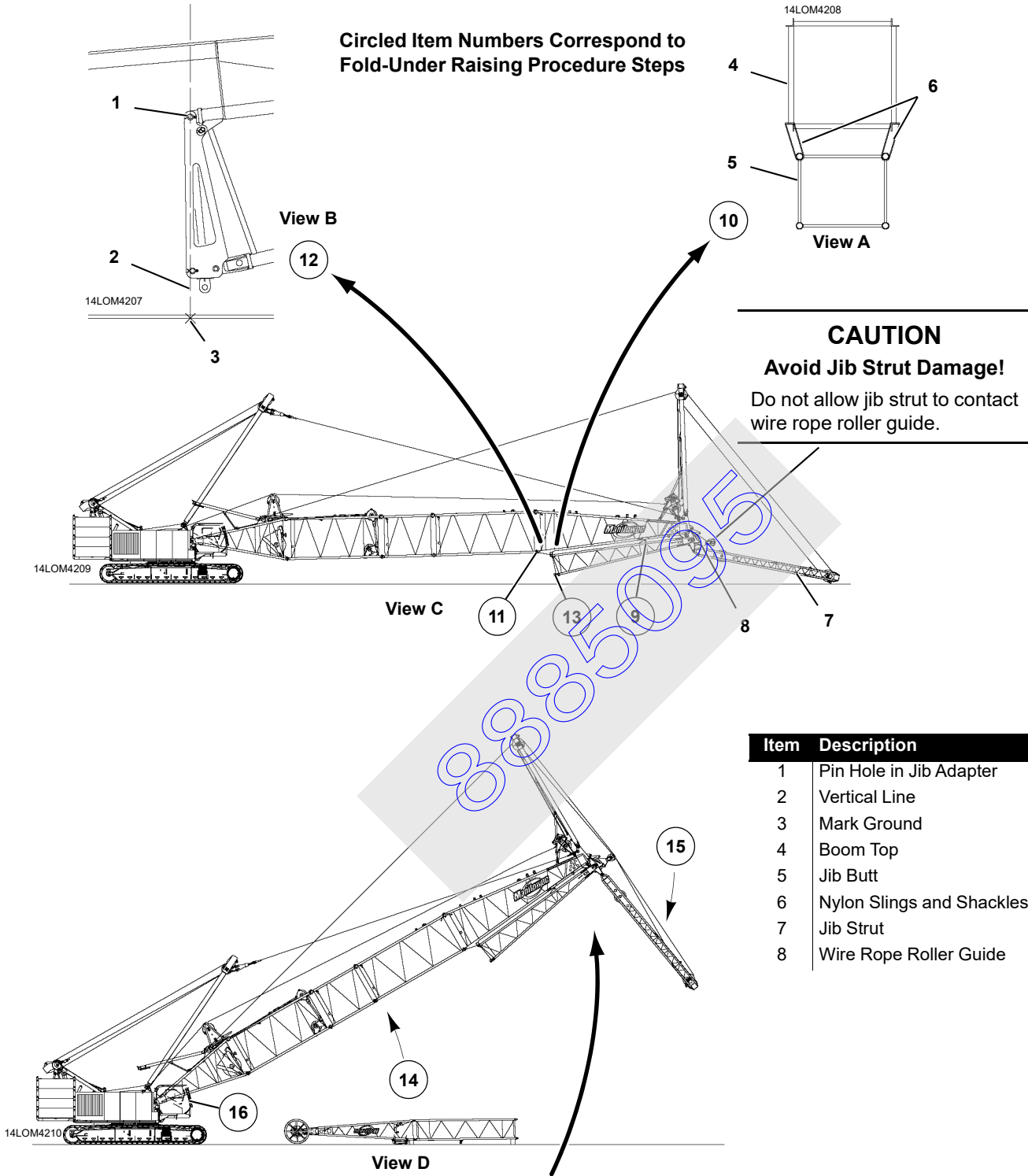
4. Raise the boom and pay out luffing hoist wire rope to lower the jib strut and the butt to vertical position (View C).
5. Disconnect the jib strut from the jib butt:
 - a. Luff up or down as required to loosen hold-down pins (8, View B).
 - b. Remove hold-down pins.
 - c. Luff up until the jib strut is clear of the jib butt.
 - d. Store pins in hold-down lugs (9, View B).
6. Connect free end of lever-operated hoist (5) to chord on the jib butt. Make sure the connection is secure to prevent sliding movement on chord.
7. Lift the jib butt toward the boom top using lever operated hoist.
8. Slowly lower the boom and luff up while lifting the butt.

CAUTION

Avoid Jib Strut Damage!

Be alert and maintain adequate space between the jib strut and wire rope roller guide when hauling in luffing hoist wire rope.

Avoid the jib strut crashing into wire rope guide on the boom top when luffing up.



CAUTION

Avoid Jib Strut Damage!

Do not lower the jib strut to point that strut and luffing hoist reeving are in a straight line. Jib strut will fall violently and crash into jib. Severe damage will occur.

FIGURE 4-14

Circled numbered steps in the following procedure apply to item numbers in [Figure 4-14](#).

9. Stop lowering the boom and lifting the butt when jib stop strut and jib stop beam are 2 to 3 in (50 to 75 mm) from contacting the boom top.
10. Securely attach jib butt chords to the boom top by attaching nylon slings and shackles (6) to both sides of top chords of the jib butt (5) and bottom chords of the boom top (4, View A).
11. Remove lever-operated hoist.
12. Mark ground at intersection of vertical line extended through pin hole in jib adapter (1, View B). This is where insert will be pinned to adapter assembly.
13. Pull jib butt adapter cable to retract pins (see Adapter Frame drawing at the end of this section).
14. Slowly raise the boom and swing as required to allow space to build inverted jib insert(s) and top.
15. Luff down while booming up until the jib strut is in-line with main strut.

CAUTION

Avoid Jib Strut Damage!

Do not lower the jib strut to a point that strut and luffing hoist reeving are in a straight line. Jib strut will fall violently and crash into the jib. Severe damage will occur.

16. Engage swing lock, engage boom hoist pawl, and apply boom hoist parking brake to hold the boom in position.

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Item	Description	Item	Description
1	Pins	12	Jib Top Chord
2	Pin at Holes	13	Pivot Pin
3	Nylon Slings	14	Top Hole
4	Assist Crane Load Line	15	Bottom Hole
5	Wire Rope Roller Guide	16	Jib Insert
6	Load Line	17	Jib Butt
7	Chords on Insert	18	Pin and Washers
8	Wire Rope Guide with Positioning Winch	19	Jib Butt Adapter
9	Lift Here	20	Spring Loaded Pins
10	Jib Top Wire Rope Guide	21	Pins
11	Frame	22	Pin at Holes

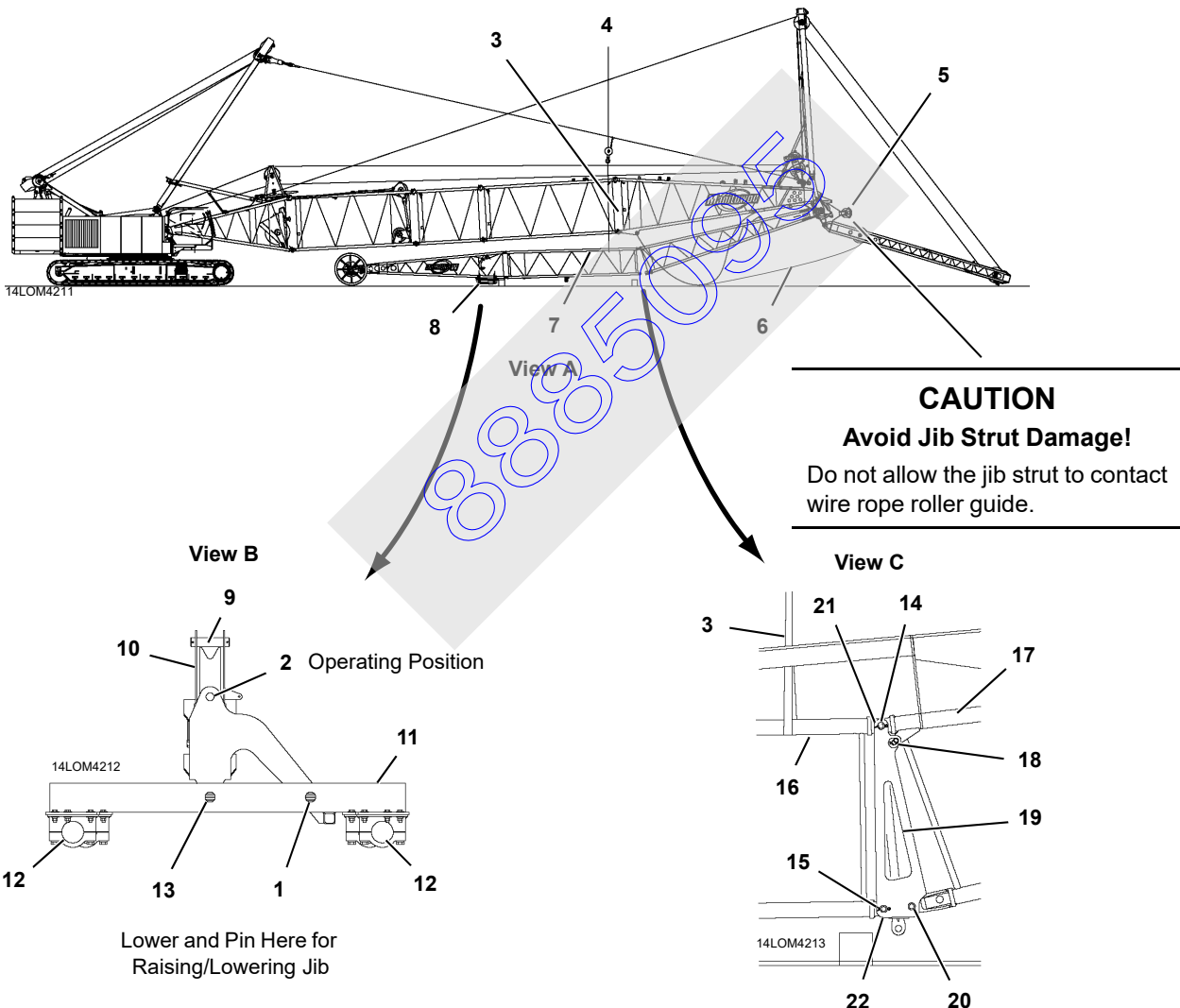


FIGURE 4-15

Assemble Jib Top and Inserts

See [Figure 4-15](#) for the following procedure.

1. Wire rope rollers on inserts may be shipped upside down. If necessary, unscrew roller brackets and reattach them right side up.
2. Prepare the jib top as follows:
 - a. Install hand winch for jib stop control cable if not already installed (see [Figure 4-8](#)).
 - b. Install hand winch for jib butt adapter control cable. See Adapter Frame drawing at the end of this section.
 - c. Install hand winch and control cable for jib top wire rope guide. See Jib Top Wire Rope Guide Winch Assembly drawing at the end of this section.
3. Lower wire rope guide on the jib top to stowed position as follows (View B):
 - a. Support wire rope guide with load line from assist crane.
 - b. Remove pins (1, View B).
 - c. Lower wire rope guide and pin at holes (2, View B).
4. Starting at mark made on ground earlier in procedure, assemble desired length of jib inserts and top upside down:
 - a. Make sure inserts are assembled in-line with center line of carbody.
 - b. Make sure inserts are assembled in the proper sequence with shortest inserts toward the jib butt (see rigging drawing).
 - c. Block inserts only high enough to prevent jib top wire rope guide from contacting ground.
 - d. Take care not to damage hand winch on the boom top. Rotate winch handles to required position and engage winch pawls so handles do not contact the ground when the jib top is installed.
5. Remove pins (21 and 22, View C) from jib butt adapter.
6. Swing the boom back in-line with crawlers.
7. Slowly lower the boom until top holes in the jib butt (17) are 2 to 3 in (50 to 75 mm) from engaging top holes in adjacent insert (16).
Luff up to raise the jib strut as the boom is lowered. Use caution — do not allow the jib strut to contact wire rope roller guide on the boom point.
8. Using nylon slings, connect load line from assist crane to chords on insert adjacent to jib butt (View C). **Avoid contacting lacings in boom.**
9. Slowly raise the boom and hoist with assist crane (4) to align top holes in jib butt adapter, jib butt, and adjacent insert.
10. Install pins (21, View C) to connect top holes in jib butt adapter, jib butt, and adjacent insert.
11. Continue to slowly raise the boom and hoist with assist crane to align bottom holes in jib butt adapter and adjacent insert.
12. Install pins (22, View C) to connect bottom holes in jib butt adapter and adjacent insert.
13. Disconnect assist crane from the jib.
14. Remove slings and shackles securing the jib butt to the boom top.
15. Install load line for jib point:
 - a. Route load line from desired drum through proper sheaves in the boom.
 - b. Route load line over wire rope guide rollers on the boom point and through sheave in the jib strut.
 - c. Pull load line approximately 20 ft (6,10 m) past end of jib point.
 - d. Load line will be routed through jib top wire rope guide and attached to load block after the jib is partially raised.
16. See Connect Jib Stop Control Cable topic and connect control cable to jib stop pins if not already connected.

Item	Description
1	Jib Stop Anchor Lugs
2	Boom Top
3	Jib Stop Pendants 24 ft 1 in (7.3 m)
4	Connector
5	Jib Stop Pendants 7 ft 9.5 in (2.4 m)
6	Jib Stop Strut Assembly
7	Jib Stop Beam
8	Assist Crane Load Line

NOTE Make sure jib stop pendants (3) are on inboard side of jib stop pendants (5).

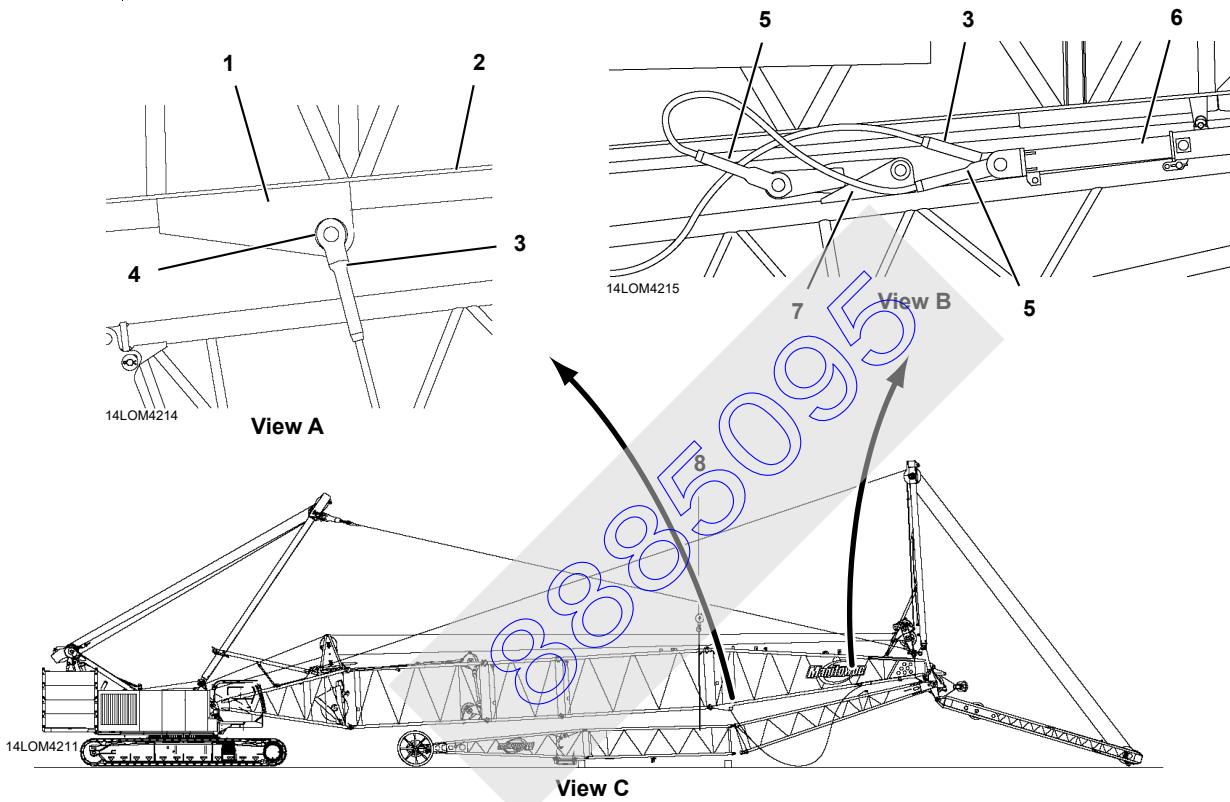


FIGURE 4-16

Install Jib Stop Pendants

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

NOTE Jib stop strut assembly was installed and fully extended earlier in assembly procedure. See Install Jib Stop Strut Assembly topic.

1. Untie jib stop beam from the jib butt.
2. Unpin jib stop strut assembly (6) from lugs on underside of the boom.
3. Connect the end of jib stop pendants (3) to jib stop anchor lugs (1, View A) on underside of the boom top.
4. Connect the end of jib stop pendants (5, View B) to lugs on jib stop beam (7).
5. Connect the other end of jib stop pendants (3 and 5, View B) to lugs on jib stop strut assembly (6).

NOTE Make sure jib stop pendants (3) are on inboard side of jib stop pendants (5) in View B.

6. Take extreme care when connecting pendants to jib stop strut assembly:
 - a. Connectors on jib stop pendants (3, View B) must be toward the boom top.
 - b. Connectors on jib stop pendants (5, View B) must be toward the jib top.

CAUTION

Avoid Jib Stop Damage!

Make sure pendants are properly attached to prevent equipment damage. Pendants must not be kinked or become entangled with jib stop strut assembly, jib stop beam, or other parts.

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INSTALL FIXED JIB (OPTIONAL)

If a fixed jib will be installed, see Fixed Jib topic in this section.

INSTALL BOOM LOAD LINE

It is permissible to handle loads from the lower boom point when equipped with a jib.

Keep in mind, however, that weight of load block, load line, slings, etc. hanging from lower boom point must be deducted from jib capacities (see capacity charts for limitations).

1. Determine parts of line required for job and size load block accordingly (see Wire Rope Specifications topic in this section).
2. Route load line from desired drum through proper guide sheaves on the boom (see Luffing Jib Reeving topic in this section).
3. Reeve load line through the lower boom point and load block sheaves and anchor load line to dead end (see Load Block Reeving topic in this section).

NOTE Rope must be located on boom side of jib stop strut cross bar when reeving load line.

4. Install block-up limit for the lower boom point (see Block-Up Limit topic in Operator Manual).
5. If not already done, remove lower boom point sheaves, boom point wire rope guide, and jib strut lower guide sheave and shaft (if required for boom and jib length in use). See Luffing Jib Raising Procedure Chart for sheave removal requirements.

INSTALL JIB LOAD LINE

The jib can be operated with up to a four-part load line over the jib point.

If the jib will be raised using In-Line Method, install load block or hook and weight ball before the boom and jib are raised.

If the jib will be raised using Jack-Knife Method, reeve load line through guide sheaves in the jib point. Pull load line approximately 20 ft (6 m) past end of the jib and lay line on ground. Securely tie off load line to the jib. Install load block or hook and weight ball after the boom and jib have been jack-knifed into position just prior to raising jib point rollers off the ground.

CAUTION

Run-Away Wire Rope!

For long boom and short jib combinations, wire rope on boom side of attachment can overhaul unsecured wire rope on jib side. This could cause personnel injuries and damage to equipment. Securely tie off load lines to the jib before raising attachment.

1. Determine parts of load line required for job and size load block accordingly (see Wire Rope Specifications).
2. Route load lines from desired drum through proper guide sheaves on the boom, jib strut, and jib point.
3. Reeve load line through required jib point sheaves and anchor load line at dead end on jib, load block, or on hook and weight ball (see Load Line Reeving topic in this section).
4. Install block-up limit for jib point (see Block-Up Limit topic in section 6 of this manual).
5. Install wind speed indicator assembly if removed for shipping. Use star washers to attach mounting bracket to jib top to provide a good ground (see Wind Speed Assembly drawing at the end of this section).

CONNECT ELECTRIC CORDS AND ADJUST ELECTRONIC DEVICES

1. Connect electrical cords to respective junction boxes and switches (see Boom Wiring Drawing at the end of this section for details):
 - Maximum jib stop limit switch on boom top
 - Minimum jib stop limit switch on boom top
 - Load sensing sheaves on jib points
 - Block-up limit reel in jib butt
 - Block-up limit switches
 - Wind speed indicator
 - Connect shorting plugs to unused electrical cords
2. Adjust electronic devices as instructed in Section 6 of this manual:
 - Jib stop limit switches
 - Jib and boom block-up limit switches
 - Boom stop limit switch (set at 88.5° for boom with luffing jib)

PRE-RAISING CHECKS

Make the following checks and correct any defects before raising the attachment.

- Boom and luffing jib assembled according to instructions in this section and to assembly drawings at the end of this section.
 - Crawlers blocked (if required for boom and jib length being raised). See Crawler Blocking Diagram in Capacity Chart Manual for blocking requirements.
 - Boom and jib inserts installed in the proper sequence according to assembly drawings.
 - Boom, jib, backstay, and jib stop pendants installed in the proper sequence according to assembly drawings.
 - All connecting pins installed and properly secured.
 - Main strut raised and main strut stop tubes pinned in operating position.
 - Jib strut unpinned from storage position.
 - Boom and luffing hoist wire rope anchored properly to drums, spooled tightly onto drums, and engaged with proper sheaves (see Boom Assembly Drawing in Crane Operator Manual, see Luffing Jib Assembly Drawing at the end of this section, and see Wire Rope Installation topic in this section). Ensure rope guard pins, bars, or rollers are installed to retain wire rope in sheaves.
 - Lower boom point sheaves removed (if required for boom and jib length in use). See Luffing Jib Raising Procedure Chart for sheave removal requirements.
 - Load lines anchored properly to drums, spooled tightly onto drums, and engaged with proper sheaves (see Reeving Diagrams and Wire Rope Installation topic in this section). Ensure rope guard pins, bars, or rollers are installed to retain wire rope in sheaves.
- If load line will be installed after the boom and jib are jack-knifed into position, make sure load line going to the jib point is securely attached to end of the jib point so load line cannot fall off the jib and boom.*
- All blocking, tools, and other items removed from the boom and jib.
 - All blocking, tools, and other items removed from jib point roller path area.
 - Pendants not hooked alongside the boom and jib. **Guide pendant connectors clear of wire rope guides and boom and jib chords as boom and jib are raised.**
 - All safety devices installed, electric cords connected, and limits adjusted (see appropriate adjustments in Section 6 of this manual):
 - RCL (rated capacity indicator/limiter)
 - Automatic boom stop (must be reset for luffing jib operation after boom and jib are raised)
 - Automatic jib stops
 - Jib and boom block-up limits
 - Luffing Jib Raising Procedure Chart reviewed
 - Raising method — In-line or jack-knife
 - Required boom to jib angle for jack-knife raising method
 - Raising procedure in this section read and thoroughly understood.
 - Wind within allowable limits for raising the boom and jib (see load charts in operator's cab).
 - All lube points greased (see Lubrication in Section 5).
 - Appropriate LUFFING JIB capacity chart is selected and displayed in Rated Capacity Indicator/Limiter working screen.

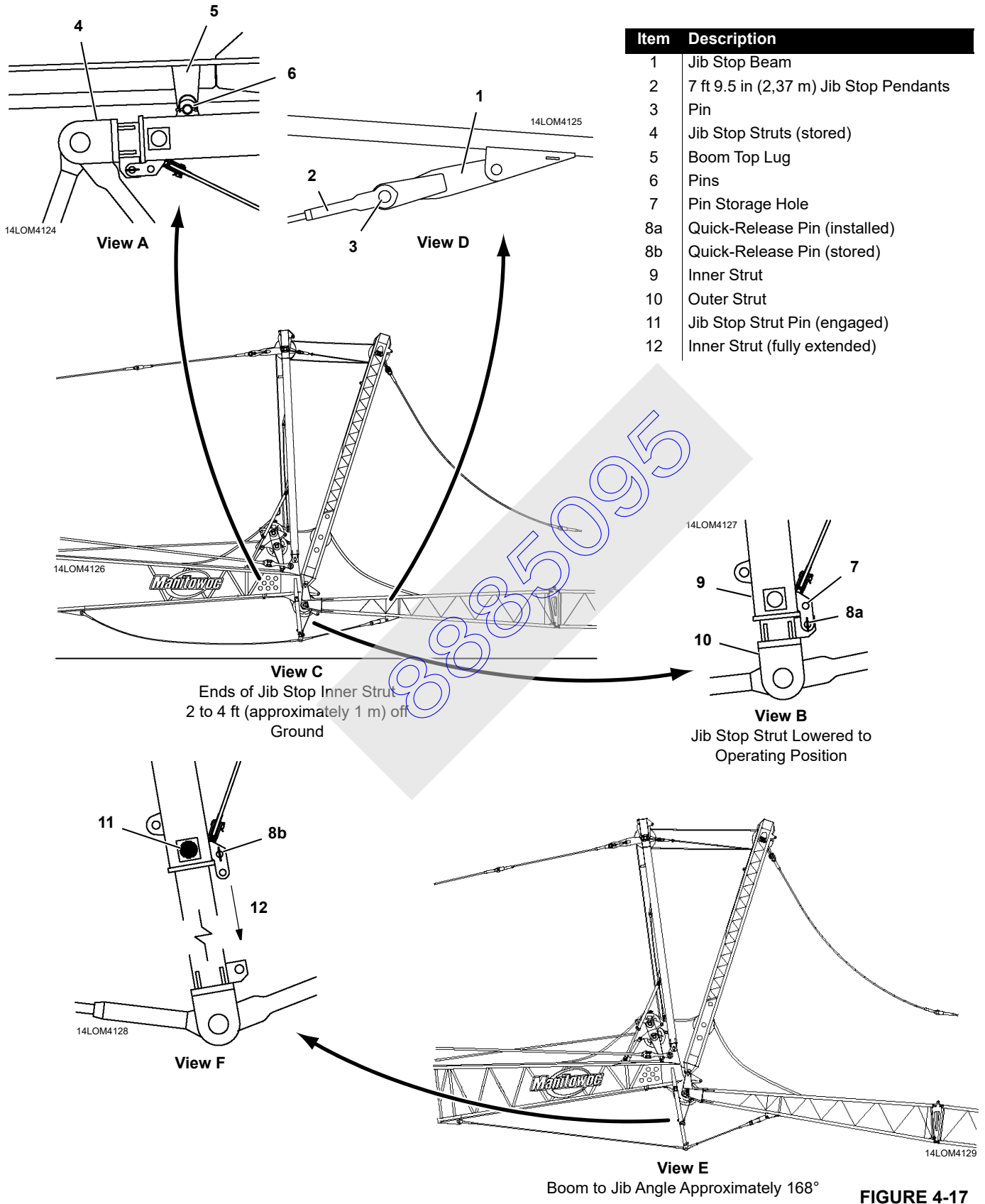


FIGURE 4-17

RAISING BOOM AND JIB

General



WARNING

Falling Boom And Jib Hazard!

Select appropriate LUFFING JIB chart in RCL (rated capacity indicator/limiter). Operating in any other mode with the luffing jib attached is prohibited.

Luffing jib limits are disabled when LUFFING JIB chart is not selected. Boom and jib could be pulled over backwards.



DANGER

Moving Part Hazard!

Warn all personnel to stand clear of jib point rollers while raising the boom and jib.

Death or severe crushing injuries will occur if personnel come into contact with rollers.

As defined in the raising procedure chart, one of two methods can be used to raise the boom and jib depending on the boom and jib combination:

- In-Line Method
- Jack-Knife Method

See raising procedure chart to determine which method can be used.

Preliminary Raising Procedure

See [Figure 4-17](#) for the following procedure.

1. Using hand winch on left side of jib top ([Figure 4-8](#), View A), slacken jib stop control cable until it rests on bottom lacings in the jib.

Jib stop inner strut will not extend properly and pins will not engage if control cable is tight.

2. Support jib stop struts (4, View A) so they cannot fall and remove pins (6) holding struts in stored position.
3. Lower jib stop struts (View B) to operating position (View B). Store pins (6, View A) in boom top lugs (5).
4. Slowly boom up until ends of jib stop inner strut (9, View B) are 2 to 4 ft (0,6 to 1,2 m) off the ground (View C).
5. Pin jib stop pendants (2, View D) to jib stop beam (1).

6. *Stand to side of jib stop strut* and remove quick-release pin (8a, View B) from both sides jib stop strut.

Inner strut will extend slightly when this step is performed.

7. Store quick-release pins (8b, View F) in storage holes on outer strut (10).

8. Slowly boom up until jib stop inner strut is fully extended (View E). Boom to luffing jib angle will be approximately 168°.

Jib stop strut pins (11, View F) should engage automatically when inner strut is fully extended. ***Do not raise the boom any higher until both pins are engaged.***

- NOTE** Outer ends of jib stop strut pins are painted white (or other contrasting color) to make pins more visible from the ground.

9. Check that jib stop control cable is slack: pay out cable until it rests on bottom lacings in boom. ***Jib stop control cable must be slack at all times during luffing jib operation; otherwise, pins may disengage or cable may break.***

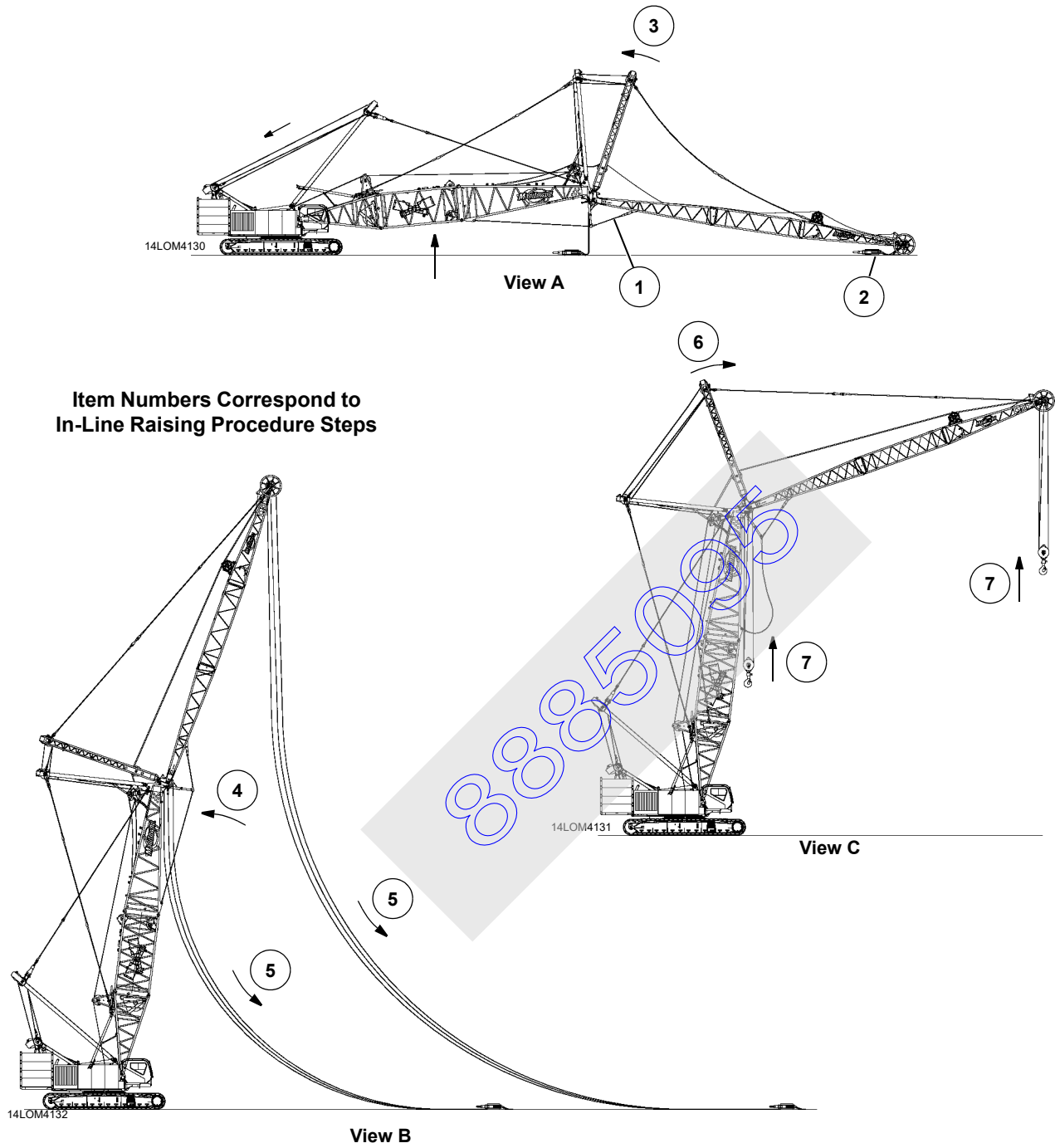


FIGURE 4-18

In-Line Raising Procedure

Item numbers in [Figure 4-18](#) correspond to numbered steps in the following procedure.



WARNING

Tipping Crane Hazard!

For in-line procedure, do not raise boom and jib combinations longer than specified on raising procedure chart. Crane will tip.

NOTE It is normal for the BLOCK UP fault to come on during the raising procedure. The fault will go off once the boom and luffing jib are raised and the load lines/block-up limit chains are hanging freely.

1. Perform Preliminary Raising Procedure.
2. Install load block and/or hook and hook and weight ball if not already done.



WARNING

Tipping Crane Hazard!

Do not lift load blocks or hook and weight balls off the ground until the boom has been raised to desired operating angle and the jib has been positioned at required operating radius. Crane could tip.

3. Slowly luff up until jib and backstay pendants start to go into tension and stop. It will be necessary to use limit bypass switch if MAX UP fault is activated.

CAUTION

Jib Stop Damage!

Do not raise the jib off the ground with luffing hoist during step 3. Jib stop pendants will be over-tensioned, possibly resulting in damage.

4. Slowly raise the boom and jib to desired boom angle. Luffing jib can be operated with the boom at one of seven angles (see capacity chart for boom angles).
5. Pay out load lines as the boom and jib are raised.
6. Luff down to position the jib at required operating radius for load to be handled. It will be necessary to use limit bypass switch if BLOCK UP fault is activated.

7. Lift load blocks or hook and hook and weight balls to desired position.

NOTE When load block from the lower boom point is not in use, it can be tied-off to lug on front of rotating bed.

Jack-Knife Raising Procedure

Item numbers in [Figure 4-19](#) correspond to numbered steps in the following procedure.

See Luffing Jib Rigging Guide and Luffing Jib Raising Procedure Chart for detailed lowering instructions.

For Fold-under luffing jib, remove the fixed jib at this time and proceed to lower the boom and luffing jib. See Luffing Jib Rigging Guide and Luffing Jib Raising Procedure Chart for detailed lowering instructions.



WARNING

Tipping Hazard!

Determine BOOM TO LUFFING JIB ANGLE that the boom and jib must be jack-knifed to before the jib can be raised (see Raising Procedure Chart). Crane will tip or structural damage will result if specified angle is not adhered to.

Monitor angle on digital display as the boom and jib are raised.

CAUTION

Avoid possible structural damage to the boom and jib from side loading as boom and jib are raised:

Disengage swing lock and release swing brake until boom and jib have been raised to required boom to luffing jib angle.

It is normal for the following fault limits to come on during the raising procedure:

- BLOCK UP – this fault will go off once the boom and luffing jib are raised and the load lines/block-up limit chains are hanging freely.
- MAX UP – this fault will go off once the boom to luffing jib angle is less than 168°.

Continued on [page 4-37](#)

Item Numbers Correspond to Jack-Knife Raising Procedure Steps

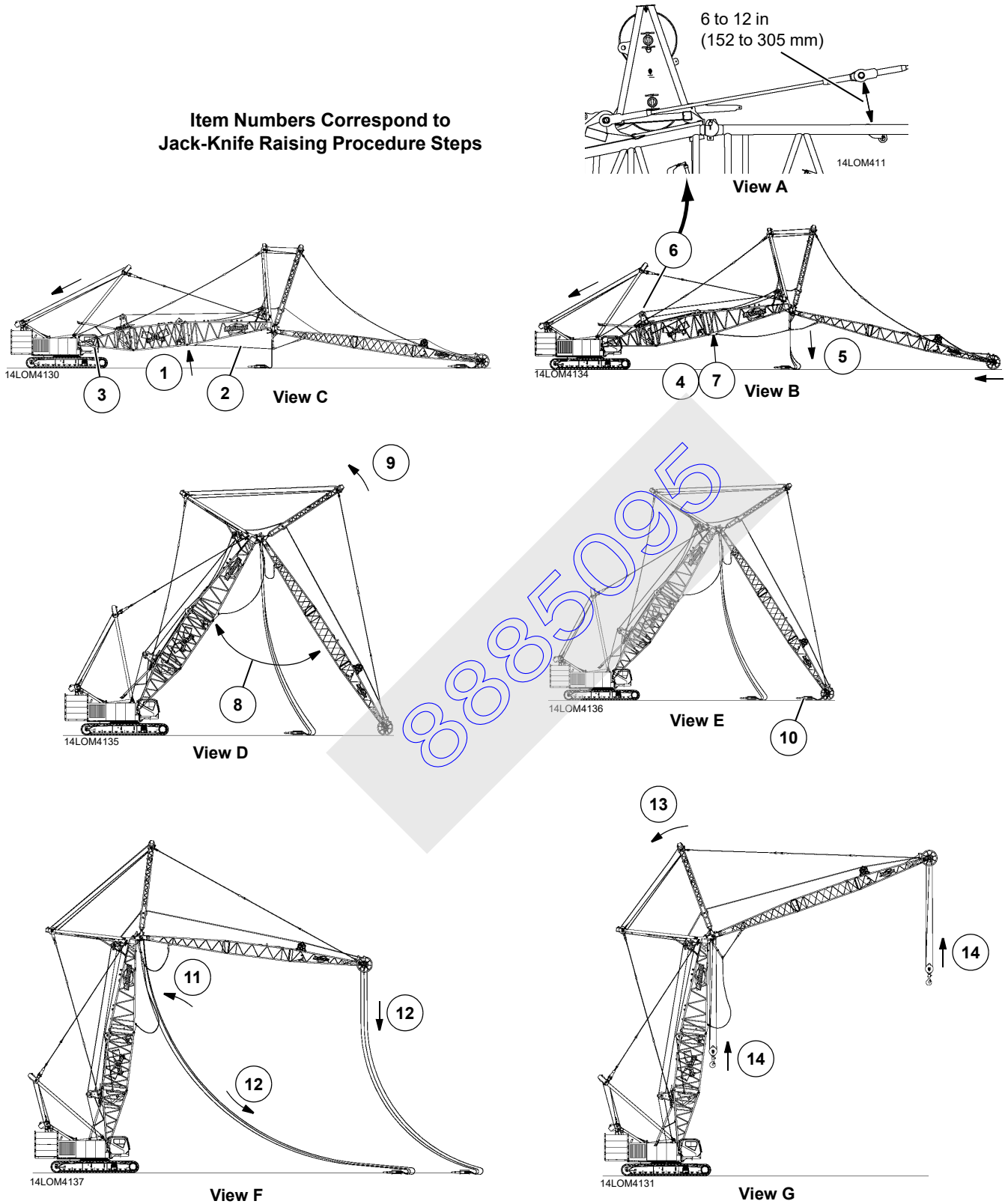


FIGURE 4-19

1. Determine boom to luffing jib angle the boom and jib must be raised to before the jib can be raised (see Luffing Jib Raising Procedure Chart).
2. Perform Preliminary Raising Procedure.
3. Disengage swing lock and release swing brake.
4. Slowly boom up. Jib point rollers will roll along the ground as the boom and jib are jack-knifed into position.
5. Pay out load lines as the boom is raised and jib point rolls along the ground.
7. Slowly continue with Jack-Knife Raising Procedure steps 4 – 6.
8. Stop raising when the boom and jib have been positioned at required boom to luffing jib angle or the jib is vertical, whichever occurs first. **Monitor this angle on display screen.**

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

Do not lift load blocks or hook and weight balls from the ground until the boom has been raised to desired operating angle and the jib has been positioned at required operating radius, or crane could tip.

6. Jib and backstay pendants will tighten as the boom and jib rise.

Operator, watch backstay pendants along left side of the boom. Luff up and down, as required, while the boom and jib rise so backstay pendant connectors nearest you remain 6 to 12 in (152 to 305 mm) above boom chord. It will be necessary to use limit bypass switch to luff down if BLOCK UP fault is activated.

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

Do not allow jib and backstay pendants to become too tight during raising steps. Crane will tip or structural damage will result.

Do not allow jib and backstay pendants to become too slack during raising steps. Pendant connectors will bounce against boom and jib inserts, possibly resulting in damage.

**DANGER****Falling Jib Hazard!**

Do not position the boom and jib at any boom to luffing jib angle less than minimum stop (60°). Structural damage to the jib butt will occur, possibly causing the jib to collapse.

9. Slowly luff up until jib and backstay pendants start to go into tension and stop.
10. Boom up to raise jib point rollers clear of the ground, apply swing brake, and install load blocks or hook and weight balls at jib points.

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

Load line going up the boom can overhaul load line going down the

jib. Do not untie load line from jib until load block or hook and hook and weight ball have been installed. Load line can fall off boom if this precaution is not followed.

11. Slowly raise boom and jib to desired boom angle. Luffing jib can be operated with boom at one of seven angles (see capacity chart for boom angles).
12. Pay out load lines as boom and jib are raised.
13. Position jib at required operating radius.
14. Lift load blocks and/or hook and weight balls to desired position.

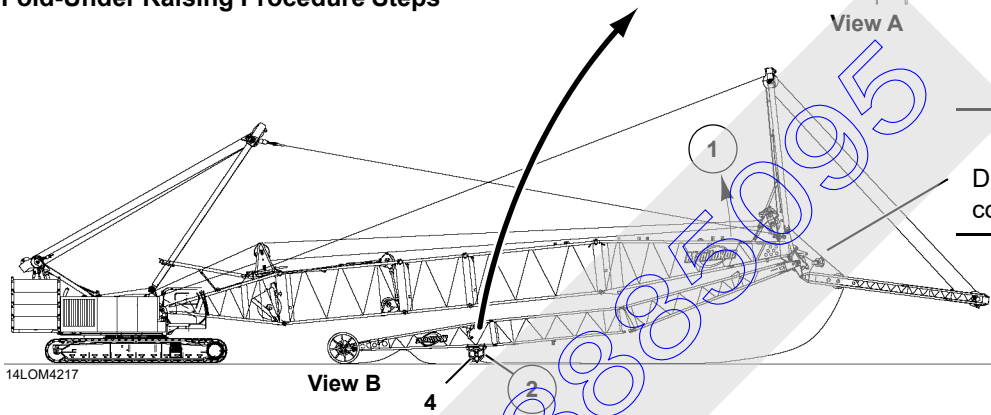
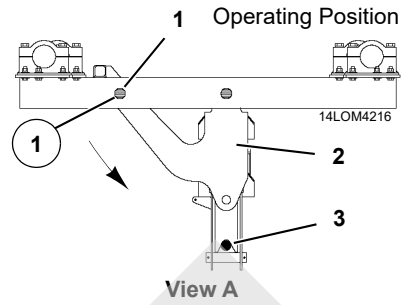
NOTE When load block from lower boom point is not in use, it can be tied-off to lug on front of rotating bed.

Item	Description	Item	Description
1	Pins	8	Pendant Link
2	Jib Top Wire Rope Guide	9	Load Line Attached to Jib Top
3	Load Line	10	Basic Pendants 25 ft 11 in (7,90 m)
4	Clearance 3 ft (0,9 m)	11	Stowable or 20 in (6,10 m) or Non-Stowable Basic Pendants 20 ft 1.5 in (6,13 m)
5	Pendant Link	12	Pendant Link 2 ft (0,61 m) (see NOTE 1:)
6	Jib Strut	13	Jib Pendants - Length Varies (see NOTE 2:)
7	Jib Top		

NOTE 1: Required only for 70 to 100 ft (21,3 to 30,5 m) jib lengths. Must be installed next to basic pendant (10).

NOTE 2: Must be installed in sequence shown on Jib Assembly drawing.

Circled Item Numbers Correspond to Fold-Under Raising Procedure Steps



CAUTION
Do not allow jib strut to contact wire rope roller guide.

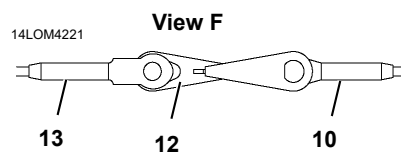
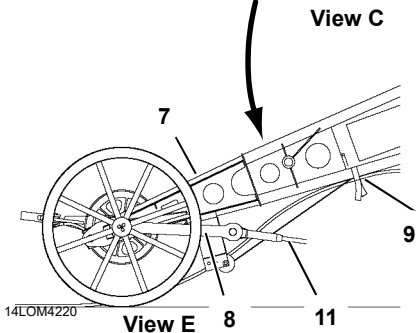
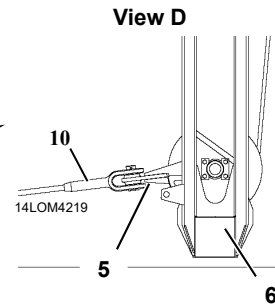
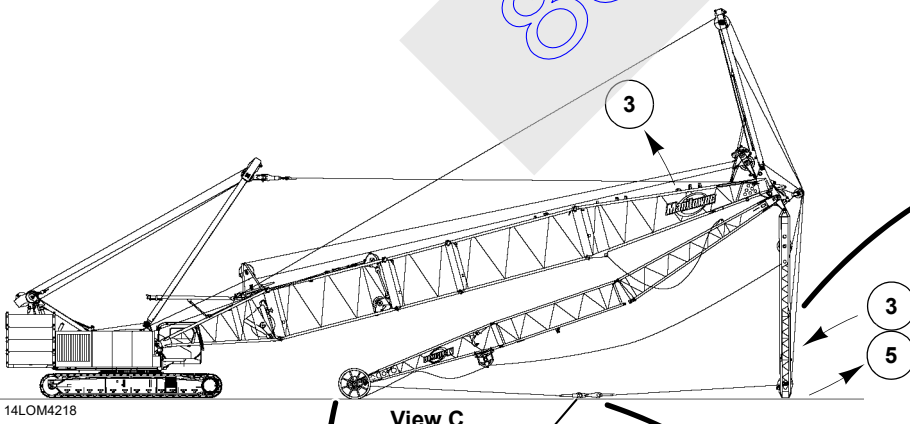


FIGURE 4-20

RAISING BOOM AND JIB — FOLD-UNDER

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



WARNING

Falling Boom And Jib Hazard!

Select appropriate LUFFING JIB chart in Rated Capacity Indicator/Limiter. Operating in any other mode with luffing jib attached is prohibited.

Luffing jib limits are disabled when LUFFING JIB chart is not selected. Boom and jib could be pulled over backwards.



DANGER

Moving Part Hazard!

Warn all personnel to stand clear of jib point rollers while raising the boom and jib.

Death or severe crushing injuries will occur if personnel come into contact with rollers.

NOTE A signal person is required to verify clearances, pin engagement/disengagement, and to ensure jib stop pendants are not kinked or hooked on other parts.

Circled item numbers in [Figure 4-20](#) correspond to numbered steps in following procedure.

1. Slowly boom up until jib top wire rope guide can be lowered to operating position.
Jib point rollers will roll along the ground as the boom and jib are jackknifed into position.
2. Lower jib top wire rope guide to operating position (clearance must be at least 3 ft (0,91 m):
 - a. Tighten control cable to support wire rope guide with hand winch.
 - b. Remove pins (1, View A).
 - c. Lower wire rope guide (2, View A) to operating position and install pins (1).
 - d. Route load line (3, View A) over jib top wire rope guide sheave.

- e. Route load line between jib point rollers and lay on ground under jib.
- f. Securely attach load line to side of jib (9, View E).



CAUTION

Run-Away Wire Rope!

Load line on boom side of attachment can overhaul unsecured load line on jib side. This could cause personal injury and damage to equipment. Securely attach load line to the jib top before raising attachment any further.

3. Slowly continue to boom up and luff down until jib strut hangs vertically 2 to 3 ft (0,61 to 0.91 m) off the ground.

NOTE Signal person, watch jib stop pendants when the boom and jib are raised. Stop raising the boom and jib if pendants get kinked or hooked on other parts. Correct cause of problem before continuing.

4. Install jib pendants:
 - a. Connect basic jib pendants (10) to pendant links (5, View D) at jib strut.
 - b. Connect basic jib pendants (11) to pendant links (8, View E) at jib point.
 - c. If required, connect pendant links (12) to basic jib pendants (10, View F).

NOTE Pendant links (12) are required only for jib lengths of 70 to 100 ft (21,34 to 30,48 m).

- d. Connect remaining jib pendants (13, View F) between basic jib pendants (10) or pendant links (12) and basic jib pendants (11). **Jib pendants must be installed in the same sequence as jib inserts.**
5. Luff up only enough to remove excess pendant slack.



CAUTION

Avoid Jib Strut Damage!

Do not pull jib pendants into tension or struts could be damaged. Remove excess slack only.

Item Description

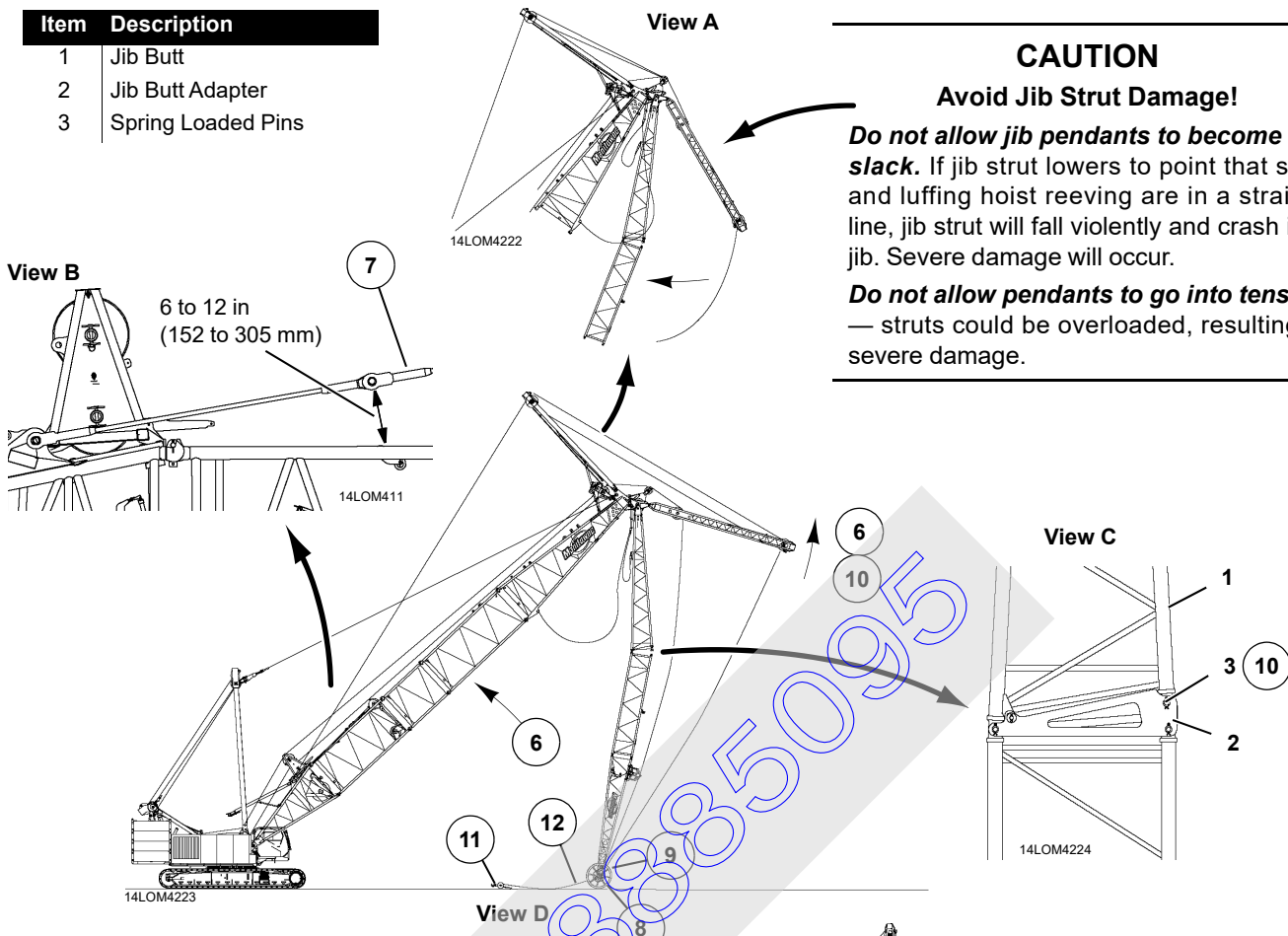
- 1 Jib Butt
- 2 Jib Butt Adapter
- 3 Spring Loaded Pins

CAUTION

Avoid Jib Strut Damage!

Do not allow jib pendants to become too slack. If jib strut lowers to point that strut and luffing hoist reeving are in a straight line, jib strut will fall violently and crash into jib. Severe damage will occur.

Do not allow pendants to go into tension — struts could be overloaded, resulting in severe damage.



Circled Item Numbers Correspond to Fold-Under Raising Procedure Steps

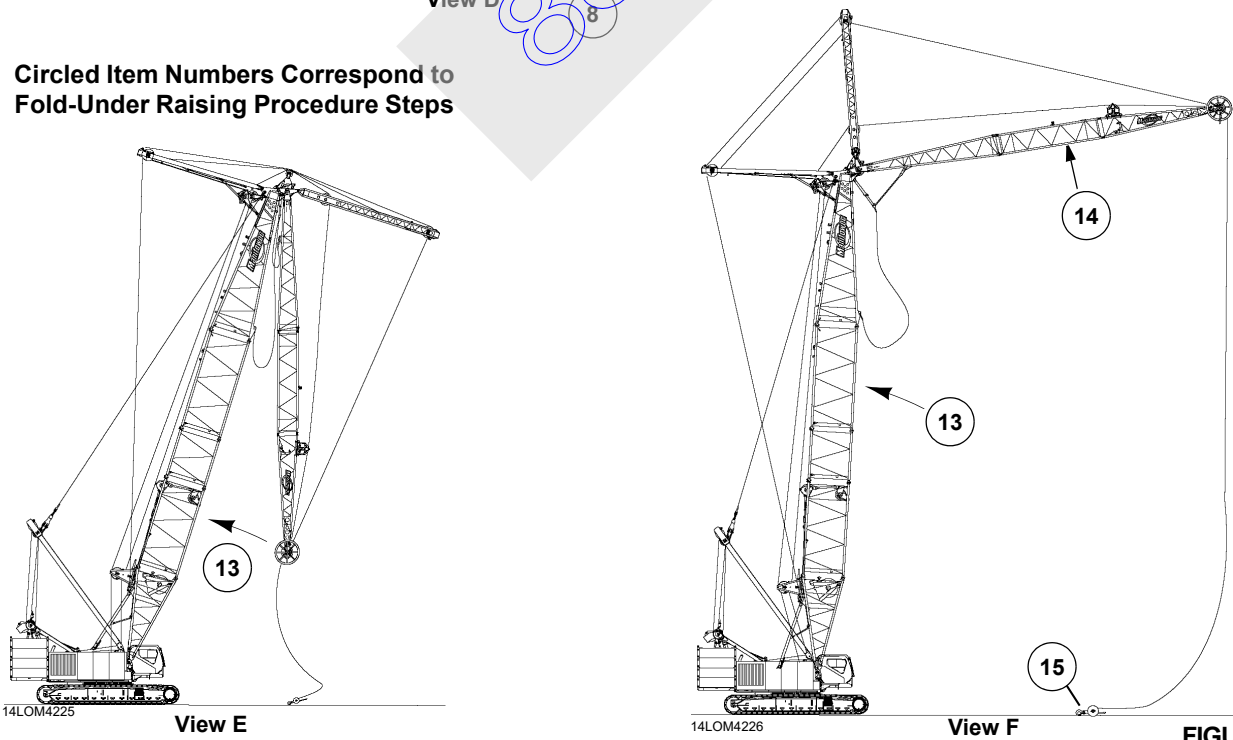


FIGURE 4-21

Circled item numbers in [Figure 4-21](#) correspond to numbered steps in the following procedure.

6. Continue to slowly boom up and luff up to raise the boom and jib.
7. Operator, watch backstay pendants along left side of the boom while raising the boom and jib (View B). Control luff up speed as required, so the backstay pendant connectors nearest you remain 6 to 12 in (152 to 305 mm) above boom chord.

CAUTION

Avoid Jib Strut Damage!

Do not allow jib pendants to become too slack. If jib strut lowers to a point that strut and luffing hoist reeving are in a straight line, jib strut will fall violently and crash into the jib. Severe damage will occur.

Do not allow pendants to go into tension — struts could be overloaded, resulting in severe damage.

8. Stop booming and luffing up when the jib is vertical with rollers 1 to 2 ft (0,30 to 0,61 m) off the ground.
9. Using hand winch, loosen control cable for spring loaded pins (3) on jib butt adapter (2, View C).

Spring loaded pins will not engage if control cable is not slack.

10. Slowly luff up only to point that spring loaded pins on jib butt adapter fully engage to connect jib butt to adapter.
11. Install load line:
 - a. Route wire rope through desired lower jib point sheaves.
 - b. Install load block or hook and weight ball.
Read Liftcrane Luffing Jib Capacity Chart to determine minimum block weight for backward stability.

- c. Untie load line from side of jib top.



WARNING

Falling Load Hazard!

Load lines going up the boom can overhaul load lines going down the jib. Do not untie load lines from the jib until load block and/or hook and weight ball have been installed. Load lines can fall off the boom if this precaution is not followed.

12. Install block-up limit for jib point (see Block-Up Limit Control topic in Section 6).
13. Continue to boom up to desired boom angle.



WARNING

Tipping Crane Hazard!

Do not lift load blocks or hook and weight ball off the ground until the boom and jib have been raised to required operating radius as specified on capacity chart. Crane may tip.

14. Luff up to required working radius.



WARNING

Tipping Crane Hazard!

Do not luff up until the boom is at or above 60°. Crane could tip.

15. Load block or hook-and-weight ball can now be lifted from the ground.

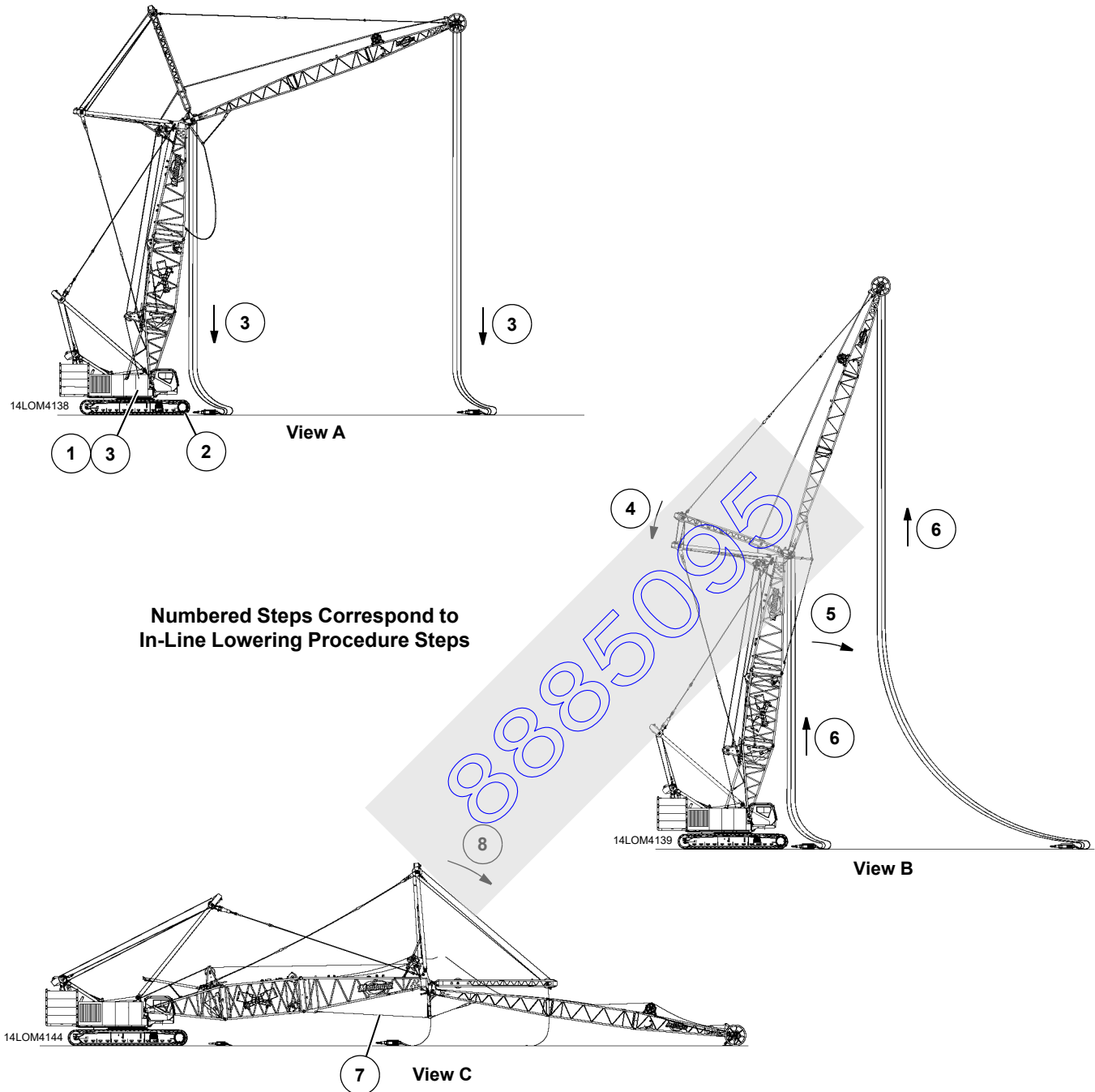


FIGURE 4-22

LOWERING BOOM AND JIB

General



WARNING

Falling Boom And Jib Hazard!

Select appropriate LUFFING JIB chart in RCL. Operating in any other mode with luffing jib attached is prohibited.

Luffing jib limits are disabled when LUFFING JIB chart is not selected. Boom and jib could be pulled over backwards.



DANGER

Moving Part Hazard!

Warn all personnel to stand clear of jib point rollers while lowering the boom and jib.

Death or severe crushing injuries will occur if personnel come into contact with rollers.

As defined in the raising procedure chart, one of two methods can be used to lower the boom and jib depending on the boom and jib combination:

- In-Line Method
- Jack-Knife Method

See raising procedure chart to determine which method can be used.

In-Line Lowering Procedure

Item numbers in [Figure 4-22](#) correspond to numbered steps in the following procedure.

NOTE It is normal for the BLOCK UP and MAX UP fault to come on during the lowering procedure.

1. Swing upperworks in-line with lowerworks so boom is over *front* of crawlers.
2. If required, travel front crawler rollers onto blocking.



DANGER

Tipping Crane Hazard!

If required per Luffing Jib Capacity Chart and Raising Procedure Chart, lower the boom and jib over blocked crawlers; otherwise the crane will tip.

3. Swing the boom and jib slightly to either side of center and lower load blocks and/or hook and weight balls onto the ground. Then swing boom and jib in-line with crawlers.



WARNING

Tipping Crane Hazard!

Lower all load blocks and/or hook and hook and weight balls onto the ground before lowering the boom and jib. Crane could tip if this step is not performed.



DANGER

Tipping Crane Hazard!

For in-line method, do not lower boom and jib combinations longer than specified in Luffing Jib Raising Procedure Chart. Crane will tip.

4. Raise the jib to 168° boom to luffing jib angle.
5. Slowly boom down to lower the boom and jib until jib point rollers contact the ground. It will be necessary to use limit bypass switch if BLOCK UP fault is activated.
6. Haul in load lines as the boom and jib are lowered, but do not lift load blocks or hook and weight balls off the ground.

CAUTION

Jib Stop Damage!

Do not lower the boom any farther until in-line lowering step 7 is performed. Once jib point rollers contact the ground, damage to jib stop struts or pendants will result if struts are over tensioned.

7. Retract and store jib stop struts. Perform Final Lowering Procedure.
8. Jib struts and main struts can now be lowered, if required. See Lowering Jib Strut and Main Strut topic in this section for procedure.

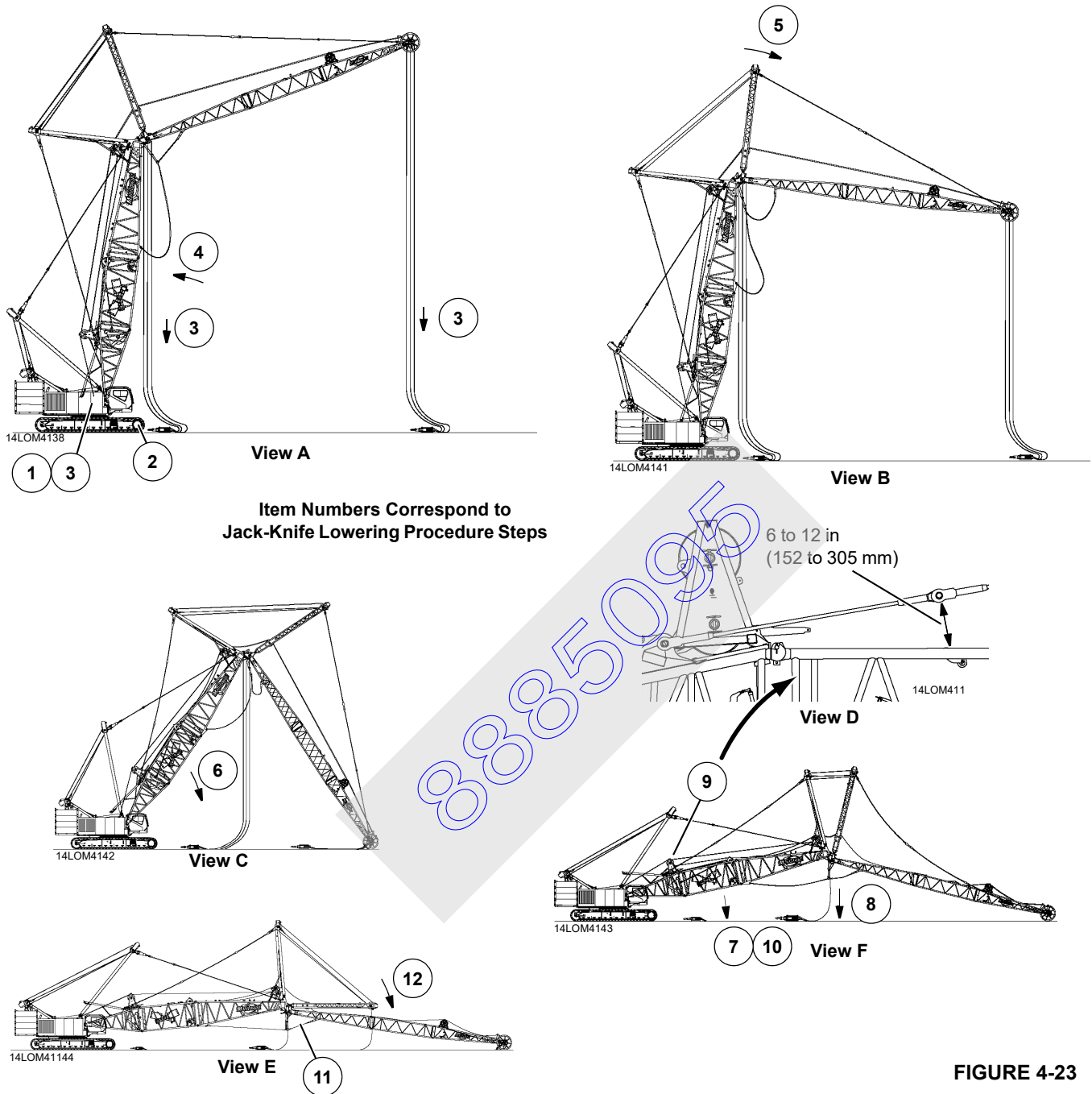


FIGURE 4-23

Jack-Knife Lowering Procedure

Item numbers in [Figure 4-23](#) correspond to numbered steps in the following procedure.

NOTE It is normal for the BLOCK UP and MAX UP fault to come on during the lowering procedure.

1. Swing upperworks in-line with lowerworks so boom is over front of crawlers.
2. If required, travel front crawler rollers onto blocking.



DANGER

Tipping Crane Hazard!

If required per Luffing Jib Capacity Chart and Raising Procedure Chart, lower the boom and jib over blocked crawlers; otherwise the crane will tip.

3. Swing the boom and jib slightly to either side of center and lower load blocks and/or hook and weight balls onto the ground. Then swing the boom and jib in-line with crawlers and apply swing brake.

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

Lower all load blocks and/or hook and weight balls onto the ground before lowering the boom and jib. Crane could tip if this step is not performed.

4. Raise the boom to a minimum angle of 85°.
5. Position the jib at the required boom to luffing jib angle (see Luffing Jib Raising Procedure Chart for this angle).

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

For jack-knife method, do not lower the boom and jib to the ground until the boom has been positioned at minimum boom angle of 85° and jib has been positioned at the specified boom to luffing jib angle. Crane will tip.

Falling Jib Hazard!

Do not lower the jib to any boom to luffing jib angle less than minimum stop (60°). Structural damage to the jib butt will occur, possibly causing the jib to collapse.

CAUTION**Boom or Jib Damage!**

Avoid possible structural damage to the boom and jib from side loading as the boom and jib are lowered:

Disengage swing lock and release swing brake when jib point rollers contact the ground.

6. Slowly lower the boom until jib point rollers contact the ground.

Depending on boom and jib combination, the jib may be hanging vertical when rollers contact ground. If this happens, raise jib (luff up) until the jib is a few degrees forward of vertical.

It will be necessary to use limit bypass switch to boom down if BLOCK UP fault is activated.

7. Release swing brake (disengage swing lock) and continue to lower the boom slowly.

Jib point rollers will roll along the ground as the boom and jib are jack-knifed into position.

8. Haul in load lines as the boom and jib are lowered.

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

Do not allow jib and backstay pendants to become too tight during lowering steps. Crane will tip or structural damage will result.

Do not allow jib and backstay pendants to become too slack during lowering steps. Pendant connectors will bounce against boom and jib inserts, possibly resulting in damage.

9. Jib and backstay pendants will slacken as the boom and jib lower.

Operator, watch backstay pendants along left side of the boom. Luff up and down, as required, while the boom and jib lower so backstay pendant connectors nearest you remain 6 to 12 in (152 to 305 mm) above boom chord.

It will be necessary to use limit bypass switch to luff down if BLOCK UP fault is activated.

10. Continue with Jack-Knife Lowering Procedure steps until jib stop pendants start to go into tension (approximately 168° boom to jib angle). **Monitor this angle on display screens.**

CAUTION**Jib Stop Damage!**

Once jib stop pendants start to go into tension, do not lower the boom any farther until jack-knife lowering step 11 is performed. Damage to jib stop struts or pendants will result if struts are over tensioned.

11. Retract and store jib stop struts. Perform Final Lowering Procedure.

12. Jib struts and main struts can now be lowered, if required. See Lowering Jib Strut and Main Strut topic in this section for procedure.

Final Lowering Procedure

See [Figure 4-17](#) for the following procedure.

Perform the following steps once the boom and jib have been lowered to either of the following positions:

- IN-LINE PROCEDURE — jib point rollers just contact the ground.
 - JACK-KNIFE PROCEDURE — jib stop pendants just start to go into tension (approximately 168° boom to jib angle).
1. Disengage jib stop strut pins with hand winch on left side of jib top ([Figure 4-8](#), View A).

NOTE Outer end of jib stop strut pins are painted white (or other contrasting color) to make pins more visible from the ground.

2. Slowly lower the boom to retract jib stop inner strut.
It will be necessary to use limit bypass switch to boom down if BLOCK UP or MAX UP fault is activated.
3. Stop lowering the boom when jib stop inner strut is fully retracted (View B).
4. Remove both quick-release pins (8b, View F) from storage holes and install pins (8a, View B) to connect jib stop inner strut to outer strut in retracted position.
5. Unpin both jib stop pendants (2, View D) from jib stop beam (1).
6. Rotate jib stop strut (4, View A) rearward and pin to the boom top for storage.
7. Lower the boom top onto blocking so distance from center of lower boom point shaft to the ground is approximately 29 in (737 mm) as shown in [Figure 4-4](#), View E.
8. Lower jib strut and main strut if required.

Lowering Jib Strut and Main Strut



WARNING **Moving Part Hazard!**

Do not stand on the boom top or jib butt while main strut is being raised or lowered.

Wait until main strut is stopped and supported by load line or luffing hoist wire rope before climbing onto the boom top or jib butt when connecting and disconnecting strut stop tubes.

See [Figure 4-12](#) in the following steps.

1. Luff down to lower jib strut to approximately 2 ft (0,6 m) above top of jib and stop (View C).
Guide pendants while luffing down to assure pendants and connectors do not strike side of the jib.
2. Unpin basic jib pendants (13, View C) from pendant links (12) on jib strut.
3. Remove hold-down pins (10, View D) from stored position in hold-down lugs on jib adapter.
4. Pay out luffing hoist wire rope as required to lower jib strut (8, View D) to hold-down pin position.
5. Pin jib strut to hold-down lugs (View D).
6. Remove quick-release pins (7, View B) from storage holes in main strut stop tubes and install both quick-release pins in erecting holes (6). It may be necessary to luff up or down slightly to align holes.
7. Remove both stop pins (3, View B). It may be necessary to luff up or down slightly to loosen pins.

See [Figure 4-11](#) in the following steps.

8. Pay out luffing hoist wire rope to lower main strut until holes in middle stop tubes (12, View E) line up with bottom holes in lower stop tubes (16).
9. Install stop pins (18, View E) to connect middle stop tubes (12) to lower stop tubes (16).
10. Unpin basic backstay pendants (9, View D) on main strut from backstay pendants or links on the boom. Lower pendants onto the boom top.
11. Remove load block or hook and weight ball from rear drum load line (if attached).
12. Guide load line (1, View F) from rear drum over upper sheave in wire rope guide (7) on the boom butt.
13. **Temporarily remove rope guard (8) or it will be damaged.**
14. Continue to guide load line over center of upper shaft in boom top wire rope guide.
15. Remove socket and wedge from jib point and attach it to load line from rear drum (View B).
16. Unpin strut handling link (3, View A) and pendant (4) from storage lugs on main strut.
17. Pin socket and wedge on load line from rear drum to strut handling link (3, View B).
18. Haul in rear drum load line so load line and strut handling pendant are just slightly slack.

Keep load line slacker than luffing hoist wire rope so jib strut is not over tensioned.

19. Unpin lower stop tubes (16, View E) from lugs on the boom top. It may be necessary to luff up or down to loosen pins.
20. Slowly pay out load line while hauling in luffing hoist wire rope to raise main strut to vertical.
21. Tighten load line as main strut nears vertical so strut moves smoothly past vertical.
22. Continue to lower main strut to approximately 3 ft (1 m) above jib strut.
23. Unpin strut supports (6b, [Figure 4-7](#), View A) from storage position and allow them to hang vertically. Slowly pay out load line to lower strut supports to lugs on jib strut.
24. Pin strut supports to lugs on jib strut.
25. Unpin strut handling link (3, [Figure 4-9](#), View B) from socket and wedge (2) and pin link and pendant to storage lugs on main strut (View A).
26. Remove socket and wedge from rear drum load line and reinstall at jib point.

Removing Jib

Removing the jib is opposite of installing the jib. If a fixed jib is attached, remove the fixed jib from luffing jib top (see Removing Fixed Jib topic in this section). The luffing jib butt and jib strut can be removed and shipped as an assembled unit.

NOTE Automatic boom stop must be reset to 84° for operation without the luffing jib (see Automatic Boom Stop topic in Section 6 of this manual).

Remove and store the wind speed indicator assembly so it is not damaged during shipping.



WARNING

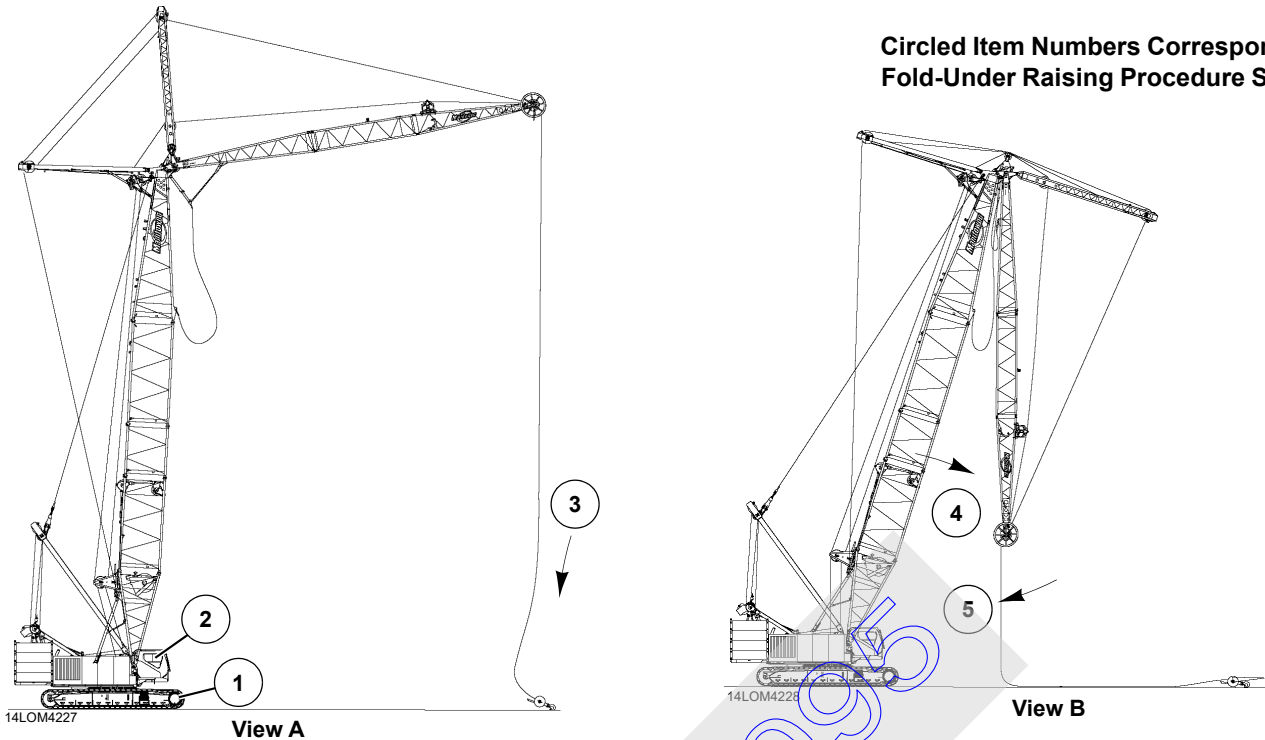
Collapsing Boom/Jib Hazard!

Improper disassembly of the boom and jib sections can cause the boom or jib to collapse onto personnel removing connecting pins.

Death or serious injury can result if the precautions listed below are not taken:

- Lower the boom/jib so boom and jib points are supported on blocking on the ground.
- Slacken rigging — do not attempt to remove connecting pins while the boom or jib is supported by rigging.
- Block below both ends of each boom or jib section before removing connecting pins.

Stand on outside of boom or jib sections when removing connecting pins. Never work under or inside boom or jib sections. Use care not to damage lacings and chords as pins are knocked out.



Circled Item Numbers Correspond to Fold-Under Raising Procedure Steps

Item	Description
1	Jib Butt
2	Jib Butt Adapter
3	Spring Loaded Pins
4	Pendant Link

CAUTION

Avoid Jib Strut Damage!

Do not allow jib pendants to become too slack. If jib strut lowers to point that strut and luffing hoist reeving are in a straight line, jib strut will fall violently and crash into jib. Severe damage will occur.

Do not allow pendants to go into tension — struts could be overloaded, resulting in severe damage.

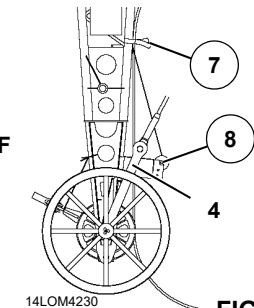
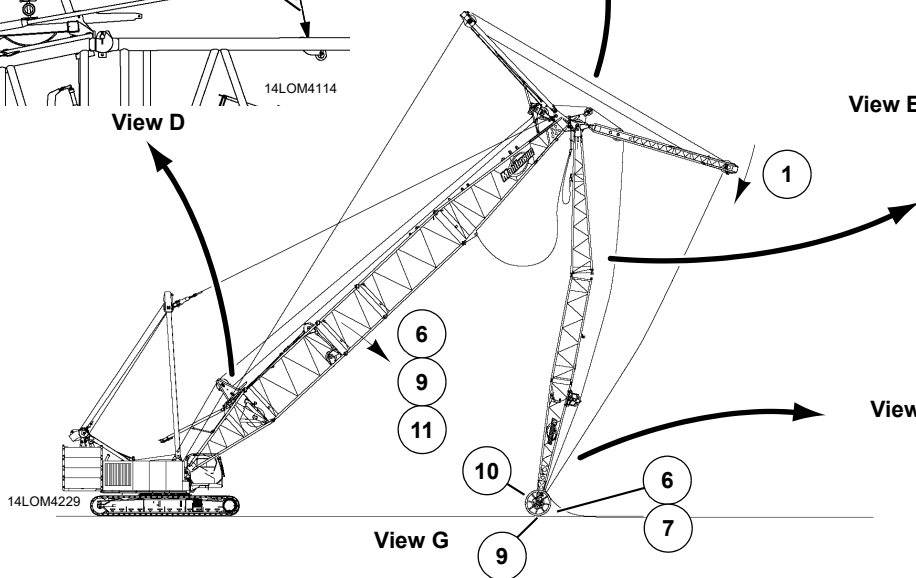
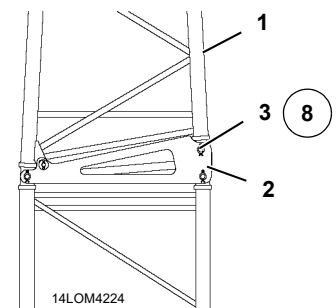
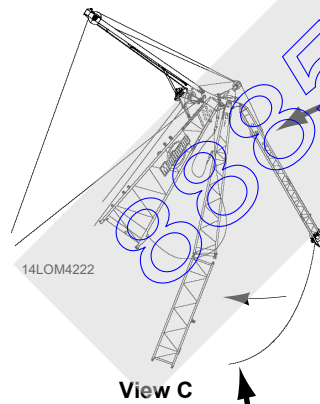
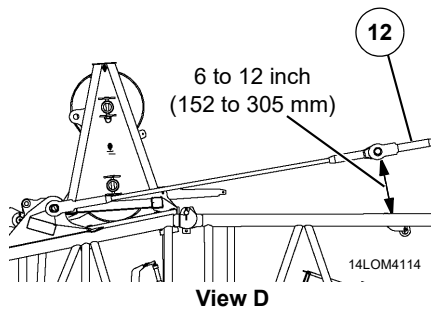


FIGURE 4-24

LOWERING BOOM AND JIB — FOLD-UNDER

See [Figure 4-24](#) and [Figure 4-25](#) for the following procedure.



DANGER

Moving Part Hazard!

Warn all personnel to stand clear of jib point rollers while lowering the boom and jib.

Death or severe crushing injuries will occur if personnel come into contact with rollers.

NOTE All boom lowering must be done over front of blocked crawlers. No travel is allowed.

A signal person is required to verify clearances, pin engagement/disengagement, and ensure jib stop pendants are not kinked or hooked on other parts.

Circled item numbers in [Figure 4-24](#) correspond to numbered steps in the following procedure.

1. Travel front crawler rollers onto blocking. See Luffing Jib Capacity Charts and Raising Procedure Charts for blocked crawler requirements. Also see Crawler Blocking Diagram in Luffing Jib Capacity Chart Manual for instructions.



WARNING

Tipping Hazard!

Do not attempt to lower the boom and jib to the ground until front crawler rollers are blocked. Crane will tip.

2. Swing upperworks in-line with lower works so the boom is over front of crawlers.
3. Lower load block or hook-and-weight ball onto ground.



WARNING

Tipping Hazard!

Do not attempt to lower the boom and jib to the ground until all load blocks and/or hook and weight balls have been lowered to the ground. Crane may tip.

NOTE Haul in load line while performing steps 5 through 19, but do not lift load block or hook-and-weight ball off the ground.

4. Slowly boom down to lower the boom to 75°.
5. Slowly luff down to lower the jib until it hangs vertically.

6. Boom down to lower the boom until jib point rollers are 1 to 2 in (25 to 51 m) off the ground.
7. Remove load block or hook-and-weight ball:
 - a. Attach load line to side of the jib top before removing load block or hook-and-weight ball (View F).
 - b. Remove block up limit chain and weight from load line. Connect terminating plugs to jib top junction box.
 - c. Remove load block or hook-and-weight ball.
 - d. Move load line to a position that will prevent it from being rolled over by jib point rollers.
 - e. Securely tie up dead-end link at the jib point so it cannot dig into the ground.



CAUTION

Run-Away Wire Rope!

Load line on boom side of attachment can overhaul unsecured load line on jib side. This could cause personnel injury and damage to equipment. Securely attach load line to the jib top before removing load block or hook-and-weight ball.

8. Using hand winch on right side of the jib top, disengage spring loaded pins at jib butt adapter (3, View E). Engage pawl on winch to keep pins disengaged.
 - a. It may be necessary to luff down slightly to remove loading on pins.
 - b. Jib butt will slowly rotate to offset position when pins are disengaged.
9. Boom down until jib point rollers lightly contact ground.

NOTE For soft ground, it may be necessary to lay wood planks on the ground so jib point rollers do not dig in as the boom and jib are lowered.

10. Securely attach an assist crane to the jib point. Assist crane is required to assist in pulling the jib under the boom during step 11.

CAUTION

Avoid Wire Rope Damage!

Watch load line going up back side of the boom. Keep load line slack during remainder of lowering procedure.

11. Slowly boom down and luff down while pulling jib under boom.

Continue this step until jib point rollers roll freely on their own. Then disconnect assist crane.

Circled Item Numbers Correspond to Fold-Under Raising Procedure Steps

CAUTION

Avoid Jib Strut Damage!
Do not allow jib strut to contact wire rope roller guide.

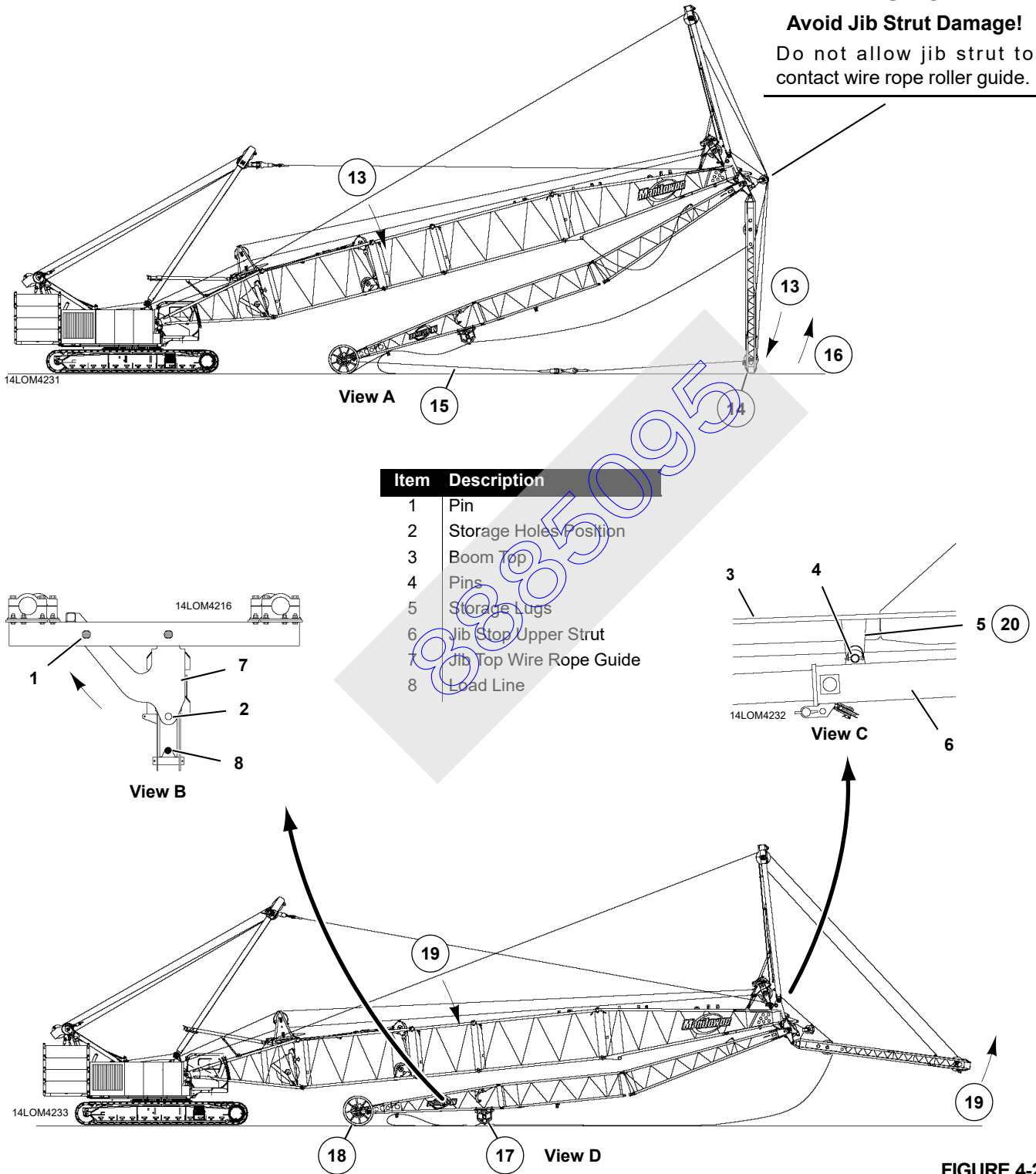


FIGURE 4-25

12. Operator, watch backstay pendants along left side of the boom. Luff up and down, as required, while the boom and jib lower so backstay pendant connectors nearest you remain 6 to 12 in (152 to 305 mm) above boom chord (Figure 4-24, View D).

Circled item numbers in Figure 4-25 correspond to numbered steps in the following procedure.

CAUTION

Avoid Jib Strut Damage!

Do not allow jib pendants to become too slack. If jib strut lowers to point that strut and luffing hoist reeving are in a straight line, jib strut will fall violently and crash into the jib. Severe damage will occur.

Do not allow pendants to go into tension — struts could be overloaded, resulting in severe damage.

-
13. Continue to slowly lower the boom and luff down.
14. Stop booming down and luffing down when jib strut is 3 to 6 in (76 to 152 mm) from contacting the ground.
15. Remove jib pendants from between jib strut and jib point.
16. Luff up to raise jib strut clear of the ground.

CAUTION

Avoid Jib Strut Damage!

Do not allow jib strut to contact jib point roller assembly at the boom point.

17. Continue to slowly boom down and luff up until jib top wire rope guide is 1 to 2 ft (0,30 to 0,61 m) from contacting the ground. Retract jib top wire rope guide as follows:

- a. Remove pin (1, View B).
- b. Using hand winch, raise wire rope guide to storage holes position (2, View B) aligned with holes in frame.
- c. Install pins (4) to retain wire rope guide with storage lugs (5, View C).

18. Rotate winch control handles on the jib top to required position and engage winch pawls so handles cannot contact the ground.

19. Slowly continue to boom down and luff up to lower the boom to final position.

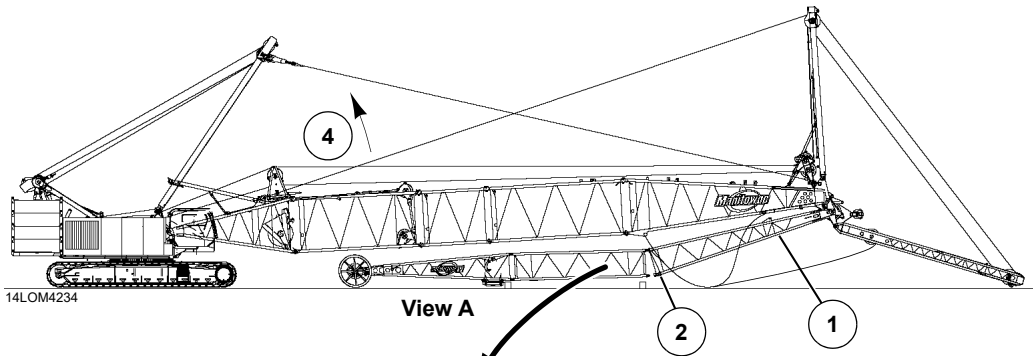
CAUTION

Avoid Parts Damage!

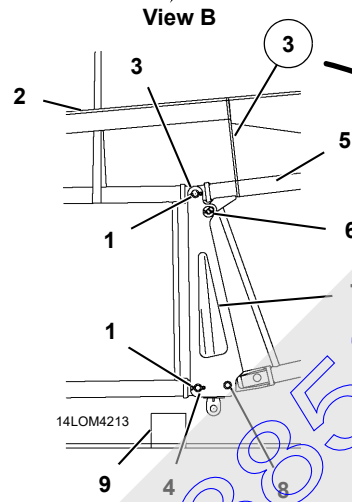
Watch closely for interference at the following locations:

- Jib top wire rope guide – do not allow it to contact the ground.
- Boom lacings – do not allow the jib to contact boom lacings.
- Jib stop struts – do not allow them to contact boom lacings.

-
20. Stop booming down when slotted holes in storage lugs on the boom top line up with holes in storage lugs on jib stop upper strut (View C). Install pins to fasten jib stop struts in storage position on the boom top.

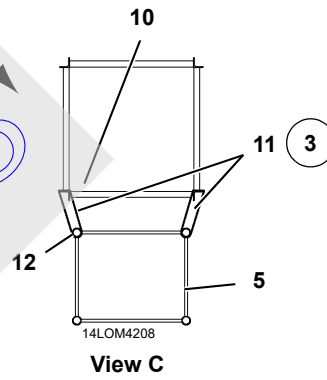


View A



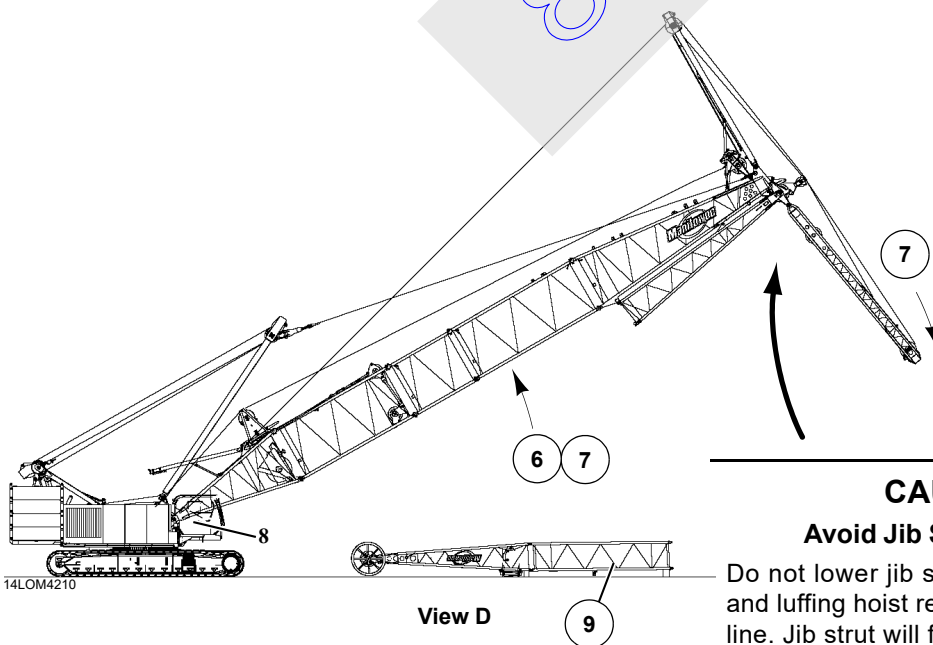
View B

Circled Item Numbers Correspond to Fold-Under Raising Procedure Steps



View C

Item	Description
1	Pins
2	Jib Insert
3	Top Hole
4	Bottom Hole
5	Jib Butt
6	Pin and Washers
7	Jib Butt Adapter
8	Spring Loaded Pins
9	Blocking
10	Boom Top Chords
11	Nylon Slings & Shackles
12	Jib Butt Chords



View D

CAUTION

Avoid Jib Strut Damage!

Do not lower jib strut to point that strut and luffing hoist reeving are in a straight line. Jib strut will fall violently and crash into the jib. Severe damage will occur.

FIGURE 4-26

Disassemble Jib Top and Inserts — Fold-Under

See [Figure 4-26](#) and [Figure 4-27](#) for the following procedure.

Circled item numbers in [Figure 4-26](#) apply to the following procedure.

1. Remove jib stop pendants.
2. Securely block beneath the jib top and insert connectors.
3. Secure the jib butt beneath the boom top by attaching nylon slings and shackles to both sides of top chords of the jib butt and bottom chords of the boom top (Views B and C).
4. Boom up just enough to support the boom.
5. Remove pins (1, View B) to disconnect jib butt adapter from insert.
6. Slowly raise the boom and swing as required to allow room to remove inverted jib insert(s) and top.
7. Luff down while booming up until the jib strut is in-line with main strut.

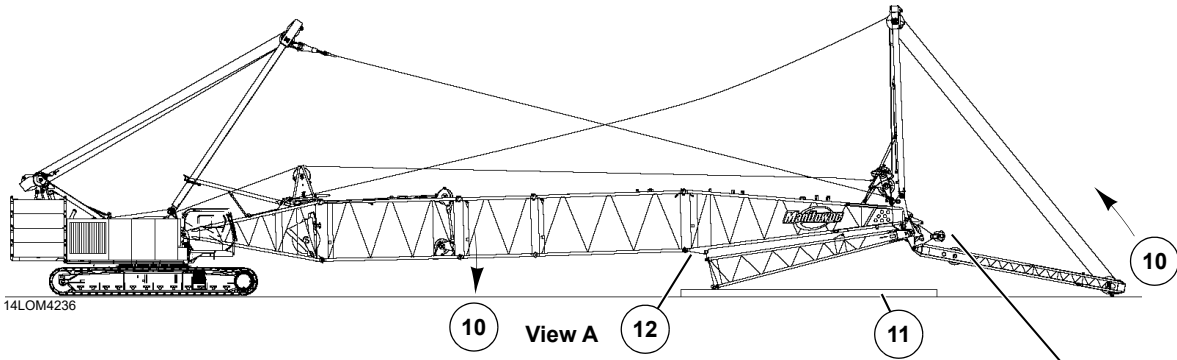
CAUTION

Avoid Jib Strut Damage!

Do not lower jib strut to point that strut and luffing hoist reeving are in a straight line. Jib strut will fall violently and crash into the jib. Severe damage will occur.

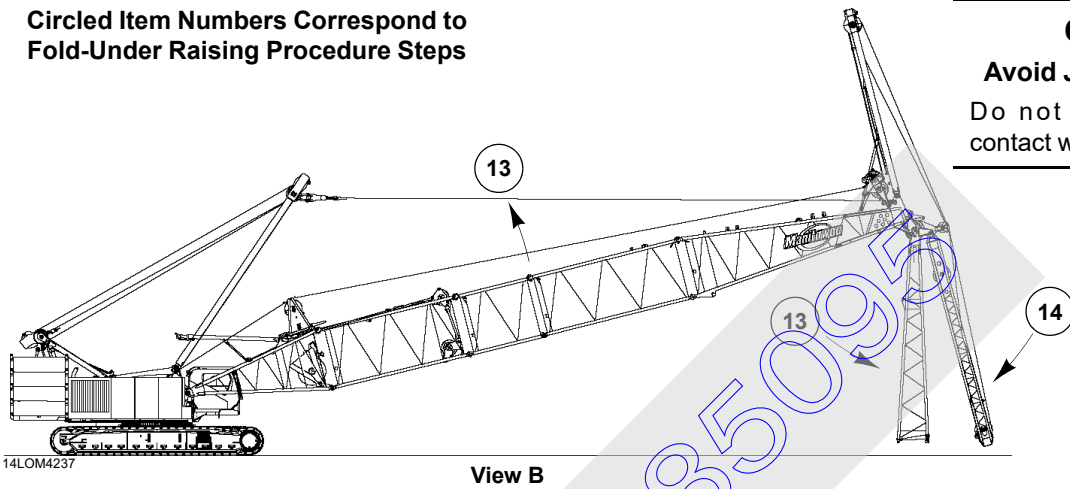
8. Engage swing lock and boom hoist pawl. Apply boom hoist parking brake to hold the boom in position.
9. Remove the jib top and inserts. Reverse installation steps.

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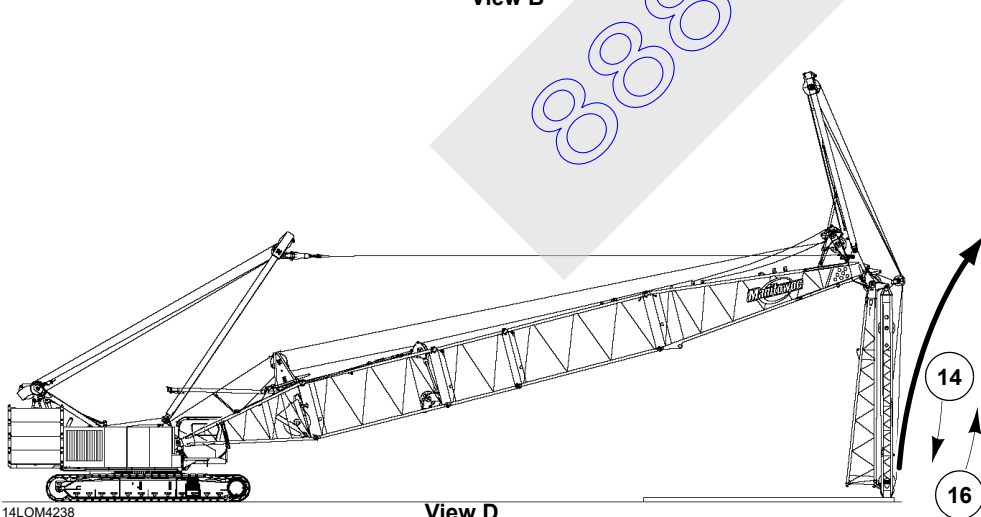


Circled Item Numbers Correspond to Fold-Under Raising Procedure Steps

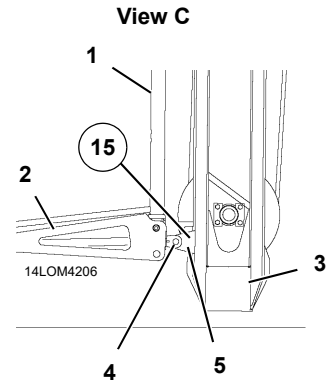
CAUTION
Avoid Jib Strut Damage!
 Do not allow jib strut to contact wire rope roller guide.



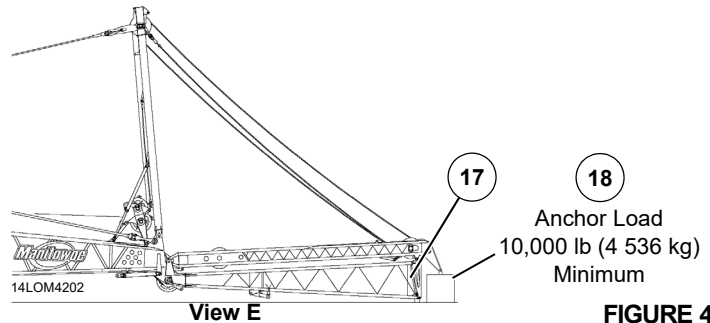
View B



View D



View C



View E

Item	Description
1	Jib Butt
2	Jib Butt Adapter
3	Jib Strut
4	Hold Down Pins
5	Hold Down Lugs

Anchor Load
 10,000 lb (4 536 kg)
 Minimum

FIGURE 4-27

Circled item numbers in [Figure 4-27](#) apply to the following procedure.



WARNING **Collapsing Boom/Jib Hazard!**

Improper disassembly of boom and jib sections can cause the boom or jib to collapse onto personnel removing connecting pins.

Death or serious injury can result if the precautions listed below are not taken:

- Lower the boom/jib so boom and jib points are supported on blocking on the ground.
- Slacken rigging — do not attempt to remove connecting pins while the boom or jib is supported by rigging.
- Block below both ends of each boom or jib section before removing connecting pins.
- Stand on outside of boom or jib sections when removing connecting pins. Never work under or inside boom or jib sections. Use care not to damage lacing and chords as pins are knocked out.

10. Slowly lower the boom and luff up until the butt is 1 to 2 in (25 to 51 mm) from the ground.

CAUTION

Avoid Jib Strut Damage!

Do not allow the jib strut to contact wire rope guide on the boom point.

11. Place wooden plank beneath jib butt adapter to prevent lug on jib butt adapter contacting the ground.
12. Untie the butt from the top by removing slings and shackles securing the jib butt to boom top.
13. Slowly boom up to allow the jib butt to lower to vertical.
14. Luff down to lower the jib strut to vertical.
15. Remove hold-down pins from stored position and attach jib strut to jib butt adapter by inserting hold-down pins (4) through hold-down lugs (5, View C).
16. Luff up to raise jib strut and jib butt in line with the boom.

CAUTION

Avoid Jib Strut Damage!

Do not allow the jib strut to contact wire rope roller guide on the boom point.

17. Lower the boom and jib butt with jib strut onto blocking.
18. Prevent the jib strut and jib butt from raising during main strut lowering procedure by anchoring jib strut to a minimum load of 10,000 lb (4 536 kg).

Lower Main Strut and Disconnect Backstay Pendants



WARNING **Moving Part Hazard!**

Do not stand on the boom top or jib butt while main strut is being raised or lowered.

Wait until main strut is stopped and supported by load line or luffing hoist wire rope before climbing onto the boom top or jib butt when connecting and disconnecting strut stop tubes.

1. Remove quick-release pins from storage holes in main strut stop tubes ([Figure 4-11](#), View F) and install both quick-release pins in erecting holes. It may be necessary to luff up or down slightly to align holes.
2. Remove both stop pins from both middle stop tubes ([Figure 4-11](#), View F). It may be necessary to luff up or down slightly to loosen pins.
3. Pay out luffing hoist wire rope to lower main strut until holes in middle stop tubes line up with bottom holes in lower stop tubes ([Figure 4-11](#), View F).
4. Install stop pins to connect middle stop tubes to lower stop tubes ([Figure 4-11](#), View F).
5. Unpin basic backstay pendants ([Figure 4-9](#), 20) on main strut from backstay pendants or links allowing pendants to rest on the boom top.
6. Route front drum load line through upper guide sheave as shown in [Figure 4-11](#), View G.
7. Remove socket and wedge from jib point.
8. Connect socket and wedge for 1 inch (25,4 mm) rope to load line from front drum ([Figure 4-11](#), View B).
9. Unpin strut handling link and strut handling pendant from storage lugs on main strut ([Figure 4-11](#), View A).
10. Pin socket on load line to strut handling link ([Figure 4-11](#), View B).
11. Haul in front drum load line so load line and strut handling pendant are just slightly slack.

Keep load line slacker than luffing hoist wire rope so jib strut is not over tensioned.

12. Unpin lower stop tubes from lugs on the boom top ([Figure 4-11](#), View F). It may be necessary to luff up or down to loosen pins.
13. Slowly pay out load line while hauling in luffing hoist wire rope to raise main strut to vertical.

CAUTION

Avoid Jib Strut Damage!

Do not allow luffing hoist wire rope to go into tension until main strut is near vertical. Jib strut could be damaged.

14. Tighten up load line as main strut nears vertical so strut moves smoothly past vertical.
15. Continue to lower main strut to approximately 3 feet (1 m) above jib strut.
16. Unpin strut supports from storage position ([Figure 4-9](#), View A) and allow to hang vertically. Slowly pay out load line to lower strut supports to lugs on jib strut.

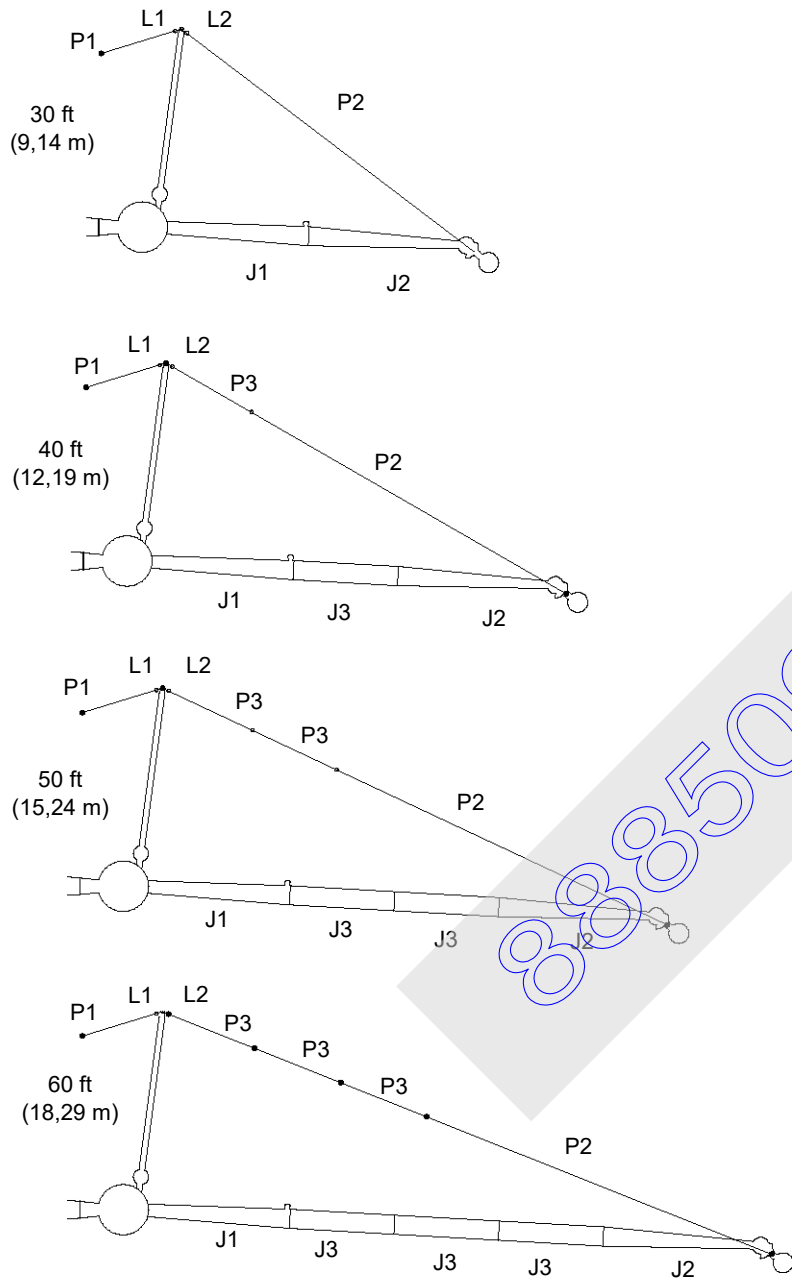
17. Pin strut supports to lugs on jib strut ([Figure 4-9](#), View A).
18. Unpin strut handling link from socket and pin link and pendant to storage lugs on main strut ([Figure 4-11](#), View B).
19. Remove socket and wedge from front drum load line and reinstall at jib point.

Remove Struts and Butt

1. Remove and store luffing hoist wire rope.
2. Remove the main strut.
3. Disconnect electric cables between the boom and jib butt.
4. Remove the butt with jib strut attached.

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Item	Description
J1	Jib Butt — 15 ft (4,57 m)
J2	Jib Top — 15 ft (4,57 m)
J3	Jib Insert — 10 ft (3,05 m)
L1	Backstay Pendant Link
L2	Jib Pendant Link
P1	Backstay Pendant — 56 ft 6-1/2 in (17,23 m)
P2*	Basic Jib Pendant — 70 ft 6 in (21,49 m)
P3**	Jib Insert Pendant — 9 ft (2,74 m)

* Single pendant wraps around saddle at jib point.
 ** Matched sets of two each insert.

FIGURE 4-28

FIXED JIB

This section contains installation and removal instructions for the #138 fixed jib on the #135 luffing jib.

The fixed jib consists of a 15 ft (4,57 m) butt and a 15 ft (4,57 m) top, providing a basic length of 30 ft (9,14 m). Inserts are available to assemble additional jib lengths of 40 to 60 ft (12,19 to 18,29 m) as shown in [Figure 4-28](#).

See the applicable Jib Lifting Capacities Chart to determine boom and luffing jib length limitations with fixed jib attached.

See Crane Weights topic in Section 1 of this manual for the weights of the individual boom, luffing jib, and fixed jib components.

Jib Assembly Drawing

Jib components (top, inserts, butt, pendants) must be assembled in the proper sequence according to [Figure 4-28](#) and the Jib Assembly Drawing at the end of this section.

Item	Description	Item	Description	Item	Description
1	Backstay Pendant (P1)	9b	Jib Insert Pendant (P3)	17	Jib Top Wire Rope Guide
2	Backstay Lug	10	Top Hole – 30 ft (9,14 m) Jib	18	Luffing Jib Top
3	Pin	11	Middle Hole – 40 ft (12,19 m) Jib	19	10 ft (3,05 m) Fixed Jib Insert
4	Fixed Jib Stop	12	Bottom Hole – 50 and 60 ft (15,24 and 18,29 m) Jib	20	Pin
5	Fixed Jib Strut	13	Links	21	Pin (head out)
6	Fixed Jib Butt	14	Wheel	22	Link (L1)
7	Pin	15	Wheel Frame	23	Link (L2)
8	Fixed Jib Top	16	Pendant Retaining Bolt	24	Pin
9a	Basic Jib Pendant (P2)				

See [Figure 4-28](#) for Identification of P1, P2, P3, L1, and L2

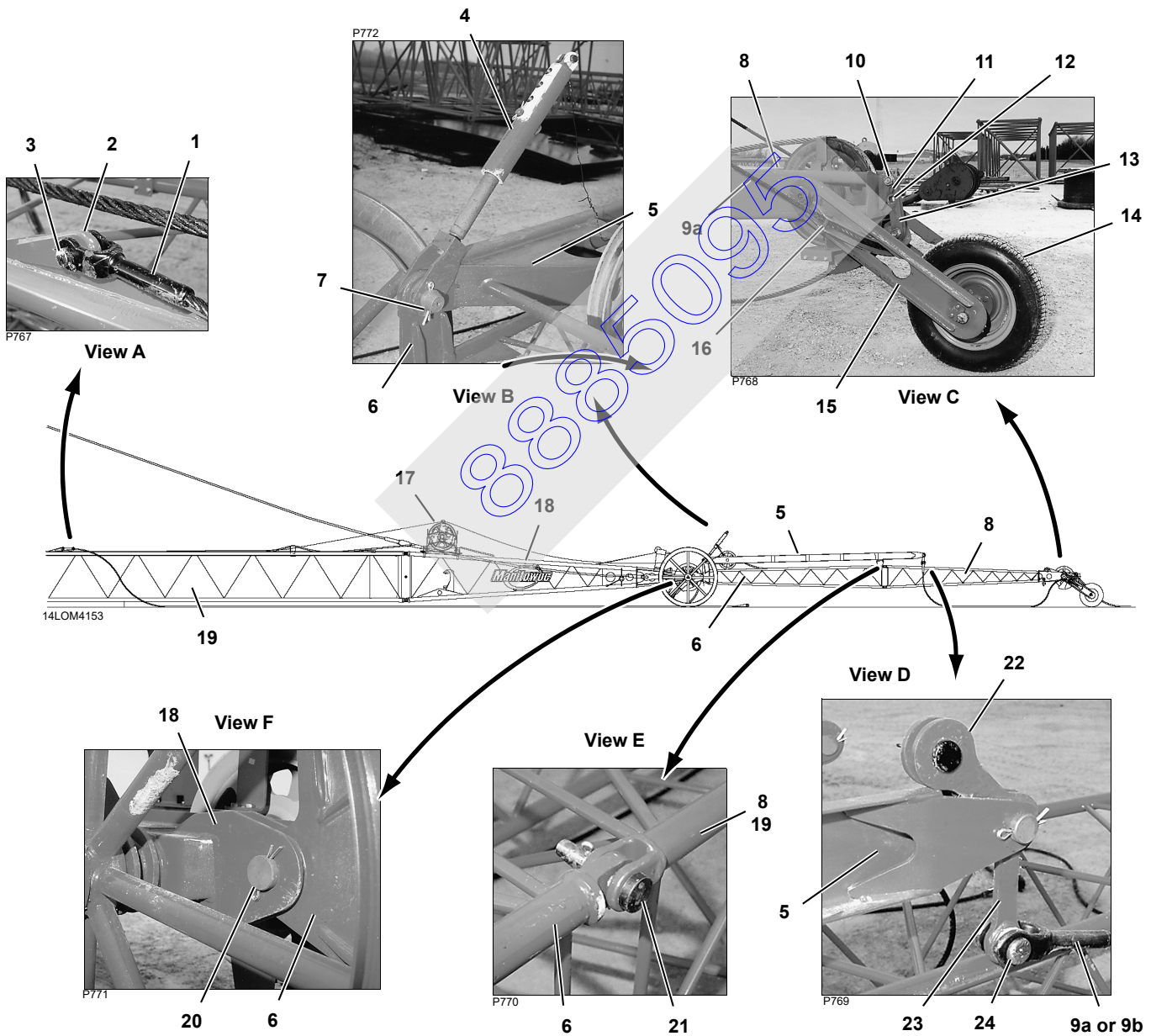


FIGURE 4-29

Preparing Boom and Luffing Jib

See [Figure 4-29](#) for the following procedure.

This instruction assumes that the boom and luffing jib are completely assembled and ready to be raised.

The luffing jib must be prepared as follows for fixed jib installation and use:

1. 40 ft (12,19 m) insert (19) with jib backstay lugs (2, View A) installed next to the luffing jib top (18).
2. Sheave packs removed from the boom point if required per Luffing Jib Raising Procedure Chart:

Luffing Jib Configuration

The luffing jib can be in one of the following configurations when installing the fixed jib:

Layout Luffing Jib

1. Boom and luffing jib fully assembled on the ground.
2. Boom and luffing jib fully assembled and raised to jack-knife angle called for in Luffing Jib Raising Procedure Chart with jib point rollers resting on the ground.

Fold-Under Luffing Jib

Boom and luffing jib fully assembled and raised so jib point rollers are resting on the ground and the jib is positioned as follows:

1. Luffing jib angle is -75 to -80° (10 to 15° forward of vertical).

Interference will prevent fixed jib from being pinned to luffing jib if luffing jib is at a lesser angle.

2. Boom to luffing jib angle is not greater than 60° .

CAUTION

Tipping Hazard!

Crane can tip, possibly allowing the jib to collapse, if boom to luffing jib angle is greater than 60° when the fixed jib is raised from the ground.

Installing Fixed Jib

See [Figure 4-29](#) for the following procedure.

Install Jib Butt

Jib strut (5, View B) and jib stop tubes (4) are shipped in the stored position on the jib butt (View B). Securely fasten the jib stop tubes to the strut so the tubes cannot fall.

1. Lift the jib butt (6, View F) into position at end of the luffing jib top (18).

2. Align holes in the jib butt with holes in luffing jib top and install connecting pins (20, View F).

Install Jib Inserts

1. Pin desired length of jib inserts (19, View E) to the butt. **Pin heads must be toward outside of jib.**
2. Block inserts as assembly progresses.

Install Jib Top

1. Securely attach proper holes in wheel frame links (13, View C) to end of the jib top (8):
 - Top hole for 30 ft (9,14 m) jib
 - Middle hole for 40 ft (12,19 m) jib
 - Bottom hole for 50 and 60 ft (15,24 and 18,29 m) jib
2. Pin the jib top (8, View E) to last insert or the butt, depending on jib length. **Pin heads must be toward outside of jib.**

Install Jib Pendants

The jib pendants are furnished in matched sets of two and must be installed in matched sets — pendant on one side of insert must match pendant on other side of insert.

1. Install basic jib pendant (9a, View C) through holes in wheel frame and engage saddle.
2. Install bolts (16, View C) to retain pendant in saddle.
3. Lay basic jib pendant on the ground alongside jib.
4. If required, pin jib insert pendants (1) to basic pendant (9a).
5. Pin basic jib pendants (9a, View D) or jib insert pendants (9b) to links (23) at jib strut.

Install Backstay Pendants

If the boom and luffing jib will be jack-knifed into position before the fixed jib is installed, perform step 1 before raising the boom and luffing jib.

1. Pin backstay pendants (1, View A) to lugs (2) on 40 ft (12,19 m) luffing jib insert.
2. Lay backstay pendants on the ground alongside luffing jib.

NOTE Jib strut will be raised and backstay pendants pinned to strut after the boom and luffing jib are raised.

Installing Load Line

The load line from the front drum on the crane is be used for the fixed jib. See [Figure 4-31](#) for wire rope routing.

Wire Rope Specifications

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

- Line pull and parts of line required for various loads
- Wire rope lengths and notes about hoisting distance for various parts of line
- Maximum spooling capacity of load drums

Load Block or Hook and Weight Ball Requirements

It is the crane user’s responsibility to ensure that the selected load block or hook and weight ball meets the following operating conditions:

- Capacity equal to or greater than load to be handled
- Sufficient weight to overhaul load line at highest lifting height

Install Load Line

See [Figure 4-30](#) for the following procedure.

If the boom and luffing jib will be jack-knifed into position before the fixed jib is installed, then perform steps 1 and 2

before raising the boom and luffing jib and securely fasten the load line to the luffing jib point.

1. Route load line through proper guide sheaves on the boom and in luffing jib strut (see Luffing Jib Load Line Reeving drawing).
2. Route load line **under** small guide sheave on luffing jib top (View A) and **over** guide sheave in fixed jib strut (View B).
3. Route load line around load sensing sheave.
4. Pull approximately 50 ft (5,24 m) of load line past end of the jib point and securely fasten load line to end of the jib. Load block or hook and weight ball will be installed just prior to lifting the jib from the ground.



WARNING

Falling Wire Rope Hazard!

For long boom and short luffing jib combinations, load line on boom side of attachment can overhaul load line on luffing jib side of attachment. Load line could fall off the boom as attachment is raised. Securely fasten load line to the jib point before raising attachment.

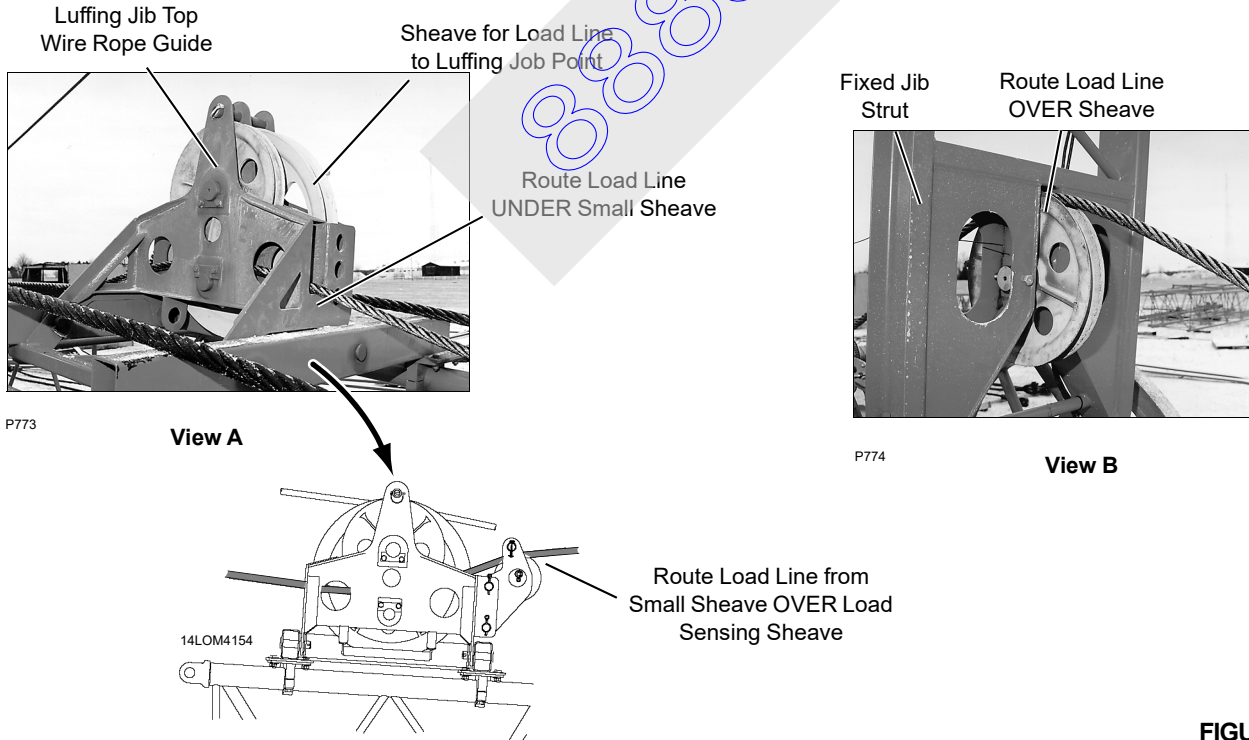


FIGURE 4-30

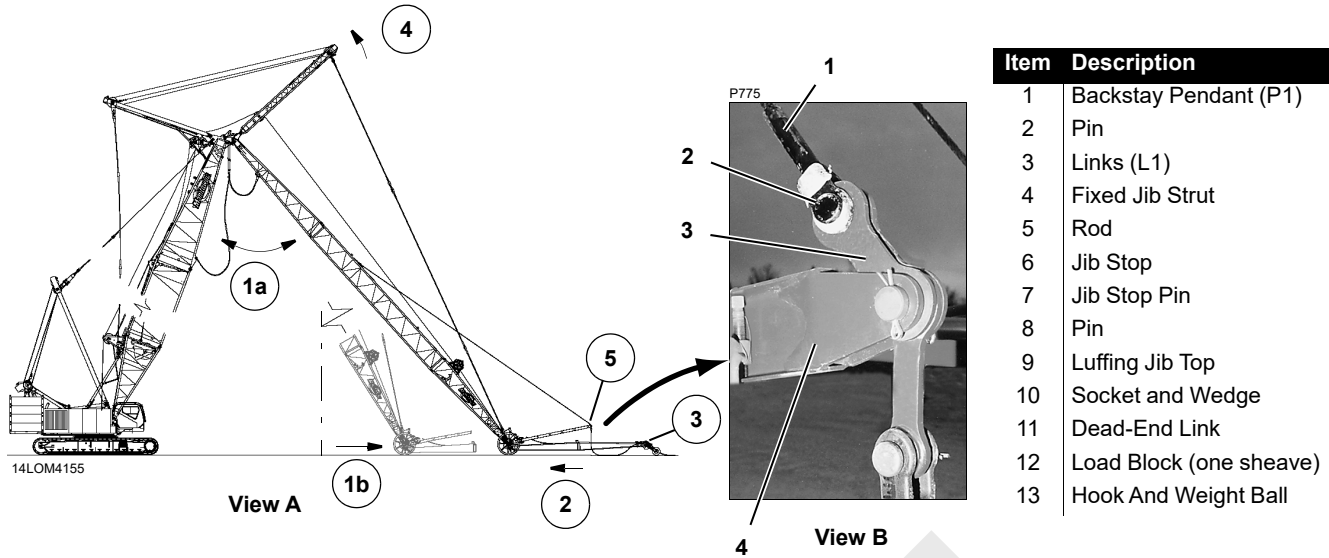
Install Electronic Devices

1. Install block-up limit and load indicator components and connect electric cords to junction boxes on luffing jib point and on fixed jib point (see Boom Wiring Drawing at the end of this section).
2. Shorting plugs connected to all unused electric cords. *Boom will not lower and drums will not hoist if electric cords are not shorted out.*
3. Install wind speed indicator assembly if removed for shipping. Use star washers to attach mounting bracket to the jib top to provide a good ground (see Wind Speed Assembly drawing at the end of this section).
4. Adjust block-up limit switch at fixed jib point according to instructions in Section 6 of this manual.

PRE-RAISING CHECKS

- Boom, luffing jib, and fixed jib are properly assembled according to instructions in this section and assembly drawings at the end of this section.
- Crawlers blocked (if required for all boom and jib lengths being raised). Also see Crawler Blocking Diagram in Luffing Jib Capacity Chart Manual for instructions.
- All connecting pins installed and properly secured.
- Load line to fixed jib anchored properly on drum, spooled tightly onto drum, and engaged with proper sheaves. *Make sure rope guard pins, bars, or rollers are installed to retain wire rope in sheaves.*
- If load line will be installed after the boom and luffing jib are jack-knifed into position, **make sure load line going to the jib point is securely attached to end of the jib point so load line cannot fall off the jib and boom.**
- All blocking, tools, and other items have been removed from jib and jib point roller path area.
- Pendants not hooked alongside the jib. **Guide pendant connectors clear of jib chords as the jib is raised.**
- All safety devices installed, electric cords connected, and limits adjusted.
- Luffing Jib Raising Procedure Chart reviewed to determine required boom to luffing jib angle for raising the fixed jib.
- Wind within allowable limits for raising the boom and jib (see charts in Luffing Jib Operator/Parts Manual).
- All lube points greased (see Lubrication Guide in Luffing Jib Operator/Parts Manual).

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Item Numbers Correspond to Steps in Lowering Boom and Jib Procedure

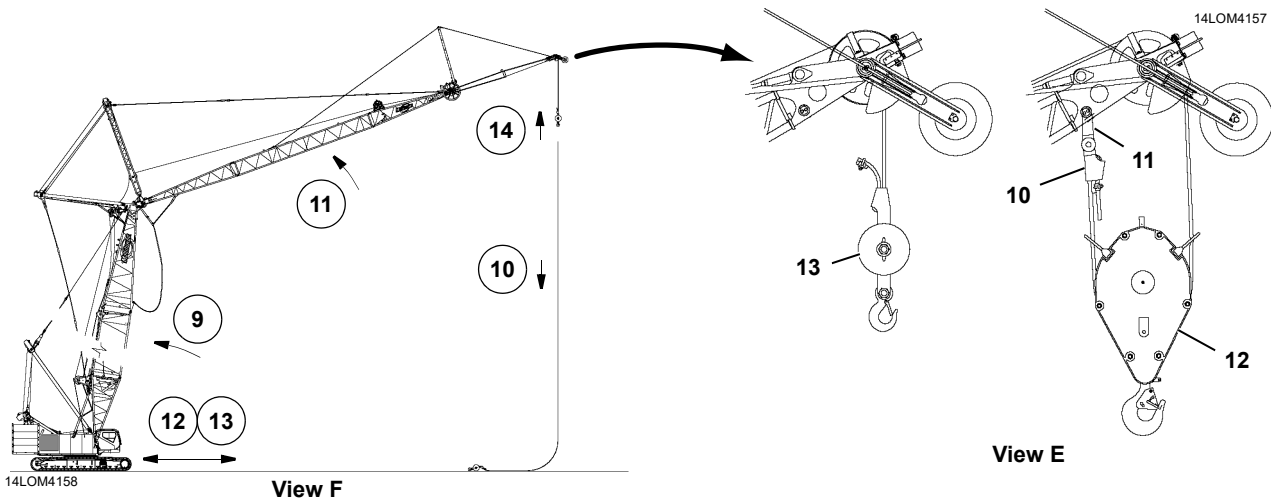
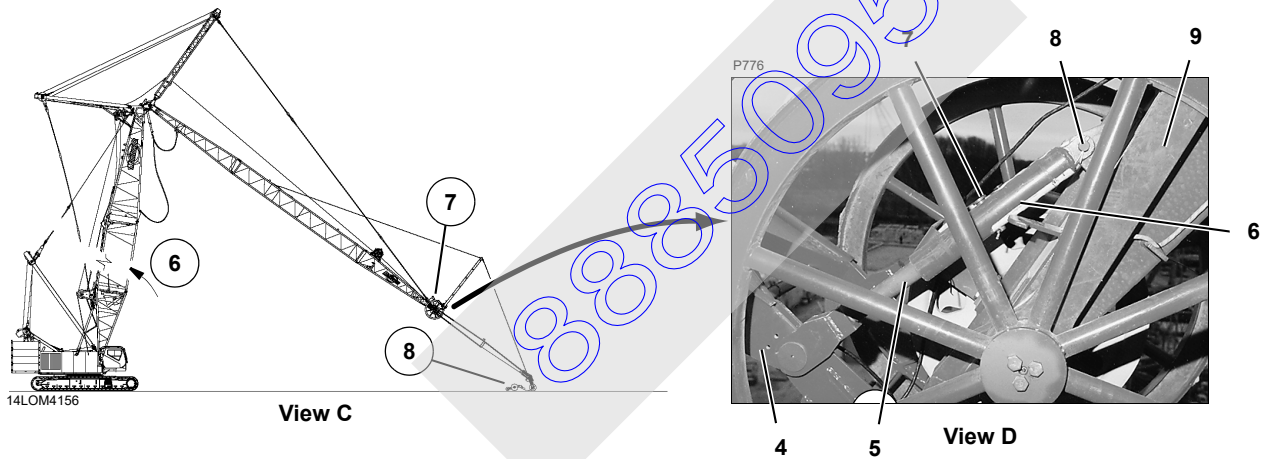


FIGURE 4-31

RAISING BOOM AND JIB

Item numbers in [Figure 4-31](#) correspond to numbered steps in the following procedure.

Monitor angles on digital display in operator's cab while raising the boom and jib.

1. Raise the boom and luffing jib to proper angle (View A):
 - a. FOR LAYOUT LUFFING JIB, boom and luffing jib raised to jack-knife angle called for in Luffing Jib Raising Procedure Chart with jib point rollers resting on the ground.
 - b. FOR FOLD-UNDER LUFFING JIB, boom and luffing jib raised so jib point rollers are resting on the ground and the jib is rotated forward to a jib angle of -75 to -80° (10 to 15° forward of vertical)



WARNING

Tipping Hazard!

Crane can tip if the boom and luffing jib are not at specified angle when the boom is raised with fixed jib attached.

2. If fixed jib is already installed, it will roll along the ground as the boom and luffing jib are raised.
3. If the fixed jib is not installed, install it after the boom and luffing jib have been positioned at specified angle.
4. Once the boom and luffing jib have been raised to specified angle, slowly haul in luffing hoist wire rope until luffing jib pendants start to go into tension and stop. **Do not attempt to lift the luffing jib at this time or the crane will tip.**
5. Connect fixed jib backstay pendants (View B):
 - a. Using an assist crane, raise fixed jib strut and pin backstay pendants (1) to links (3).
 - b. Lower strut until it is supported by backstay pendants and disconnect assist crane.
6. Slowly raise the boom — **do not raise luffing jib** — until the fixed jib is hanging from backstay pendants with wheel just lightly touching the ground (View C).

Take care not to allow jib pendants to get caught on side of fixed jib. Guide jib pendants clear of jib sections as the fixed jib rises.

7. Connect jib stops (View D):
 - a. Unfasten both jib stops (6) from the fixed jib strut (4).
 - b. Make sure stop pin (7) is installed in **hole nearest rod end of both tubes.**
 - c. Pin both jib stop tubes to lugs on the luffing jib top. Adjust rods if required to align connecting holes.
8. Install load block or hook and weight ball (View E).



WARNING

Falling Load Hazard!

Load line going up the boom can overhaul load line going down the luffing jib. Do not untie load line from the luffing jib or fixed jib until load block or hook and weight ball has been installed. Load line can fall off the boom if this precaution is not followed.



WARNING

Tipping Crane Hazard!

Do not lift load block or hook and weight ball from the ground until the boom has been raised to desired operating angle and the luffing jib has been positioned at proper operating radius to lift weight ball or load block. Crane could tip.

9. Raise the boom to desired operating angle (see Capacity Chart).
10. Pay out load line as the boom and jib are raised.
11. Position luffing jib at required operating radius.
12. Travel crawler rollers off blocking (if installed).
See Maximum Allowable Travel Specifications chart for travel instructions.
13. Travel as required to position load block or hook and weight ball below the jib point.
14. Lift load block or hook and weight ball to desired position.

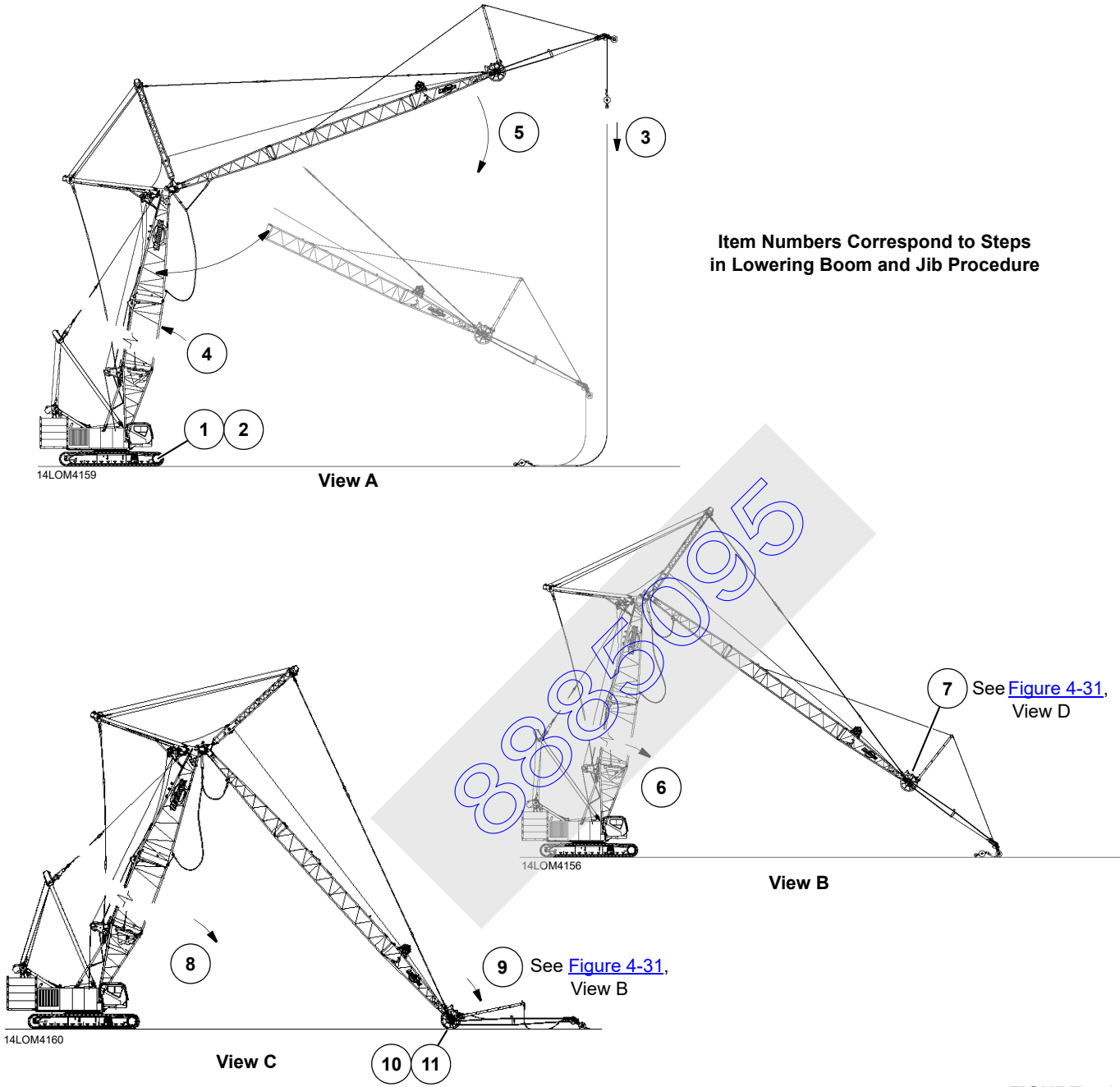


FIGURE 4-32

LOWERING BOOM AND JIB

Item numbers in [Figure 4-32](#) correspond to numbered steps in the following procedure.

Monitor angles on digital display in operator’s cab while lowering the boom and jib.

**! WARNING
Moving Part Hazard!**

Warn all personnel to stand clear of jib point wheel while lowering the boom and jib.

Death or severe crushing injuries will occur if personnel come into contact with wheel.

1. Swing *upperworks in-line with lowerworks so the boom is over front of crawlers*.

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

If required per Luffing Jib Capacity Chart and Raising Procedure Chart, lower the boom and jib over blocked crawlers; otherwise the crane will tip.

2. If required, travel front crawler rollers onto blocking.
3. Swing the boom and jib slightly to either side of center and lower load block or hook and weight ball onto the ground. Then swing the boom and jib in-line with crawlers.

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

Lower all load blocks or hook and weight balls onto the ground before lowering the boom and jib. Crane could tip if this step is not performed.

NOTE Steps 4 through 9 must be performed for both the fold-under luffing jib and the layout luffing jib. The luffing jib cannot be folded under the boom until the fixed jib is removed.

4. Raise the boom to a minimum angle of 85°.
5. Position the jib at required boom to luffing jib angle (View A). See Luffing Jib Raising Procedure Chart for angle.

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

Do not lower the boom and jibs to the ground until the boom has been positioned at minimum angle of 85° and the luffing jib has been positioned at specified boom to luffing jib angle. Crane will tip.

6. Slowly lower the boom until fixed jib point wheel just lightly contacts the ground (View B).
7. Disconnect jib stops (Figure 4-31, View D):
 - a. Unpin both jib stop tubes from lugs on the luffing jib top. Store pins with jib stops.
 - b. Rotate jib stops forward against jib strut and securely fasten both jib stops to strut.

8. Continue to lower the boom slowly — **do not lower the luffing jib** — until luffing jib rollers contact the ground (View C).

Fixed jib point wheel will roll along the ground as the boom is lowered.

9. Disconnect fixed jib backstay pendants (Figure 4-31, View B):
 - a. Using an assist crane, support fixed jib strut.
 - b. Unpin backstay pendants from links.
 - c. Lower strut onto the fixed jib butt and disconnect assist crane.
10. For FOLD-UNDER luffing jib, remove fixed jib at this time and proceed to lower the boom and luffing jib. See Luffing Jib Rigging drawing and Luffing Jib Raising Procedure Chart for detailed lowering instructions.
11. For LAYOUT LUFFING jib, remove fixed jib at this time or after the boom and luffing jib have been lowered to ground level. See Luffing Jib Rigging drawing and Luffing Jib Raising Procedure Chart for detailed lowering instructions.

Removing Fixed Jib

Removing the fixed jib is opposite of installing the jib.

The jib butt, jib strut, and jib stops can be shipped as an assembled unit.

Remove and store the wind speed indicator assembly so it is not damaged during shipping.

**WARNING****Collapsing Jib Hazard!**

Improper disassembly of jib sections can cause the jib to collapse onto personnel removing connecting pins.

Death or serious injury can result if the precautions listed below are not taken:

- Lower the boom so luffing jib and fixed jib points are supported on the ground.
- Slacken rigging — do not attempt to remove connecting pins while the jib is supported by rigging.
- Block below both ends of jib sections before removing connecting pins.

Stand on outside of jib sections when removing connecting pins. Never work under or inside jib sections. Use care not to damage lacings and chords as pins are knocked out.

WIRE ROPE INSTALLATION

NOTE: Wire rope manufacturer’s recommendations take precedence over information in this section.

Wire Rope Storage

Store wire rope in coils or on reels off the ground or floor in a clean and dry indoor location. If outdoor storage is necessary, the wire rope must be covered with a protective wrapper. Keep the wire rope away from acids, fumes, and other corrosives. Keep the wire rope away from heat that can dry out the lubricant. If the storage period will be long, lubricate the wire rope and perform periodic inspection given in this section at least monthly.

Removing Wire Rope from Shipping Reel

CAUTION!

Wire Rope Damage!

Shipping reel must rotate when wire rope is unwound. Attempting to remove wire rope from a stationary reel can result in a “kinked” wire rope, and wire rope will be ruined.

1. Mount wire rope shipping reel on a shaft supported at both ends by jacks or blocks as shown in [Figure 4-33](#).

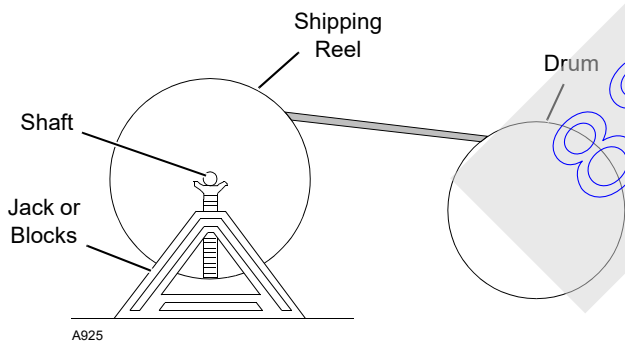


FIGURE 4-33

2. Provide a brake at shipping reel ([Figure 4-34](#)) so wire rope can be wound tightly onto drum.

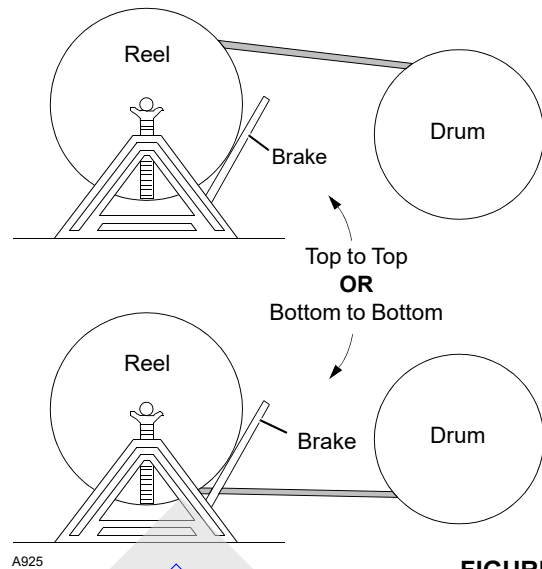


FIGURE 4-34

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 4-34](#).
4. Avoid dragging wire rope in dirt or around objects that can scrape, nick, cut, or crush wire rope.

Seizing and Cutting Wire Rope

Apply tight seizings of annealed wire to the ends of all wire rope. If not done, the rope wires and strands may slacken. This action will result in overloading of some strands and underloading of others. Bird caging and breakage of the wire rope can occur.

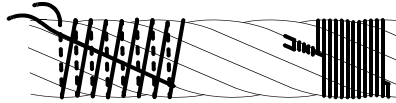
Before cutting wire rope, apply seizings on both sides of the point where the cut will be made. Then cut the wire rope with a torch, rope cutter, or abrasive cut-off wheel.

See [Figure 4-35](#) for:

- Number of seizings to be applied to the ends of wire rope and to both sides of the point where a cut will be made
- Proper application method- each seizing should be one rope diameter long.

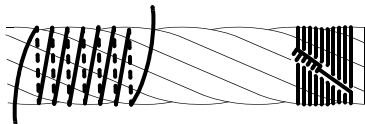
Wire Rope Type	Seizings Required
Preformed	1
Non-preformed	3

Place free end of seizing wire in valley between two stands. Then wind seizing wire over free end as shown. Finally, twist and pull two ends of seizing wire together until seizing is tight.



View A — Rope Diameter 1 in (26 mm) and Larger

Wind seizing wire around wire rope as shown. Then twist two ends of seizing wire together at center of seizing. Alternately twist and pull ends until seizing is tight.



View B — Rope Diameter Smaller than 1 in (26 mm)

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FIGURE 4-35

Anchoring Wire Rope to Drum

See [Figure 4-36](#) for the following procedure.

Use the correct wedge part number for the size of wire rope being used; see Luffing Hoist and Drum Shaft Drawings in Parts Manual for correct part numbers.

1. Assemble wire rope and wedge to drum socket.

2. Tighten wedge by rapping back of wedge with a brass drift pin and hammer.



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.

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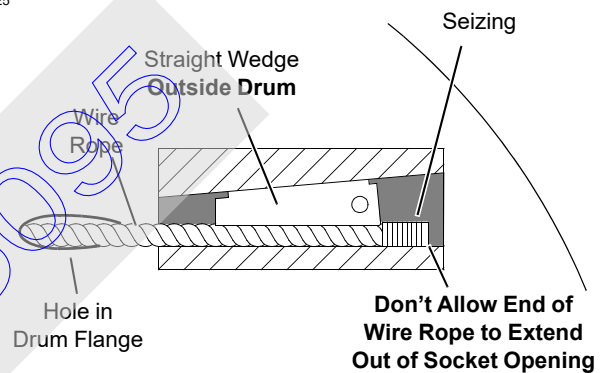


FIGURE 4-36

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 4-37).

3. Tap adjacent wraps against each other with a soft metal or wooden mallet.

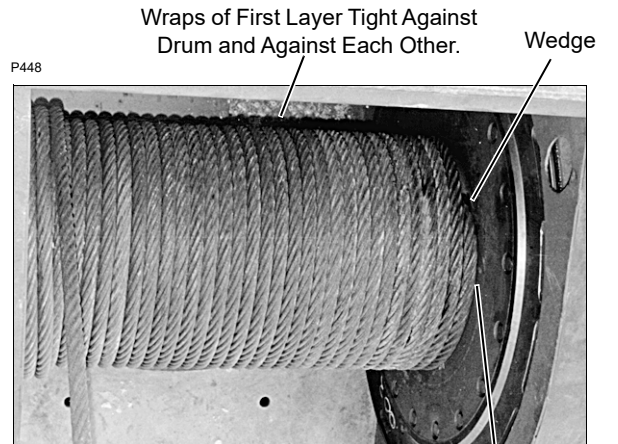
Use extreme care not to put twists or turns in wire rope; allow rope to assume its natural lay.

CAUTION!

Wire Rope Damage!

Voids or spaced wraps in first layer (Figure 4-37, View B) will permit movement and a wedging action with subsequent layers. Wedging action will cause crushing and abrasion of wire rope.

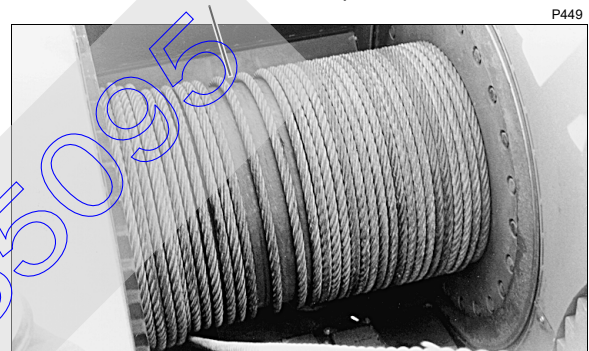
Never allow wire rope to “cross wind” on drums.



View A

First Wrap Tight Against Flange for 3/4 of Diameter.

Voids and Loose Wraps in First Layer Cause Severe Wear of Wire Rope.



View B

FIGURE 4-37

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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 the 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 the 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.

 **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.

See [Figure 4-38](#) 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.
5. Use a brass hammer to seat wedge and wire rope as deep into socket as possible.
6. 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.

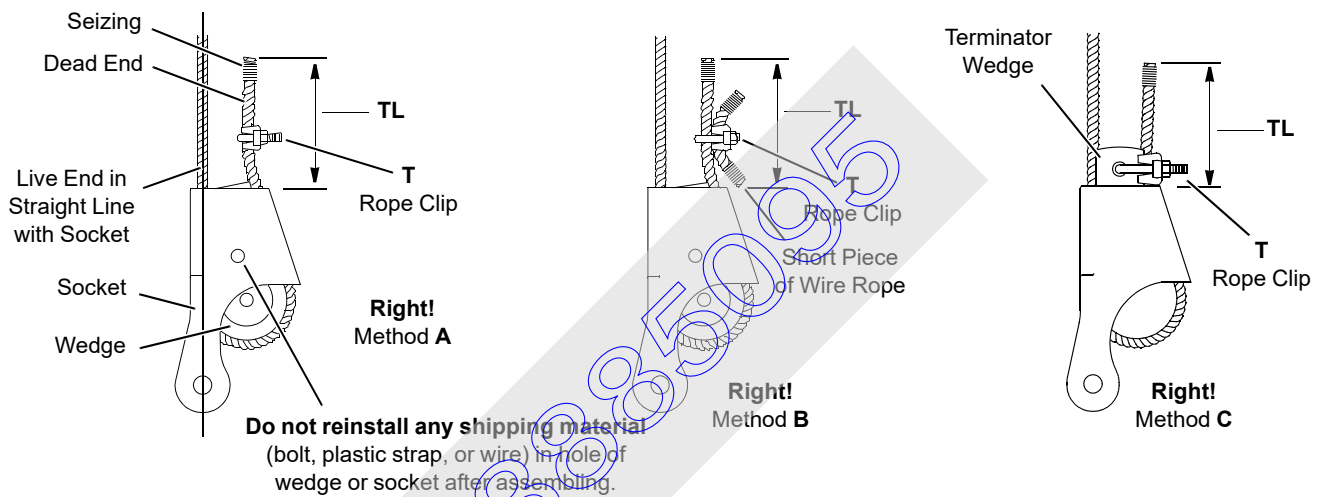
7. After socket is pinned in place, hoist load slowly so wedge seats tight. *Do not shock load socket and wedge.*

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)

inch (mm)	Wire Rope/Clip Size			
	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!

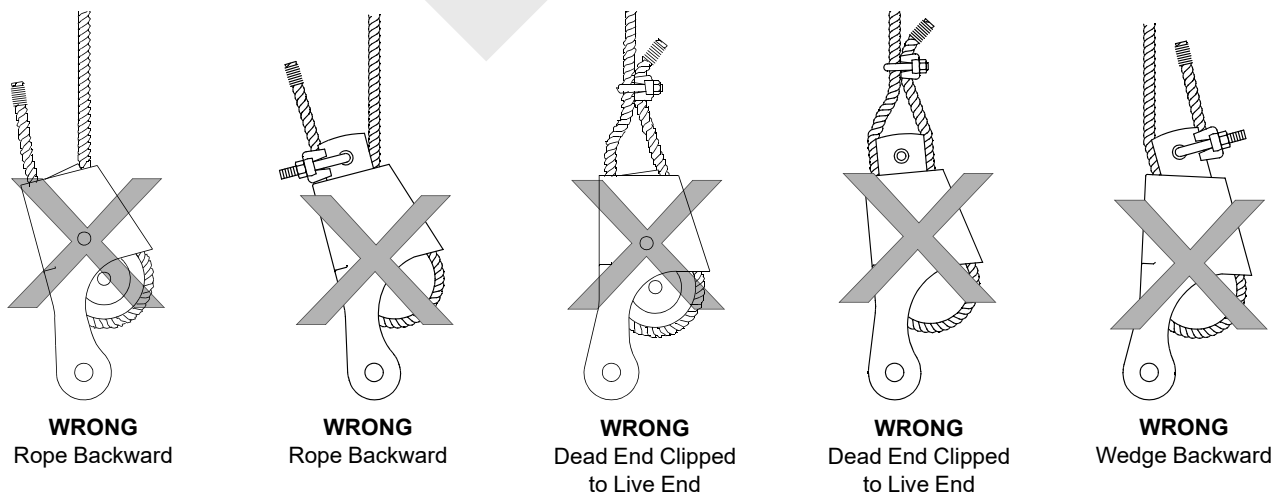


FIGURE 4-38

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Anchoring Wire Rope to Button Socket

See [Figure 4-39](#) 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.

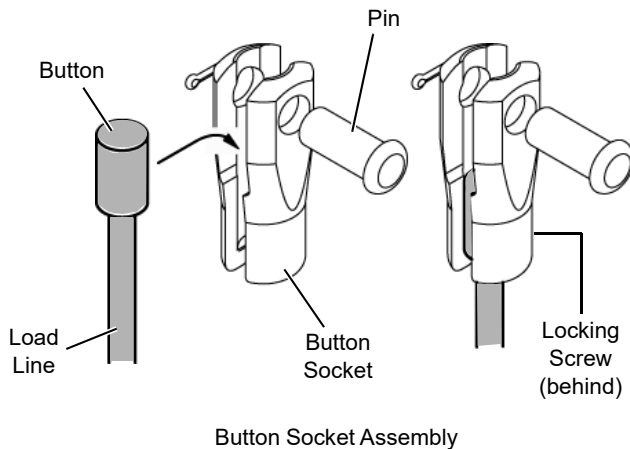


FIGURE 4-39

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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.

PAD EYE USAGE FOR WIRE ROPE REEVING

See [Figure 4-40](#) for the following procedure.

General

Some rotation-resistant wire rope supplied by Manitowoc is equipped with a No. 1.5 pad eye welded to the leading end of the wire rope 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. For No. 1.5 pad eye, do not exceed 1,000 lb (4,45 kN) single line pull.
2. Make sure rigging line and attaching hardware (clips and rope connectors) are rated for at least 1,000 lb (4,45 kN) line pull.
3. Inspect pad eye prior to each use. **Replace it if:**
 - Any original dimensions have changed
 - Cracks or breaks exist in metal or weld



WARNING

Flying Part Hazard!

Pad eye on end of wire rope has been provided **for reeving purposes only**. Any other use is neither intended nor approved.

Pad eye can break and fly apart with considerable force if it is overloaded, not used properly, or not maintained properly.

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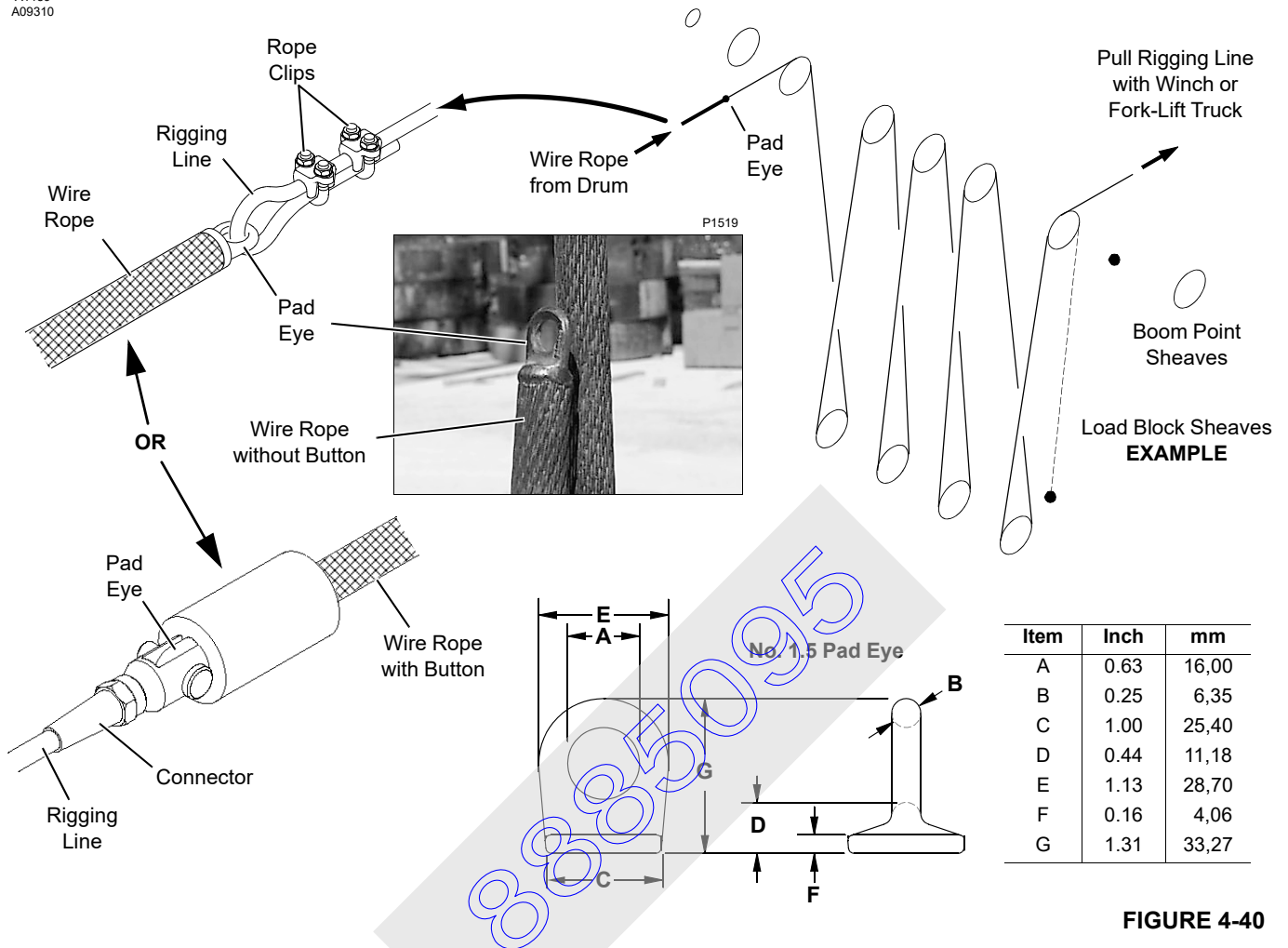


FIGURE 4-40

LOAD LINE REEVING



WARNING

Falling Load Hazard!

Use only a load block or hook and weight ball with a capacity equal to or greater than load to be handled. Load block can fail if overloaded, allowing load to fall.

Load Block Identification

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

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.

Guide Sheaves and Drums

See [Figure 4-41](#) for identification of the load drums and guide sheaves.

Once the 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

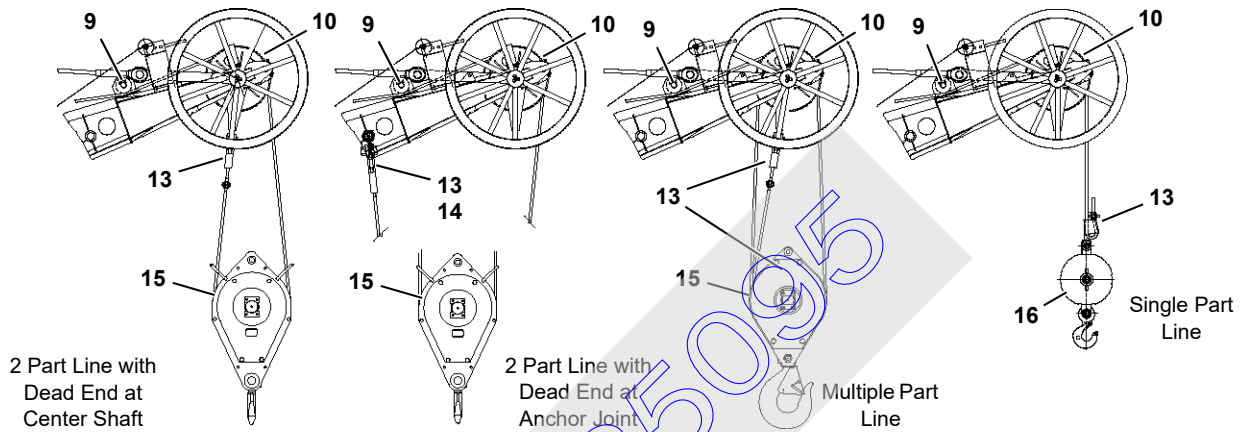
See [Figure 4-41](#) for dead-end locations and components in luffing jib point and for reeving diagrams. Reeving the load block in any manner other than shown can result in excessive block twist.

CAUTION

Wire Rope Damage!

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

14LOM4145



WARNING

Avoid Death or Serious Injury!

If you are using a load block that can be stood up vertically for reeving, exercise care, as the potential for tipping exists. Potential causes of tipping are unstable work area, boom or jib movement, and the reeving process.

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

FIGURE 4-41

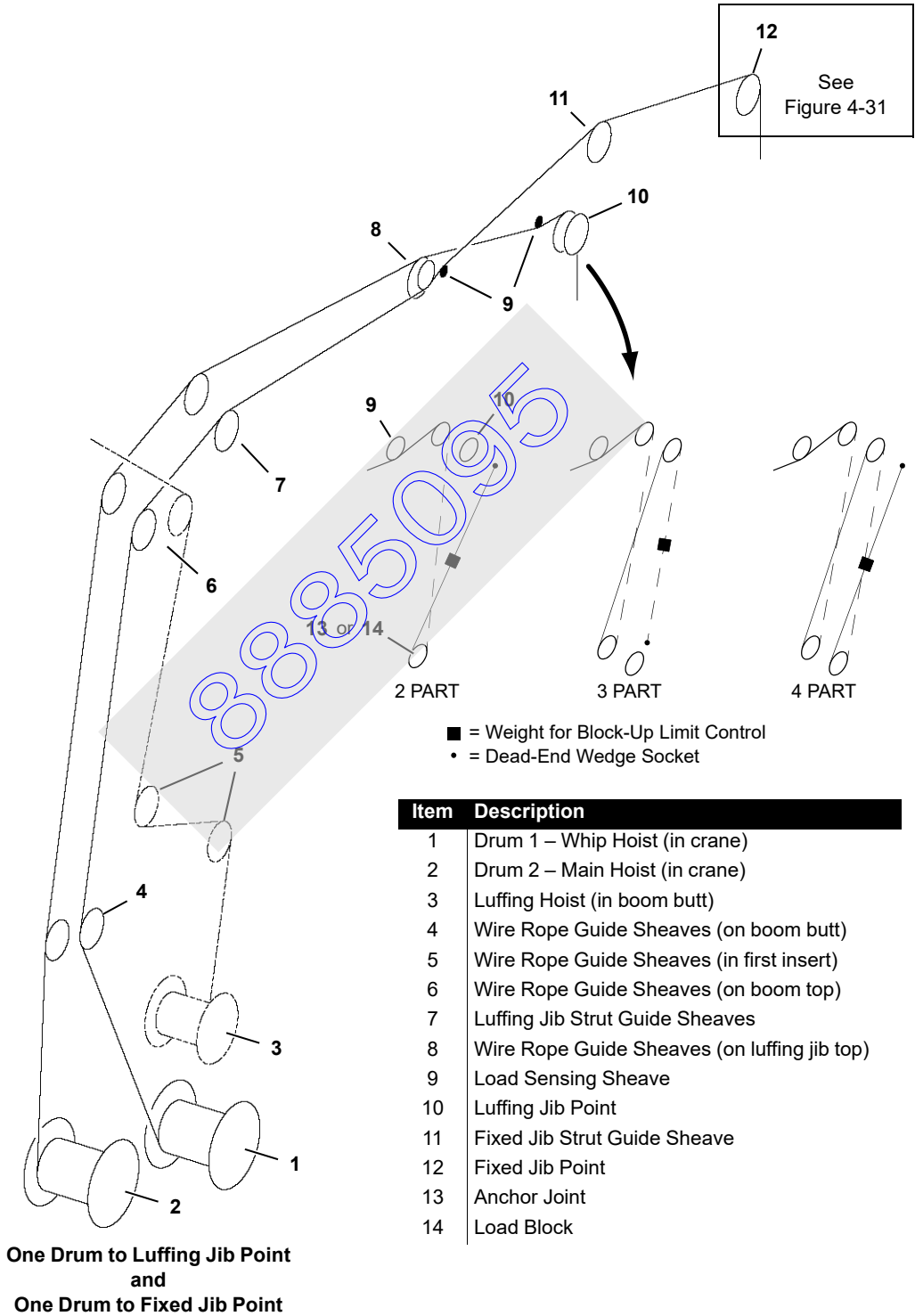


FIGURE 4-41 continued

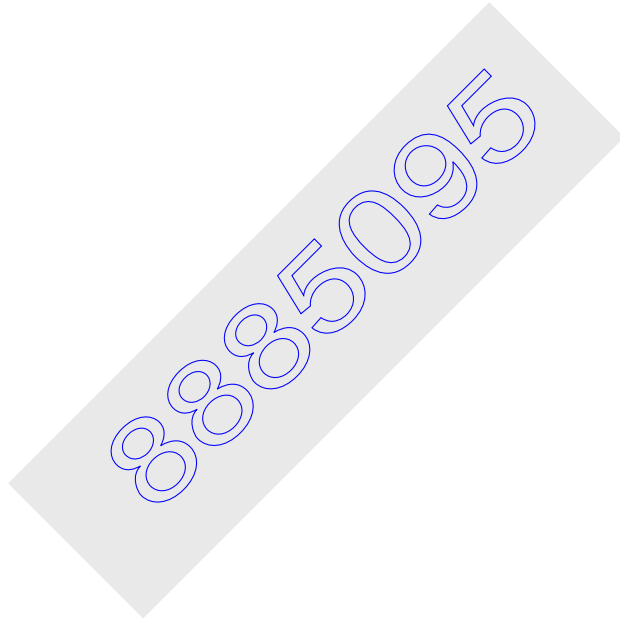
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SECTION 5 LUBRICATION

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Lube and Coolant Product Guide	5-1



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SECTION 5 LUBRICATION

LUBRICATION GUIDE

See F2129 at the end of this section.

LUBE AND COOLANT PRODUCT GUIDE

See the publication at the end of this section.

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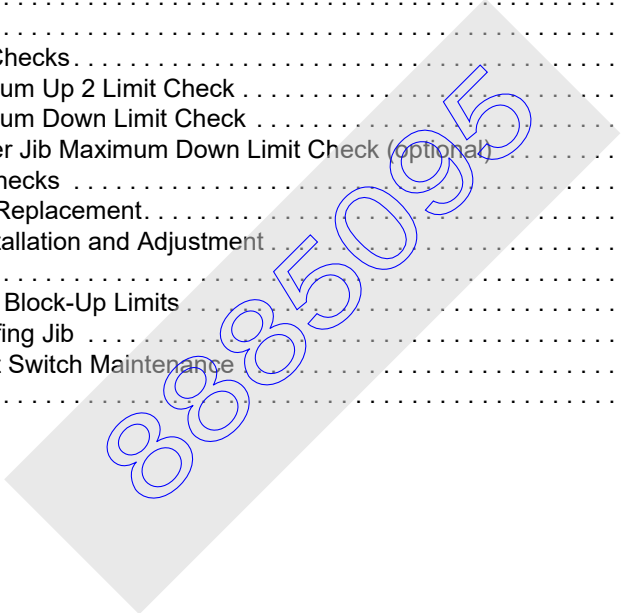
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SECTION 6

MAINTENANCE PROCEDURES

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SECTION 6 MAINTENANCE PROCEDURES

GENERAL MAINTENANCE

This section contains maintenance and adjustment instructions for the limit devices used with the luffing jib attachment.

For maintenance and inspection of the following components, see the Service Manual supplied with your crane:

- Straps
- Wire Rope
- Load Block and Weight Ball
- Boom and Jib

BOOM AND LUFFING JIB ANGLE INDICATOR CALIBRATION

An angle indicator potentiometer is located inside the node controller mounted on the boom top and the luffing jib top. Boom and luffing jib angles are calibrated automatically by the crane's programmable controller as part of load indicator calibration procedure (see Rated Capacity Indicator/Limiter Operation Manual for instructions).

AUTOMATIC BOOM STOP ADJUSTMENT



WARNING

Falling Attachment Hazard!

Do not operate the crane unless the 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.

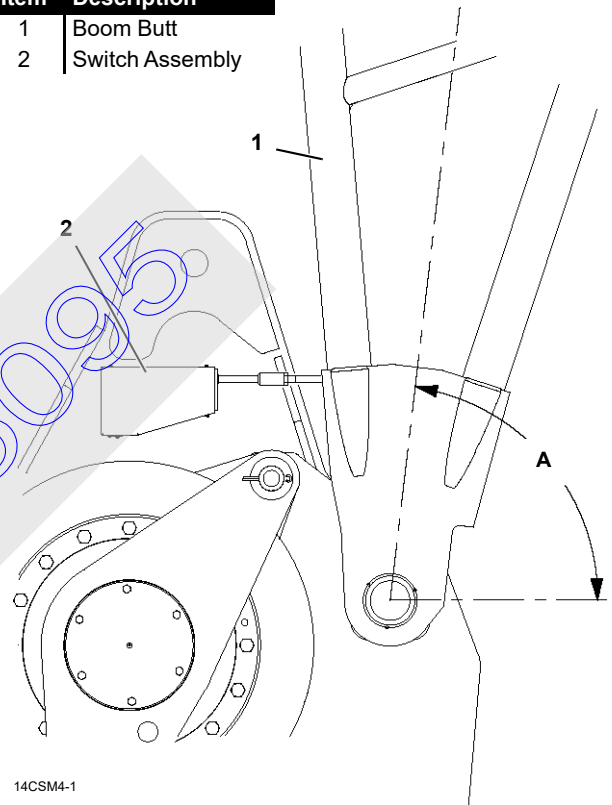
Maximum Operating Angles

Boom stop limit switch (6, [Figure 6-2](#)) automatically stops the boom and applies the boom hoist brake when the boom is raised to **Angle A** shown in [Figure 6-1](#).

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.

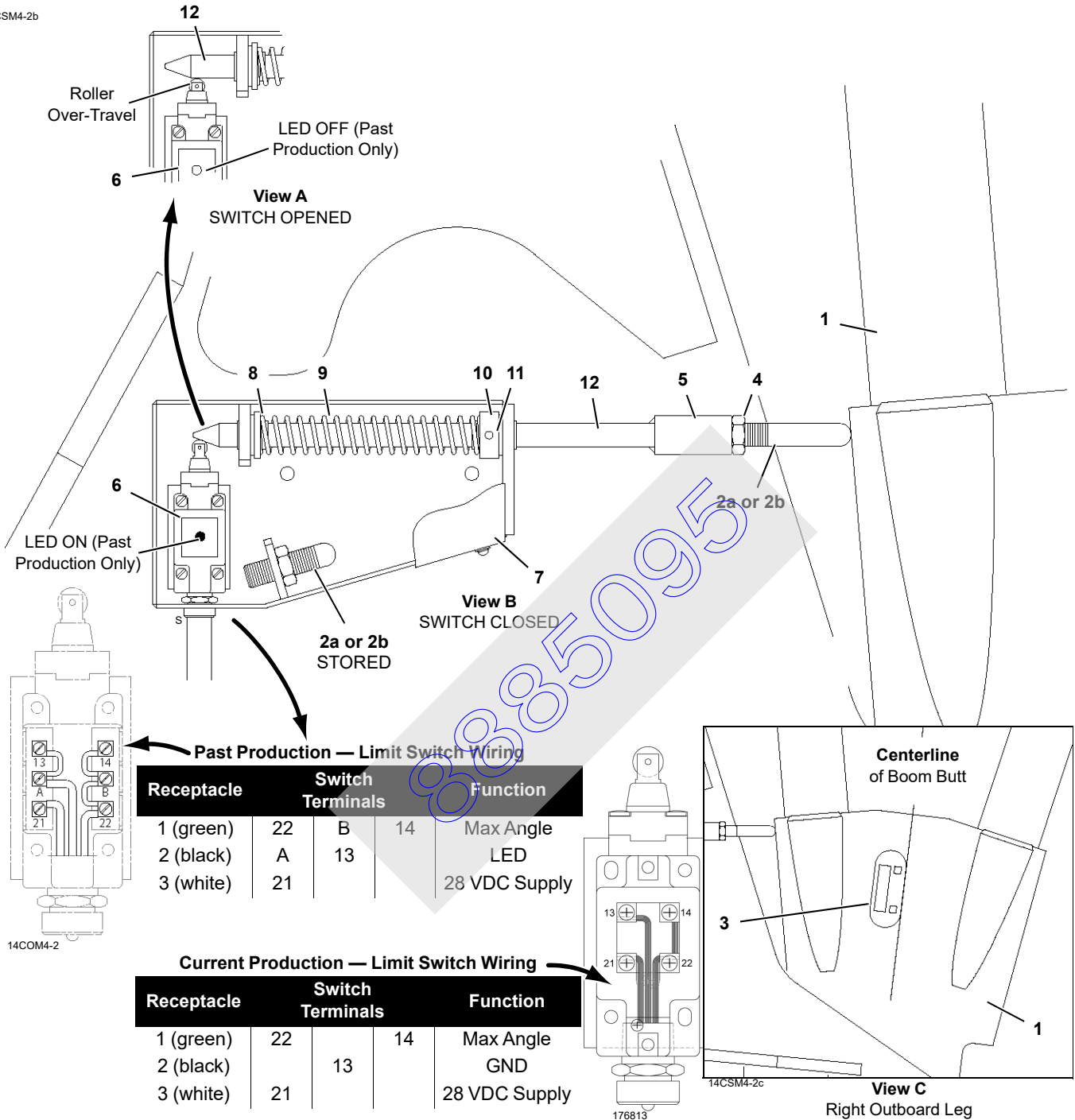
Item	Description
1	Boom Butt
2	Switch Assembly



A	84° for #76 Boom WITHOUT Luffing Jib
	88.5° for #76 Boom WITH Luffing Jib

FIGURE 6-1

14CSM4-2b



14COM4-2

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14CSM4-2c

Item	Description	Item	Description
1	Boom Butt	7	Cover
2a	84° Adjusting Rod – 5-1/4 in (133 mm) Long	8	Spring Washer
2b	88.5° Adjusting Rod – 3-1/2 in (88,9 mm) Long	9	Spring
3	Digital Protractor-Level	10	Spring Washer
4	Jam Nut	11	Dowel Pin 1/4 in (6,35 mm) Diameter
5	Coupling	12	Actuator Rod
6	Limit Switch		

FIGURE 6-2

Adjustment

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

The following instructions assume that the Rated Capacity Indicator/Limiter (RCL) is installed and properly calibrated.

During the following procedure, the boom angle is monitored on the working screen of the RCL and on a digital protractor-level.

The automatic boom stop was set at the factory and should not require periodic adjustment. Adjustment is necessary when:

- Parts are replaced
- Luffing jib is installed or removed

1. Park the crane on a firm level surface or level the crane by blocking under crawlers.
2. Make sure proper adjusting rod is installed:
 - Rod (2a) for boom WITHOUT LUFFING JIB
 - Rod (2b) for boom WITH LUFFING JIB
3. Boom up slowly while monitoring the boom angle on RCL working screen.
4. Stop booming up when boom reaches specified **Angle A** ([Figure 6-1](#)).

Verify boom angle with an accurate digital protractor-level (3, View C) held on centerline of the boom butt. Angle on protractor-level should be within 1° of angle on RCL working screen. If not, calibrate RCL.

- If the boom stops at specified angle, further adjustment is not needed.
 - If the boom stops before reaching specified angle, go to step 5.
 - If the boom reaches specified angle before it stops, go to step 6.
5. If the boom stops before reaching specified angle:
 - a. Loosen jam nut (4, View B).
 - b. Turn adjusting rod (2a or 2b) all the way into coupling (5).
 - c. Boom up slowly until the boom reaches specified angle.

- d. Turn adjusting rod (2a or 2b) out against the boom butt (1) until limit switch (6) “clicks” open. On Past Production, the LED on the limit switch should go OFF (View A).
 - e. Tighten jam nut (4).
6. If the boom reaches specified angle before it stops:
 - a. Loosen jam nut (4, View B).
 - b. Turn adjusting rod (2a or 2b) out against the boom butt (1) until limit switch (6) “clicks” open. On Past Production, the LED on the limit switch should go OFF (View A).
 - c. Tighten jam nut (4).
 7. Check that actuator rod (12) over-travels limit switch as shown in View A.
 8. Boom down and then back up. **Boom must stop at specified angle. If the boom fails to stop, repeat steps 3 through 7.**

Actuator Rod Replacement

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

1. Remove damaged actuator rod (12).
2. Slide spring washers (8 and 10) and spring (9) over new actuator rod while sliding new actuator rod into bracket assembly.
3. Position actuator rod (12) so tapered end just touches limit switch (6) roller (View B). Actuator rod must not depress limit switch roller.
4. Drill 1/4 in (6,35 mm) hole through spring washer (10) and actuator rod (12).
5. Install dowel pin (11).
6. Check limit switch roller to insure there is over-travel as shown in View A.
7. Install proper adjusting rod (2a or 2b) and adjust as needed for correct maximum angle.

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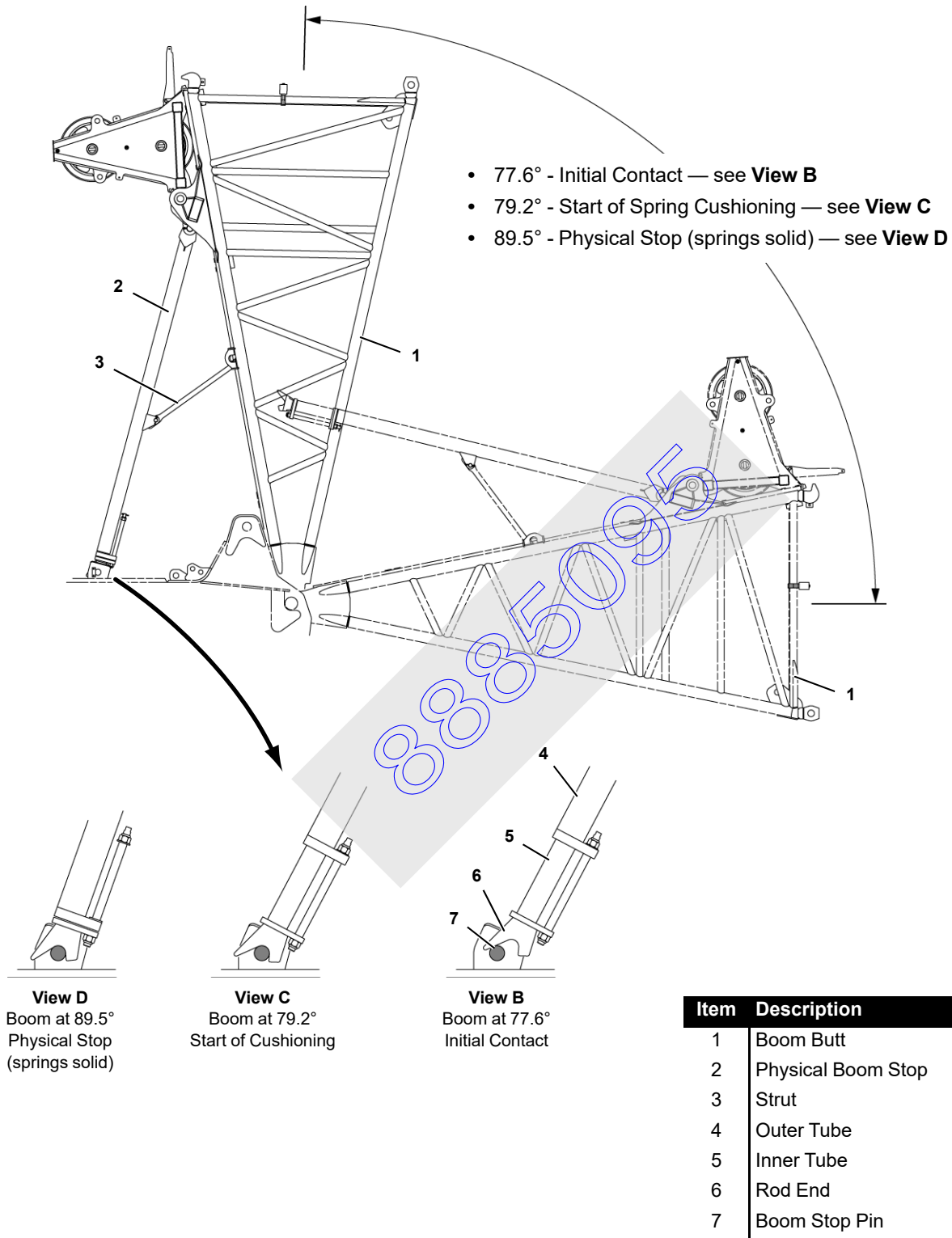


FIGURE 6-3

PHYSICAL BOOM STOP



WARNING

Physical boom stops must be installed for all crane operations.

Physical boom stops do not automatically stop the boom at maximum operating angle. Automatic boom stop must be installed and properly adjusted.

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

Physical Boom Stop Angles

Physical boom stops (2) serve the following purposes:

- Assist in stopping the boom smoothly at any angle above 77.6°
- Assist in preventing boom rigging from pulling the boom back when traveling or setting loads with the boom at any angle above 77.6°

- Assist in moving the boom forward when lowering the boom from any angle above 77.6°
- Provide a physical stop at 89.5°

Operation

1. When the boom is raised to 77.6°, springs in boom stop tubes begin to compress.
2. As the boom is raised higher, spring compression increases to exert greater force against the boom.
3. If for any reason the boom is raised to 89.5°, boom stop springs fully compress to provide a physical stop.

Adjustment

Struts (3) have slotted ends that do not require adjustment

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Item	Description	Deactivated	Activated
D1	Edge of Actuator Rod to Edge of Limit Switch Housing	21.67 in (550,5 mm)	21.40 in (543,6 mm)
D2	Edge of Actuator Rod to Front Edge of Jib Stop Mounting Bracket	3.48 in (88,4 mm)	3.25 in (82,6 mm)
D3	Edge of Actuator Rod to Front Edge of Jib Stop Mounting Bracket (optional fold-under)	3.73 in (94,7 mm)	3.50 in (88,9 mm)

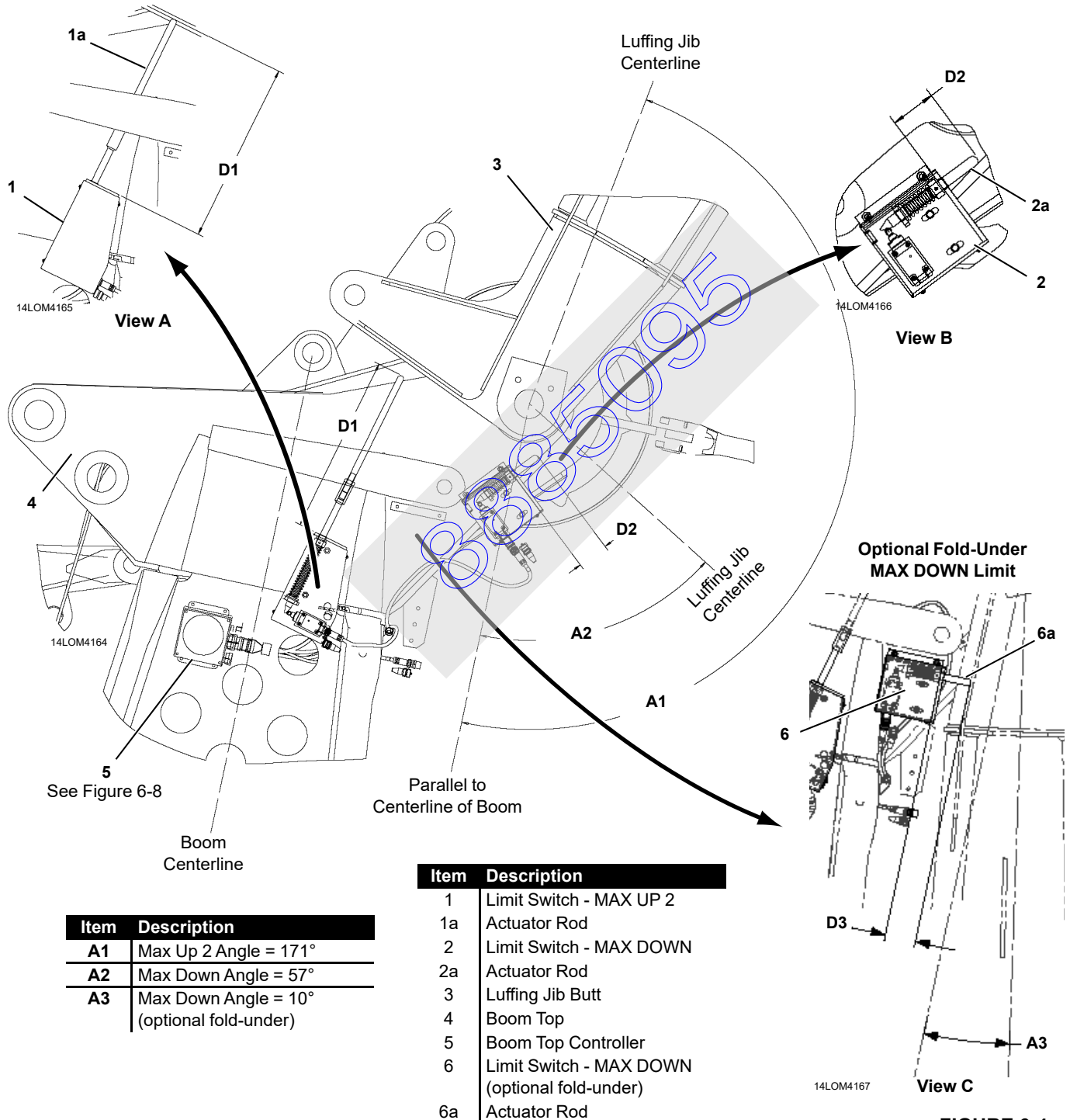


FIGURE 6-4

JIB STOP ADJUSTMENT



WARNING

Falling Attachment Hazard!

Do not operate the crane unless luffing jib stops are properly adjusted and operational.

Operating luffing jib above MAXIMUM UP 2 limit or below MAXIMUM DOWN limit is neither intended nor approved. Jib can be pulled over backwards or collapse.

General

The luffing jib attachment is equipped with two limits which automatically stop the luffing hoist and apply its brake when the luffing jib is raised or lowered to the following angles.

NOTE: Luffing jib angles given in this section can vary plus or minus 1°.

- JIB MAXIMUM UP 1 (maximum working angle) – 168° boom to luffing jib angle. This is a programmed limit controlled by the crane's programmable controller in conjunction with signals from the boom and jib angle sensors.

This limit can be bypassed, allowing the luffing jib to be raised an additional 3° to MAXIMUM UP 2 limit.

- JIB MAXIMUM UP 2 (maximum angle limit) – 171° boom to luffing jib angle. This limit is controlled by limit switch (1, [Figure 6-4](#)).
- JIB MAXIMUM DOWN (minimum angle) – 50° boom to luffing jib angle. This is a programmed limit controlled by the crane's programmable controller in conjunction with signals from the jib angle sensor.
- JIB MAXIMUM DOWN (minimum limit) – 57° minimum limit switch is provided as a backup to stop the jib if the programmed minimum limit fails (2, [Figure 6-4](#)).

An optional *fold-under* maximum down limit stops the luffing hoist and apply its brake when the luffing jib is lowered to the following angles:

- JIB MAXIMUM DOWN (minimum angle) – 13° boom to luffing jib angle. This is a programmed limit controlled by the crane's programmable controller in conjunction with signals from the jib angle sensor.
- JIB MAXIMUM DOWN (minimum limit) – 10° minimum limit switch is provided as a backup to stop the jib if the programmed minimum limit fails (6, [Figure 6-4](#)).

Maintenance

At least once weekly and each time the attachment is erected, check that the luffing jib stops at the specified angles.

Pre-Erection Checks

To insure proper operation of the luffing jib stops:

- The jib stop limit switches must be mounted properly.
- The jib stop cable (WBN1) must be connected to N2 center receptacle ([Figure 6-8](#)).
- The luffing jib angles must be properly calibrated. See Rated Capacity Indicator/Limiter Operation Guide for instructions.

Jib Maximum Up 2 Limit Check

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

Perform the following steps with the boom and luffing jib on the ground:

1. Check Dimension (D1, View A) and if necessary, adjust actuator rod to obtain deactivated dimension.

Perform remaining steps with engine running and appropriate Luffing Jib Capacity Chart selected.

2. Depress limit switch (1a) actuator rod to activated Dimension D1 and hold. Listen for limit switch to "click" open (on Past Production switches the LED will go OFF).
3. Pull the luffing jib handle back.

Luffing hoist must not turn in up direction and JIB MAXIMUM UP 2 fault should come on.

Jib Maximum Down Limit Check

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

Perform the following steps with the boom and luffing jib on the ground:

1. Check Dimension (D2, View B) and if necessary, adjust position of limit switch housing to obtain deactivated dimension.

Perform the remaining steps with the engine running and appropriate Luffing Jib Capacity Chart selected.

2. Depress limit switch (2a) actuator rod to activated Dimension D2 and hold. Listen for limit switch to "click" open (on Past Production switches the LED will go OFF).
3. Push the luffing jib handle forward.

Luffing hoist must not turn in down direction and JIB MAXIMUM DOWN fault should come on.

Fold-Under Jib Maximum Down Limit Check (optional)

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

Perform the following steps (if equipped with fold-under option) with the boom and luffing jib on the ground:

1. Check Dimension (D3, View C) and if necessary, adjust position of limit switch housing to obtain deactivated dimension.

Perform the remaining steps with the engine running and appropriate Luffing Jib Capacity Chart selected.

2. Depress limit switch (6a) actuator rod to activated Dimension D3 and hold. Listen for limit switch to “click” open (on Past Production switches the LED will go OFF).
3. Push the luffing jib handle forward.

Luffing hoist must not turn in down direction and JIB MAXIMUM DOWN fault should come on.

Operational Checks

Make the following operational checks after the boom and jib are raised.

1. Travel the crane onto a firm level surface or level the crane by blocking under crawlers.
2. Raise the boom and luffing jib until the boom is at 80°.
3. Monitor BOOM TO LUFFING JIB ANGLE on main display information screen while performing the remaining steps.
4. SLOWLY raise the luffing jib.
5. Luffing hoist must stop and be inoperable in up direction when boom to luffing jib angle is 168°.
6. Fault alarm should come on indicating JIB MAXIMUM UP 1 angle has been reached.
7. Turn jib up limit bypass key switch clockwise to bypass MAXIMUM UP 1 angle.

8. SLOWLY raise luffing jib past MAXIMUM UP LIMIT 1.
9. Luffing hoist must stop and be inoperable in up direction when boom to luffing jib angle is 171°.
10. Fault alarm should come on indicating JIB MAXIMUM UP 2 limit has been reached.

If maximum stops do not operate properly, troubleshoot system.

11. SLOWLY lower the luffing jib.
12. Luffing hoist must stop and be inoperable when boom to luffing jib angle is:

- 60° boom-to-luffing jib angle for layout luffing jib
- 13° boom-to-luffing jib angle for fold-under luffing jib

Turn normal limit bypass key clockwise to bypass minimum angle and lower the jib. Luffing hoist must stop and be inoperable in down direction when boom to luffing jib angle is:

- 57° boom-to-luffing jib angle for layout luffing jib
- 10° boom-to-luffing jib angle for fold-under luffing jib

If minimum stops do not operate properly, troubleshoot system.

Actuator Rod Replacement

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

1. Remove damaged actuator rod (1).
2. Slide spring washers (3 and 5) and spring (4) over new actuator rod while sliding actuator rod into bracket assembly.
3. Position actuator rod (1) so tapered end just touches limit switch (6) roller (View A). Actuator rod must not depress limit switch roller.
4. Drill 1/4 in (6,35 mm) hole through spring washer (3) and actuator rod (1).
5. Install dowel pin (2).
6. Check limit switch roller to insure there is over-travel as shown in View B.



WARNING

Falling Attachment Hazard!

Watch that physical jib stop pendants do not become tight before MAXIMUM UP 2 limit switch is activated.

Jib can be pulled over backwards or collapse.

Item	Description
1	Actuator Rod
2	Dowel Pin
3	Spring Washer
4	Spring
5	Spring Washer
6	Limit Switch
7	Cover
8	Bracket Assembly

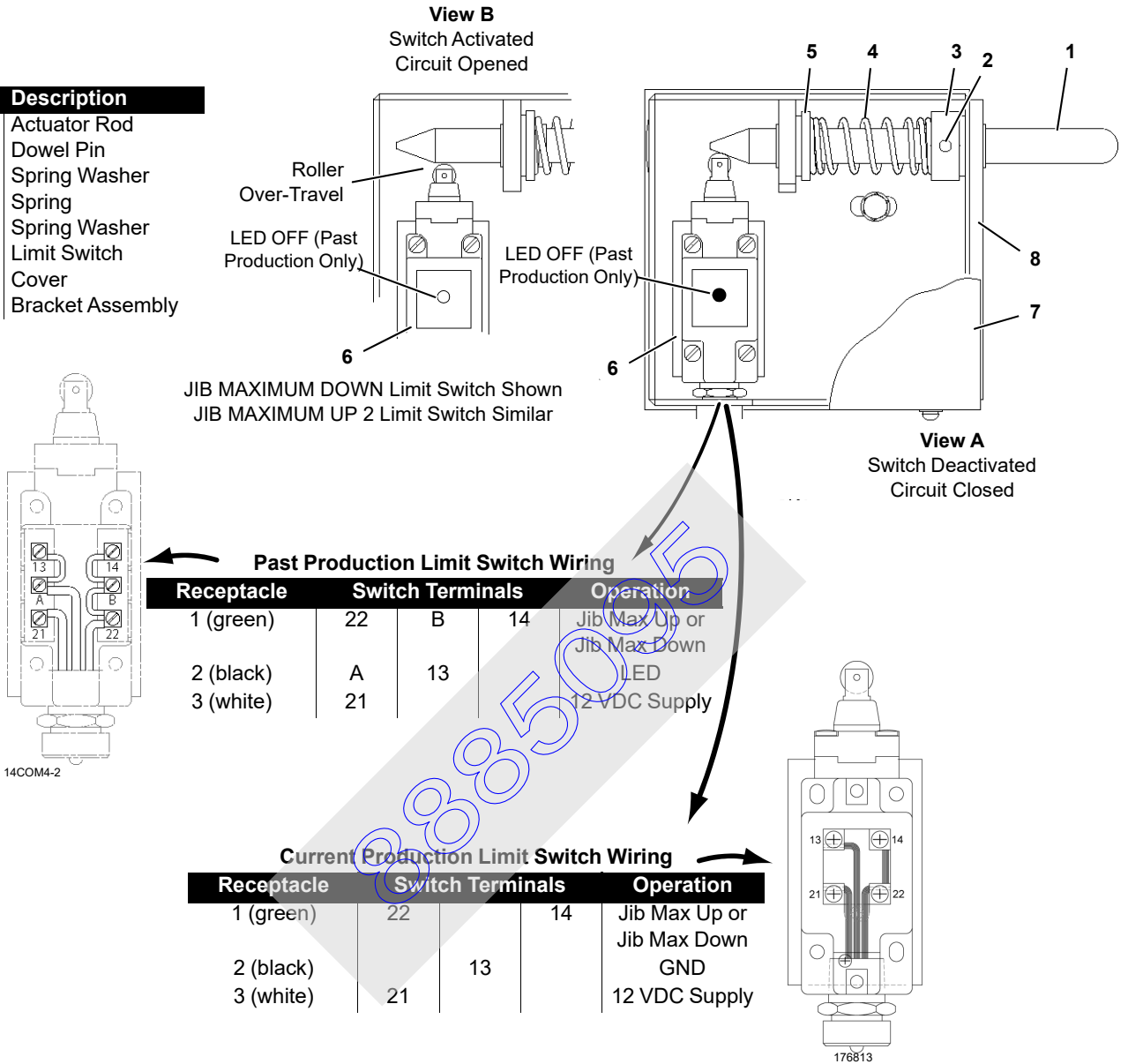
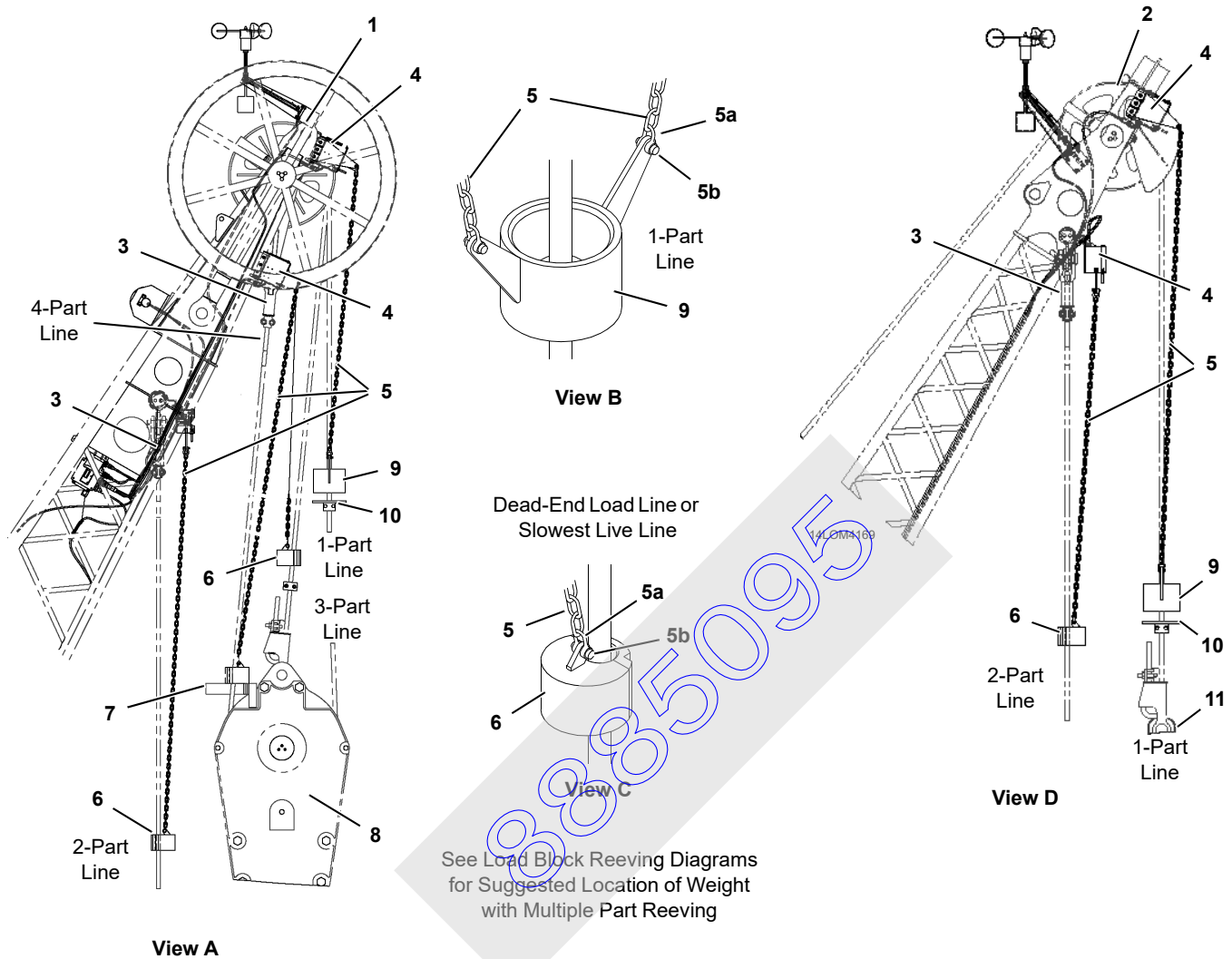


FIGURE 6-5

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Item	Description	Item	Description
1	Luffing Jib Point	6	Weight
2	Fixed Jib Point	7	Lift Plate
3	Wire Rope Anchor Point	8	Load Block
4	Block-Up Limit Switch	9	Weight
5	Chain	10	Lift Block
5a	Shackle	11	Weight Ball (if used)
5b	Pin		

FIGURE 6-6

BLOCK-UP LIMIT INSTALLATION AND ADJUSTMENT



WARNING Two-Blocking Hazard!

Block-up limit control is a protective device designed only to assist operator in preventing a two-blocking condition; any other use is neither intended nor approved.

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

General

The block-up limit control (also called anti two-block device) is a two-blocking prevention device which automatically stops the load drum from hoisting and the luffing jib (and fixed jib) from lowering when a load is hoisted a predetermined distance from either jib point.

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.

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

1. Jib top controller
2. Normally closed limit switch assembly fastened at either or both of the following locations:
 - a. Luffing jib point
 - b. Fixed jib point

3. Weight freely suspended by chain from each limit switch actuating lever (weight encircles load line as shown).
4. Lift block fastened to load line or lift plates fastened to load block.
5. Cable reel in jib butt ([Figure 6-7](#)) allows cable to be lengthened or shortened to meet varying jib lengths.

For identification and location of the block-up limit components in the boom, see the Operator and Service Manuals supplied with the crane.

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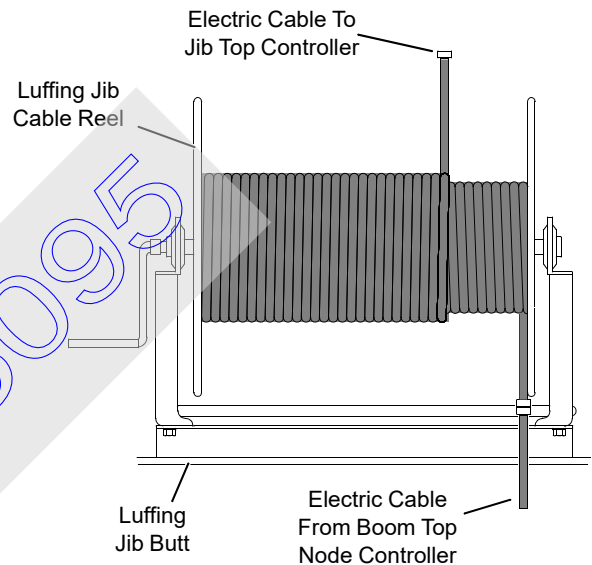


FIGURE 6-7

Disconnecting Block-Up Limits

See [Figure 6-8](#) for the following procedures.

Failing to perform the following steps will prevent load drums from hoisting and the boom and luffing jib from lowering. Also, fault alarm will come on.

1. To provide proper operation, the electric cables from the block-up limit switches must be connected to N3 receptacle (WJN1).
2. Always connect dust caps to ends of cables not in use.

Removing Luffing Jib

Failing to perform the following steps will prevent load drums from hoisting and the boom and luffing jib from lowering. Also, fault alarm will come on.

1. Disconnect electric cable (WJC) from cable reel (CR2) and at receptacle (WBN1) on boom top controller.
2. Connect dust caps to ends of cable and receptacle, then coil onto cable reel in jib butt.

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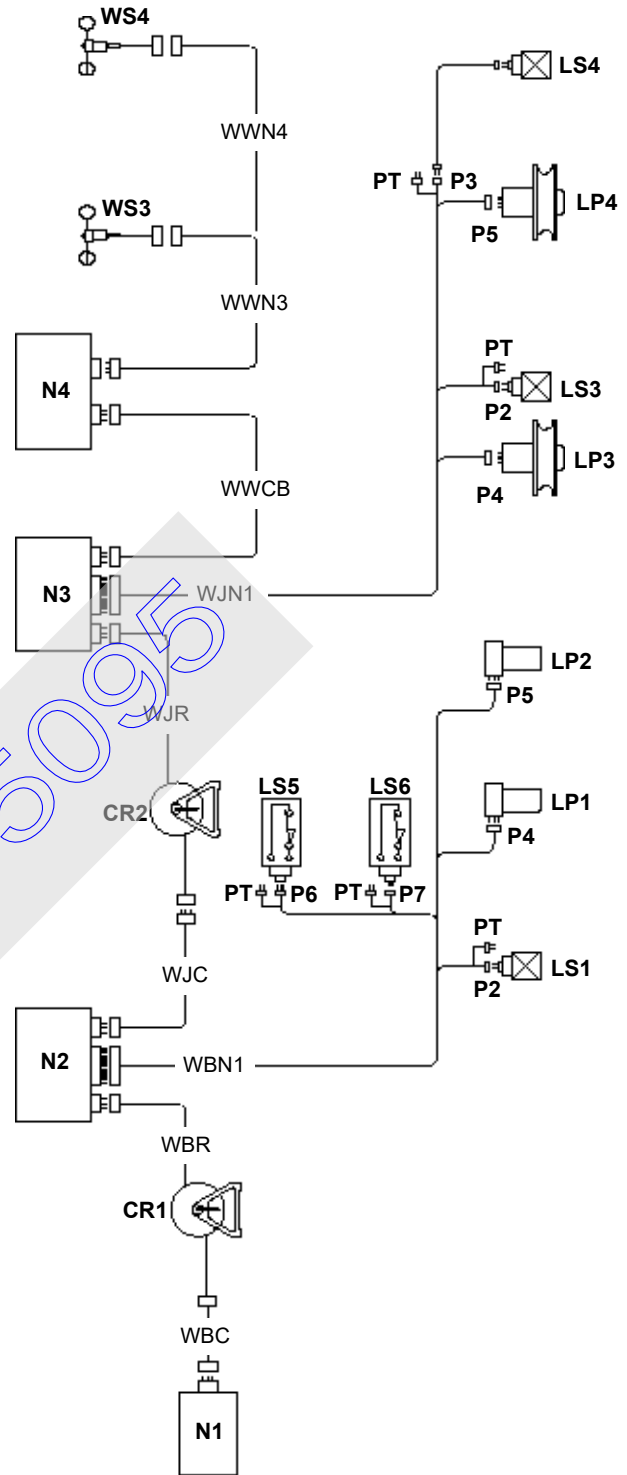
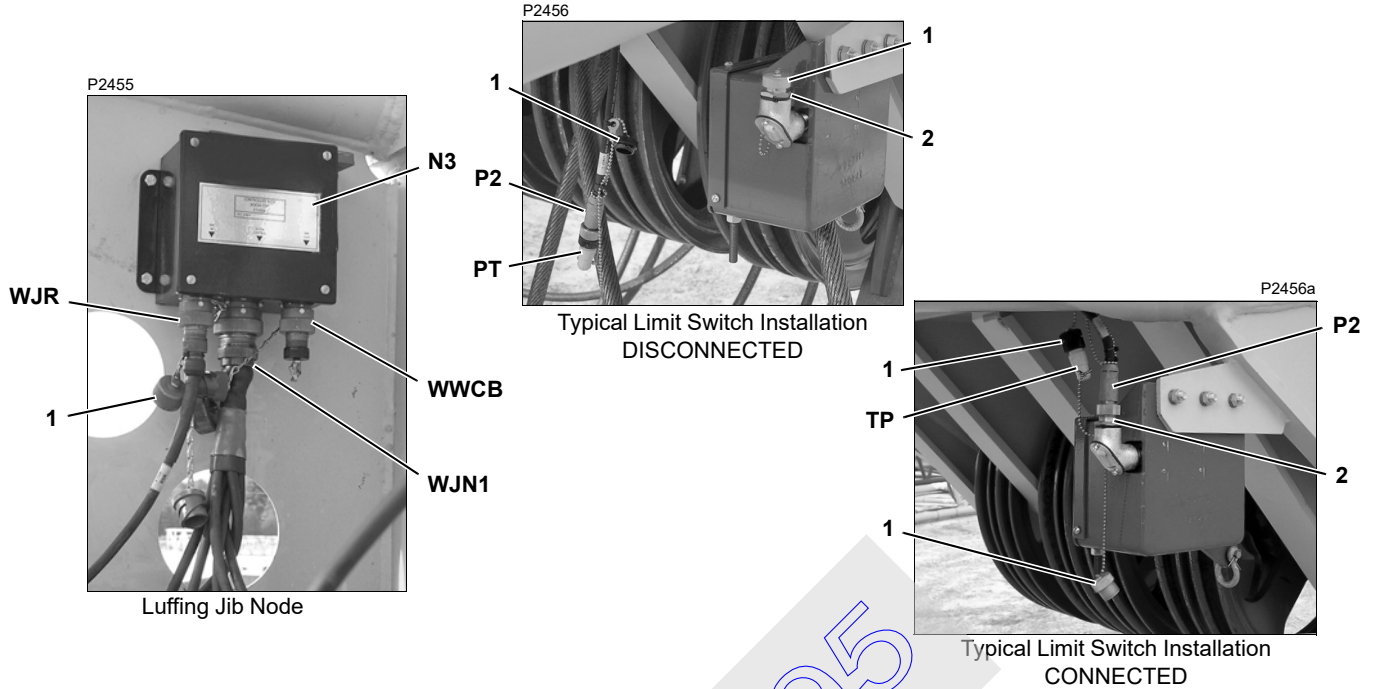


FIGURE 6-8



Item	Description	Item	Description
CABLE ENDS		LS3	Block-Up, Luffing Jib Point
1	Dust Cap	LS4	Block-Up, Fixed Jib Point
2	Receptacle	LS5	Max Up Limit, Luffing Jib
CABLES		LS6	Max Down Limit, Luffing Jib
WBC	From Engine Node	LOAD PINS/SHEAVES	
WBR	From Boom Butt Cable Reel	LP1	Boom Point, Left Side
WBN1	To Boom Top	LP2	Boom Point, Right Side
WJC	To Luffing Jib Butt Cable Reel	LP3	Luffing Jib Point (sheave)
WJR	From Luffing Jib Top Node	LP4	Fixed Jib Point (sheave)
WJN1	To Luffing Jib Top	PLUGS	
WWCB	To Wind Speed Node	P2	Block-Up Limit Switch, Lower Boom Point OR Block-Up Limit Switch, Lower Luffing Jib Point
WWN3	To Wind Speed Indicator	P3	Block-Up Limit Switch, Fixed Jib Point
WWN4		P4	Load Sensing Pin, Boom Left Side OR Load Sensing Sheave, Luffing Jib Point
CABLE REELS		P5	Load Sensing Pin, Boom Right Side OR Load Sensing Sheave, Fixed Jib Point
CR1	Boom Butt	P6	Max Up Limit, Luffing Jib
CR2	Luffing Jib Butt	P7	Max Down Limit, Luffing Jib
NODES		PT	Plug, Terminating
N1	Engine	WIND SPEED TRANSMITTERS	
N2	Boom	WS3	Luffing Jib Top
N3	Jib	WS4	Fixed Jib Top
N4	Wind Speed		
LIMIT SWITCHES			
LS1	Block-Up, Lower Boom Point		
LS2	Block-Up, Upper Boom Point		

FIGURE 6-8 continued

Block-Up Limit Switch Maintenance

CAUTION

Prevent Damage

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

At least once weekly, inspect and test block-up limit switches, as follows:

1. Lower the boom onto blocking at ground level and carefully inspect the following items:
 - a. Inspect each limit switch lever and actuating lever ([Figure 6-9](#)) for freedom of movement. Apply one-half shot of grease to the fitting on the actuating lever. Wipe away any excess grease.
 - b. Inspect each weight (6, [Figure 6-6](#)) for freedom of movement on the load line.
 - c. Inspect each weight, chain, shackle and connecting pin ([Figure 6-6](#)) for excessive or abnormal wear. Make sure cotter pins for shackles are installed and spread.
 - d. Inspect entire length of electric cables for damage.
 - e. Check that electric cables are clear of all moving parts on the boom and jib and that cables are securely fastened to the boom and jib with clips or nylon straps.

- f. Check that all cables and terminating plugs ([Figure 6-8](#)) are securely fastened.
2. Test block-up limit controls for proper operation using either of the following methods:
 - a. BOOM AND JIB LOWERED: Manually lift each weight — **one at a time** — while the engine is running. Load drum should not operate in up direction and boom/luffing hoist should not operate in down direction.
 - b. BOOM AND JIB 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/luffing hoist should not operate in down direction.

CAUTION

Avoid Sheave Damage

Use extreme care when testing block-up limit controls when the boom and jib are raised. If block-up limit control fails to stop load, immediately stop load by moving drum control handle to off or by applying drum working brake; otherwise two-blocking may occur.

Adjustment

See [Figure 6-9](#) for the following procedure.

Lower the boom and jib onto blocking at ground level and adjust each limit switch as follows:

1. Adjust spring tension (10) so there is enough force to lift weight of chain and rotate actuating lever (6) up when weight is lifted.
2. Loosen setscrew (11) in limit switch lever (4) so lever is free to rotate.
3. Manually lift weight to allow actuating lever (6) to rotate up.
 4. Hold lever (6) at Dimension A.
 5. Hold roller (5) on limit switch lever (4) against actuating lever (6) while performing step 6.
 6. Turn limit switch shaft (3) in required direction (see below) *only enough to “click” limit switch open and hold.* Then securely tighten setscrew (11) in limit switch lever.
 - COUNTERCLOCKWISE for lower jib point
 - CLOCKWISE for upper jib point
 7. Test limit switch for proper operation (see Maintenance topic); repeat adjustment steps until limit switch operates properly.

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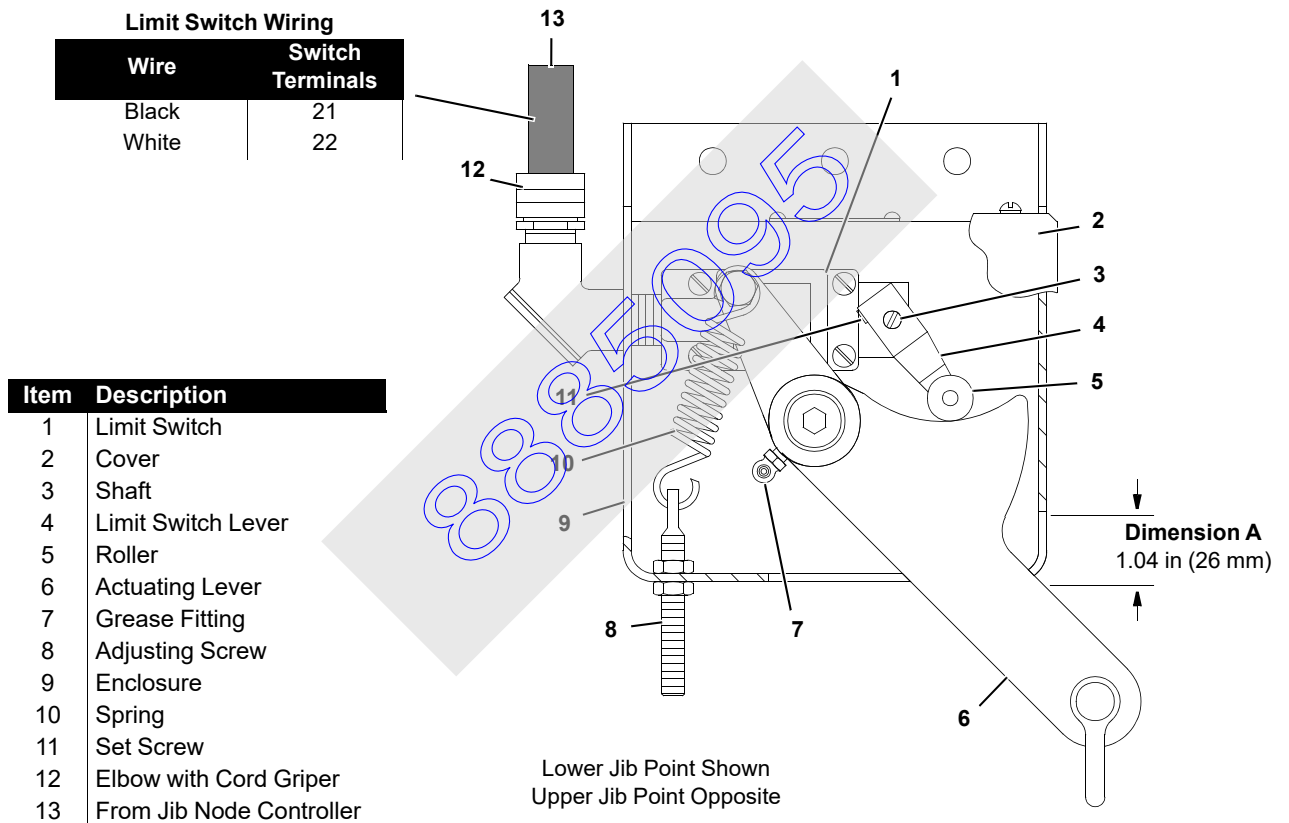


FIGURE 6-9

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Grove

Manitowoc

National Crane

Potain

