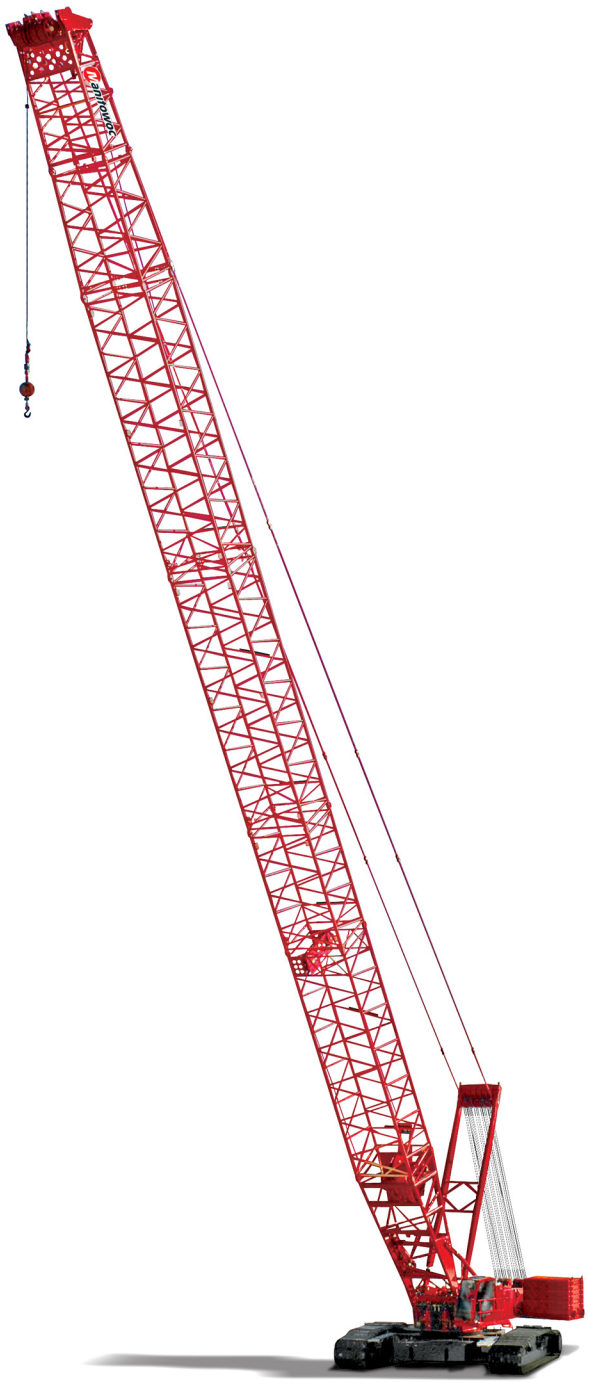
Manitowoc 16000

Operator Manual
Luffing Jib Attachment



Grove Manitowoc National Crane Potain

Manitowoc

OPERATOR MANUAL

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

16000

Luffing Jib Model Number

16005Ref

Luffing Jib Serial Number

This Manual is divided into the following sections:

NOTICE

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

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

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

⚠ WARNING

To prevent death or serious injury:

- 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 distributor for a new one.

Published 05-08-17, Control # 012-17

THE ORIGINAL LANGUAGE OF THIS PUBLICATION IS ENGLISH

See end of this manual for Alphabetical Index

SECTION 1
INTRODUCTION

TABLE OF CONTENTS

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Published 05-08-17, Control # 012-17

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.

CHANGE OF OWNERSHIP REGISTRATION

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

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

MANITOWOC DEALER

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

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

CRANE/ATTACHMENT IDENTIFICATION

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

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

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

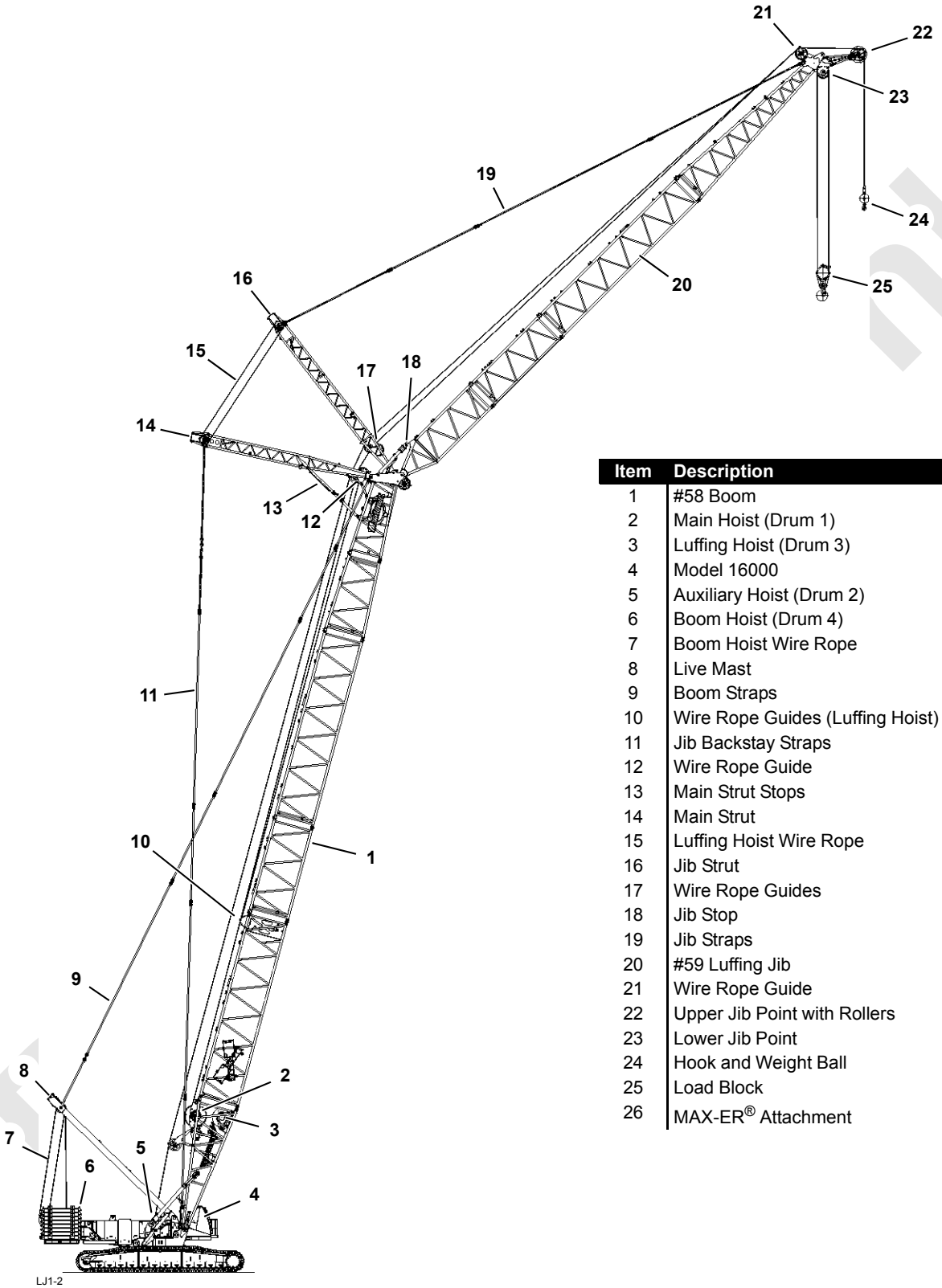
CRANE ORIENTATION

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

- The boom is on the front of the rotating bed.
- The carbody and crawler controls are on the front of the carbody.

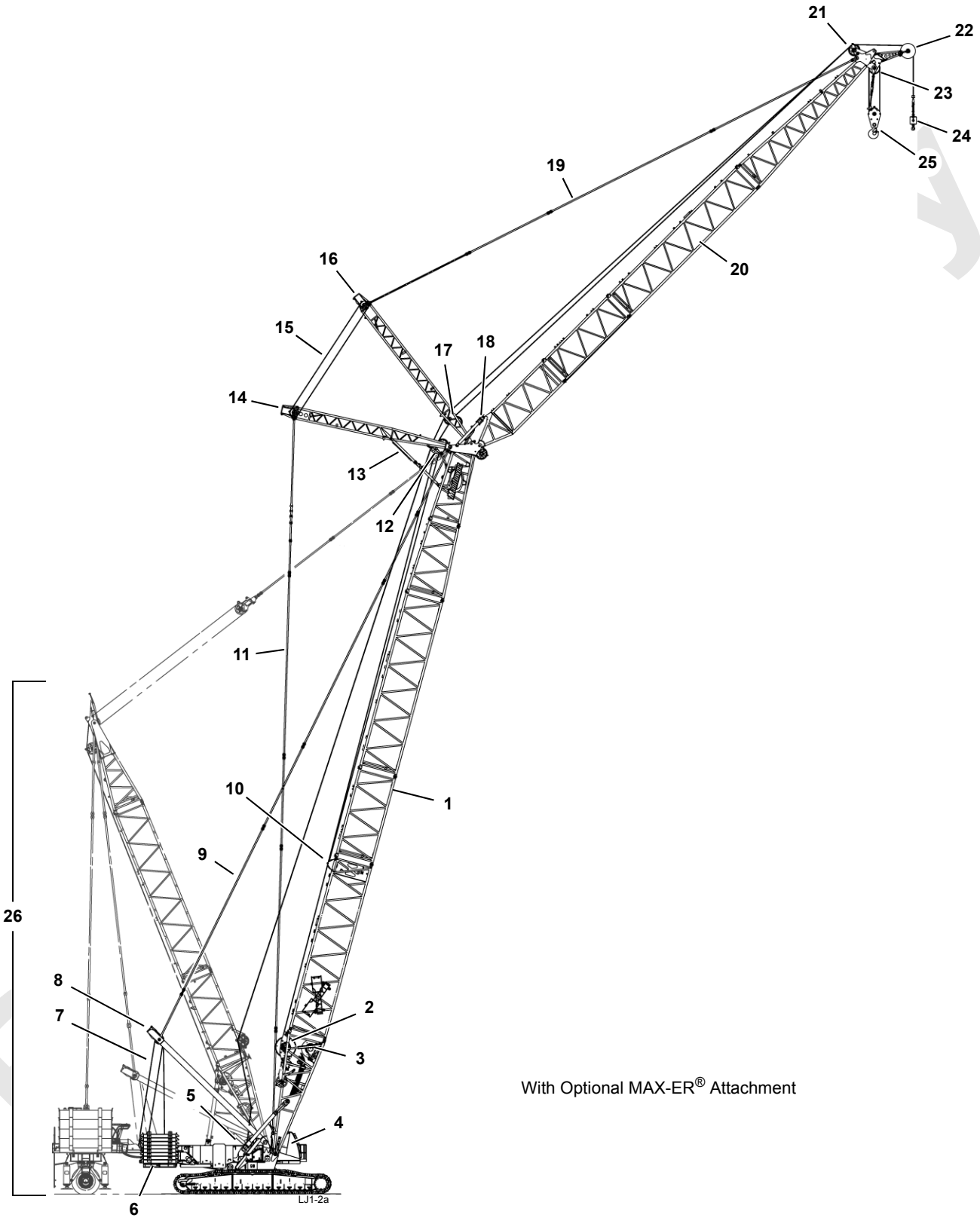
FIGURE 1-1

IDENTIFICATION AND LOCATION OF COMPONENTS



Item	Description
1	#58 Boom
2	Main Hoist (Drum 1)
3	Luffing Hoist (Drum 3)
4	Model 16000
5	Auxiliary Hoist (Drum 2)
6	Boom Hoist (Drum 4)
7	Boom Hoist Wire Rope
8	Live Mast
9	Boom Straps
10	Wire Rope Guides (Luffing Hoist)
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 Guides
18	Jib Stop
19	Jib Straps
20	#59 Luffing Jib
21	Wire Rope Guide
22	Upper Jib Point with Rollers
23	Lower Jib Point
24	Hook and Weight Ball
25	Load Block
26	MAX-ER® Attachment

FIGURE 1-2



With Optional MAX-ER® Attachment

FIGURE 1-2 continued

ENGLISH AND METRIC CONVERSIONS

Direct Conversion

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

12 ft x 0.3048 = 3,6576 m

Inverse Conversion

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

3,6576 m ÷ 0.3048 = 12

To Convert	Symbol	Application	To	Symbol	Multiply By
AREA					
Square Inch	in^2	Filter Area Clutch Contact	Square Centimeter	cm^2	6.4516
Square Foot	ft^2	Ground Contact	Square Meter	m^2	0.0929
FORCE					
Pound Force	lb	Pedal Effort	KiloNewton Newton	kN N	0.00445 4.4482
Pound Force	lb	Line Pull	KiloNewton	kN	0.00445
Pound Force Per Inch	lb/in.	Spring Force	Newton per millimeter	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

To Convert	Symbol	Application	To	Symbol	Multiply By
VOLUME (LIQUID)					
Ounce	oz	Fluid Capacities	Milliliter	mL	29.5735
Pint	pt		Liter	L	0.4732
Quart	qt		Liter	L	0.9464
Gallon	gal		Liter	L	3.7854
Gallon Per Minute	gpm	Pump Flow	Liters Per Minute	L/min	3.7854
WEIGHT					
Pound	lb	Unit/Component	Kilogram	kg	0.4536
Ton (2,000 lb.)	USt	Load Ratings	Metric Ton	t	0.9072
Ton (2,000 lb.)	USt		Kilogram	kg	907.1847

MANITOWOC DEALERS

To locate the Manitowoc dealer nearest you:

1. Go to **www.manitowoc.com.**
2. Click on Manitowoc logo.
3. Click on ***DEALERS.***
4. Follow on-screen instructions to locate distributor.
5. When calling a dealer with parts or service questions, you need to know the model and serial number of your crane or attachment. This information is located on the Crane Identification Plate on the crane cab or on the attachment.

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SECTION 2
SAFETY INFORMATION

TABLE OF CONTENTS

SECTION 2
SAFETY INFORMATION

WARNING

California Proposition 65

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

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

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

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

California Spark Arrestor

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

CONTINUOUS INNOVATION

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

NAMEPLATES AND DECALS

See drawing at the end of this section.

SAFETY MESSAGES

General

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

To alert personnel to hazardous operating practices and maintenance procedures, safety messages are used throughout the manual. Each safety message contains a safety alert symbol and a signal word to identify the hazard's degree of seriousness.

Safety Alert Symbol

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

Signal Words

DANGER

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

WARNING

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

CAUTION

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

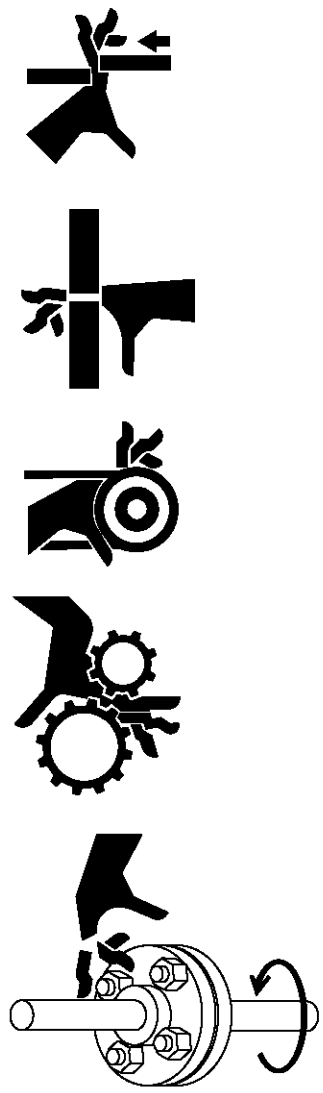
CAUTION

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

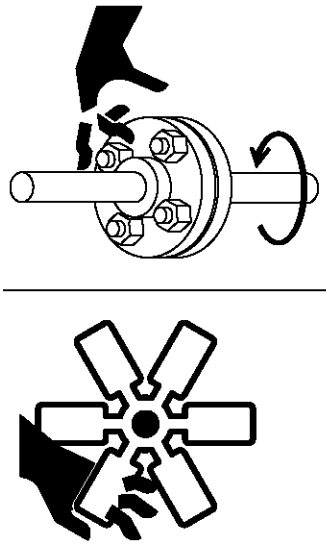
NOTE: Highlights operation or maintenance procedures.

Safety Symbol Identification

The symbols used in the safety and information signs and nameplates on this crane are identified in Figure 2-1.

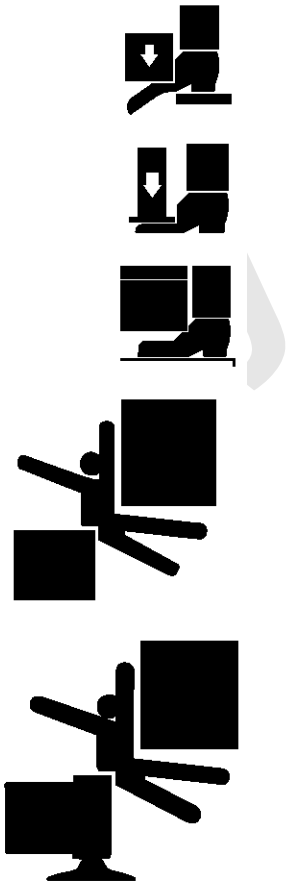


Cut or Crush Hazards



Cut Hazard

Crush Hazards

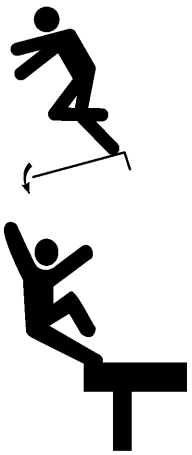


Electrocution Hazard

Explosion Hazard

Fall Hazard

FIGURE 2-1

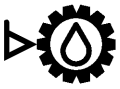


Fall Hazards

Engine Coolant

Engine Coolant Vent

Engine Oil Level



Pump Drive Oil Level

Diesel Fuel

Hydraulic Filter

Hydraulic Oil

Fluid Symbols

2

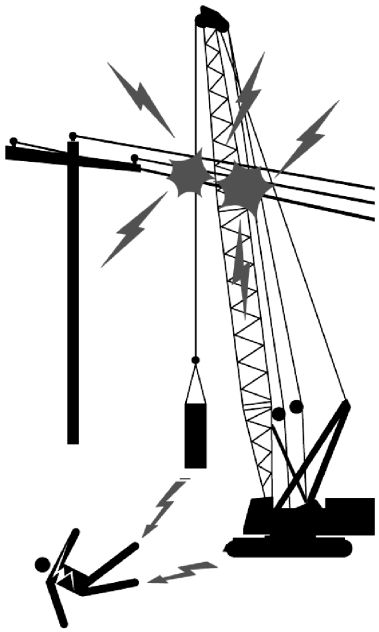
Falling Boom Hazards (Crush Hazard)

Flying Object Hazards

Overhead Obstruction Hazard

Falling Load Hazards (Crush Hazard)

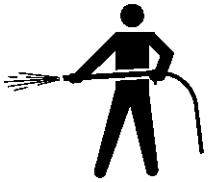
Fire Extinguisher



Power Line Hazard (Electrocution)

FIGURE 2-1 continued

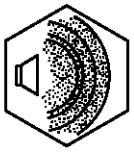
Personal Fall Protection



Pressure Cleaning

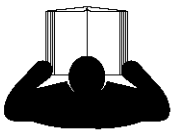
Pressure Release Hazard

Sound Power Level



Read Manual

OR



Tire Pressure (if applicable)

FIGURE 2-1 continued

SAFETY AND INFORMATION SIGNS

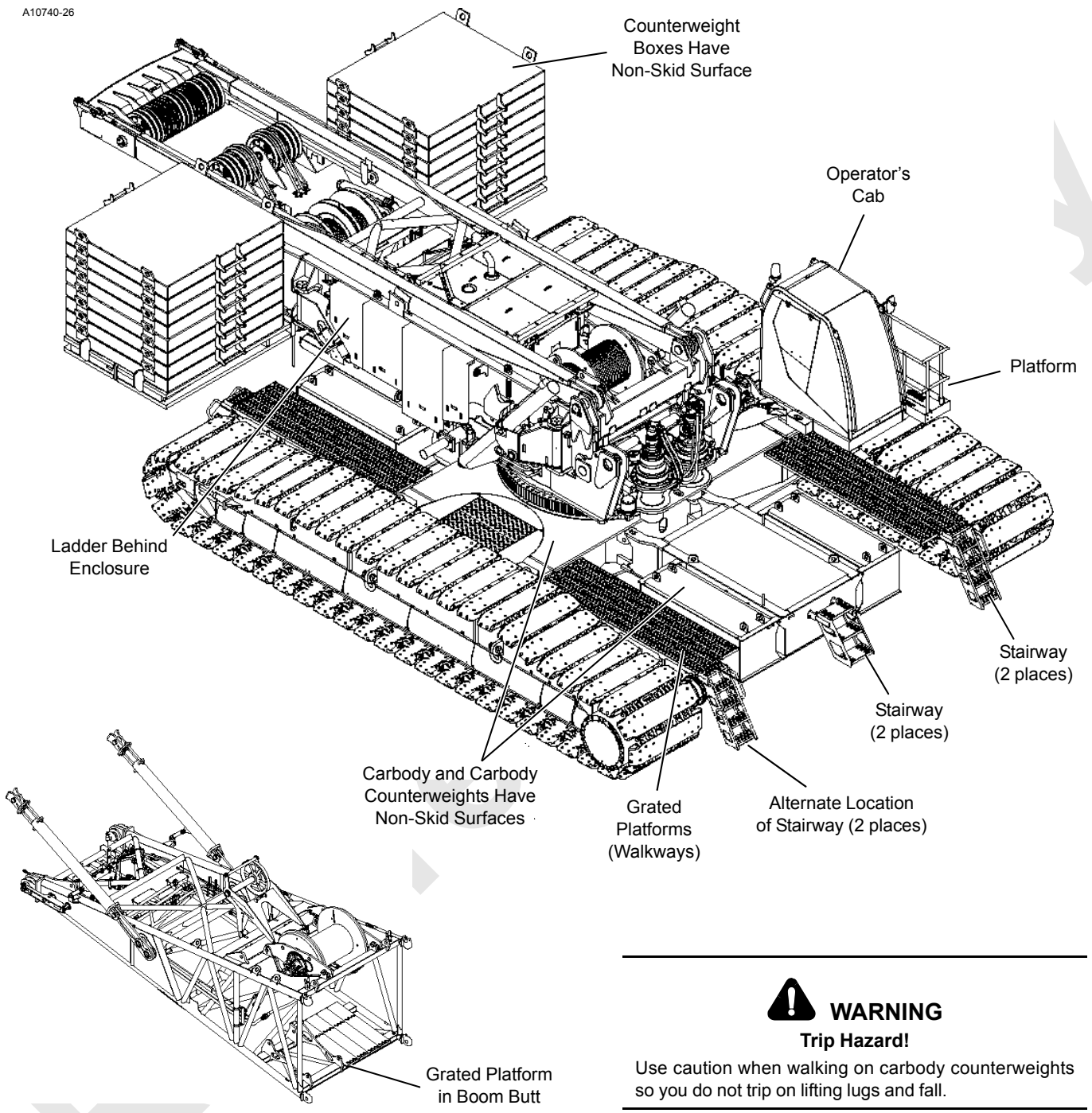
Maintaining Signs

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

Ordering Signs

Order replacement safety and information signs from your Manitowoc dealer.

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



WARNING

Trip Hazard!

Use caution when walking on carbody counterweights so you do not trip on lifting lugs and fall.

FIGURE 2-2

CRANE ACCESS POINTS

WARNING

Crush Hazard!

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

Moving crawlers can crush personnel climbing on or off crane.

To prevent death or serious injury:

- Barricade all accessible areas to crane so personnel cannot be struck or crushed when upperworks is swung. See Swing Radius Barrier topic in this section.
- Do not climb onto or off crane while upperworks is being swung or crane is being traveled.
- Signal operator for permission to climb onto/off crane.
- Operator: do not swing or travel while personnel are climbing onto or off crane. Stop swing and travel motions. Apply swing brake and turn on travel park.
- Operator: Always sound horn to alert personnel before you swing or travel.
- Automatic alarms will sound to alert personnel when the crane is swung or traveled.

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

General

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

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

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

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

- Access points must be kept clear to prevent personal injury and unsafe operation of crane. Store clothing and other personal belongings so they do not interfere with controls in operator's cab or with operation of crane.
- Do not allow ground personnel to store their personal belongings (clothing, lunch boxes, water coolers, and the like) on the crane.

  This practice will prevent ground personnel from being crushed or electrocuted when they attempt to access personal belongings stored on the crane.
- Tools, oil cans, spare parts, and other necessary equipment must be stored in tool boxes or other appropriate locations. Do not allow these items to lie around loose in operators cab or on steps, ladders, catwalks, and platforms.
- To reduce risk of slipping, non-skid material (sand in paint) has been applied to painted walkways and platforms.

  Walkways and platforms can be slippery when wet and when oil or is grease is spilled on them. ***Keep walkways and platforms clean and dry to prevent slipping on them.*** When non-skid material wears out, reapply it.
- Wear shoes with a highly slip-resistant sole material. Clean any mud or debris from shoes before entering the crane cab or climbing onto the cab. A shoe that is not clean might slip off a control pedal during operation.
- Do not make modifications or additions to the crane's access system that have not been evaluated and approved by Manitowoc.
- Do not use top of mast, boom, or jib as walkways unless they have catwalks.

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

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

GETTING ON OR OFF CRANE

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

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

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

OPERATOR MANUAL/CAPACITY CHART STORAGE

General

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

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

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

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

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

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

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

Storing Manuals

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

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

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

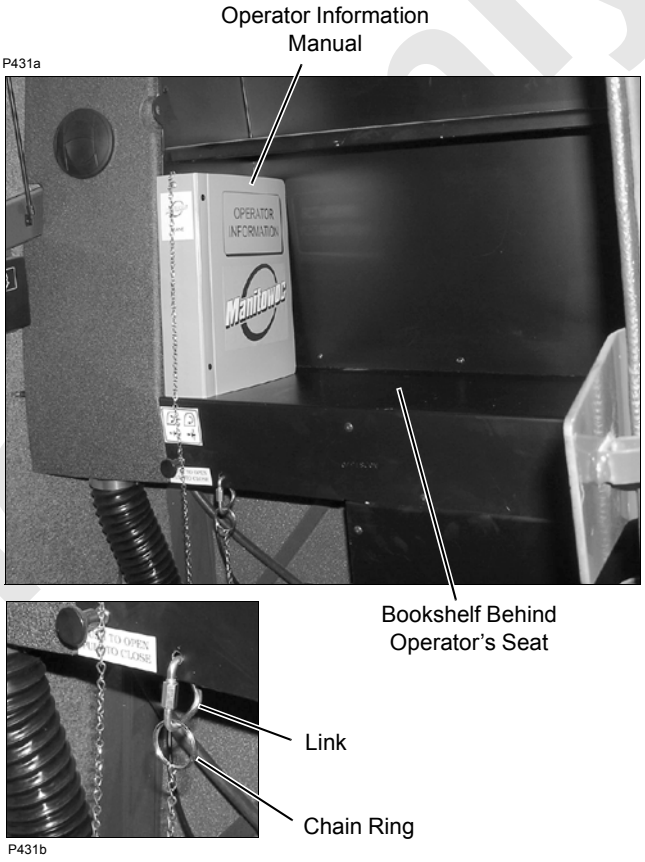


FIGURE 2-3

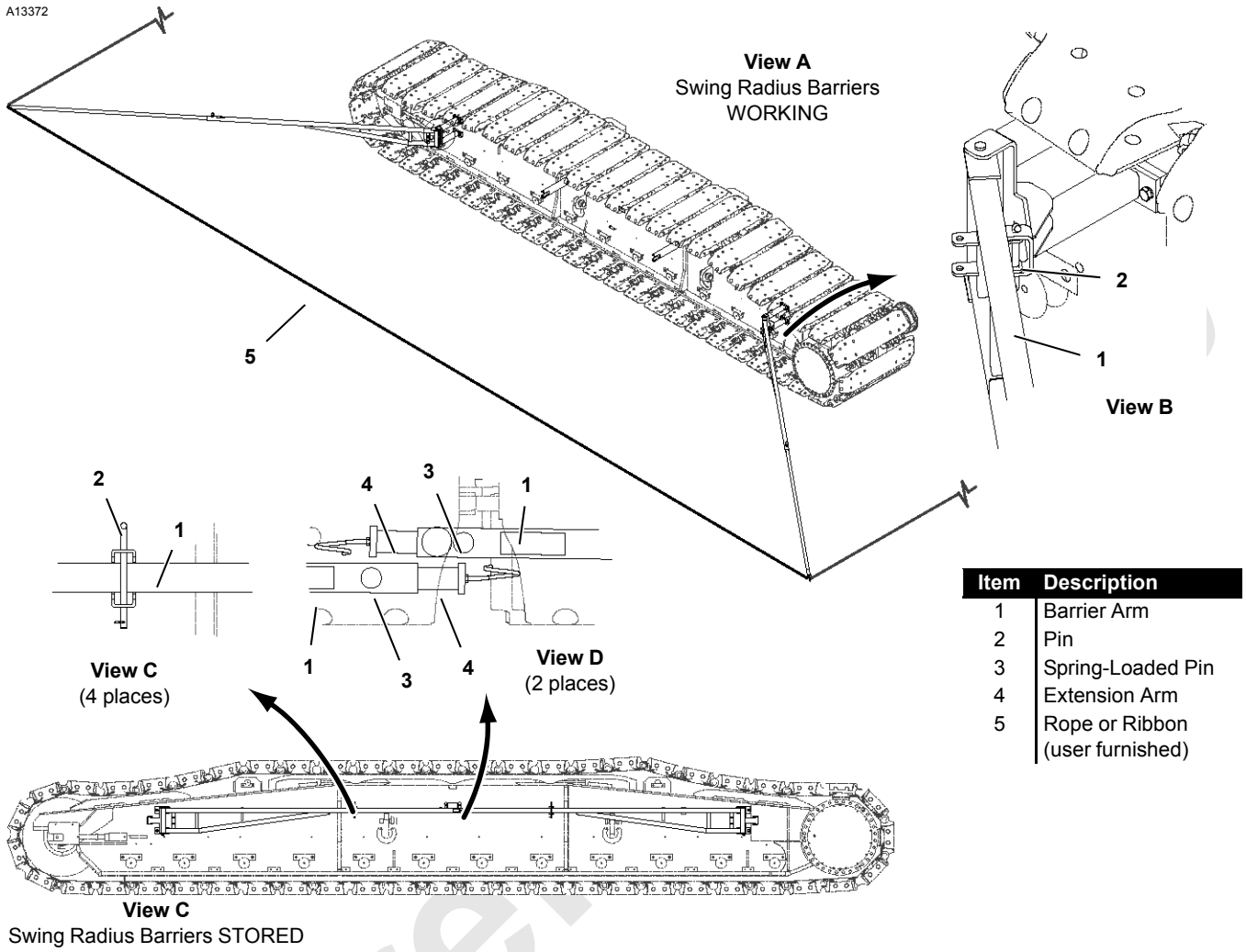
SWING RADIUS BARRIER

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.



Item	Description
1	Barrier Arm
2	Pin
3	Spring-Loaded Pin
4	Extension Arm
5	Rope or Ribbon (user furnished)

FIGURE 2-4

Deploying Swing Radius Barrier

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

Storing Swing Radius Barrier

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

SAFE OPERATING PRACTICES

General

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

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

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

Read Operator Manual

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

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

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

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

Operator Qualifications

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

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

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

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

Operator training and qualification is crane owner's responsibility.

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

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

- Phone 202-512-1899
- Fax 202-512-2250
- Online at www.osha.gov

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

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

Operator Conduct

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

4. The operator shall be thoroughly familiar with operation of crane and its proper care. If adjustments or repairs are necessary or if there are known defects that impair safe operation, the crane must not be operated until unsafe conditions have been corrected.
5. If there is a warning sign at the start controls, the operator shall not start the engine until the warning sign has been removed by the person who installed it.
6. Before starting the engine, the operator shall make sure that:
   a. All daily inspection and maintenance services have been performed.
   b. All controls are in off the position and all brakes and locking devices are applied or engaged.
   c. All personnel are clear of the crane. Deploy a swing radius barrier.

WARNING

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

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

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

7. The operator shall test all controls, limits, and communication systems at the start of each shift. Any defects found must be corrected before operation is begun.
8. The operator shall not start crane movement if the load or designated signal person is not within his/her range of vision or communication.
9. The operator shall understand and respond to signals from the person directing the lift or from the designated signal person. When a signal person or crane follower is not required, the operator is responsible for the lift. ***Operator shall obey a stop signal at all times, no matter who gives it***.
10. The operator shall verify that the Capacity Chart being used is the correct one for the cranes configuration (boom length, load line reeving, counterweight, etc.).
11. The operator shall verify that:
    a. All attachments are properly assembled and attached to the crane according to the rigging drawings called for in the Capacity Chart.
    b. The counterweight — to include applicable auxiliary counterweight — is in place and of proper weight. ***Maximum required counterweight 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's cab for any reason:
    a. Park crane and position upperworks so crane does not interfere with operation of other equipment.
    b. Apply travel and swing brakes or locking devices.
    c. Land any attached load.
    d. Lower the boom onto blocking at ground level or onto a boom rest if possible.

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

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

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

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

13. The operator shall perform the following operations if power or a control function fails during operation:
    a. Land all suspended loads, if possible, under brake or power control.

b. Apply all brakes and locking devices.

c. Move all controls to off.

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

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

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

Never operate the crane during an electrical thunderstorm.

When a local weather storm warning exists (including electrical thunderstorm), stop operation and secure the crane. See step 12 under Operator Conduct topic.

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

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

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

a. If the wind causes the load to swing forward past the allowable operating radius or sideways past either boom hinge pin, land the load and apply the drum brakes.

b. If the wind exceeds 35 mph, land all loads and apply the drum brakes, lower the boom onto blocking at ground level or otherwise restrain it, and apply the swing and travel brakes and/or locks.

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

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

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

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

Handling Load

Size of Load

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

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

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

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

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

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

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

Attaching Load

1. Attach the hook to the load with slings, or other suitable rigging. Each hook shall have a latch that is in proper working order. ***Hook latches must not be wired open***.

a. Inspect each hook and latch before using.

b. Never use a hook or latch that is distorted or bent.

c. Make sure spring will force the latch against the tip of the hook.

d. Make sure the hook supports the load. The latch must never support the load. Latches are only intended to retain loose slings under slack conditions.

2. Only use slings and other rigging that are in safe operating condition and have a rating equal to or greater than the load to be lifted.

3. Do not wrap the load line around the load.

4. Use suitable protection between slings and any sharp edges on the load. When synthetic slings are used, the synthetic sling manufacturer's instructions, limitations, specifications, and recommendations must be followed.
5. Secure unused legs of a multi-leg sling before handling a load with one leg of sling.

Lifting/Moving Load

1. Before lifting or moving a load, the operator or qualified person directing the lift shall make the following checks:
   - **a.** Crane has a firm, uniformly supporting foundation under all crawlers. Unless otherwise specified in the Capacity Chart, the foundation must be level to within 1% — 1ft (0,3 m) rise or fall in 100 ft (30,5 m) distance.

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

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

     The operator shall test the load drum brakes each time a load approaching the rated load is handled. Lift the load 3 to 6 in (76 to 152 mm) and fully apply the brakes — *load must not lower through applied brakes*.
   - **j.** Unused load drums are parked (working and parking brakes applied; if equipped, drum pawls engaged).
   - **k.** All personnel are clear of the swing radius of the crane's counterweight.
2. While lifting or moving the load, the operator shall take the following precautions:
   - **a.** Accelerate and decelerate the load smoothly to avoid excessive stress on the crane boom and machinery.
   - **b.** Avoid sudden starts and stops while swinging. Keep the swing speed under control to prevent the load from swinging out beyond the radius at which the load can be handled and to minimize the pendulum action of the load.
   - **c.** Sound the signal horn before swinging and intermittently while swinging, especially when approaching personnel.

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

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

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

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

     - Free of defects
     - Strong enough to prevent crushing, bending, or shear failure

- Of sufficient thickness, width, and length to completely support the jack pad or float, transmit the load to the supporting surface, and prevent shifting, toppling, or excessive settlement under load

k. Fully retract and lock the jacks and the outrigger beams so they cannot extend when not in use.

l. Operate with extreme caution when using two or more cranes to lift the same load.

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

m. Do not lower the load or the boom to a point where less than three full wraps of wire rope are remaining on the respective drum (or as otherwise indicated in local, state, or federal regulations).

n. Engage the boom hoist pawl when operating with the boom at a fixed radius.

o. Engage the luffing hoist pawl when operating with the luffing jib at a fixed radius.

3. While traveling, the operator shall take the following precautions:

a. Sound the signal horn before traveling and intermittently while traveling, especially when approaching personnel.

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

b. Carry the boom in-line with the lowerworks and facing the direction of travel.

c. Do not position the boom so high that it could bounce over backwards whether traveling with or without load.

d. Secure the rotating bed against rotation except:

- When operating with a MAX-ER® attachment
- When it is necessary to negotiate a turn, and then only when the operator is seated at controls or the boom is supported on a dolly

e. Lash or otherwise restrain unused hooks so they cannot swing freely.

4. Before traveling with a load, the operator shall take the following additional precautions:

a. A designated person shall be responsible for operation. Decisions such as the necessity to reduce crane ratings, load position, boom position, ground support, and speed of movements shall be in accordance with the designated person's decision.

b. Maintain specified tire pressures (truck cranes).

c. Avoid sudden starts and stops. Use taglines or other restraints to control the position of the load.

Multiple Load Line Operation

WARNING

Avoid Over Load and Side Load Damage to Crane

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

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

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

1. The qualified lift planner and the crane operator shall read and become thoroughly familiar with the appropriate Capacity Charts and Wire Rope Specification Charts.

2. The lift planner and the crane operator shall make sure the total load does not exceed the rated capacity given in the Capacity Chart and Wire Rope Specification Chart for given boom point or jib point, whichever is less.

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

3. The crane must be thoroughly inspected by a qualified person prior to setup.

4. The crane must be thoroughly inspected for load line interference caused by routing and reeving of multiple load lines. If interference is found, it must be eliminated.

5. For cranes produced before 2003, Rated Capacity Indicators/Limiters were not required by ASME B30.5 for non-personnel lifting.

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

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

6. Manitowoc recommends that each load line be equipped with an anti two-block device.
7. Manitowoc's Capacity Charts are based on freely suspended loads. To prevent side load damage to the boom, the jib, and the sheaves:
   - The load lines must hang as close to vertical as possible to minimize side and forward loads.

     The distance between the load points and the hook points must be a minimum of three times the horizontal distance between the hook point on the load being lifted.
   - The load must remain centered on the boom and jib point shafts unless special lift approval is granted by Manitowoc.
   - The load lines should be located over the load's center of gravity as it is supported on a trailer, a barge, or the ground.
8. The crane operator shall be familiar with the operational characteristic of the crane as it relates to multiple drum operation (simultaneous operation, same or opposite direction, or individual operation).
9. When using tandem drums, the maximum operating layers may be limited depending on whether the crane was initially designed for tandem drum operation or not.
10. Load shift when lifting with two hooks may be more unpredictable than typical one hook lifting.

Holding Load

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

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

SIGNALS

1. Continuous communication shall be maintained between the operator and the signal person during all crane movements. If communication is disrupted, ***operator shall stop all crane movements***.
2. Signals to the operator shall be in accordance with the standard signals shown in Section 3, unless communications equipment (telephone, radio, etc.) is used.
3. All signals shall be easily understood by the operator at all times. The operator shall not respond to any signal which is not clearly understood.
4. For operations not covered in the standard signals, or for special situations or emergencies, additional signals may be required. In those cases, the signals used shall be agreed upon in advance by the operator and the signal person. The signals used shall not conflict with or have potential to be confused with the standard signals.
5. When it is necessary to give instructions to the operator (other than those established by the signal system), all crane motions must be stopped.
6. The signal person shall:
   a. Be tested by a designated person and show that he or she has a basic understanding of crane operations and limitations, to include boom deflection
   b. Be thoroughly familiar with the standard hand signals and voice signals if used
   c. Be positioned in clear view of the operator. The signal person's position should give him or her a clear view of the load, the crane, and the operating area.
   d. Direct the load so it does not pass over personnel
   e. Keep unnecessary personnel out of the crane's operating area
7. When moving the crane, the following audible signals shall be used:
   a. STOP - one short audible signal
   b. GO AHEAD - two short audible signals
   c. BACK UP - three short audible signals

SAFETY DEVICES

WARNING

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

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

Manitowoc provides the following safety devices on its cranes.

1. Horn activated by a switch on the control console in the operator's cab

   If the horn is not working properly, it must be tagged-out or removed, if possible.

2. Crane level indicator: either electronic (viewable in crane's electronic display) or mechanical (viewable from operator's cab seat). If the crane level indicator is not working properly, it must be tagged-out or removed, if possible.
3. Cranes operating on a barge require: a trim indicator, a swing brake, and a wind direction indicator if the wind is a factor (supplied by crane owner or user).
4. Boom stops, both physical and automatic

   If a boom stop is damaged or not working properly, it must be tagged-out or removed if possible.

5. Jib stops, both physical and automatic (for fixed jib and luffing jib)

   If a jib stop is damaged or not working properly, it must be tagged-out or removed, if possible.

6. Pedal locks for all foot-operated brakes (if applicable)

   If a pedal lock is damaged or not working properly, it must be tagged-out or removed if possible.

7. An integral holding device or check valve on each jacking cylinder

OPERATIONAL AIDS

WARNING

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

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

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

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

Category 1 Operational Aids

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

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

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

   Temporary alternative measures if inoperative or malfunctioning:

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

   a. Measure radius using a tape measure.

   b. Measure the boom angle with a protractor-level on the centerline of boom.

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

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

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

2. Anti-Two-Block Device

Temporary alternative measures if inoperative or malfunctioning:

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

a. Assign a signal person to signal the operator to stop hoisting when the load is a safe distance from the boom or jib point.

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

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

Category 2 Operational Aids

If a Category 2 operational aid is not working properly, it must be repaired no later than 30 calendar days after the deficiency occurs. Exception: If the employer documents that 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 (viewable from operator's cab).

b. Measure the boom angle with a protractor-level on the centerline of boom.

c. Measure radius using a tape measure.

3. Jib Angle or **Radius Indicator**

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

a. First, make sure you know the boom angle (see item 2 above).

b. Then, measure radius using a tape measure.

4. Drum Rotation Indicator

Temporary alternative measures if inoperative or malfunctioning:

Mark the drum to indicate its rotation.

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

5. OPTIONAL **Swing Limiter** or **Proximity Device**

Temporary alternative measures if inoperative or malfunctioning:

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

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

Temporary alternative measures if inoperative or malfunctioning:

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

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

Temporary alternative measures if inoperative or malfunctioning:

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

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

Electrocution Hazard

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

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

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

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

WARNING

Electrocution Hazard!

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

1. Keep all personnel and their personal belongings (clothing, water coolers, lunch boxes, etc.) away from the crane if it is being operated near electrical power lines or equipment.
2. Before operating the crane in the vicinity of electrical power lines or equipment, notify the power utility company. Obtain positive and absolute assurance that the power has been turned off.

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

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

   The rules in this section must be followed at all times, even if the electrical power lines or equipment have been de-energized.
3. Crane operation is dangerous when close to an energized electrical power source. Exercise extreme caution and prudent judgment. Operate slowly and cautiously when in the vicinity of power lines.
4. If the load, wire rope, boom, or any portion of the crane contacts or comes too close to an electrical power source, everyone in, on, and around the crane can be seriously injured or killed.

   The safest way to avoid electrocution is to stay away from electrical power lines and electrical power sources.
5. The operator is responsible for alerting all personnel to the dangers associated with electrical power lines and equipment. The crane is not insulated. Do not allow unnecessary personnel in the vicinity of the crane while operating. Permit no one to lean against or touch the crane. Permit no one, including riggers and load handlers, to hold the load, load lines, taglines, or rigging gear.
6. Even if the crane operator is not affected by an electrical contact, others in the area may become seriously injured or killed.
7. It is not always necessary to contact a power line or power source to become electrocuted. Electricity, depending on magnitude, can arc or jump to any part of the load, load line, or crane boom if it comes too close to an electrical power source. Low voltages can also be dangerous.

Set-Up and Operation

1. During crane use, assume that every line is energized ("hot" or "live") and take necessary precautions.
2. Position the crane such that the load, boom, or any part of the crane and its attachments cannot be moved to within 20 ft (6 m) of electrical power lines or equipment. This includes the crane boom and all attachments. Overhead lines tend to blow in the wind, so allow for movement of the overhead lines when determining a safe operating distance.
3. Erect a suitable barricade to physically restrain the crane, all attachments, and the load from entering into an unsafe distance from electrical power lines or equipment.
4. Plan ahead and always plan a safe route before traveling under power lines. A wooden clearance frame should be constructed to ensure sufficient clearance is maintained between crane and power lines.
5. Appoint a reliable and qualified signal person, equipped with a loud signal whistle or horn and voice communication equipment, to warn the operator when any part of the crane or load moves near a power

source. This person should have no other duties while the crane is working.

6. Taglines should always be made of non-conductive materials. Any tagline that is wet or dirty can conduct electricity.
7. DO NOT store materials under power lines or close to electrical power sources.
8. When operating near transmitter/communication towers where an electrical charge can be induced into the crane or load:
   - The transmitter must be deenergized OR,
   - Tests must be made to determine if an electrical charge will be induced into the crane or load.
   - The crane must be provided an electrical ground.
   - If taglines are used, they must be non-conductive.
   - Every precaution must be taken to dissipate induced voltages. Consult with a qualified RF (radio frequency) Consultant. Also refer to local, state, and federal codes and regulations.

Electrocution Hazard Devices

1. The use of insulated links, insulated boom cages/ guards, proximity warning devices, or mechanical limit stops does not ensure that electrical contact will not occur. Even if codes or regulations require the use of such devices, failure to follow the rules in this section may result in serious injury or death.
2. Be aware that such devices have limitations and you should follow the rules and precautions outlined in this section at all times even if the crane is equipped with these devices.
3. Insulating links installed into the load line afford limited protection from electrocution hazards. Links are limited in their lifting abilities, insulating properties, and other properties that affect their performance. Moisture, dust, dirt, oils, and other contaminants can cause a link to conduct electricity. Due to their capacity ratings, some links are not effective for large cranes and/or high voltages/currents.
4. The only protection that may be afforded by an insulated link is below the link (electrically downstream), provided the link has been kept clean, free of contamination, has not been scratched or damaged, and is periodically tested (just before use) for its dielectric integrity.
5. Boom cages and boom guards afford limited protection from electrocution hazards. They are designed to cover only the boom nose and a small portion of the boom. Performance of boom cages and boom guards is limited by their physical size, insulating characteristics, and operating environment (dust, dirt, moisture, etc.). The insulating characteristics of these devices can be compromised if not kept clean, free of contamination, and undamaged.
6. Proximity sensing and warning devices are available in different types. Some use boom point (localized) sensors and others use full boom length sensors. No warning may be given for components, cables, loads, and other attachments located outside of the sensing area. Reliance is placed upon the operator in selecting and properly setting the sensitivity of these devices.
7. Never rely solely on a device to protect you and your fellow workers from danger.

   Some variables to know and understand are:
   - Proximity devices are advertised to detect the existence of electricity and not its distance, quantity, or magnitude.
   - Some proximity devices may detect only alternating current (AC) and not direct current (DC).
   - Some proximity devices detect radio frequency (RF) energy and others do not.
   - Most proximity devices simply provide a signal (audible, visual, or both) for the operator and this signal must not be ignored.
   - Sometimes the sensing portion of the proximity devices becomes confused by complex or differing arrays of power lines and power sources.
8. DO NOT depend on grounding. Grounding of a crane affords little or no protection from electrical hazards. The effectiveness of grounding is limited by the size of the (wire) conductor used, the condition of the ground, the magnitude of the voltage and current present, and numerous other factors.

Electrical Contact

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

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

   Only as a last resort should an operator attempt to leave the crane upon contacting a power source. If it is absolutely necessary to leave the cab, JUMP

COMPLETELY CLEAR OF CRANE. DO NOT STEP OFF. Hop away with both feet together. DO NOT walk or run.

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

REFUELING

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 crane.
3. Smoking and open flames shall be prohibited in refueling area.

FIRE EXTINGUISHERS

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

ACCIDENTS

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

Manitowoc Cranes
2401 So. 30th St.
Manitowoc, WI 54220

Phone: 920-684-6621

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

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

SAFE MAINTENANCE

WARNING

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

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

Maintenance Instructions

To ensure safe and proper operation of Manitowoc cranes, they must be maintained according to the instructions contained in this manual and in the Operator 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 crane is being serviced and the engine must not be started. ***Do not remove sign until it is safe to return crane to service.***

2. Do not attempt to maintain or repair any part of the crane while the engine is running, unless absolutely necessary.

If the engine must be run, keep your clothing and all parts of your body away from moving parts. ***Maintain constant verbal communication between person at controls and person performing maintenance or repair procedure***.

3. Wear clothing that is relatively tight and belted.

4. Wear appropriate eye protection and approved hard hat.

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

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

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

6. The boom and gantry are not intended as ladders. Do not attempt to climb lattice work of the boom or gantry to get to maintenance points. If the boom or gantry is not equipped with an approved ladder, lower them before performing maintenance or repair procedures.

7. Do not remove cylinders until the working unit has been securely restrained against movement.

8. Pinch points are impossible to eliminate; watch for them closely.

9. Pressurized air, coolant, and hydraulic oil can cause serious injury. Make sure all air, coolant, and hydraulic lines, fittings, and components are tight and serviceable.

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

- Use a soap and water solution to check for air leaks (apply to fittings and lines and watch for bubbles).
- Use a piece of cardboard or wood to check for coolant and hydraulic oil leaks.

10. Relieve pressure before disconnecting air, coolant, and hydraulic lines and fittings.

11. Do not remove the radiator cap while the coolant is hot or under pressure. Stop the engine, wait until the pressure drops and the coolant cools, then slowly remove the cap.

12. Avoid battery explosion: do not smoke while performing battery maintenance or short across battery terminals to check its charge.

13. Read the safety information in the battery manufacturer's instructions before attempting to charge a battery.

14. Avoid battery acid contact with skin and eyes. If contact occurs, flush the area with water and immediately consult a doctor.

15. Stop the engine before refueling crane.

16. Do not smoke or allow open flames in refueling area.

17. Use a safety-type can with an automatic closing cap and flame arrestor for refueling.

18. Hydraulic oil can also be flammable. Do not smoke or allow open flames in the area when filling hydraulic tanks.

19. Never handle wire rope with bare hands. Always wear heavy-duty gloves to prevent being cut by broken wires.

20. Use extreme care when handling coiled pendants. Stored energy can cause the coiled pendants to uncoil quickly with considerable force.

21. When inflating tires, use a tire cage, a clip-on inflator, and an extension hose which permits standing well away from the tire.

22. Only use cleaning solvents which are non-volatile and non-flammable.

23. Do not attempt to lift heavy components by hand. Use a hoist, jacks, or blocking to lift components.

24. Use care while welding or burning on the crane. Cover all hoses and components with non-flammable shields or blankets to prevent a fire or other damage.

25. To prevent damage to crane parts (bearings, cylinders, swivels, slewing ring, computers, etc.), perform the following steps ***before welding on crane***:

- Disconnect all cables from batteries
- Disconnect output cables at engine junction box
- Attach the ground cable from the welder directly to the part being welded and as close to the weld as possible

Do not weld on the engine or engine mounted parts (per engine manufacturer).

26. Disconnect and lock the power supply switch before attempting to service high voltage electrical components and before entering tight areas (such as carbody openings) containing high voltage components.

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

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

28. Unless authorized in writing by Manitowoc, do not alter the crane in any way that affects the crane's performance (to include welding, cutting, or burning of structural members or changing pressures and flows of air/hydraulic components). Doing so will invalidate all warranties and Capacity Charts and make the crane owner/user liable for any resultant accidents.

29. ***Keep crane clean.*** Accumulations of dirt, grease, oil, rags, paper, and other waste will not only interfere with safe operation and maintenance but also create a fire hazard.

30. Store tools, oil cans, spare parts, and other necessary equipment in tool boxes. Do not allow these items to lie around loose in the operator's cab or on walkways and stairs.

31. Do not store flammable materials on the crane.

32. Do not return the crane to service at completion of maintenance or repair procedures until all guards and covers have been reinstalled, trapped air has been bled from hydraulic systems, safety devices have been reactivated, and all maintenance equipment has been removed.

33. Perform a function check to ensure proper operation at the completion of maintenance or repair.

ENVIRONMENTAL PROTECTION

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

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

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

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

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

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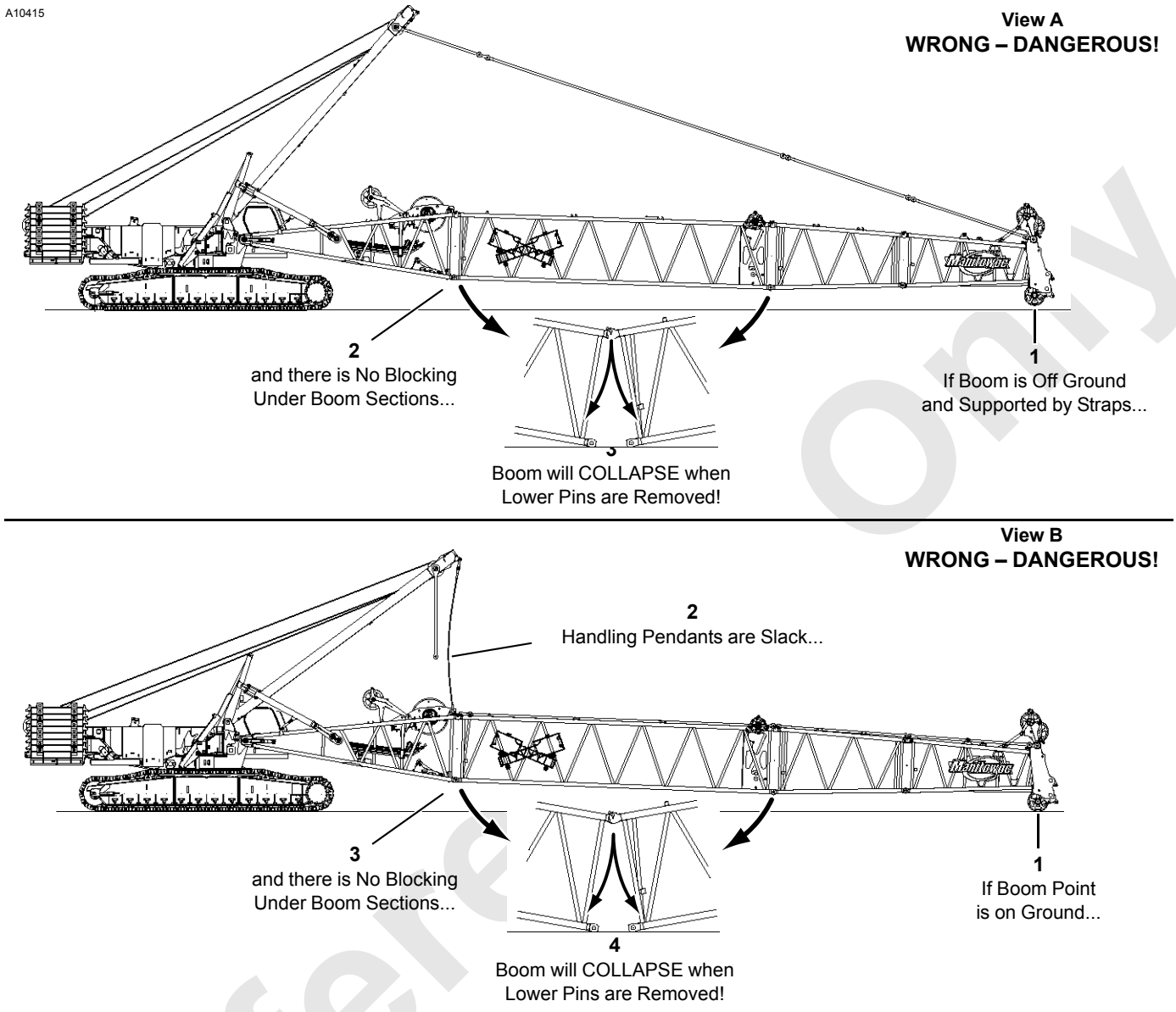


FIGURE 2-5

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.

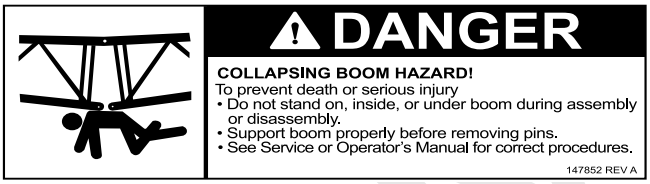


FIGURE 2-6

Disassembly Precaution

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

DANGER

Collapsing Boom Hazard!

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

- Do not remove bottom connecting pins from any boom section when boom is supported by straps as shown in Figure 2-5, View A.
- Do not remove strap connecting pins until straps are fully lowered into supports as shown in Figure 2-5, View C.
- Do not remove bottom connecting pins from any boom section when boom point is resting on ground and handling pendants are 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 boom unless it has walkways.

DANGER

Falling Boom Hazard!

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

PERSONNEL HANDLING POLICY

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

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

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

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

- The crane user shall comply with the manufacturer's specifications and limitations for lifting accessories (hooks, slings, personnel platforms, etc.).
- The requirements of the applicable national, state and local regulations and safety codes are met.
- A determination has been made that use of a crane to handle personnel is the least hazardous means to perform the work.
- The crane operator shall be qualified to operate the specific type of hoisting equipment used in the personnel lift.
- The crane operator shall remain in the crane cab at all times when personnel are off the ground.
- The crane operator and occupants have been instructed in the recognized hazards of personnel platform lifts.
- The crane is in proper working order.
- Load and boom hoist drum brakes, swing brakes, and locking devices such as pawls and dogs must be engaged when the occupied personnel platform is in a stationary position.
- The crane must be equipped with a boom angle indicator that is visible to the crane operator.
- The crane must be equipped with boom hoist limiting device.
- If the luffing jib is used for hoisting personnel, the crane must be equipped with a luffing jib angle indicator that is visible to the crane operator.
- If the luffing jib is used for hoisting personnel, the crane must be equipped with a luffing hoist limiting device.
- The crane is equipped with a positive acting device which prevents contact between the load block or overhaul ball and the boom tip (anti-two-block device).

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

  Free fall of the hoist line is prohibited.
- The crane's Operator Manual is in the cab, readily accessible to the operator.
- The crane's load Capacity Chart is affixed inside the crane cab, readily accessible to the operator. The total weight of the loaded personnel platform and related rigging must not exceed 50 percent of the rated capacity for the radius and configuration of the crane.
- The crane is uniformly level within one percent of level grade and located on a firm footing. Some Capacity Charts require more stringent levelness criteria.

  Cranes with outriggers or stabilizers 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 (personal fall-protection system, etc.)

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

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

- Automatic brakes such that when the equipment operating controls are released, the motions are brought to rest.
- A holding device (such as a load hold check valve) must be provided in the hydraulic or pneumatic systems to prevent uncontrolled movement of the hoisting equipment in the case of a system failure.

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

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

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

Manitowoc Cranes
2401 So. 30th St.
Manitowoc, WI 54220

Phone: 920-684-6621

PEDESTAL/BARGE MOUNTED CRANES

WARNING

Overload Hazard!

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

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

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

WARNING

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

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

Pedestal Mounted Crane

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

Definition

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

Examples

1. Crane rotating bed mounted on a turret (pedestal) which is securely fastened to the foundation (Figure 2-7).

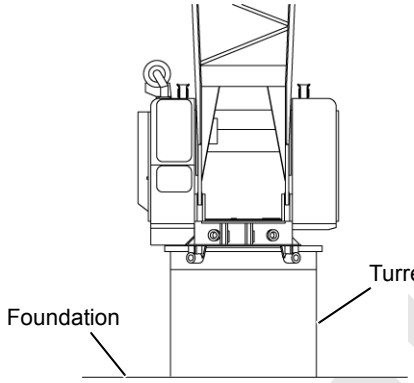
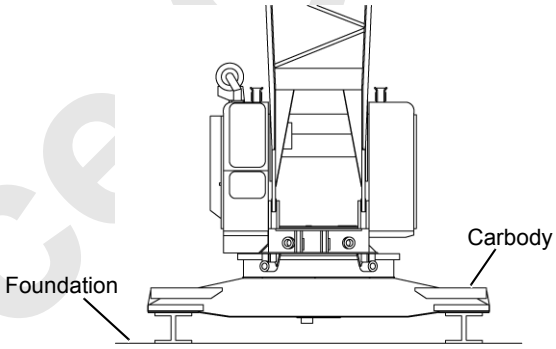


FIGURE 2-7

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



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

FIGURE 2-8

Barge Mounted Crane

Definition

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

Examples

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

1. Crawler-mounted crane with carbody anchored with tie-downs to the foundation (Figure 2-9).

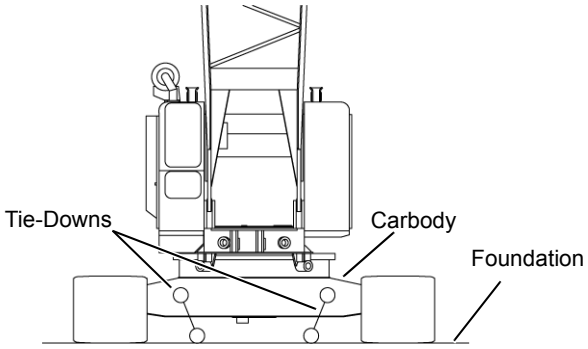
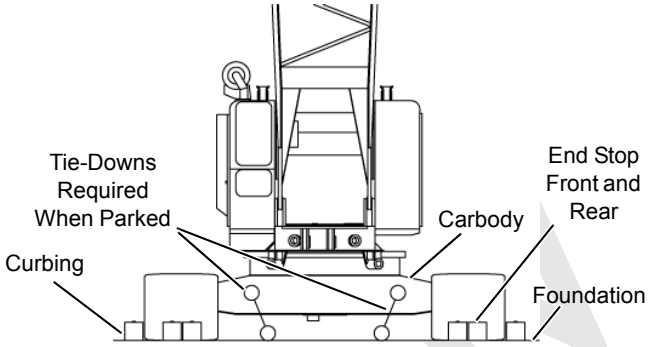


FIGURE 2-9

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***.

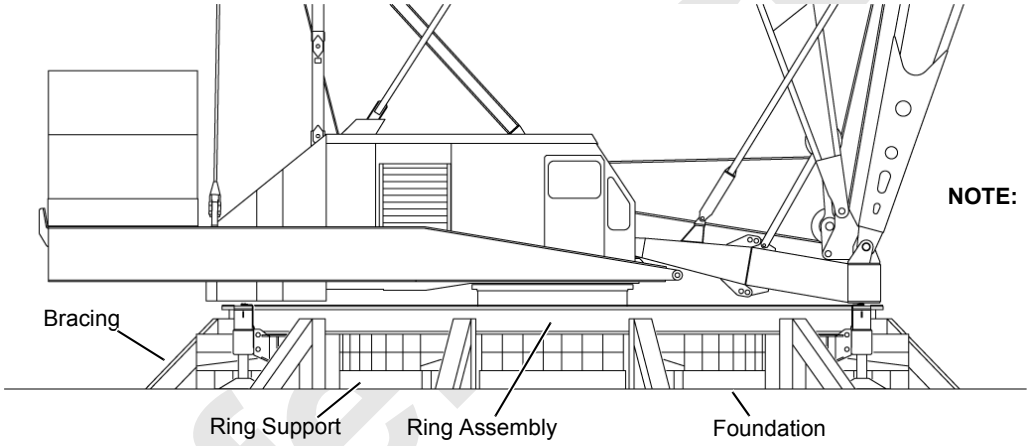


NOTE: Manitowoc does not permit traveling with load.

FIGURE 2-10

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).

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



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

FIGURE 2-11

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

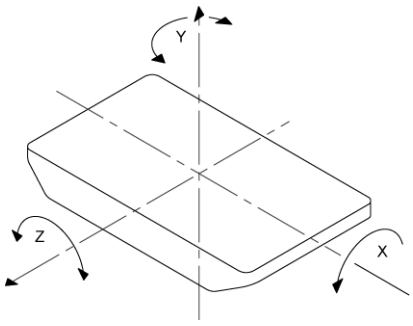


FIGURE 2-12

Capacity Charts

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

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

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

Shock Loading

Definition

Shock loads to the crane can be experienced when the barge is subjected to up and down movement of wave action (referred to as DYNAMICS). Figure 2-12 illustrates the dynamic conditions of the barge which influence crane capacity.

CAUTION

Structural Damage Hazard!

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

General

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

WARNING

Tipping Crane Hazard!

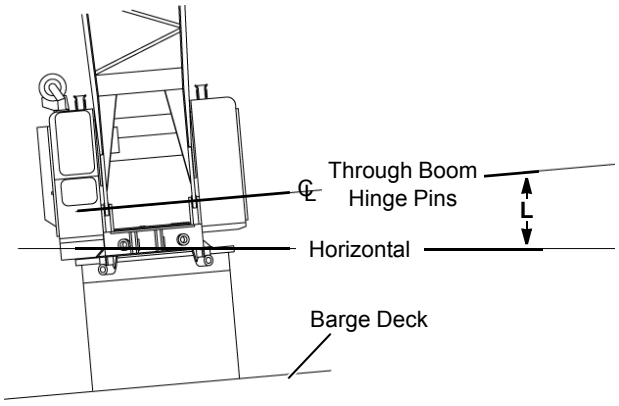
Tie-downs which only prevent crane from shifting as in barge, ship or floating platform mounting, may not provide adequate support when using a Capacity Chart for pedestal mounting. Before operating a crane on a barge, ship or floating platform, crane user shall verify that correct Capacity Chart is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

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

Definitions

1. Machine List, as defined by Manitowoc, is the crane's out-of-level condition — from side-to-side — as measured by the angle between horizontal and a line drawn through the centerline of the crane's boom hinge pins (Figure 2-13). This out-of-level condition creates side load and affects the crane's lifting capacity.
2. Barge List (also referred to as heel or trim) causes swing out of the load and may produce side load. When Manitowoc provides a Capacity Chart showing capacities for a 2° machine list for example, we are referring to the maximum allowable lifting capacity for the crane when experiencing an out-of-level condition (side-to-side) of 2° as measured by angle between horizontal and a line drawn through centerline of the crane's boom hinge pins.

   Unless otherwise specified in the Capacity Chart, barge list (heel or trim) must not exceed the machine list degrees given in the Capacity Chart.
3. Barge List and Machine List are not same. As the crane rotates on a barge, barge list (as defined above) will change. The worst machine list condition generally occurs when the crane swings over the corner of the barge, producing maximum side load.



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

FIGURE 2-13

Crane Inspection

To aid in preventing harmful and damaging failure as previously indicated, regular inspection for signs of overloading in the following load bearing components is required. Correct each defect found before placing the crane into service.

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

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

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

Transporting Crane on Barge

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

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SECTION 3
OPERATING CONTROLS AND PROCEDURES

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Published 05-08-17, Control # 012-17

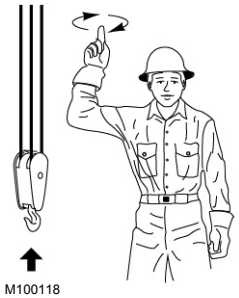
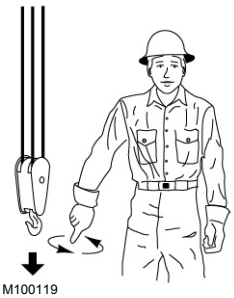
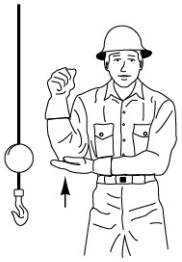
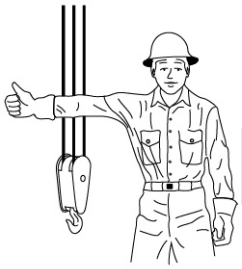
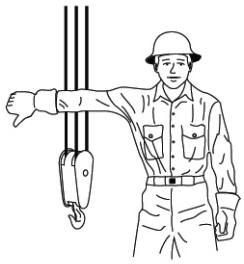
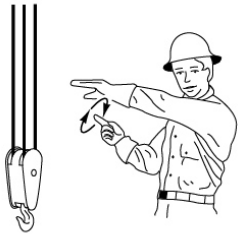
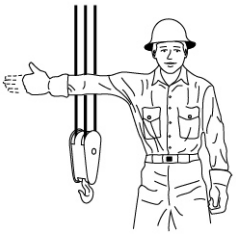
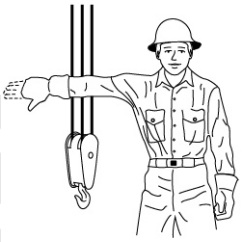
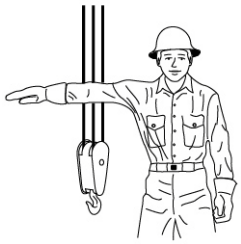
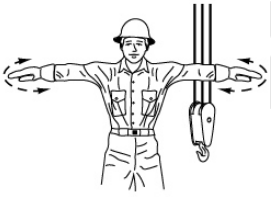
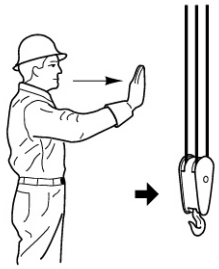
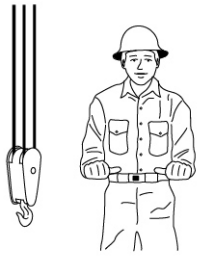
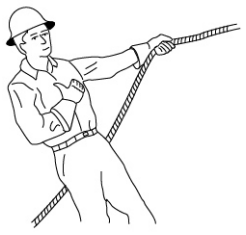
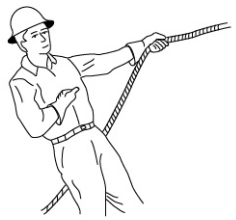
SECTION 3
OPERATING CONTROLS AND PROCEDURES

THIS SECTION STARTS ON THE NEXT PAGE

STANDARD HAND SIGNALS FOR CONTROLLING CRANE OPERATIONS

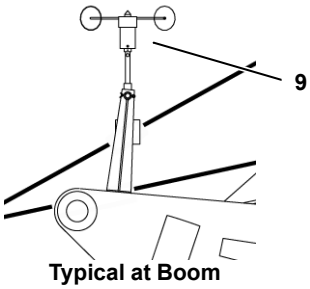
The following standard hand signals comply with ASME B30.5-2014.

Table 3-1 Standard Hand Signals For Controlling Crane Operations

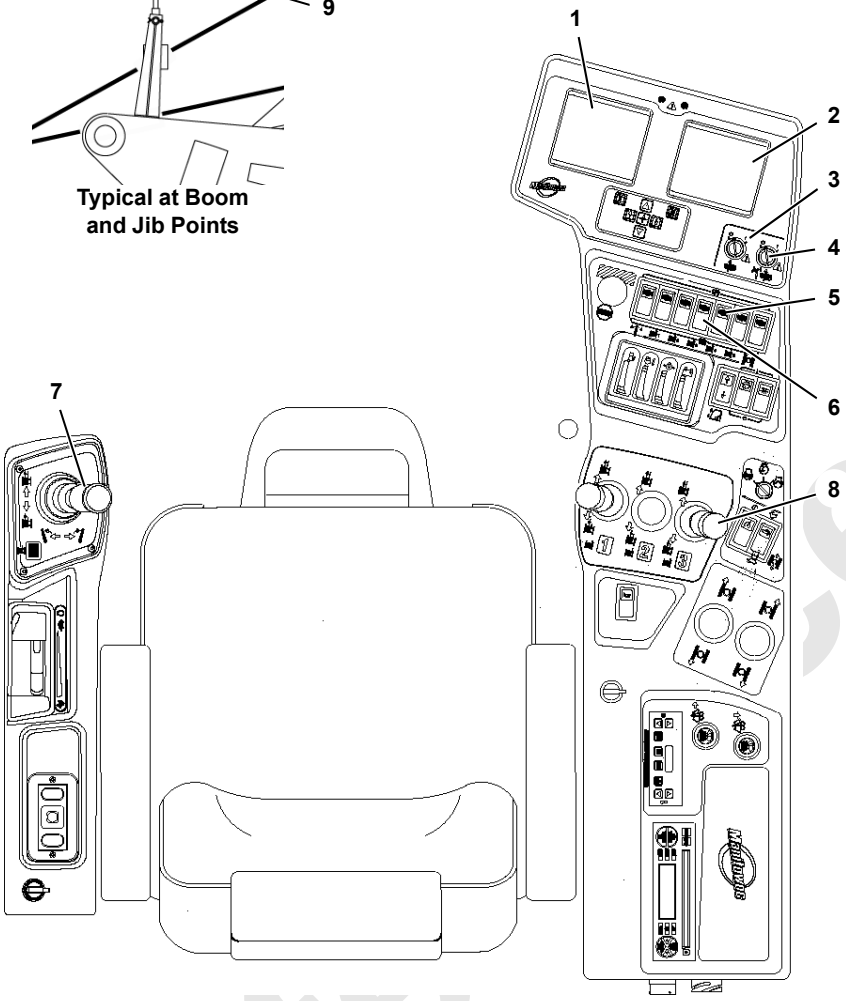
1	2	3	4	5
 M100118	 M100119	 M100120	 M100121	 M100122
6	**7**	**8**	**9**	**10**
 M100123	 M100124	 M100125	 M100126	 M100127
11	**12**	**13**	**14**	**15**
 M100128	 M100129	 M100130	 M100131	 M100132
16	**17**	**18**	**19**	**20**
 M100133	 M100134	 M100135	 M100136	 M100137

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.

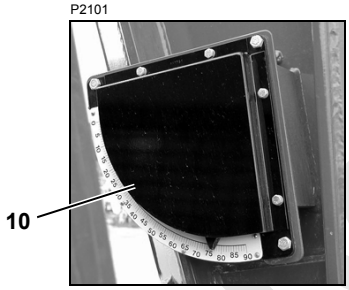
A05717



Typical at Boom and Jib Points

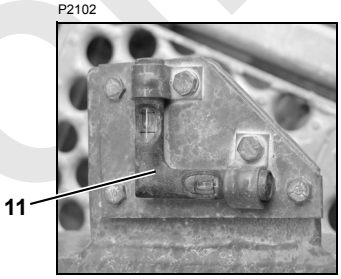


P2101

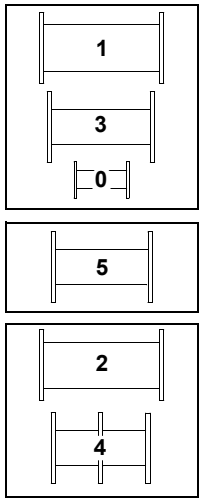


Left Side of Boom

P2102



Item	Identification
1	RCI/RCL Display
2	Main Display
3	Limit Bypass Switch
4	Jib Up Limit Bypass Switch
5	Boom Hoist Park Switch
6	Luffing Hoist Park Switch
7	Boom Hoist and Swing Control
8	Luffing Hoist Control
9	Wind Speed Transmitter
10	Mechanical Boom Angle Indicator
11	Mechanical Level



Boom Butt

Mast Only with MAX-ER®

Crane

Drum No.	Description
0	Rigging Winch
1	Main Hoist
2	Auxiliary Hoist
3	Luffing Hoist
4	Boom/Mast Hoist
5	Boom Hoist - with MAX-ER®

FIGURE 3-1

GENERAL OPERATION

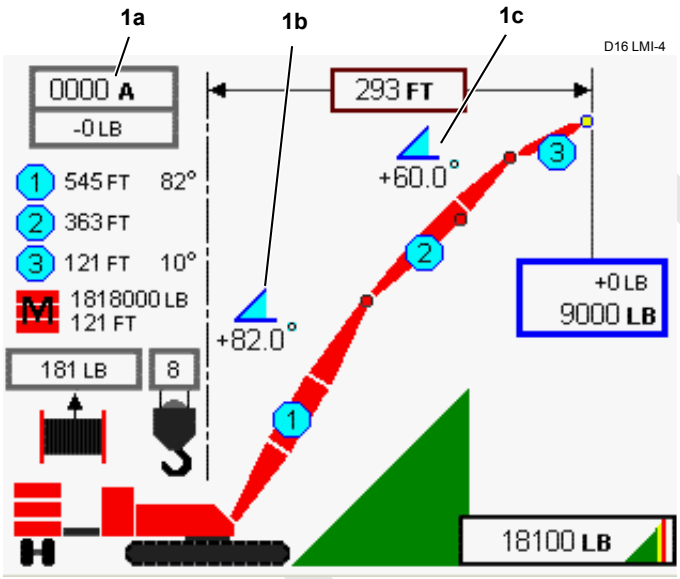
The instructions in this section supplement the operating control instructions in the Crane Operator Manual. This section has two purposes:

- 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, and in MAX-ER® Operator Manual (if equipped).



Item	Identification
1a	Capacity Chart Number
1b	Boom Angle
1c	Luffing Jib Angle

FIGURE 3-2

LUFFING JIB OPERATING CONTROLS

See Figure 3-1 for Location of Controls

1 – Rated Capacity Indicator/Limiter (RCI/RCL) Display

Read and become thoroughly familiar with Rated Capacity Indicator/Limiter Operation Guide — publication F2108 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 RCI/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 crane cab for a complete list of luffing jib capacity charts for your crane.

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

Boom Angle

See item 1b, Figure 3-2.

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

Luffing Jib Angle

See item 1c, Figure 3-2.

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

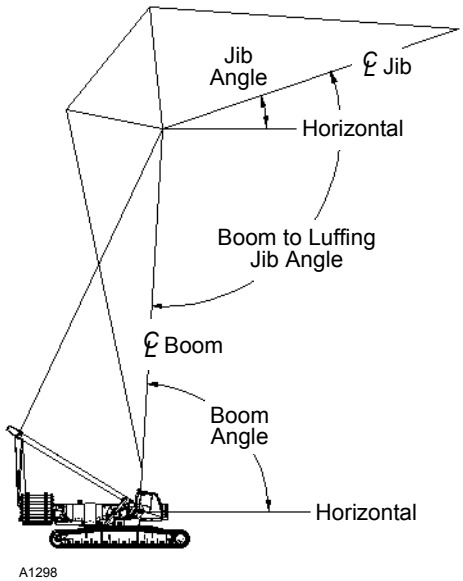


FIGURE 3-3

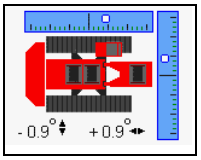
3

2 – Main Display

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

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

Crane Levelness

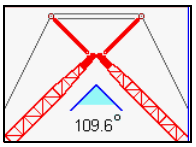


Shows how level the crane is from side to side and front to rear.

If equipped, levelness is also indicated on level (11, Figure 3-1).

Unless otherwise specified in capacity charts, 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).

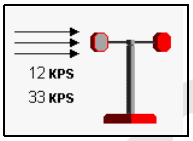
Boom to Luffing Jib Angle



Shows the angle between the center line of the boom and the center line of the luffing jib (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 later in this section for allowable wind speeds during operation.

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

Boom Up Limit

Automatically stops the boom when it is raised to either of the following maximum angles:

PAST PRODUCTION

- 83° for boom with or without fixed jib (without luffing jib) when boom up limit ***can be bypassed***.
- 87° for boom with luffing jib when boom up limit ***can be bypassed***.

CURRENT PRODUCTION

- 84° for boom with or without fixed jib (without luffing jib) when boom up limit ***cannot be bypassed***.
- 88° for boom with luffing jib when boom up limit ***cannot be bypassed***.

The boom can be lowered after the limit is contacted.

LIMIT BYPASS TEST: To determine if the boom up limit can be bypassed on your crane, perform the following test:

WARNING

Falling Boom/Jib Hazard!

If you bypass boom up limit for any reason, DO NOT allow physical boom stops to bottom out. Boom butt could be damaged, causing boom and jib to fall over backwards.

Crush Hazard!

Maintain constant communication between operator and assistant during following steps.

Stay clear of moving parts.

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

Block-Up Limit

Automatically stops the boom or luffing hoist from lowering and the load drums from hoisting if the load contacts a block-up limit switch.

The load on the corresponding drum can be lowered and the boom or luffing jib can be raised after a block-up limit switch is contacted.

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!

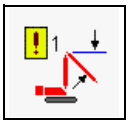
If it is necessary to hoist a load above block-up limit, do so slowly with extreme caution to prevent two-blocking.

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.

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

Luffing Jib Down Limits

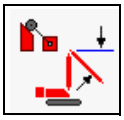


Two luffing jib down limits are provided:

- **JIB MAXIMUM DOWN 1** (minimum working angle):

  For PAST PRODUCTION cranes (before S/N 16001128) this programmed limit does not stop operation. It only activates Fault 50 alarm when the boom to jib angle is 70°.

  For CURRENT PRODUCTION cranes (S/N 16001128 and newer) this programmed limit stops operation when the boom to jib angle is 70°.



- **JIB MAXIMUM DOWN 2** (minimum angle): automatically stops the luffing jib when the boom to jib angle is 67°.

NOTE: For cranes with 2010 European Requirements and with crane software version FCN 2.654 and newer, the JIB MAXIMUM DOWN 2 limit can be bypassed if the limit switch malfunctions. If the limit switch stops the luffing jib before it reaches the minimum angle given in the Luffing Jib Raising Procedure Chart, proceed as follows:

- Release the control handle to off
- Turn the bypass switch to the bypass position
- Lower the luffing jib slowly until it is at the specified minimum angle. Monitor the angle in the working screen of the RCI/RCL display

WARNING

Falling Boom/Jib Hazard!

Do not lower luffing jib below minimum angle given in Luffing Jib Raising (and lowering) Procedure Chart. Structural damage could result, possibly causing boom and luffing jib to collapse.

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

NOTE: For cranes with 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.

Luffing Jib Up Limits

Two luffing jib up limits are provided:

- **JIB MAXIMUM UP 1** (max working angle): this programmed limit automatically stops the luffing jib when the boom to jib angle is 169°.

  The appropriate limit bypass switch must be turned to the bypass position to allow the jib to be raised an additional 1.5° to JIB MAXIMUM UP 2 limit.

Jib Maximum Up 2 Limit

- **JIB MAXIMUM UP 2** (max angle): automatically stops the luffing jib when the boom to jib angle is 170.5°.

  This limit can be bypassed only when the boom is below 50° (during luffing jib raising and lowering procedure).

WARNING

Falling Boom/Jib Hazard!

Proceed slowly when operating the luffing jib above the JIB MAXIMUM UP 1 limit.

Do not raise luffing jib above JIB MAXIMUM UP 2 limit. Structural damage will occur, possibly causing boom and luffing jib to be pulled over backwards.

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

NOTE: For cranes meeting 2010 European Requirements and with crane software version FCN 2.654 and newer, the luffing jib cannot be lowered after JIB MAXIMUM UP 2 limit is contacted until the limit switch is reset.

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.

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3 – Limit Bypass Switch

This switch bypasses the limits identified in Table 3-2 or Table 3-3 on current production cranes without luffing jib limit bypass switch (4).

Insert key. Turn CLOCKWISE and hold to BYPASS (deactivate) reached operating limits. This position allows the functions to be operated beyond the limits.

RELEASE to ACTIVATE operating limits. This position allows the limits to stop the functions in the normal manner.

Remove key to prevent unauthorized operation.

4 – Luffing Jib Limit Bypass Switch

This switch bypasses the limits identified in Table 3-2. This switch is not provided on current production cranes.

This switch is not provided on current production cranes.

Insert Key. Turn CLOCKWISE to BYPASS corresponding limits. This position allows functions to be operated beyond the limits.

Turn COUNTERCLOCKWISE to ACTIVATE corresponding limits. This position allows limits to stop functions in the normal manner. ***Key must be in this position for all normal operation. Otherwise, structural damage can occur.***

Remove key to prevent unauthorized operation.

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

See Operating Controls in Section 3 of Crane Operator Manual for operation of these controls.

9 – Wind Speed Transmitter

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

10 – 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 RCI/RCL working screen.

11 – Crane Level

On past production cranes with upperworks jacking (S/N 16001032 and older), a bubble level is mounted on the cab support.

On current production cranes (S/N 16001118 and newer), a bubble level is mounted on the front of the carbody.

The bubble level indicates crane levelness from front to rear and from side to side as shown in Figure 3-4.

Crane levelness can also be viewed in the Information Screen of the main display.

WARNING

Tipping Hazard!

Unless otherwise specified on capacity chart, all crane operations must be performed with crane ***level*** to within one percent of grade in all directions – 1 ft in 100 ft (0,3 m in 30 m); otherwise, crane could tip.

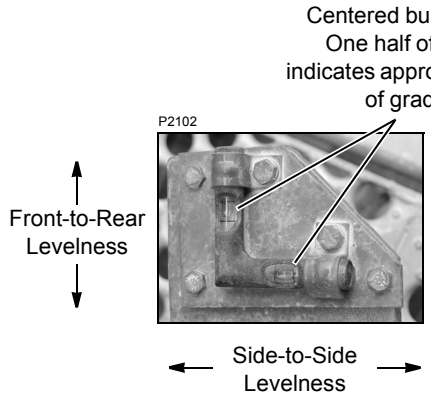

FIGURE 3-4

Table 3-2 Bypassable Limit Identification

This Table Applies Only to Cranes with Limit Bypass Switch (3) and Luffing Jib Limit Bypass Switch (4)		
Limit	Limit Bypass Switch (D3) (momentary key switch)	Luffing Jib Limit Bypass Switch (D4) [1, 2] (maintained key switch)
Boom Up	Yes or No [3]	No
Block-Up (each drum)	Yes	Yes
Minimum Bail — (each drum)	Yes	No
Luffing Jib Maximum UP 1	Yes	Yes
Luffing Jib Maximum UP 2	No	No
Luffing Jib Maximum Down 1	[4]	[4]
Luffing Jib Maximum Down 2	No	No
Mast Too Far Forward	Yes	Yes
Rated Capacity Indicator/Limiter	Yes	Yes

[1] Use only for rigging.

[2] Luffing Jib Limit Bypass Switch (4) is not provided on current production cranes.

[3] The boom up limit cannot be bypassed on current production cranes. To determine if the boom up limit can be bypassed on your crane, perform the test given on page 3-6 in this section.

[4] When you reach luffing jib maximum down limit, operation does not stop. Fault 50 alarm comes on. You can lower luffing jib an additional 3° to luffing jib maximum down 2 limit.

Table 3-3 Bypassable Limit Identification

This Table Applies Only to Cranes without Limit Bypass Switch (D4)					
Limit	Limit Bypass Switch (D3) (momentary key switch)		Limit Bypass Switch (D3) (momentary key switch) Luffing Jib Setup Mode On [1]		External Override Switch [2]
	Non-CE [3]	**CE** [3]	**Non-CE** [3]	**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[4]	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	Yes	Yes	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 3-13 for Turning on Luffing Jib Setup Mode.

[2] 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 3-7 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] The speed of the crane functions is limited to 15% of their maximum speed for movements that increase load.

NOTE: 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.

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TURNING ON LUFFING JIB SETUP MODE

For cranes with software version FCN 2.654 and newer, the Luffing Jib Setup Mode must be turned on before the limits identified in the center two columns of Table 3-3 can be bypassed.

NOTE: The software version off your crane is shown in the Manitowoc screen of the main display.

1. Enter the function mode screen in the main display (Figure 3-5).

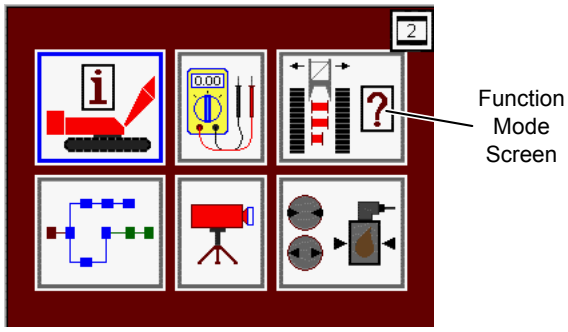


FIGURE 3-5

2. Scroll to and enter the setup screen (Figure 3-6).

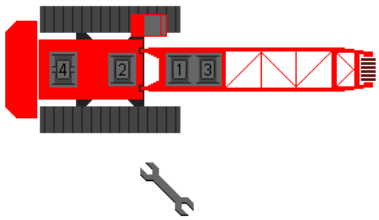


FIGURE 3-6

3. The screen shown in Figure 3-7 will appear.

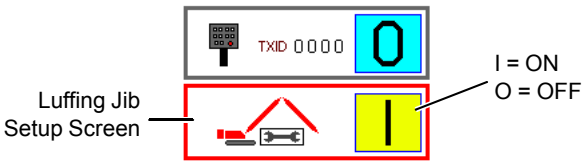


FIGURE 3-7

4. Turn the luffing jib setup mode on (or off when done with luffing jib setup).
5. Rotate limit bypass switch (D3) 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.
7. 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.

When a fault is activated the following occurs:

- Operation does not stop.
- Alarm in cab sounds continuously until fault is corrected.
- Fault icon appears on fault screen in main display.

OPERATING PRECAUTIONS

1. 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 crane and MAX-ER® Attachment (if equipped).

2. Read and comply with instructions in this manual and in Crane Operator Manual.
3. Read and comply with Maximum Allowable Travel Specifications in Luffing Jib Capacity Chart Manual.
4. Make sure luffing jib attachment is installed properly. Read and comply with instructions in Section 4.

WARNING

Explosion Hazard!

Main strut stop cylinders are precharged with nitrogen.

To prevent cylinders from exploding or from releasing high pressure hydraulic oil:

- Do not tamper with or attempt to service main strut stop cylinders unless you are an authorized, trained hydraulic technician who is thoroughly familiar with nitrogen charged accumulators and how to fill and discharge them.

5. Before raising boom and jib, verify that pressure in main strut stop cylinders (Figure 3-8) is at proper setting. For detailed instructions, see Section 4. If pressure is not within specified range, contact your Manitowoc dealer for assistance.

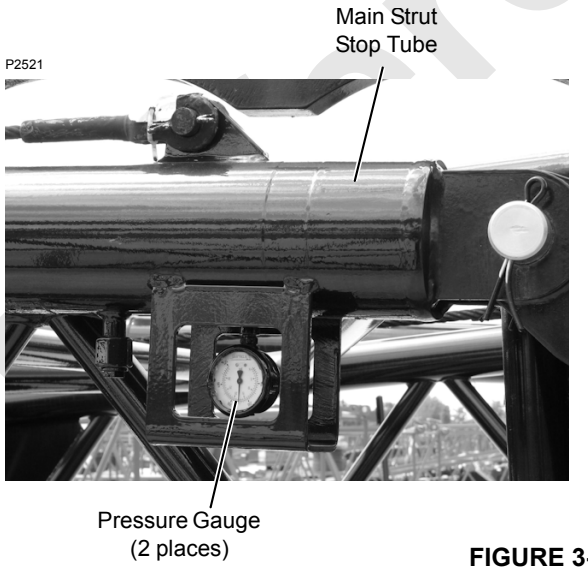


FIGURE 3-8

WARNING

Explosion Hazard!

Main strut stop cylinders are precharged with nitrogen.

To prevent cylinders from exploding or from releasing high pressure hydraulic oil:

- Do not tamper with or attempt to service main strut stop cylinders unless you are an authorized, trained hydraulic technician who is thoroughly familiar with nitrogen charged accumulators and how to fill or discharge them.

6. Make sure all operating limits — block-up, boom and jib stops, boom and jib angle indicators, and RCI/RCL — are installed and operating properly. See Section 6 for adjustment procedures.

   See separate Rated Capacity Indicator/Limiter Manual for operation and calibration of the RCI/RCL.

7. Make sure proper luffing jib capacity chart is selected to operate luffing jib.
8. Raise and lower attachment as instructed in Section 4.
9. Perform all operations with crane on a firm, level, uniformly supporting surface.
10. Operate all crane functions slowly and smoothly. Avoid sudden starts and stops which could side load or shock load attachment.
11. Do not operate crane, to include raising boom from ground level, if wind exceeds limits given in Capacity Charts. 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 Crane Operator Manual and in Section 3 of MAX-ER® Operator Manual.

WIND CONDITIONS

Wind adversely affects lifting capacity and stability as shown in Figure 3-9. The result could be loss of control over the load and crane, even if the load is within the crane's capacity.

WARNING

Tipping Crane Hazard!

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

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

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

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.

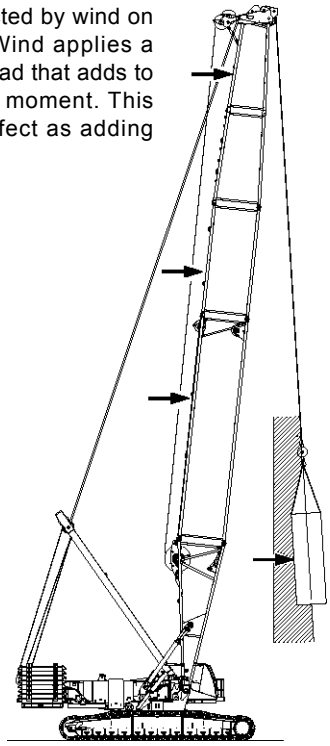
As a general rule, ratings and operating speeds must be reduced when:

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 crane and attachments.

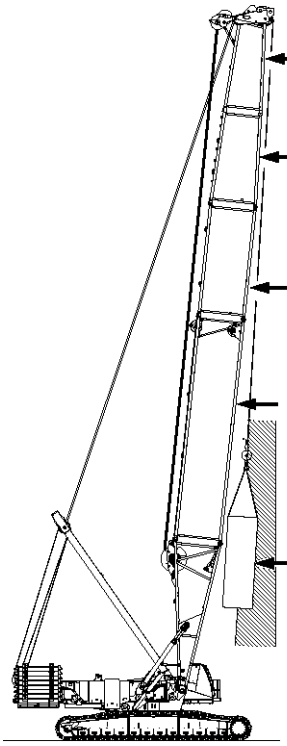
A910

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



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

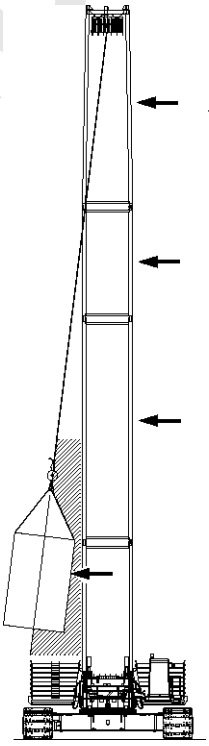
To avoid this hazard, reduce operating speeds and load (see Wind Conditions Chart at the end of this section or see wind conditions in Capacity Charts if applicable).



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

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

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



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

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

To avoid this hazard, reduce operating speeds and load (see Wind Conditions Chart at the end of this section or see wind conditions in Capacity Charts if applicable).

FIGURE 3-9

SECTION 4
SET-UP AND INSTALLATION

TABLE OF CONTENTS

SECTION 4
SET-UP AND INSTALLATION

WARNING

Avoid Death or Serious injury!

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

Moving Parts/Pinch Points!

Avoid death or crushing injury during crane assembly and disassembly:

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

KEEP UNAUTHORIZED PERSONNEL WELL CLEAR OF CRANE.

Falling Load Hazard!

To prevent lifting equipment from failing and load from dropping, crane owner/user shall verify the 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 #59 luffing jib attachment on a Model 16000 with or without MAX-ER® attachment.

For the remainder of this section, luffing jib attachment is referred to as ***jib or attachment.***

The instructions in this section assume that the crane, MAX-ER® attachment (if equipped), and required length of boom are already installed and ready for jib installation.

The 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 Rigging 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 (0,03 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 Jib Assembly Drawings at the end of this section for:

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

CRANE ORIENTATION

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

ACCESSING PARTS

Many parts of the crane, boom, and jib cannot be reached from the ground. Take 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 ground. Adhere to local, state, and federal regulations for handling personnel.

Optional boom ladders (stored in boom butt) are available from Manitowoc. If your crane has ladders, see Section 3 in Operator Manual provided with crane.

CRANE WEIGHTS

See Crane Weights in Section 1 for the weights of the individual boom and jib components.

OPERATING CONTROLS

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

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COUNTERWEIGHT REQUIREMENT

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

WARNING

Tipping Hazard!

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

BLOCKED CRAWLERS

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

JIB ASSEMBLY DRAWINGS

See the end of this section for the Jib Assembly Drawing.

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

Two tables are provided on the Jib Assembly Drawing: one table lists the boom sections and backstay pendants required for various boom lengths; the other table lists the boom sections required for various jib lengths. Make sure proper table is referred to. Read and comply with insert and pendant notes on the assembly drawing.

LUFFING JIB RAISING PROCEDURE

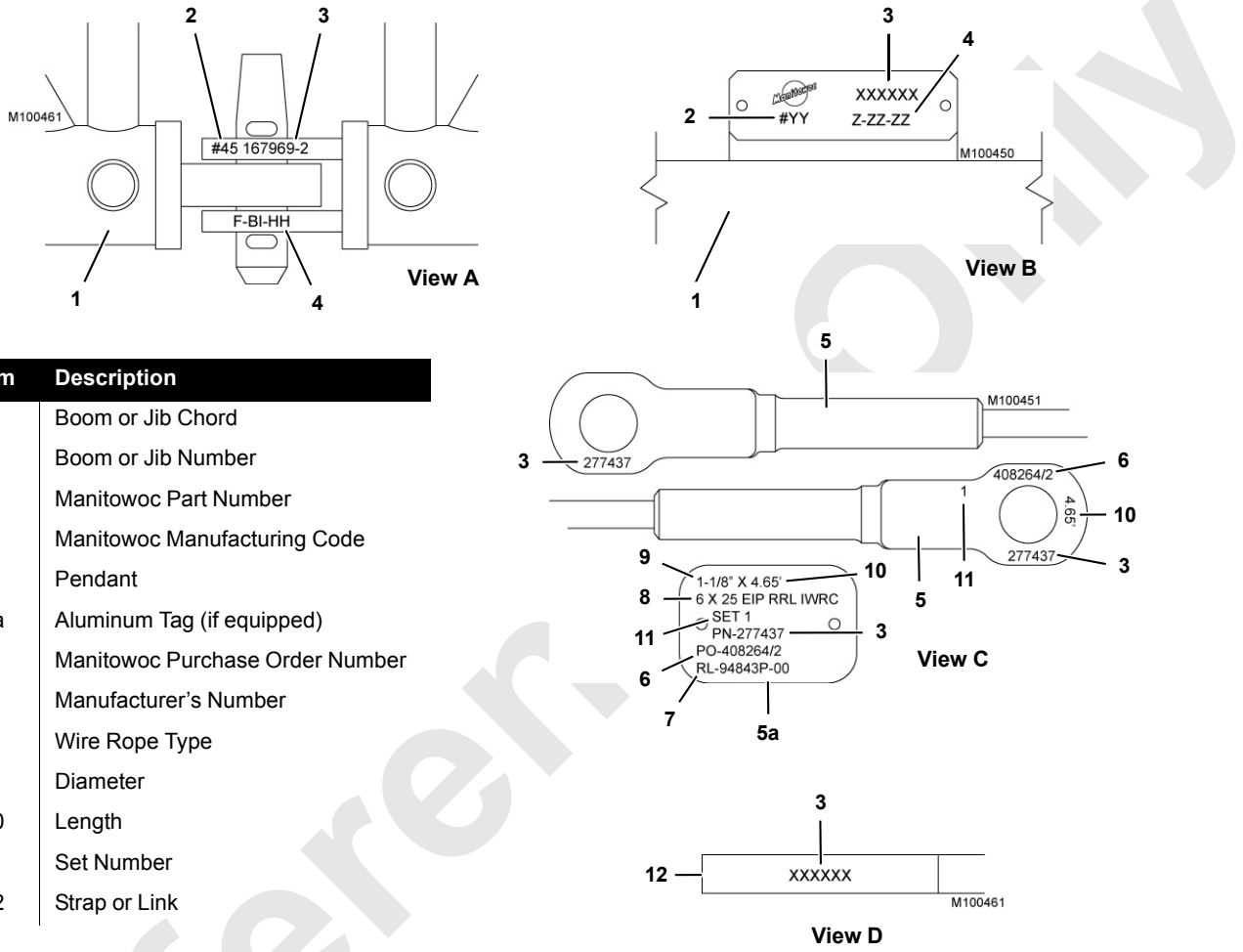
See the end of this section for the Luffing Jib Raising (and Lowering) Procedure Chart.

IDENTIFYING BOOM AND JIB COMPONENTS

Boom and jib sections are marked for proper identification as shown in Views A and B, Figure 4-1.

Boom and jib pendants are marked for proper identification as shown in View C, Figure 4-1.

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



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

HANDLING COMPONENTS

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

The major components are equipped with lifting lugs which are identified in the assembly and disassembly steps.

When lifting lugs are not provided, use nylon lifting slings. If wire rope or chain slings are used, install protective covering (such as sections of rubber tire) between slings and component being lifted.

CAUTION

Personal Injury or Property Damage!

Ensure the boom straps remain properly secured in the shipping position to the boom insert or boom top during transportation loading or unloading and assembly or disassembly of the boom. Straps could shift or fall resulting in personal injury, property damage, or lacing damage if not properly secured.

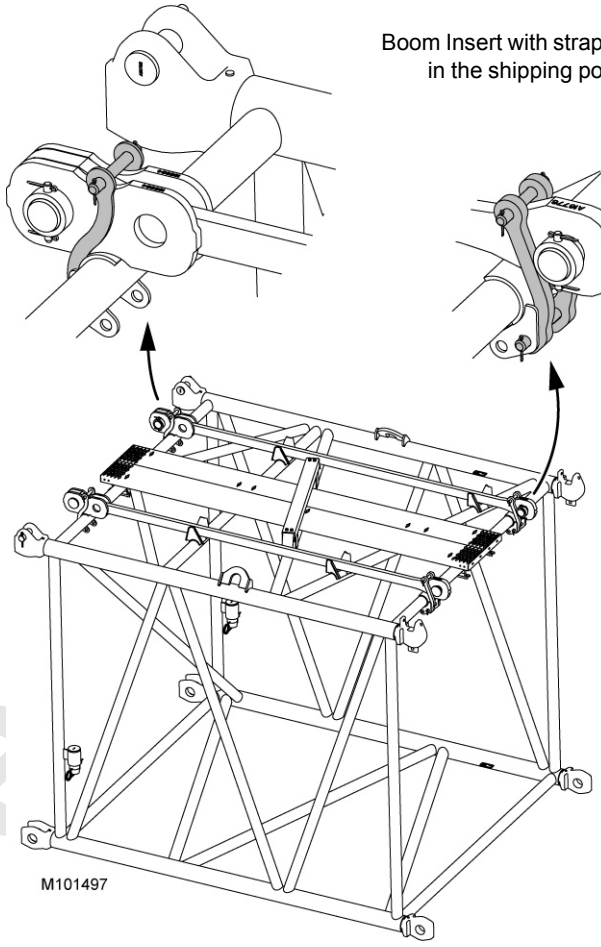


FIGURE 4-2

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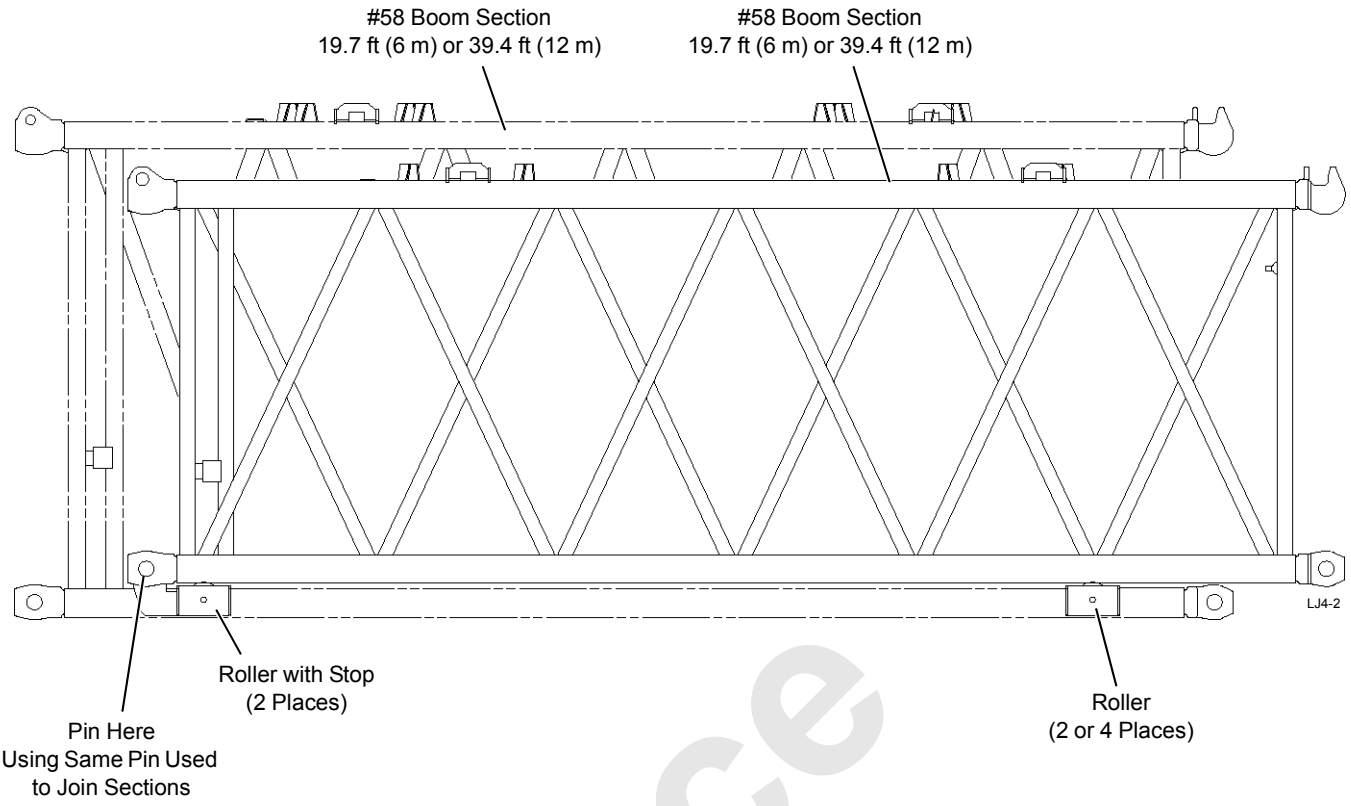
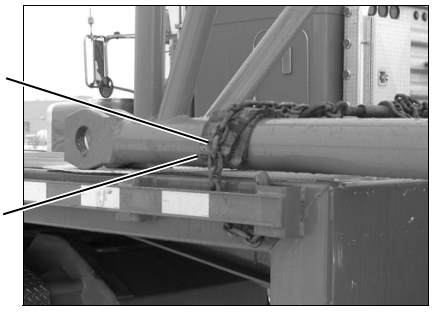


FIGURE 4-3

View A



View B

FIGURE 4-4

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 crane until all connecting pins are installed and properly retained.

SHIPPING JIB INSERTS

The jib inserts can be shipped inside the boom sections as shown in Figure 4-3.

ASSIST CRANE REQUIREMENTS

An assist crane is required for jib installation and removal.

The heaviest individual parts to be lifted are the struts which are shipped as an assembled unit. This assembly weighs approximately 21,000 lb (9 525 kg).

The assist crane must also be capable of handling 1/2 the weight of the assembled jib.

SHIPPING CRANE COMPONENTS

To ensure the crane's self-erecting system can load and unload the carbody and upperworks assembly, the trailer must meet the specifications given in Figure 4-4.

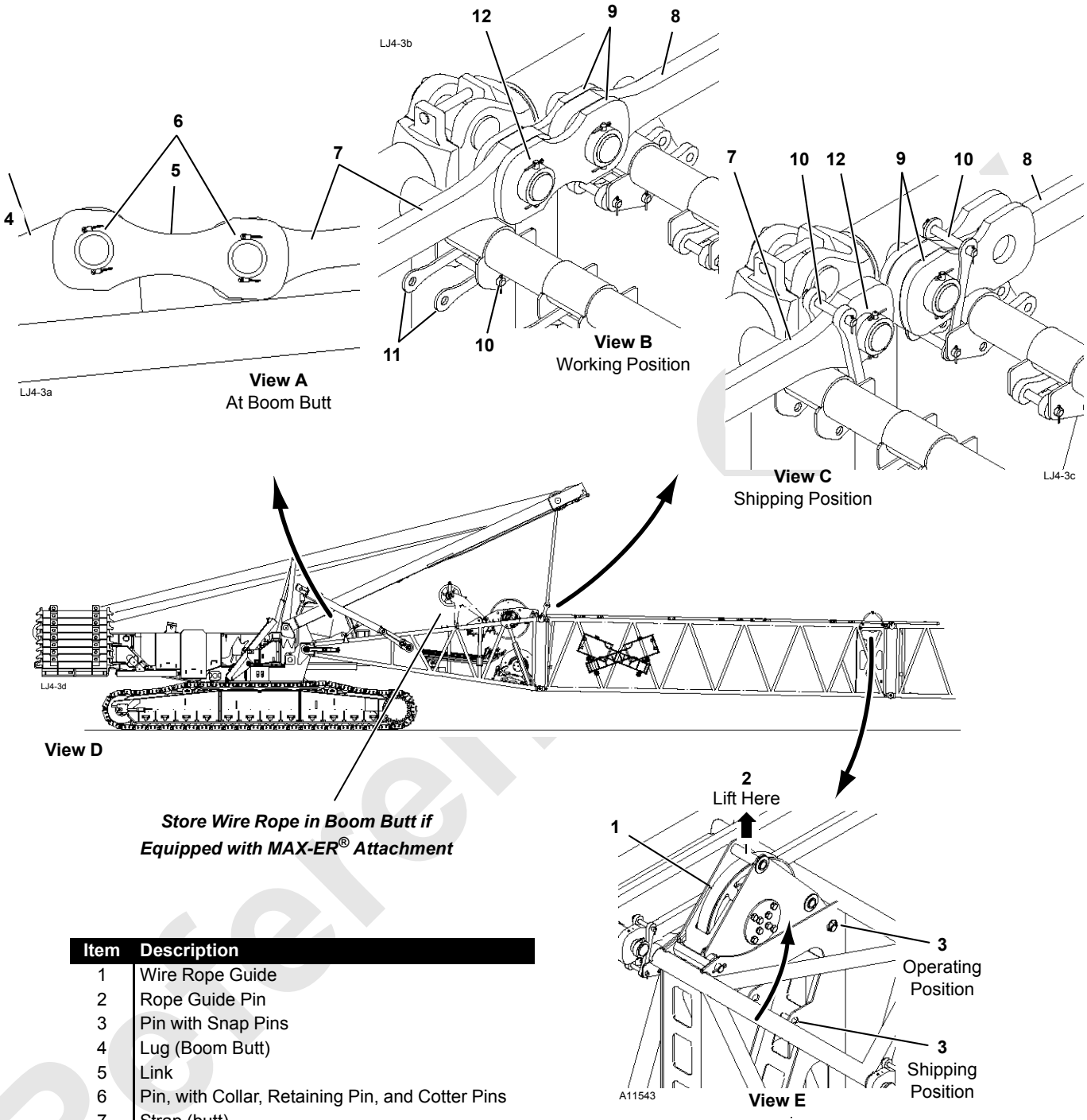
It is the owner/user's responsibility to ensure the following:

- 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 4-4, 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 4-4, 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.



Item	Description
1	Wire Rope Guide
2	Rope Guide Pin
3	Pin with Snap Pins
4	Lug (Boom Butt)
5	Link
6	Pin, with Collar, Retaining Pin, and Cotter Pins
7	Strap (butt)
8	Strap (insert)
9	Link
10	Pin
11	Link
12	Pin, with Collar, Retaining Pin, and Cotter Pins

FIGURE 4-5

PREPARING CRANE AND BOOM

As stated earlier, the instructions in this section assume the boom is already installed.

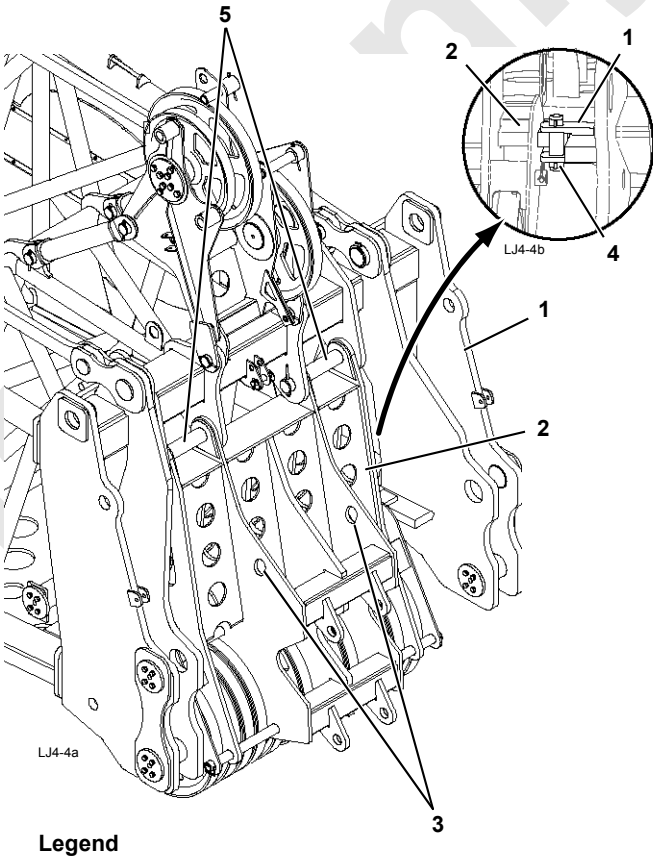
1. If required, travel crawlers onto blocking (end under boom).
2. Lower boom to ground level so boom point sheaves are clear of ground and securely block boom.
3. Remove load block from lower boom point.
4. If installed, remove load block and upper boom point.
5. Connect unused block-up limit electric cables to terminator plugs on boom top junction box.
6. Remove lower boom point, if required per Luffing Jib Raising Procedure Chart (Figure 4-6):
   a. Attach hooks from assist crane to lifting holes (3) in lower boom point (2).
   b. Remove lower pins (4).
   c. Hoist against lower boom point with assist crane until upper pins (5) are loose and remove upper pins.
   d. Swing lower boom point away from boom top and store.
   e. Store pins (4 and 5) in lower boom point holes.

See Figure 4-5 for the following procedures.

7. If equipped with a MAX-ER® attachment, store wire rope guide in boom butt.
8. Raise luffing hoist wire rope guide (1) to operating position:
   a. Attach a sling to rope guide pin (2).
   b. Hoist with assist crane to support wire rope guide and remove pin (3) from shipping position.
   c. Raise wire rope guide to operating position and install pin (3).
   d. Disconnect sling from assist crane.
9. Starting at butt end of boom (View A), install backstay straps in proper sequence on boom sections according to Luffing Jib Assembly Drawing. *This step is required only if straps are not stored on boom sections.*

   If straps are already installed, connect straps at top end of butt and each insert, as follows:

   a. Remove pins (10, View C) and rotate links (11) to working position (View B).
   b. Pin links (11, View B) in working position.
   c. Remove pin (12, View B) from end of each strap.
   d. Rotate links (9, View C) rearward and pin to adjacent strap with pin (12, View B).

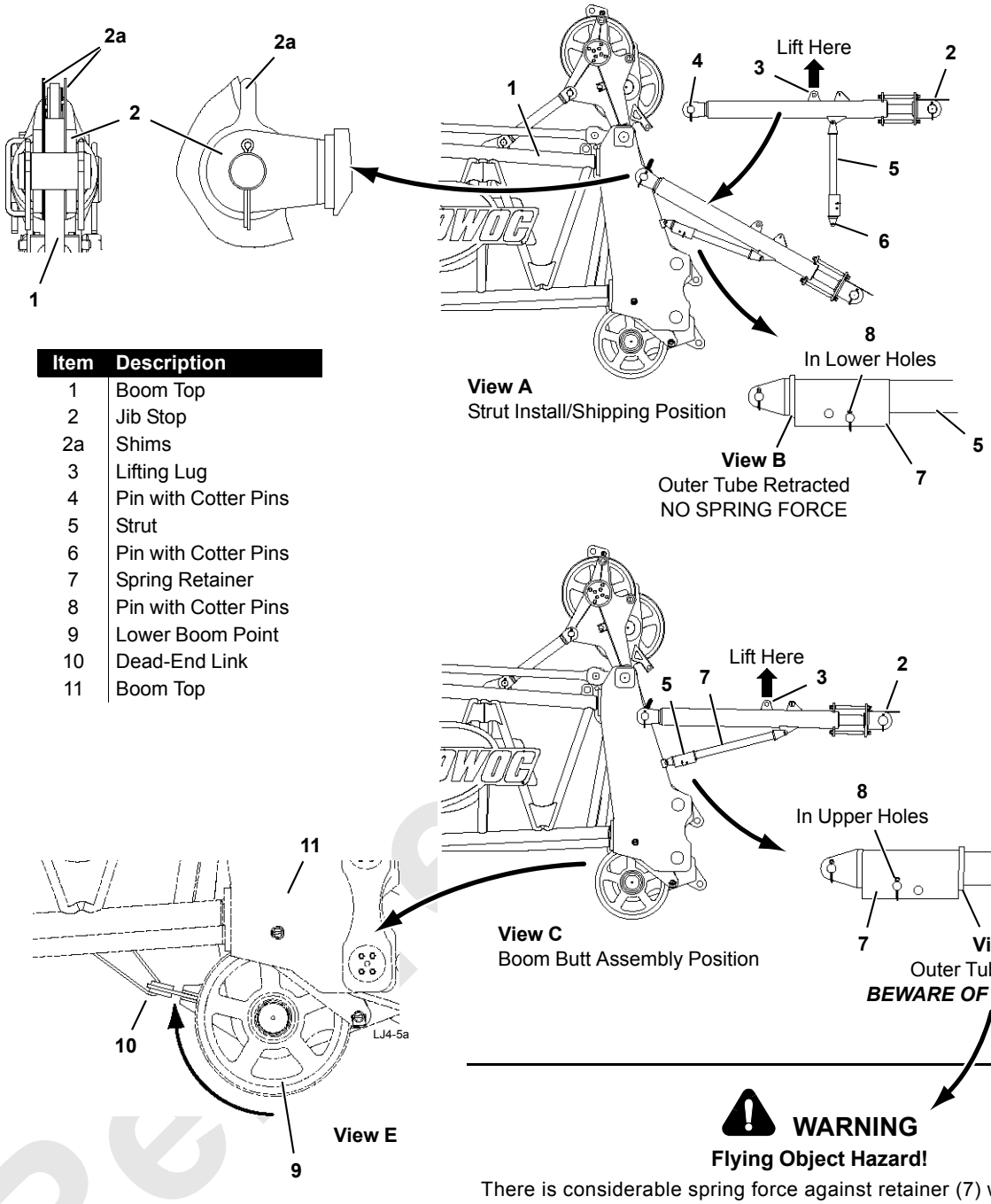


Legend

Item	Description
1	Boom Top
2	Lower Boom Point
3	Lifting Holes
4	Lower Pin with Cotter Pins
5	Upper Pin with Cotter Pins

FIGURE 4-6

LJ4-5



Item	Description
1	Boom Top
2	Jib Stop
2a	Shims
3	Lifting Lug
4	Pin with Cotter Pins
5	Strut
6	Pin with Cotter Pins
7	Spring Retainer
8	Pin with Cotter Pins
9	Lower Boom Point
10	Dead-End Link
11	Boom Top

WARNING

Flying Object Hazard!

There is considerable spring force against retainer (7) when outer tube is extended as shown in View D.

Avoid death or serious injury from flying object:

- Do not attempt to remove spring retainer until spring force is relieved.
- With jib stop (2) and strut (5) pinned to boom top (View C), perform Working Position steps on next page to relieve spring force.

FIGURE 4-7

10. Perform the following steps if lower boom point (9) is installed (Figure 4-7, View E):
    a. Rotate dead-end link (10) as far to rear as possible.
    b. Securely tie dead-end link to boom top (11).

CAUTION

Failing to perform step 10 could result in damage to bottom lacings in jib butt when boom and luffing jib are raised.

INSTALLING LUFFING JIB

See Figure 4-7 for the following procedure.

The jib stops can be shipped or stored in the working position on the boom top as shown in (View A).

Installation

Perform the following steps if jib stops are not already installed.

1. Attach a lifting sling from assist crane to lug (3, View A) on jib stop (2).
2. Lift jib stop (2, View A) into position at end of boom top (1).
3. Install shims (2a) on both sides of jib stop to ensure that it is ***in line with top lugs on jib butt***.
4. Pin jib stop (2) and strut (5) to boom top.
5. Repeat steps for other jib stop.
6. If necessary, lower jib stops to working position. Struts (main and jib) cannot be installed until this step is performed.

Jib Assembly Position

Perform the following steps to raise jib stops from Working/Shipping Position to Jib Assembly Position:

1. Support jib stop (2) with slings from assist crane.
2. Remove spring retainer (7, View B) from strut (5).
3. Raise jib stop with assist crane until strut (5) is extended just enough to allow re-installation of spring retainer (7, View C).

CAUTION

Do not raise stop any higher than necessary or damage to strut may occur.

4. Install spring retainer (7, View D). Pin (8) goes in upper holes.
5. Lower jib stop and disconnect assist crane.
6. Repeat steps for other jib stop.

Working/Shipping Position

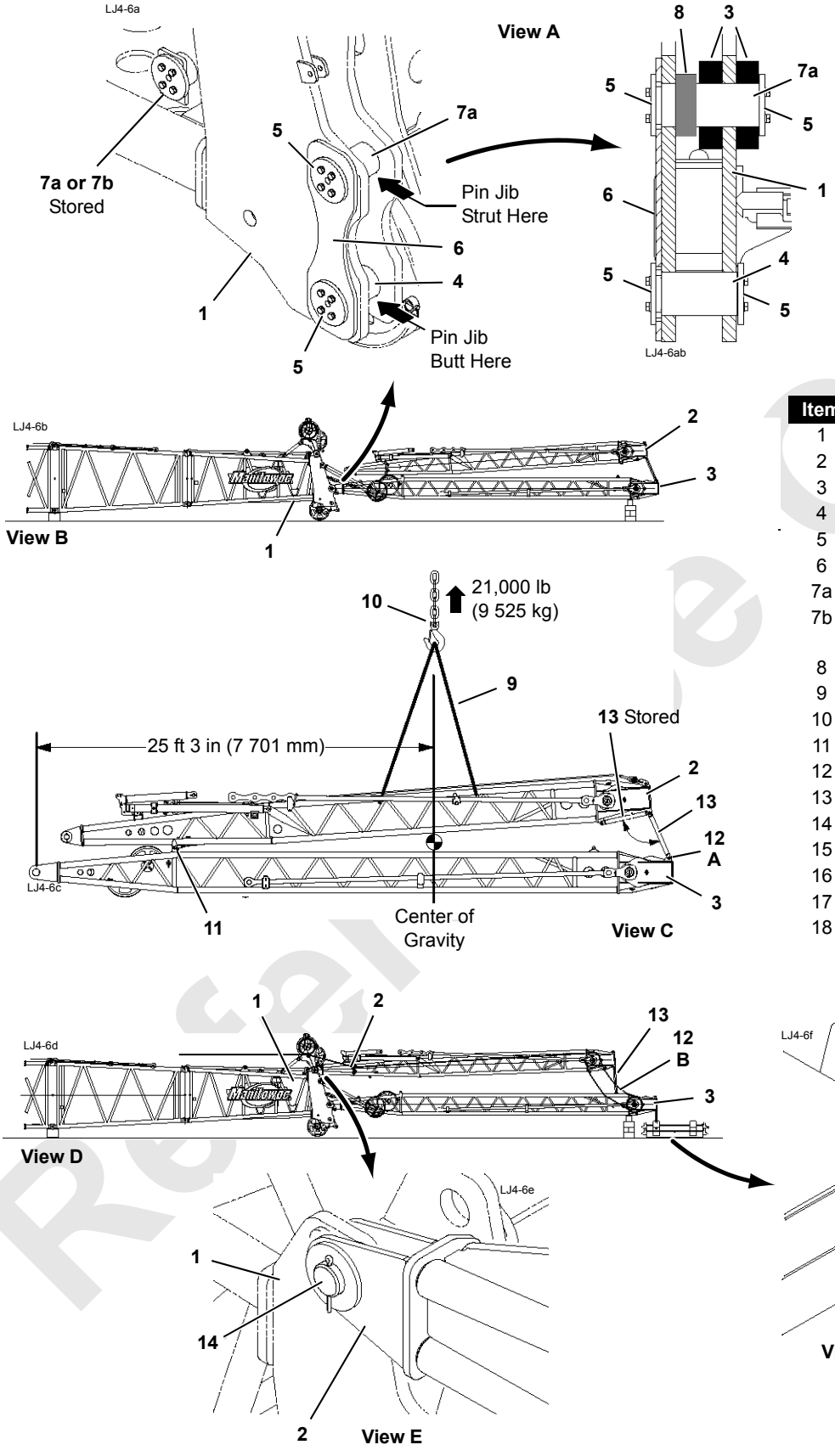
Perform the following steps to lower jib stops from Jib Assembly Position to Working/Shipping Position:

1. Support jib stop (2) with slings from assist crane.
2. Raise jib stop with assist crane just enough to ***remove spring force against spring retainer*** (7, View D).

CAUTION

Do not raise stop any higher than necessary or damage to strut may occur.

3. Remove spring retainer (7) from strut (5).
4. Lower jib stop with assist crane until strut (5) is fully retracted (View A).
5. Install spring retainer (7, View B). Pin (8) goes in lower holes.
6. Disconnect assist crane.
7. Repeat steps for other jib stop.



Item	Description
1	Boom Top
2	Main Strut
3	Jib Strut
4	Pin
5	End Plate with Hex Screws
6	Keeper Plate
7a	Pin (long)
7b	Pin (short) (for Extended Upper Boom Point)
8	Spacer
9	Lifting Slings
10	Assist Crane
11	Pin with Snap Pins
12	Pin with Cotter Pins
13	Strut Support
14	Pin with Cotter Pins
15	Counterweight Box
16	Lifting Lug
17	Lug
18	Links with Pins and Snap Pins

FIGURE 4-8

Install Struts

See Figure 4-8 for the following procedure.

NOTE: Main strut (2) and jib strut (3) are shipped together as shown in View C.

CAUTION

Avoid Jib Stop Damage!

Use extreme care when installing struts so you do not damage jib stops.

1. Lower jib stops to "Working/Shipping Position" (Figure 4-7, View C) to allow installation of struts. See procedure on page 4-12 of this section.
2. Remove pins (4 and 7a, View A) from both sides of boom top (1).

NOTE: If equipped with pins (7b), store them as shown in View A.

3. Attach nylon lifting slings (9, View C) from hook of assist crane (10) to top chords of main strut (2). ***Do not lift against lacings – damage will occur.***
4. Lift struts into position at boom top (1, View B) and align jib strut connecting holes with boom top connecting holes.
5. Loosely install top pins (7a, View A), spacers, (8), keeper plates (6), and end plates (5) to connect jib strut (3) to boom top (1).
6. Lower struts onto blocking so jib strut is horizontal.
7. Support main strut (2) with slings from assist crane, and remove shipping pins (11, View C).
8. Unpin strut supports (13) from lugs (A, View C).

   Main strut is now separated from jib strut.
9. Lift main strut (2) into position at end of boom top (1, View D) and align connecting holes.
10. Install pins (14, View E) to connect main strut (2) to boom top (1).
11. Pin strut supports (13) to lugs (B, View D).
12. Disconnect lifting slings.

Connect Jib Strut to Counterweights

WARNING

Falling Equipment Hazard!

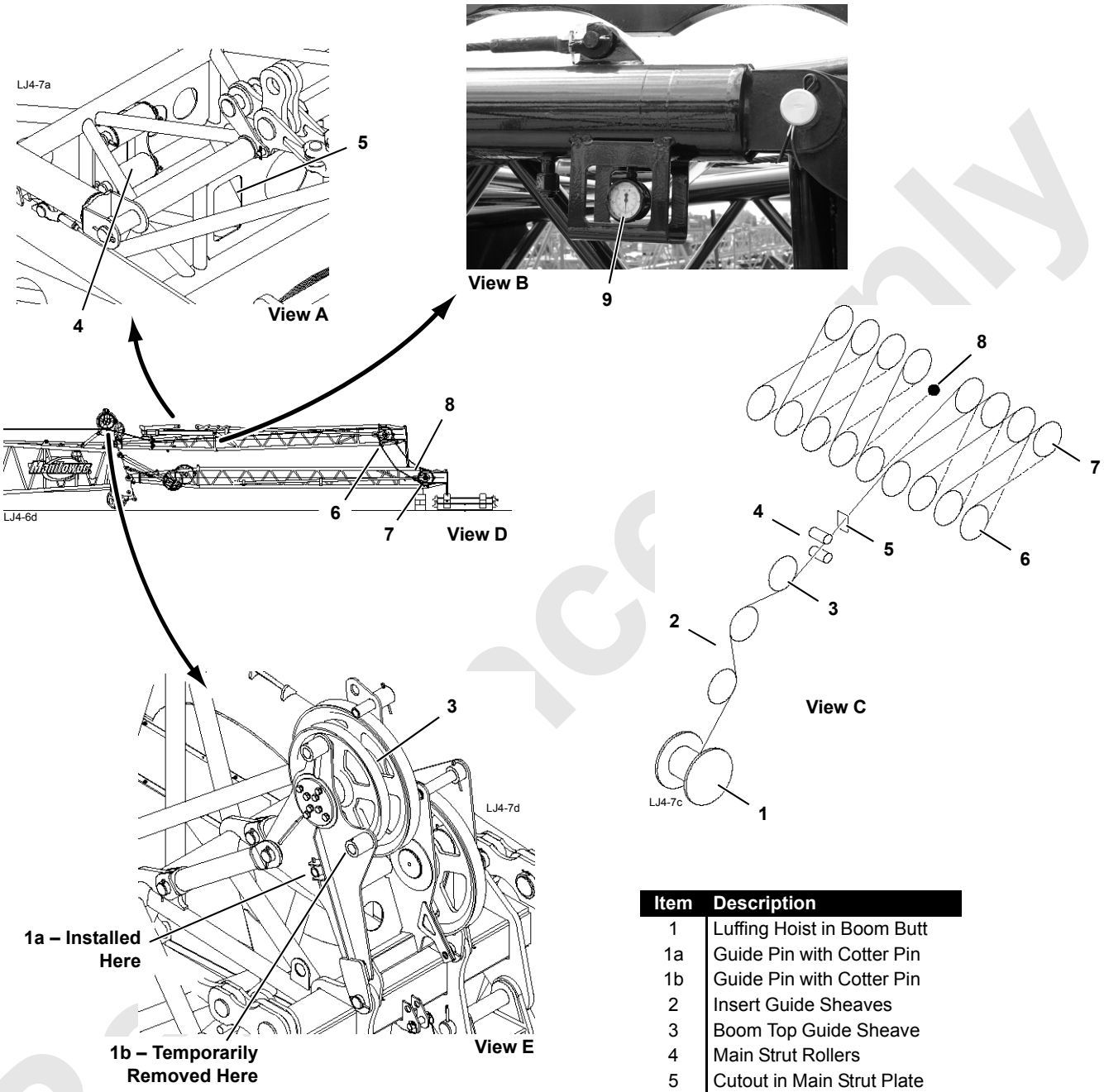
Crane counterweight is required to prevent jib strut from rising when main strut is raised with luffing hoist.

If counterweight becomes disconnected from jib strut, jib strut will rise part way and then both struts could fall forward violently. Minimum capacity required for slings is 25,000 lb (11 340 kg) per side.

See Figure 4-8, View F for the following procedure.

1. Remove top counterweight box (15) from each side of crane.

   Top boxes are equipped with lugs (17) and links (18).
2. Stack boxes (15), one at a time, under end of jib strut (3, View D).
   - Boxes must be centered under end of strut.
   - Lifting lugs on counterweight box must be in line with lugs on end of jib strut.
3. Attach shackles and suitable lifting slings to lugs on end of jib strut and to lifting lugs on top counterweight box (15).
4. ***Do not connect links (18) between lugs (17) until after main strut is raised.***



Item	Description
1	Luffing Hoist in Boom Butt
1a	Guide Pin with Cotter Pin
1b	Guide Pin with Cotter Pin
2	Insert Guide Sheaves
3	Boom Top Guide Sheave
4	Main Strut Rollers
5	Cutout in Main Strut Plate
6	Main Strut Sheaves
7	Jib Strut Sheaves
8	Dead-End Wedge Socket
9	Pressure Gauge

FIGURE 4-9

Install Luffing Hoist Wire Rope

See Luffing Jib Rigging Drawing for wire rope specifications.

See Figure 4-9 for the following procedure.

1. Make sure wire rope is properly anchored to luffing hoist drum and tightly spooled onto drum.
2. Make sure wire rope guide is raised in 39.4 ft (12 m) insert next to butt.
3. Install rope guide pin (1a, View E) at bottom of guide sheave (1).
4. Temporarily remove rope guide pin (1b, View E) from front of guide sheave (1).
5. Route wire rope through guide sheaves as shown in View C.

   To avoid wire rope damage, be sure to route wire rope through rollers (4) and cutout in main strut.
6. Anchor lead end of luffing hoist wire rope to dead-end wedge socket (8) in main strut.

Check Strut Stop Pressure

See Figure 4-9 for the following procedure.

1. Check pressure reading on gauge (9, View B) at both strut stops.
2. Gauges should read:

Ambient Temperature	Pressure [1]
90°F (32°C)	240 psi (16,54 bar)
70°F (21°C)	230 psi (15,86 bar)
50°F (10°C)	220 psi (15,17 bar)
30°F (-1°C)	210 psi (14,48 bar)

[1] Plus or minus 5 psi (0,34 bar). If pressure is not within specified range, contact your Manitowoc dealer for assistance.

It is okay to interpolate pressure for temperatures not listed.

WARNING

Explosion Hazard!

Main strut stop cylinders are precharged with nitrogen.

To prevent cylinders from exploding or from releasing high pressure hydraulic oil:

Do not tamper with or attempt to service main strut stop cylinders unless you are an authorized, trained hydraulic technician who is thoroughly familiar with nitrogen charged accumulators and how to fill and discharge them.

Item	Description
1	Strut Stop Lower Tube
2	Pin with Cotter Pins
3	Strut Stop Upper Tube
4	Pin with Cotter Pin
5	Pendant
6	Storage Pin with Cotter Pins
7	Cylinder Rod Retaining Pin with Cotter Pins
8	Storage Pin with Cotter Pins
9	Links
10	Main Strut Strap
11	Shackle
12	Assist Crane
13	Links
14	Pin with Cotter Pins
15	Pin with Cotter Pin
16	Drum 2 Load Line (with button socket)
17	Link
18	Pendants
A	Storage Hole
B	Storage Hole

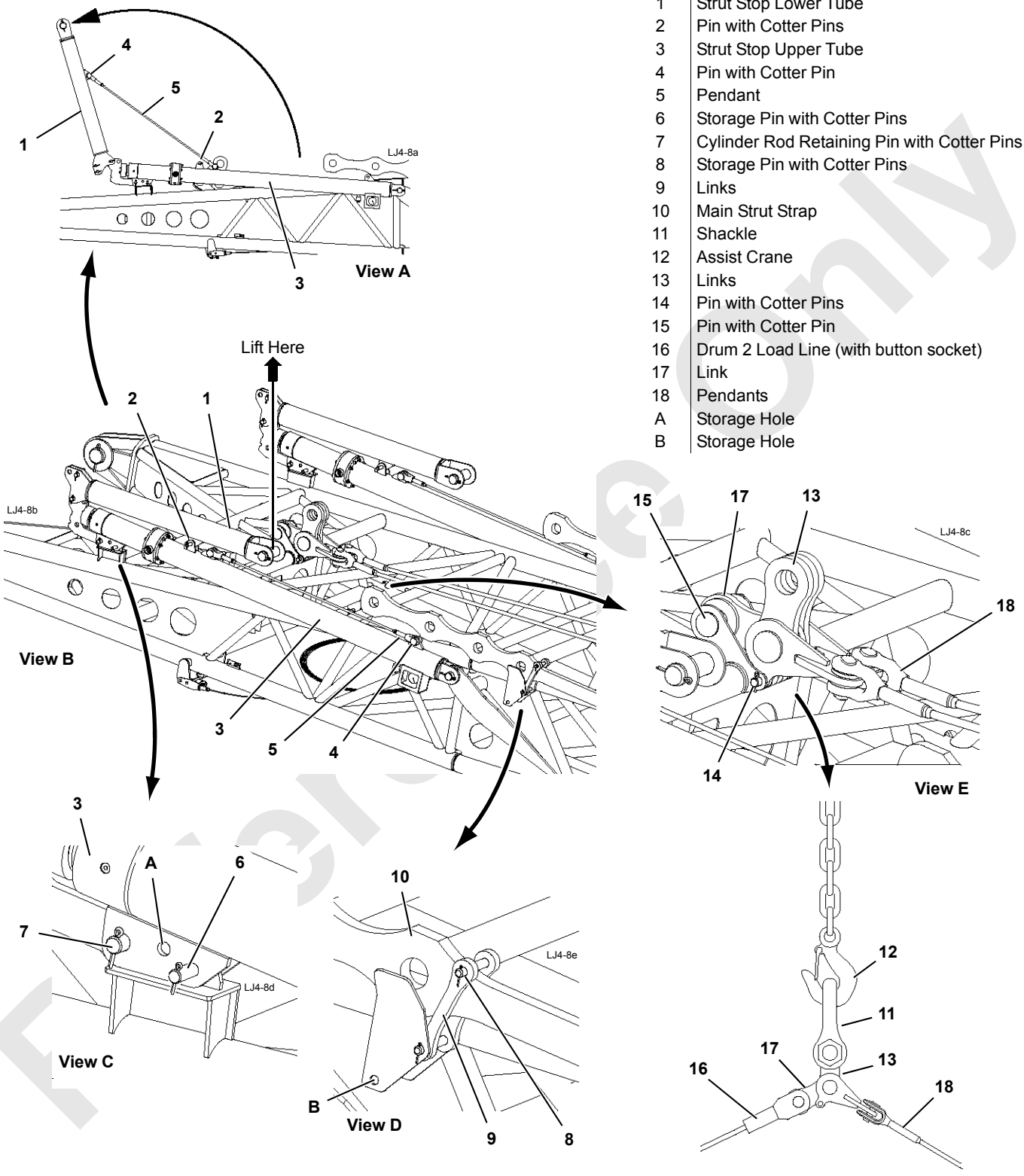


FIGURE 4-10

Prepare Strut Stops for Erection

See Figure 4-10 for the following procedure.

1. Attach a sling from assist crane hook to pin in end of strut stop lower tube (1, View B).
2. Support lower tube with assist crane and remove pin (2).
1. Raise lower tube approximately 1 ft (0,3 m). Store pins (2) in lugs on strut stop upper tube (3).
2. Remove pendant pin (4, View B).
3. Pin pendant (5) to lugs on strut stop lower tube (1, View A).
4. Raise lower tube (1) – rotate rearward – until pendant (5) supports it (View A).
5. Disconnect sling.

WARNING

Falling Load Hazard

Strut stop lower tubes can fall over forwards when positioned as shown in View A!

Warn personnel to take care when working around strut stop lower tubes.

If pushed forward, tubes will fall with severe crushing force.

6. Remove pin (6, View C) and install in storage holes (A).

WARNING

Cylinder Movement Hazard

Strut cylinder will extend forcefully if cylinder rod retaining pin (7, View C) is removed. Personal injury or strut stop damage can occur.

7. Do not remove pin (7) at this time.
8. Repeat steps for other strut stop upper tube.

Prepare Main Strut Straps for Erection

See Figure 4-10, View D for the following procedure.

1. Remove pin (8) and rotate links (9) down.
2. Position links (9) on rear side of storage holes (B) and install pin (8).
3. Repeat steps for other strap.

Raise Main Strut

See Figure 4-10, View E for the following procedure.

1. Using a 55 USt (50 t) shackle (11), connect assist crane hook (12) to links (13).

   Assist crane must have at least 80 ft (24,3 m) of boom and be capable of lifting 40,000 lb (18 144 kg).
2. Lift slightly to support links and remove pins (14 and 15).

   Store pins in same holes after links are raised.
3. Lift links approximately 1 ft (0,3 m).
4. Connect load line (16) from Drum 2 (whip hoist in crane) to link (17).

   Do not route load line through guide sheaves on boom butt or boom top. Damage will occur.

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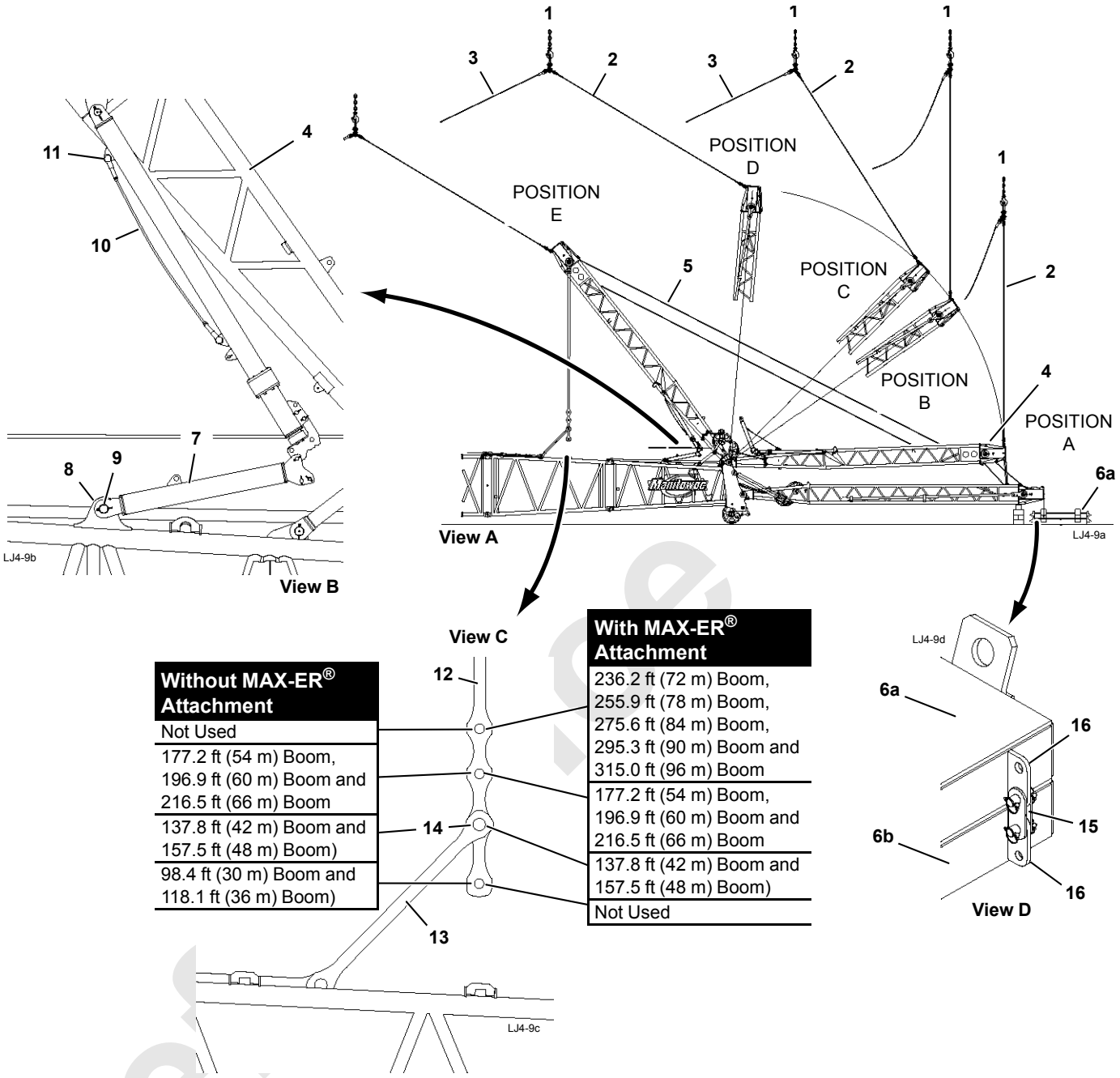

Without MAX-ER® Attachment
Not Used
177.2 ft (54 m) Boom, 196.9 ft (60 m) Boom and 216.5 ft (66 m) Boom
137.8 ft (42 m) Boom and 157.5 ft (48 m) Boom)
98.4 ft (30 m) Boom and 118.1 ft (36 m) Boom)

With MAX-ER® Attachment
236.2 ft (72 m) Boom, 255.9 ft (78 m) Boom, 275.6 ft (84 m) Boom, 295.3 ft (90 m) Boom and 315.0 ft (96 m) Boom
177.2 ft (54 m) Boom, 196.9 ft (60 m) Boom and 216.5 ft (66 m) Boom
137.8 ft (42 m) Boom and 157.5 ft (48 m) Boom)
Not Used

Item	Description	Item	Description
1	Assist Crane	9	Pin with Cotter Pins
2	Strut Handling Pendant	10	Pendant with Pin with Cotter Pin
3	Drum 2 Load LIne	11	Strut Stop Upper Tube
4	Main Strut	12	Basic Backstay Strap
5	Luffing Hoist Wire Rope	13	Backstay Links
6a	Top Counterweight Box	14	Pin with Collar and Retaining Pins
6b	Bottom Counterweight Box	15	Links with Pins and Snap Pins
7	Strut Stop Lower Tube	16	Lugs
8	Lugs		

FIGURE 4-11

Raise Main Strut (continued)

See Figure 4-11, View A for the following steps.

CAUTION

Strut Damage!

- Make sure guide pin (1a, View E, Figure 4-9) is installed in hole under guide sheave (1).
- Make sure guide pin (1b) is removed from front of guide sheave (1).

Damage will occur to strut or wire rope guide if these steps are not taken.

5. Slowly hoist with assist crane (1) until pendants (2) are taut (POSITION A). Pay out Drum 2 load line (3), as required.
6. Unpin strut supports (13, Figure 4-8, View D) from jib strut and pin supports to main strut for storage (View C).
7. Continue to hoist pendants (2) to raise main strut (4) to POSITION B. Pay out Drum 2 load line (1) and luffing hoist wire rope (5) as strut rises.

   Keep pendants (2) vertical during this step.

NOTE: Control hoist speed by observing top counterweight box (6a). Top box must not lift off bottom box during strut raising procedure.

CAUTION

Overload Hazard!

Do not allow top counterweight box (6a) to lift off bottom box at any time during strut raising procedure. Load line and pendants could be overloaded, possibly resulting in damage.

8. Once main strut is at approximately 45° (POSITION C), slowly haul in Drum 2 load line (3) while paying out luffing hoist wire rope (5).
9. Follow with assist crane — pay out load line and travel — while performing step 8.

   Do not induce any side load in main strut with assist crane. Load line from assist crane should remain vertical during strut raising procedure.

10. As main strut approaches vertical – POSITION D – pay out load line from assist crane so pendants (2) and Drum 2 load line (3) start to pull in a straight line.
11. Continue to luff down and haul in Drum 2 load line (3) while following with assist crane to lower main strut to rear.

See Figure 4-11, View B for the following steps.

12. Stop lowering main strut when strut stop lower tubes (7) are near connecting lugs (8) on boom top.
13. Connect strut stop tubes to boom top:
    a. Remove pins (9), luff down to lower main strut as required, and pin lower tubes to lugs (8).
    b. Unpin pendants (11) from lower tubes (7).
    c. Pin pendants (11) to upper tubes (12).

See Figure 4-11, View C for the following step.

14. Connect backstay links (13) to proper holes in basic backstay straps (12) with pins (14).

See Figure 4-11, View D for the following step.

15. Connect links (15) between lugs at all four corners of counterweight boxes (6a and 6b).

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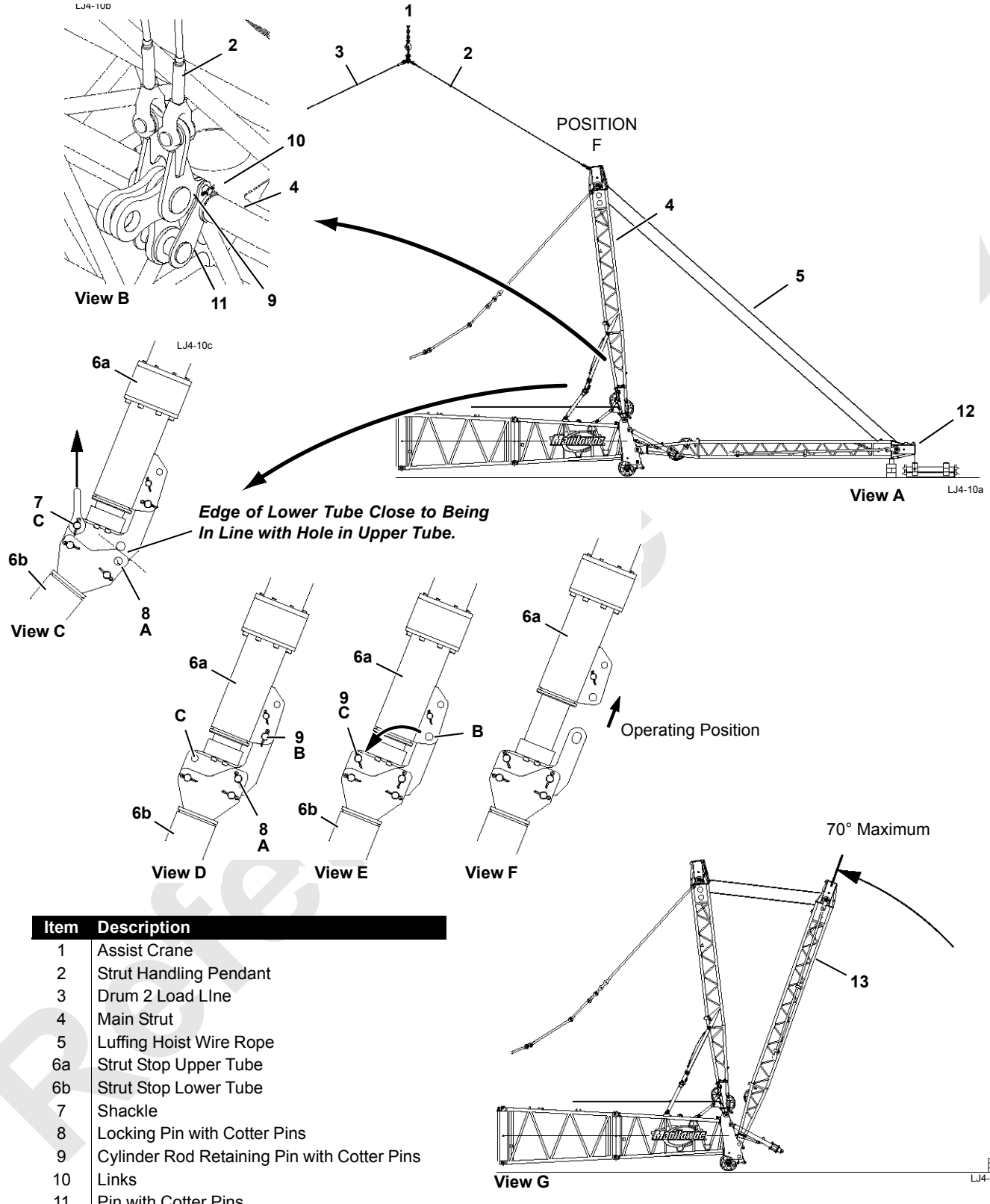


Item	Description
1	Assist Crane
2	Strut Handling Pendant
3	Drum 2 Load LIne
4	Main Strut
5	Luffing Hoist Wire Rope
6a	Strut Stop Upper Tube
6b	Strut Stop Lower Tube
7	Shackle
8	Locking Pin with Cotter Pins
9	Cylinder Rod Retaining Pin with Cotter Pins
10	Links
11	Pin with Cotter Pins
12	Pin with Cotter Pin
13	Jib Strut

FIGURE 4-12

Raise Main Strut (continued)

See Figure 4-12 for the following procedure.

16. Slowly luff up to raise main strut (4, View A) to POSITION F.

Strut stops will be positioned as shown in View C.

CAUTION

Strut Damage!

Do not attempt to fully close strut stops with luffing hoist. Structural damage will occur.

Stop raising main strut with luffing hoist when strut stops are positioned as shown in View C.

17. Close strut stop tubes:

- **a.** Remove locking pin (8, View C) from holes **A**.
- **b.** Attach shackle (7, View C) and sling from assist crane to hole **C** in strut stop upper tube (6a).
- **c.** Slowly hoist against upper tube. It should snap into position shown in View D.

  Only slight vertical movement is required to snap tube into position.
- **d.** Disconnect assist crane and remove shackle (7, View C).
- **e.** Install locking pins (8, View D) in holes **A.**
- **f.** Repeat steps 17a – 17e for other strut stop.

WARNING

Cylinder Extension Hazard

Cylinder rod retaining pins (9, View D) must be loose in holes **B** when they are removed.

Do not drive out pins (9). Strut stop cylinders will extend rapidly and forcefully. Personal injury can occur.

- **g.** Check that both cylinder rod retaining pins (9, View D) are loose in holes **B**. If they are, remove them.
- **h.** If they are not loose:
  - Luff down to lower jib strut (12) onto blocking. Allow a slight amount of slack in luffing hoist reeving.
  - Slowly hoist Drum 2 load line (pull main strut back) only enough to loosen pins (9).
  - Remove pins (9).
- **i.** Install cylinder rod retaining pins (9, View E) in holes **C**.

NOTE: Strut stop upper tubes (6a, View F) may extend slightly when the load line is slackened in step 18.

The tubes will extend to the operating position when the jib strut is raised.

18. Store main strut handling pendants:

- **a.** Lower handling pendants (2) and links (9) to vertical.
- **b.** Disconnect shackle from links (9).
- **c.** Disconnect Drum 2 load line (3) from links (9).
- **d.** Pin links (9) to lugs on main strut (4).

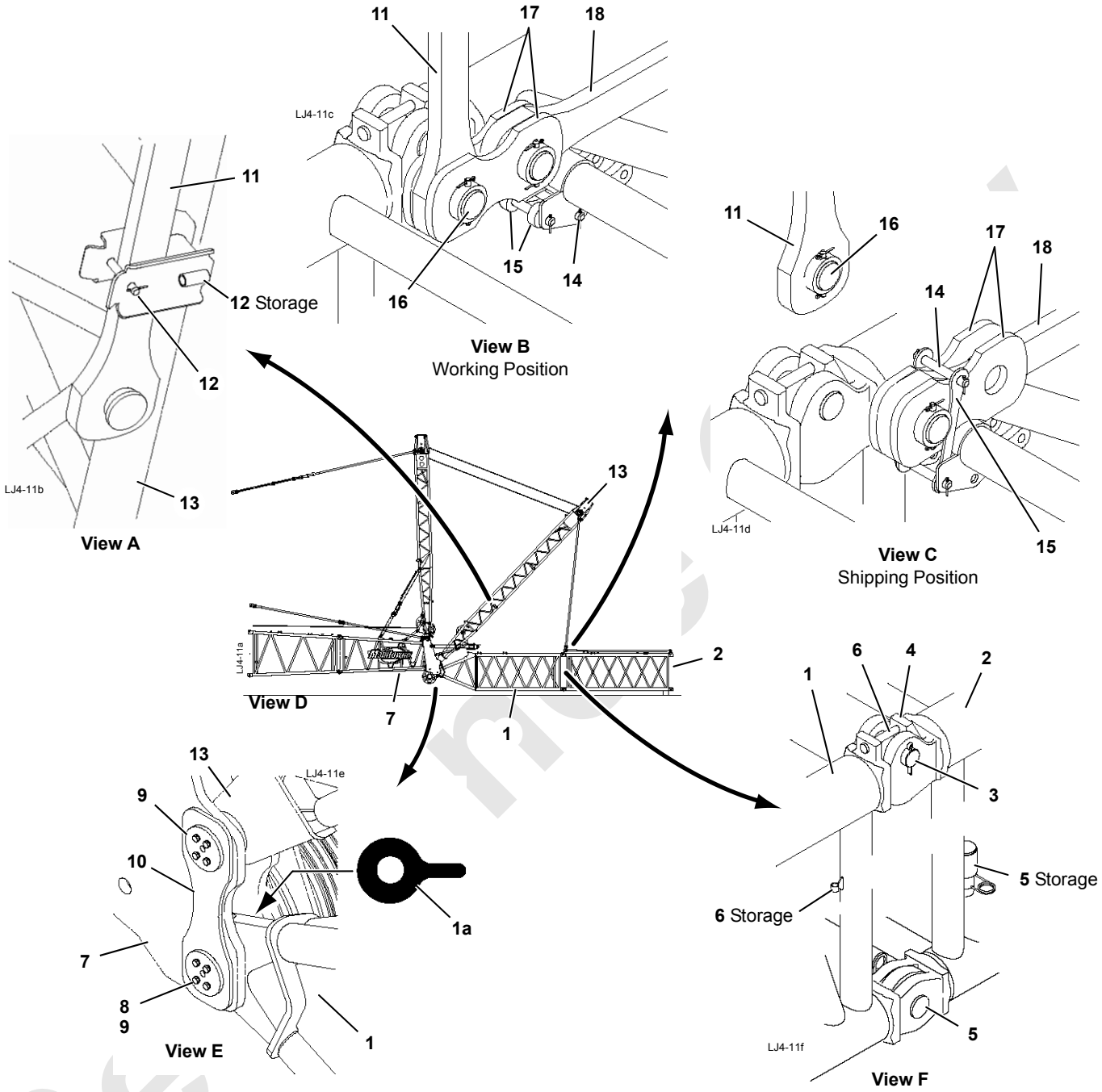
19. Install guide pin (1b, View E, Figure 4-9) in hole at front of guide sheave (1).

Raise Jib Strut

See Figure 4-12 for the following procedure.

1. Disconnect and remove counterweight boxes from under jib strut. Reinstall boxes on crane – one each side.

2. Luff up to raise jib strut (12, View G) to 70° maximum.



Item	Description	Item	Description
1	Jib Butt	10	Keeper Plate
1a	Shims	11	Basic Jib Strap
2	Jib Insert	12	Pin with Cotter Pins
3	Fixed Pin	13	Jib Strut
4	Hooked Connector	14	Pin with Cotter Pins
5	Pin with Safety Pin	15	Links
6	Pin with Washer and Cotter Pin	16	Pin, with Collar, Retaining Pin, and Cotter Pins
7	Boom Top	17	Links
8	Pin	18	Insert Strap
9	End Plate with Hex Screws		

FIGURE 4-13

Install Jib

See Figure 4-13 for the following procedure.

Install Jib Butt and First Insert

1. Raise jib stops to “Jib Assembly Position” (Figure 4-7, View C) to allow installation of jib. See procedure on page 4-12 of this section.
2. Assemble jib butt (1, View D) and first insert (2) on blocking in front of boom:
   a. Place butt on blocking.
   b. Lift insert into position at end of butt.
   c. Engage fixed pins (3, View F) in insert with hooked connectors (4) in butt.
   d. Lower insert to horizontal and install bottom connecting pins (5).
   e. Install pins (6).
3. Attach nylon lifting slings from assist crane to butt (1) and first insert (2) so they are balanced. Wrap slings around chords only. ***Do not use lifting lugs on butt or inserts and do not lift against lacings.***
4. Lift jib butt (1) and insert (2) into position at end of boom top (7).
5. Install shims (1a) on both inboard sides of jib butt so jib butt is ***centered on boom top*** (as close as possible).
6. Align connecting holes in jib butt with holes in boom top and install pins (8, View E) and end plates (9).

   Apply Loctite #243 to threads of end plate screws (jib strut and jib butt) and torque them to 100 ft-lb (136 Nm).
7. Lower jib butt and insert onto blocking so insert is horizontal.

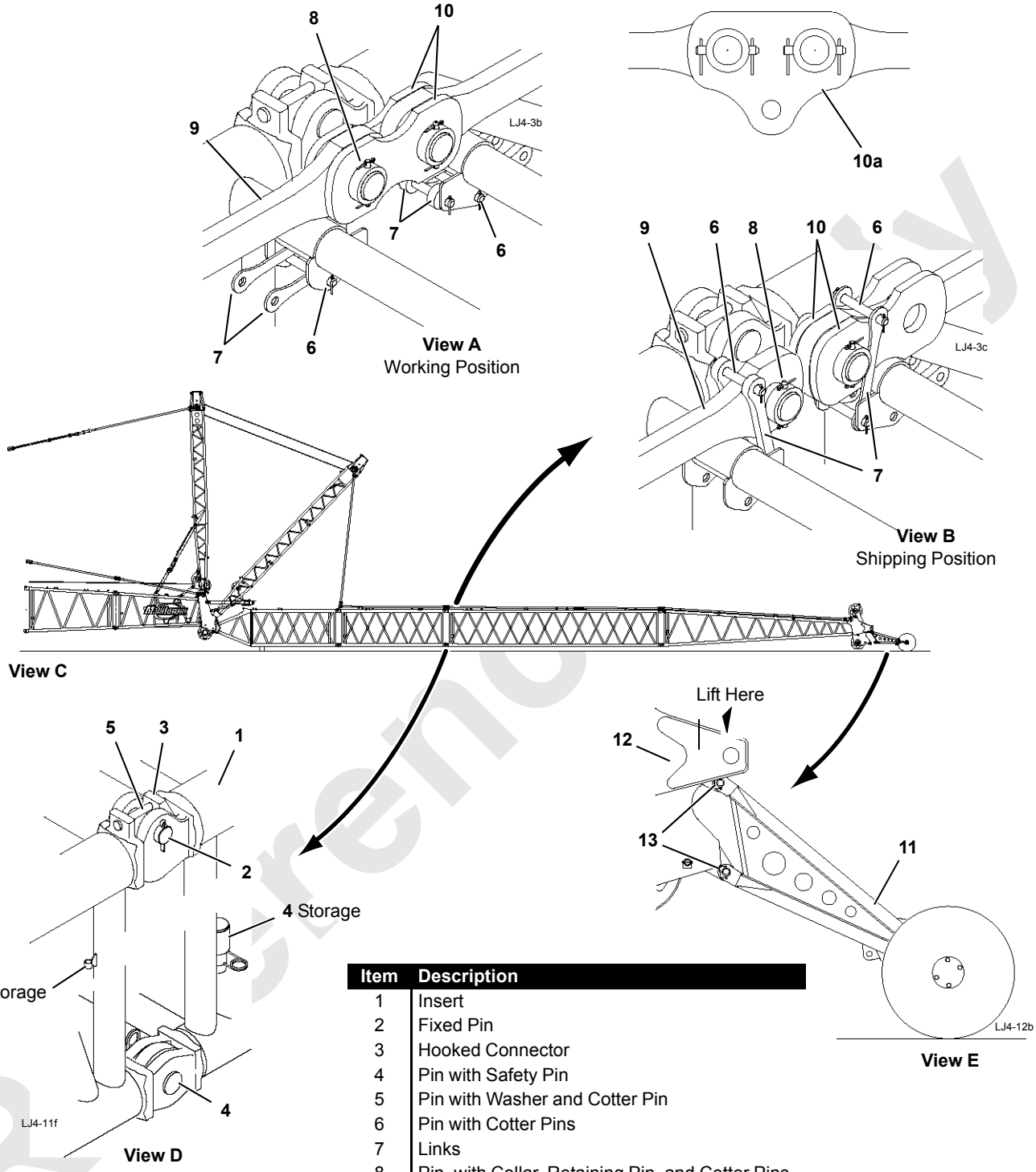
Connect Basic Jib Straps

See Figure 4-13 for the following procedure.

1. Attach slings from assist crane to basic jib straps (11, View A).
2. Remove pins (12, View A) and store.
3. Lower straps to vertical (View C).
4. Using slings from assist crane, pull against straps (11) to lower jib strut (13) until straps can be connected to links on first insert.
5. Pay out luffing hoist wire rope as strut is pulled forward.

NOTE: Jib strut is not heavy enough to overhaul luffing hoist wire rope. Approximately 15,000 lb (6 804 kg) of pull is required.

6. Pin basic jib straps to links:
   a. Remove pin (14, View C) and rotate links (15) to working position (View B).
   b. Pin links (15, View B) in working position.
   c. Remove pin (16, View C) from end of strap (11).
   d. Rotate links (17, View C) rearward and pin to strap (11, View B) with pin (16).
   e. Repeat steps for other strap.



Item	Description
1	Insert
2	Fixed Pin
3	Hooked Connector
4	Pin with Safety Pin
5	Pin with Washer and Cotter Pin
6	Pin with Cotter Pins
7	Links
8	Pin, with Collar, Retaining Pin, and Cotter Pins
9	Strap
10	Links
10a	Links (Intermediate Suspension)
11	Upper Jib Point
12	Jib Top
13	Pin with Snap Pins

FIGURE 4-14

Complete Jib Assembly

See Figure 4-14, View D for the following procedure.

1. Assemble remaining jib sections in proper sequence as shown on Luffing Jib Assembly Drawing at the end of this section:
   - **a.** Lift insert (1) into position at end of adjacent insert.
   - **b.** Engage fixed pins (2) in insert with hooked connectors (3) in adjacent insert.
   - **c.** Lower insert to horizontal and install bottom connecting pins (4).

     If equipped with intermediate suspension, install intermediate suspension links and pendants at proper bottom connectors as shown in Figure 4-15.
   - **d.** Block under top end of insert.
   - **e.** Install pins (5).
   - **f.** Repeat above steps until all inserts and jib top are installed.

See Figure 4-14 for the following procedure.

2. Connect jib straps at top end of each insert, as follows:
   - **a.** Remove pins (6, View B) and rotate links (7) to working position (View A).
   - **b.** Pin links (7, View A) in working position.
   - **c.** Remove pin (8, View B) from end of each strap (9).
   - **d.** Rotate links (10, View B) rearward and pin to adjacent strap (9) with pin (8, View A).

     If equipped with intermediate suspension, install links (10a) in place of links (10) at proper location (see Luffing Jib Assembly Drawing). Store standard links as shown in Figure 4-15.
   - **e.** If equipped with intermediate suspension, pin intermediate suspension pendants (Figure 4-15) to links (10a).
3. Install upper jib point:

An assist crane capable of lifting half the weight of the boom is required for the following procedure.

See Figure 4-14, View E for the following procedure.

- **a.** Lift upper boom point (11) into position at jib top (12).
- **b.** Pin upper jib point to upper connecting holes in jib top with pins (13).
- **c.** Attach slings from assist crane to end of jib top.
- **d.** Lift jib top until bottom connecting holes line up.
- **e.** Install bottom pins (13).
- **f.** Disconnect assist crane.

Install Jib Stop Control Cable

See Jib Stop Assembly Drawing at the end of this section for detailed instructions.

Install Load Lines

Route load lines through proper guide sheaves on boom butt, on boom top, and in jib strut. The position of the guide sheaves in the strut must match the guide sheaves on the boom top.

Pull load lines approximately 40 ft (12,19 m) past end of jib and lay them on ground. Securely fasten load lines to jib point.

NOTE: Load block(s) will be installed after boom and jib are jack-knifed to required angle.

WARNING

Falling Wire Rope Hazard!

For long boom and short jib combinations, wire rope on boom side of attachment can overhaul unsecured wire rope on jib side of attachment. Wire rope could fall off boom. Securely fasten load line to jib point before raising attachment.

Connect Electric Cables and Adjust Electronic Devices

1. Connect electric cables to respective junction boxes and switches. See Boom Wiring Assembly Drawing at the end of this section and Section 6 of this manual.
   - Jib stop limit switches on boom top and jib stop lower tube (left side of boom)
   - Cable reel in jib butt
   - Block-up limit switch in jib top
   - Wind speed indicator. If removed for shipping, install wind speed indicator assembly. Use star washers to attach mounting bracket to jib top to provide a good ground (see Wind Speed Assembly drawing at end of this section).

   Connect all unused electric cables to proper terminator plugs on junction boxes.
2. Adjust electronic devices according to instructions in Section 6 of this manual.
   - Boom stop
   - Luffing jib stops
   - Jib angle indicator
   - Block-up limits

Pre-Raising Checks

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

- ☐ All installation steps given in this section performed.
- ☐ Boom and jib inserts installed in proper sequence according to Rigging Drawings.
- ☐ Boom, jib, and backstay straps installed in proper sequence and unpinned from storage positions.
- ☐ All connecting pins installed and properly retained.
- ☐ Boom and luffing hoist wire rope anchored properly to drums, spooled tightly onto drums, and engaged with proper sheaves. Make sure rope guard pins, bars, or rollers are installed to retain wire rope in sheaves.
- ☐ Main strut raised and strut stop tubes pinned in operating position.
- ☐ Jib stops clear of boom butt.
- ☐ Load lines anchored properly to drums, spooled tightly onto drums, and engaged with proper sheaves. Make sure rope guard pins, bars, or rollers are installed to retain wire rope on sheaves.
- ☐ Load line going to jib point is securely attached to end of jib so load line cannot fall off jib and boom.
- ☐ All blocking, tools, and other items removed from boom and jib and from dolly travel path.
- ☐ All safety devices installed, electric cables connected, and limits adjusted.
- ☐ Raising instructions in this section read and thoroughly understood.
- ☐ Proper amount of crane counterweight and, if required, MAX-ER® counterweight installed.
- ☐ Wind within allowable limits for raising boom and jib.
- ☐ All lubrication points greased.
- ☐ LUFFING JIB Capacity Chart selected (see Section 3 of this manual).

WARNING

Falling Boom And Jib Hazard!

Select proper LUFFING JIB Capacity Chart to operate luffing jib. Operating luffing jib with any other type of chart selected is prohibited.

Luffing jib limits are disabled if a LUFFING JIB Capacity Chart is not selected. Boom and jib could be pulled over backwards.

RAISING BOOM AND LUFFING JIB

General

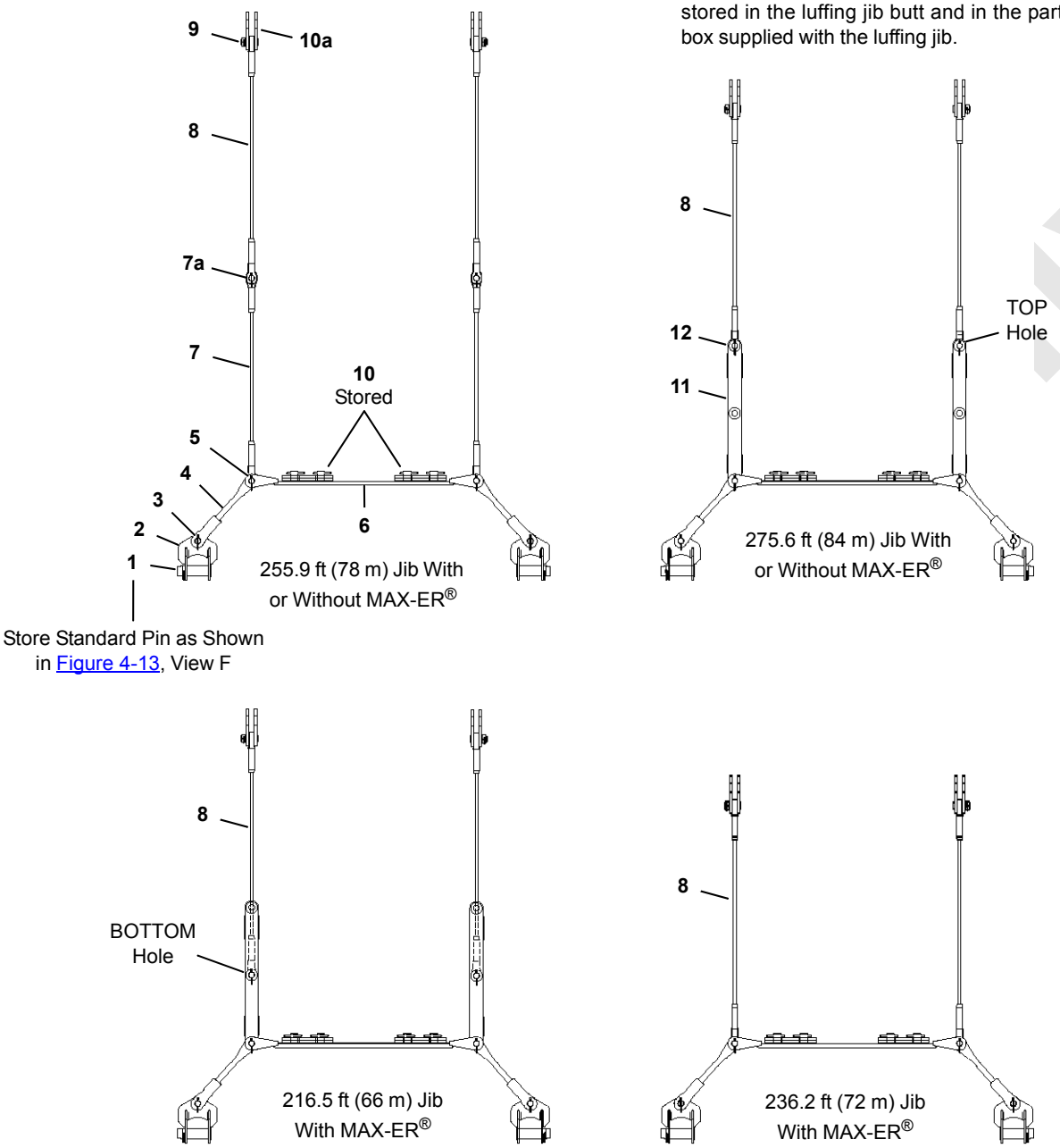
ALL boom and jib combinations must be raised and lowered using ***Jack-Knife Method.*** See Luffing Jib Raising Procedure Chart to determine the following:

- Counterweight Requirements (crane and MAX-ER®)
- Boom to Luffing Jib Angle
- Maximum Boom and Jib Lengths Raised or Lowered:
  - Over end of blocked crawlers
  - Over end or side of unblocked crawlers

4

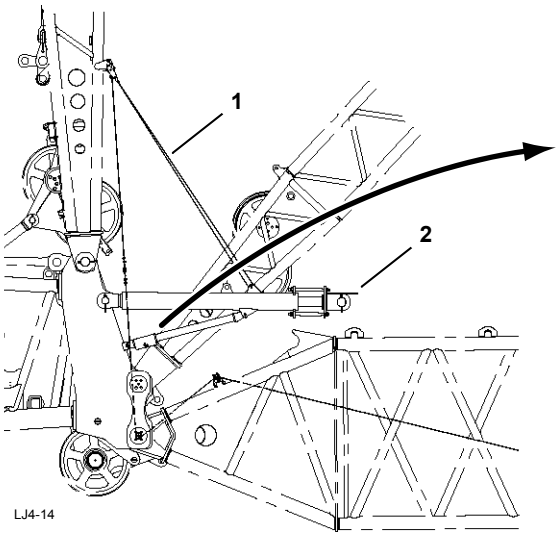
LJ4-13

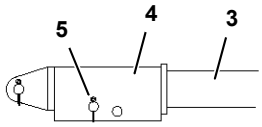
NOTE: The intermediate suspension parts are stored in the luffing jib butt and in the parts box supplied with the luffing jib.

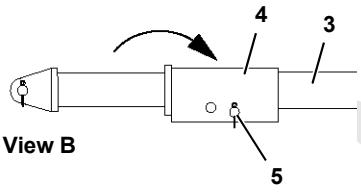


Item	Description	Item	Description
1	Pin (200 mm Long) with Safety Pins	7a	Pendant Pin with Cotter Pin
2	Link	8	Pendant (5 ft 10 in [1,78 m] Long)
3	Pin with Cotter Pin	9	Pin, with Collar, Retaining Pin, and Cotter Pins
4	Link	10	Links (Standard)
5	Pin with Cotter Pin	10a	Links (Intermediate Suspension)
6	Link	11	Link
7	Pendant (5 ft 0 in [1,52 m] Long)	12	Pin with Cotter Pin

FIGURE 4-15







Item	Description
1	Control Cable
2	Jib Stop
3	Jib Stop Strut
4	Spring Retainer
5	Pin with Cotter Pins

FIGURE 4-16

Jack-Knife Raising Procedure

WARNING

Moving Part Hazard!

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

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

Tipping Hazard!

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

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

CAUTION

Structural Damage!

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

- Disengage swing lock (past production cranes) and release swing brake until boom and jib have been raised to required boom to luffing jib angle.

NOTE: It is normal for the following 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 1 and MAX UP 2 – these faults will go off once the boom to luffing jib angle is less than 170°.

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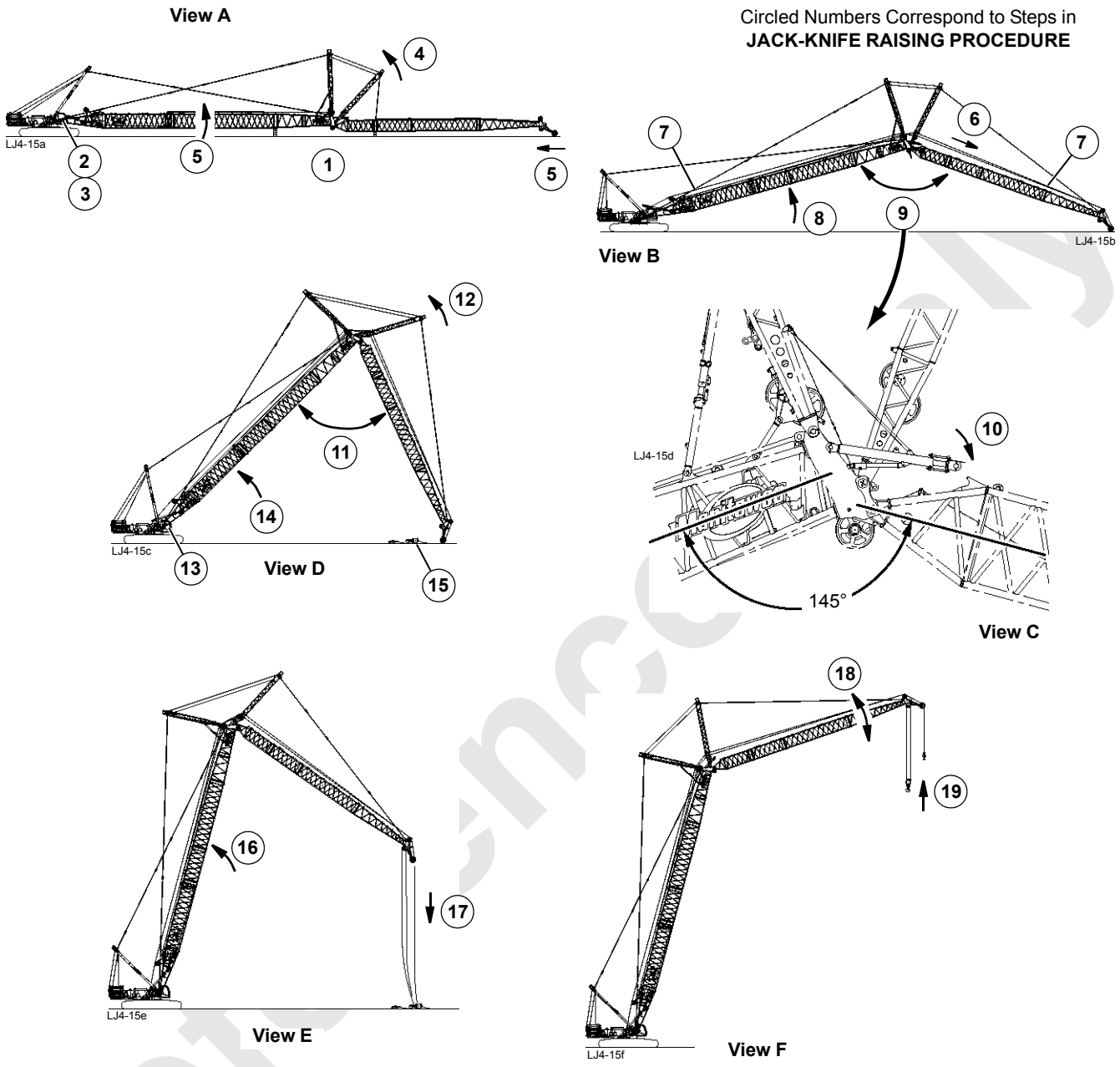


Figure 4-17

Circled numbers in Figure 4-17 correspond to numbered steps in the following procedure.

1. Prepare jib stops (Figure 4-16):

a. Using hand winch on jib top, tighten control cable (1) until jib stops (2) are clear of jib butt and spring retainers (4, View A) are loose.

b. Lock winch in this position:

PAST PRODUCTION winch on right side of jib top has a pawl. Move it to the locked position.

CURRENT PRODUCTION winch on left side of jib top has an automatic brake which holds the winch in drum in position when the handle is released.

c. Do not lower jib stops until instructed to do so later in raising procedure.

d. Move spring retainers (4) from position shown in View A to position shown in View B.

2. Determine BOOM TO LUFFING JIB ANGLE that boom and jib must be raised to before jib can be raised (see Luffing Jib Raising Procedure Chart).

3. Disengage swing lock (past production cranes) and release swing brake.
4. Luff up (raise jib strut) until straps are clear of strap supports on butt and first insert (jib strut at approximately 60°).
5. Slowly boom up.

   Jib point rollers will roll along ground as boom and jib are jack-knifed into position.
6. Pay out load line as boom and jib are raised.
7. Jib straps and backstay straps will tighten as boom and jib rise:

   OPERATOR AND SIGNAL PERSON — watch backstay straps and jib straps along left side of jib as boom and jib rise.

   Pay out luffing hoist wire rope (luff down) so straps remain slack.

   Allow backstay straps to float up and down 6 to 12 in (152 to 305 mm) above strap supports at top end of boom butt.

   Allow jib straps to float up and down 12 to 24 in (305 to 610 mm) above strap supports at butt end of jib top.

   It will be necessary to use jib up limit bypass switch to luff down if BLOCK UP limit is on.

WARNING

Tipping Hazard!

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

Do not allow jib and backstay straps to become too slack during raising steps. Jib strut could fall onto jib butt.

8. Slowly continue with Jack-Knife Raising Procedure steps 5 - 7.

   If equipped with intermediate suspension, watch pendants closely. Do not allow pendants to get caught on inserts or load lines as boom and jib rise.
9. Stop raising boom and jib when boom to luffing jib angle is 145°. ***Monitor this angle on digital display***.
10. Using hand winch on jib top, pay out control cable until it is loose. This will lower jib stops to proper operating position. Pay out an additional 3 ft (1 m) of cable.
11. Slowly continue with Jack-Knife Raising Procedure steps 5 - 7 until specified boom to luffing jib angle is reached.

WARNING

Falling Jib Hazard!

Do not position boom and jib at any boom to luffing jib angle less than minimum stop (70°). Structural damage to jib butt will occur, possibly causing jib to collapse.

12. Slowly luff up until jib straps start to go into tension and stop.
13. Apply swing brake.
14. Boom up to raise jib point rollers clear of ground.
15. Install load blocks or weight ball. See Load Block Reeving in this section. See Figure 4-19 for installation of block-up limit weights.

WARNING

Falling Load Hazard!

- Do not lift load blocks or weight balls off ground until boom has been raised to desired operating angle and jib has been positioned at required operating radius for load to be handled. Structural damage can occur and attachment can collapse if this precaution is not observed.
- Load lines going up boom can overhaul load lines going down jib. Do not untie load lines from jib until load blocks or weight balls have been installed. Load lines can fall off boom if this precaution is not followed.

16. Slowly raise boom and jib to desired boom angle (see capacity chart for boom angles).
17. Pay out load line as boom and jib are raised.
18. Position jib at required operating radius.
19. Lift load blocks and/or weight balls to desired position. ***Travel forward, as required so load blocks and/or weight balls are directly below jib point before lifting them.***

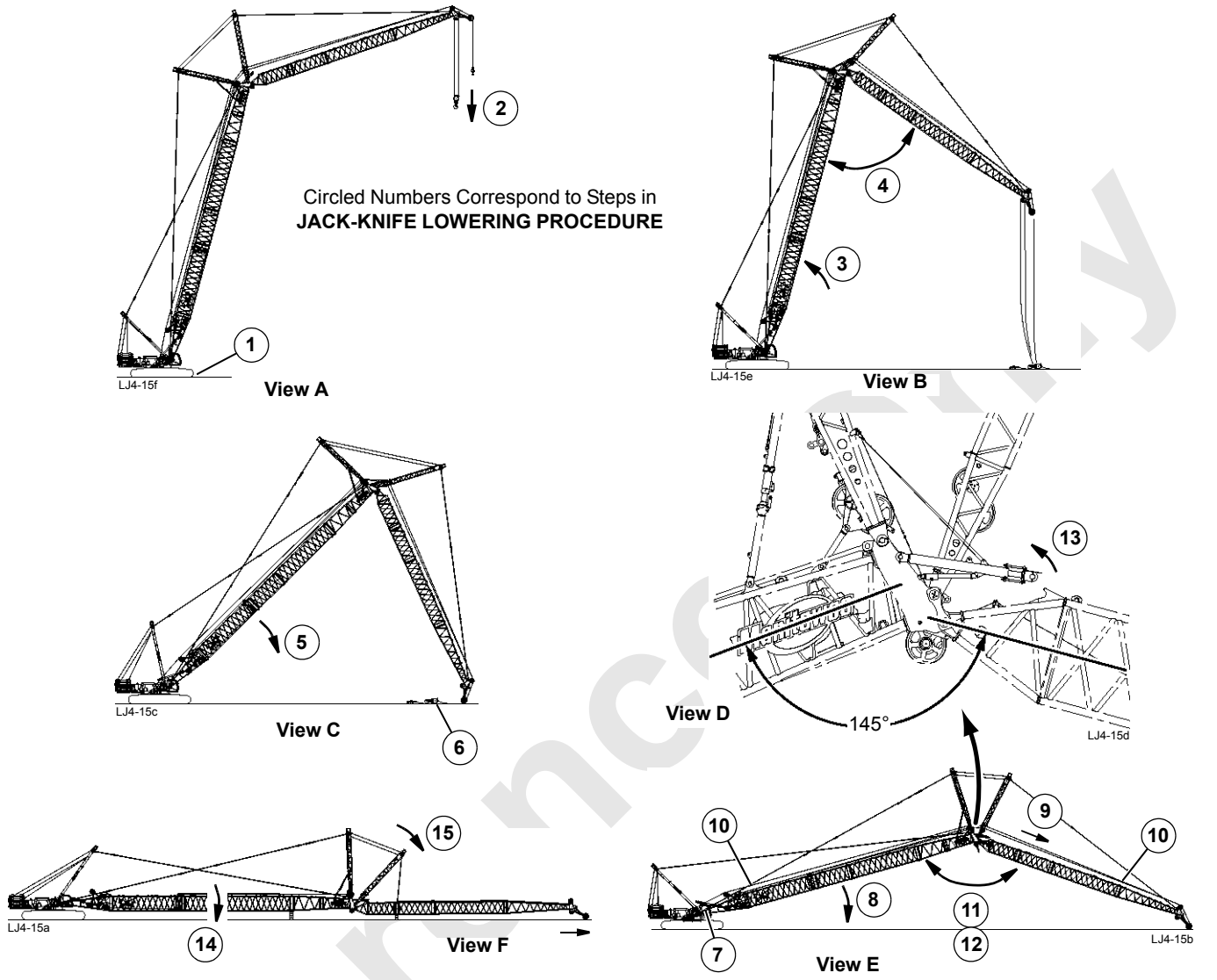


Figure 4-18

Lowering Boom and Luffing Jib

General

ALL boom and jib combinations must be raised and lowered using ***Jack-Knife Method.*** See the Liftcrane Luffing Jib Capacities Chart to determine the following:

- Counterweight Requirements (crane and MAX-ER®)
- Boom to Luffing Jib Angle
- Maximum Boom and Jib Lengths Raised or Lowered:
  - Over end of blocked crawlers
  - Over end or side of unblocked crawlers

DANGER

Moving Part Hazard!

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

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

WARNING

Tipping Crane Hazard!

Do not allow boom to luffing jib angle to become less than 70°. Structural damage to jib can occur.

Jack-Knife Lowering Procedure

CAUTION

Structural Damage!

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

Disengage swing lock (Serial Numbers through 16001159 only) and release swing brake when jib point rollers contact ground.

NOTE: It is normal for the BLOCK UP, MAX UP 1, and MAX UP 2 limits to come on during the lowering procedure.

Circled numbers in Figure 4-18 correspond to numbered steps in the following procedure.

1. If necessary, travel crawler rollers under boom onto blocking.

   Adhere to raising and lowering limitations given in Liftcrane Luffing Jib Capacities Chart.

2. Swing boom and jib slightly to either side of center and lower load blocks and/or weight balls onto ground. Then swing boom and jib to desired position with relation to crawlers and apply swing brake.

WARNING

Tipping Crane Hazard!

Lower load blocks and/or weight balls onto ground before lowering boom and jib. Structural damage can occur and attachment can collapse if this precaution is not observed.

DANGER

Tipping Crane Hazard!

Do not lower boom and jib to ground until boom has been positioned at minimum angle of 85° and jib has been positioned at specified boom to luffing jib angle. Crane will tip, or structural damage will occur, possibly causing attachment to collapse.

3. Position boom at minimum angle of 85°.
4. Position jib at required boom to luffing jib angle.

   Monitor angles on digital display.

5. Slowly lower boom until upper jib point is just clear of ground.

   It will be necessary to use jib up limit bypass switch to lower boom if BLOCK UP limit is on.

6. Remove load blocks and/or weight balls:

   a. Remove block-up limit weights and chains and connect block-up limit electric cables to terminator plugs on junction boxes.

   b. Securely fasten load lines to jib point so load lines cannot fall off boom and jib.

WARNING

Falling Wire Rope Hazard!

For long boom and short jib combinations, wire rope on boom side of attachment can overhaul unsecured wire rope on jib side of attachment. Wire rope could fall off boom. Securely fasten load lines to jib point before removing load blocks or weight balls.

7. Release swing brake and disengage swing lock (past production cranes).
8. Slowly boom down. Jib point rollers will roll along ground as boom and jib are lowered.
9. Pay out load lines as boom and jib are lowered.
10. Jib straps and backstay straps will slacken as boom and jib lower.

    OPERATOR AND SIGNAL PERSON — watch backstay straps and jib straps along left side of boom and jib as they lower.

    Allow backstay straps to float up and down 6 to 12 in (152 to 305 mm) above strap supports at top end of boom butt.

    Allow jib straps to float up and down 12 to 24 in (305 to 610 mm) above strap supports at butt end of jib top.

    It will be necessary to use jib up limit bypass switch to luff down if BLOCK UP limit is on.

WARNING

Tipping Hazard!

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

Do not allow jib and backstay straps to become too slack during raising steps. Jib strut could fall onto jib butt.

11. Slowly continue Jack-Knife Lowering Procedure steps 8 - 10.

    If equipped with intermediate suspension, watch pendants closely. Do not allow pendants to get caught on inserts or load lines as boom and jib lower.

12. Stop lowering boom and jib when boom to luffing jib angle is 145°. ***Monitor angle on digital display***.

13. Using hand winch on jib top, haul in control cable until jib stops are clear of jib butt.

CAUTION

Structural Damage Hazard!

Structural damage will occur if jib stops contact jib butt during lowering procedure.

Have a signal person watch jib stops closely during lowering procedure. Stop lowering jib if jib stops get close to butt. Repeat step 13.

14. Slowly continue lowering procedure until boom is horizontal.
15. Luff down until insert straps are resting on supports at end of jib sections.

REMOVING LUFFING JIB

Remove and Store Electronic Devices

1. Remove and store block-up limit components (see Boom Wiring and Limits Electrical Drawing at the end of this section).
2. Remove and store wind speed indicator assemblies so they cannot be damaged during shipping (see Wind Speed Assembly drawing at the end of this section).
3. Disconnect electric cable from cable reel in jib butt at boom top cable and at wireless transceiver in jib top (see Boom Wiring and Limits Electrical Drawing at the end of this section).
4. Coil cable onto cable reel.
5. Disconnect electric cables between jib top and upper point.
6. To protect electrical components:
   a. Attach sealing caps to ends of all unused cables, unused receptacles, and unused terminator plugs.
   b. If equipped, attach terminator plugs to unused receptacles.

Remove Jib Load Line

Drum 2 load line will be used to lower main strut later in the removal procedure. Haul in load line on Drum 1 and secure to drum for storage.

Remove Upper Jib Point

An assist crane capable of lifting half the weight of the jib is required for the following procedure.

See Figure 4-14, View E for the following procedure.

1. Attach slings from assist crane to end of jib top.
2. Lift jib top until bottom connecting pins (13) are loose and remove pins.
3. Support upper jib point so it can't fall and remove top pins (13).
4. Disconnect assist crane.
5. Remove and store upper jib point. Store pins (13) with upper jib point.

WARNING

Crushing Injury Hazard!

Jib sections can collapse when connecting pins are removed.

- Make sure jib straps have been lowered unto supports at end of jib sections.
- Block both ends of each jib insert before removing connecting pins.
- Never work under or inside jib sections that are not securely blocked.

4

Remove Jib

Jib removal is the reverse of installation.

1. Raise jib stops to "Jib Assembly Position" (Figure 4-7, View C) to allow removal of jib. See procedure on page 4-12 of this section.
2. Disconnect and store jib stop cable. See Jib Stop Assembly Drawing at the end of this section.
3. Disconnect jib straps and store them as shown in Figure 4-14, View B and Figure Figure 4-13, View C.
4. Remove jib top and all but first insert next to jib butt.
5. Raise jib strut to approximately 70°.
6. Remove jib butt and first insert as a unit.
7. Lower jib stops to "Working/Shipping Position" (Figure 4-7, View C) to allow removal of struts. See procedure on page 4-12 of this section.

WARNING

Tipping Hazard!

Jib stops can be stored or shipped in working/shipping position on boom top.

REMOVE JIB STOPS from boom top before operating without a luffing jib.

Crane can tip when boom is raised or lowered if this step is not performed.

Lower Jib Strut

1. Slowly luff down to lower jib strut.

   It may be necessary to pull on jib strut with outside assist to start it lowering.
2. When basic jib straps get close to ground, store them on jib strut as shown in Figure 4-13, View A.
3. Lower jib strut onto blocking so strut is horizontal.

Lower Main Strut

1. Anchor end of jib strut to counterweight:

See Figure 4-8 for the following procedure steps.

   a. Remove top counterweight box (15) from each side of crane.

      Top boxes are equipped with lugs (17) and links (18).

   b. Stack boxes (15), one at a time, under end of jib strut (3, View D).

      - Boxes must be centered under end of strut.
      - Lifting lugs on counterweight box must be in line with lugs on end of jib strut.

   c. Attach shackles and suitable lifting slings to lugs on end of jib strut and to lifting lugs on top counterweight box (15). Minimum capacity required for slings is 25,000 lb (11 340 kg) per side.

   d. Connect counterweight boxes with tie links as shown in Figure 4-11, View D (four places).

WARNING

Falling Strut Hazard!

Do not disconnect crane counterweight from jib strut until all remaining steps are performed. Counterweight is required to prevent jib strut from rising when main strut is lowered.

If counterweight is not connected to jib strut, jib strut will rise part way and then both struts could fall forward violently.

2. Luff down until luffing hoist wire rope is slack.
3. Unpin handling pendants and links from lugs on main strut (Figure 4-12, View B).
4. Attach 55 USt (50 t) shackle and hook from assist crane to links as shown on Figure 4-10, View E.
5. Connect Drum 2 load line (16, Figure 4-10, View E) to link (17).
   - Use same button socket used to anchor load line to boom or jib point.
   - Make sure load line does not pass through guide sheaves on boom butt or boom top.
6. Temporarily remove rope guide pin (1b, Figure 4-9, View E) from front of guide sheave (1).
7. Slowly haul in Drum 2 load line to retract strut stop upper tubes (6a, Figure 4-12, View E).

CAUTION

Strut Damage!

Pull strut back only until holes **B**, View E are aligned. Pulling strut further back may damage strut or strut stops.

8. Remove cylinder rod retaining pins (9, Figure 4-12, View E) from holes **C** in strut stop lower tubes (6b) and install pins (9) in holes **B**, View D. This will prevent upper tubes (6a) from extending.
9. Remove locking pins (8, Figure 4-12, View D) from holes **A**.
10. Slowly slacken Drum 2 load line to unlatch strut stop tubes (Figure 4-12, View C).

Under some conditions, it may be necessary to luff up to remove load from tubes.

11. Reinstall locking pins (8, Figure 4-12, View C) in holes **A**.

12. Slowly luff down (follow with assist crane) to lower main strut until basic backstay straps can be disconnected.

13. Disconnect backstay links (13, Figure 4-11, View C) from basic backstay straps (12). Lower links onto boom.

14. Disconnect strut stop lower tubes:

See Figure 4-11, View B for the following procedure steps.

a. Unpin pendants (10) from strut stop upper tubes (11).

b. Pin pendants (10) to strut stop lower tubes (7).

c. Luff up or down as required to loosen pins (9) and remove pins.

d. Luff up to raise strut clear of lugs and store pins (9) in lower tubes.

15. Disconnect and store links at all four corners of counterweight boxes (Figure 4-8, View F).

16. Raise strut handling pendants with assist crane so links and hook from assist crane are slightly higher than top of main strut — POSITION E, Figure 4-11, View A.

Pay out Drum 2 load line while raising pendants

17. Slowly luff up to raise main strut while paying out Drum 2 load line and following with assist crane.

Do not induce any side load in main strut with assist crane. Load line from assist crane should remain vertical during strut lowering procedure.

CAUTION

Overload Hazard!

Do not allow top counterweight box to lift off bottom box at any time during strut lowering procedure. Load line and pendants could be overloaded, possibly resulting in damage.

18. As main strut nears vertical — POSITION D, Figure 4-11, View A — tighten pendants (2) and Drum 2 load line (3) so main strut moves forward smoothly past vertical without dropping.

19. Continue to luff up while following with assist crane — pay out load line and travel — until main strut is at approximately 45° (POSITION C, Figure 4-11, View A).

20. Slacken Drum 2 load line (3) and raise pendants (2) to vertical — POSITION B, Figure 4-11, View A — while luffing up.

21. Continue to lower main strut with assist crane while luffing up until main strut is at POSITION A, Figure 4-11, View A.

As strut lowers:

- Guide strut straps into strap brackets (Figure 4-10, View D) and pin links (9) to straps.
- Guide upper tubes onto storage lugs (Figure 4-10, View D) and pin upper tubes to storage lugs.

22. Store strut stop lower tubes:

See Figure 4-10, for the following steps.

a. Support lower tube (1, View A) with a sling from assist crane.

b. Unpin pendant (5) from lower tube and pin pendant to upper tube (View B).

c. Rotate lower tube down and pin to upper tube (3, View B).

d. Disconnect assist crane.

e. Repeat steps for other lower tube.

Store Luffing Hoist Wire Rope

1. Disconnect wire rope from socket in end of main strut. Store socket with main strut.

2. Spool luffing hoist wire rope onto Drum 3 for storage.

If desired, a “sucker line” can be attached to end of luffing hoist wire rope and spooled through sheaves in struts as luffing hoist wire rope is removed. This practice will make it easier to install the luffing hoist wire rope next time.

Remove Struts

Main strut and jib strut are shipped together as shown in Figure 4-8, View C.

See Figure 4-8 for the following procedure.

1. Reinstall counterweight boxes (15, View F) on crane — one each side.

2. Attach assist crane to jib strut (2) as shown in View C.

3. Support jib strut with assist crane and remove pins (14, View E).

4. Unpin strut supports (13, View D) from inner lugs on jib strut and pin supports to outer lugs on jib strut (View B).

5. Lower main strut and install pins (11, View C). Store pins (14) with main strut.

6. Support struts with assist crane and remove pins to disconnect jib strut from boom top.

7. Attach pins (4 and 7a) and keeper plates (6) to boom top with end plates.

Store Backstay Straps

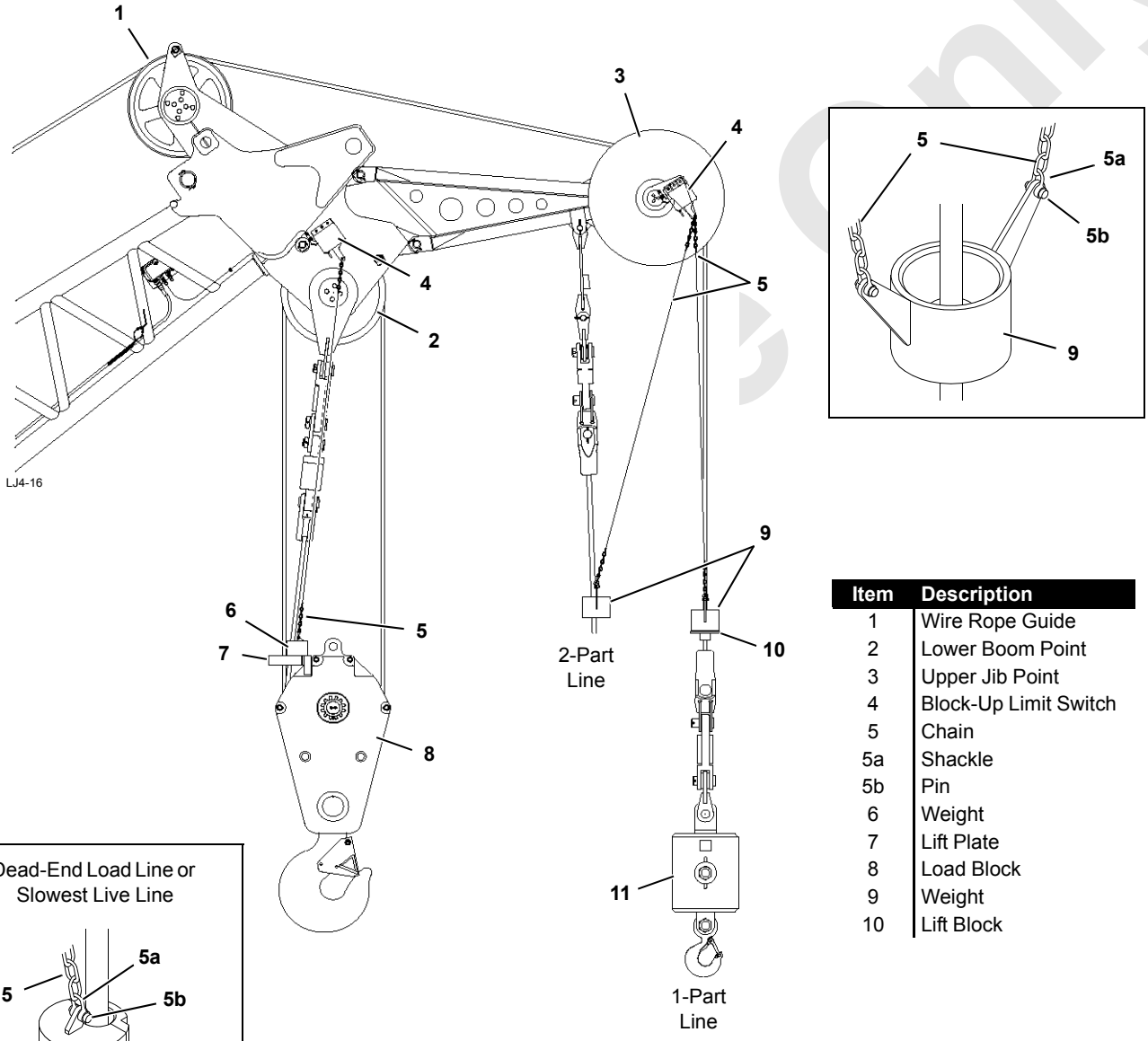
The backstay straps can be stored or shipped on the boom sections as shown in Figure 4-5, View C.

WARNING

Tipping Hazard!

REMOVE BACKSTAY STRAPS from boom sections before operating without a luffing jib.

Crane can tip when boom is raised or lowered if this step is not performed.



Item	Description
1	Wire Rope Guide
2	Lower Boom Point
3	Upper Jib Point
4	Block-Up Limit Switch
5	Chain
5a	Shackle
5b	Pin
6	Weight
7	Lift Plate
8	Load Block
9	Weight
10	Lift Block

FIGURE 4-19

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 4-20.

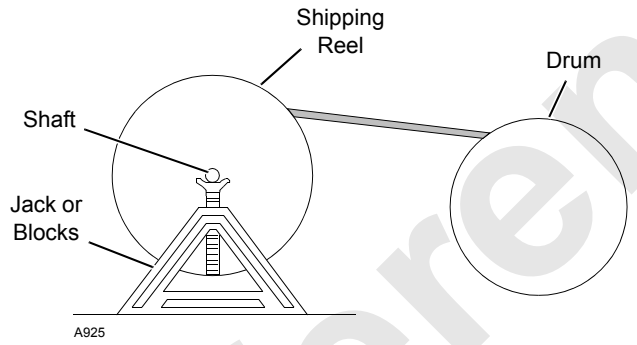


FIGURE 4-20

2. Provide a brake at shipping reel (Figure 4-21) so wire rope can be wound tightly onto drum.

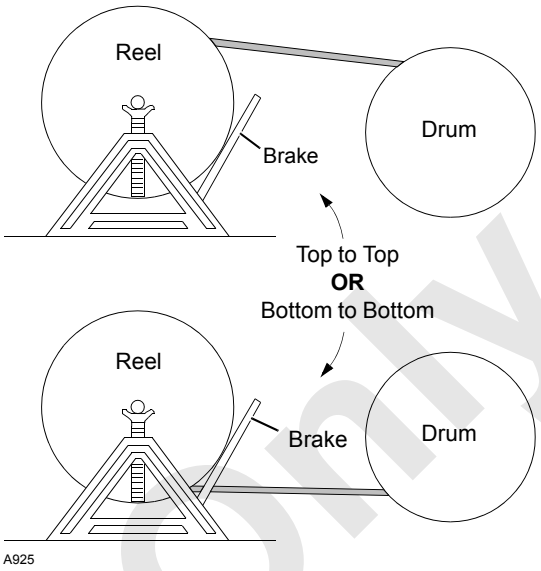


FIGURE 4-21

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 4-21.
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.

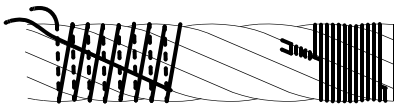
Before cutting wire rope, apply seizings on both sides of the point where the cut will be made. Then cut the wire rope with a torch, rope cutter, or abrasive cut-off wheel.

See Figure 4-22 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.

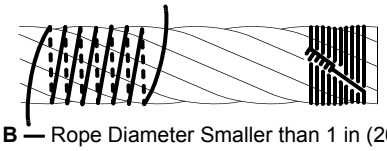
Wire Rope Type	Seizings Required
Preformed	1
Non-preformed	3

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 4-22

Anchoring Wire Rope to Drum

See Figure 4-23 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.

Drum Guards

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

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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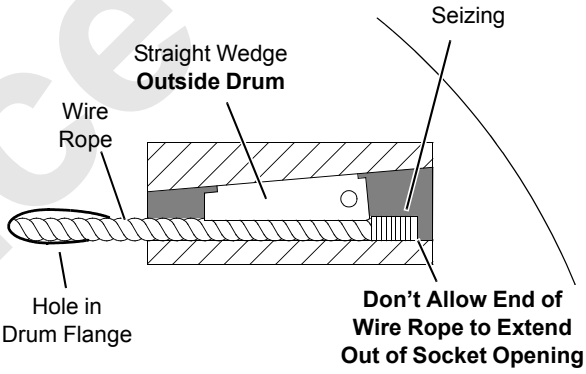

FIGURE 4-23

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 4-24).
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 4-24, 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.

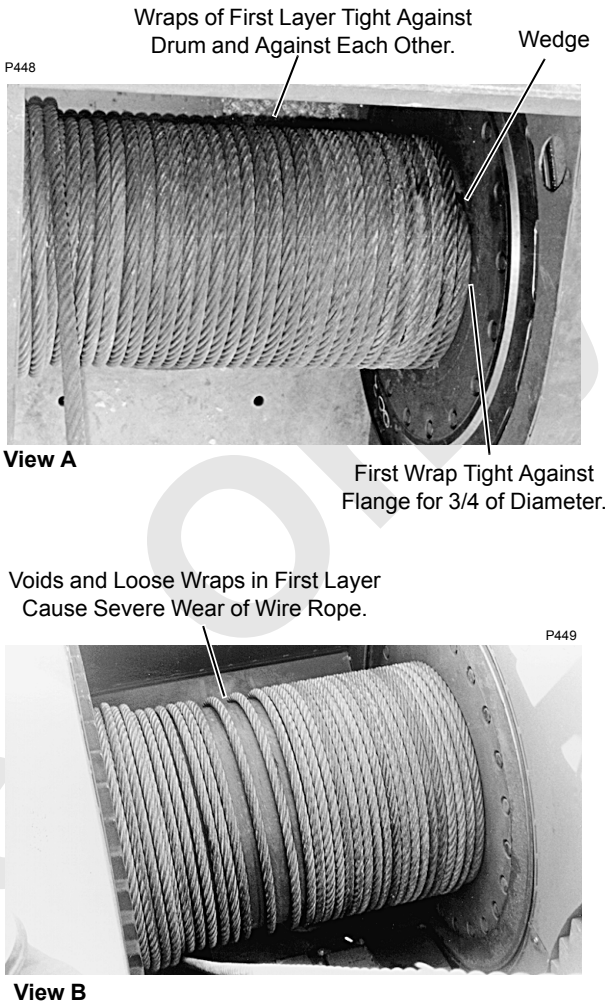

FIGURE 4-24

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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 original dimensions by more than 10%.
- Do not reinstall shipping material (bolt, plastic strap or wire) in hole of wedge or socket after assembling. Discard these materials because they can prevent wedge from tightening in socket.
- Only use a wedge and socket which are correct size for wire rope being used. Do not mix and match parts from one assembly with parts from another assembly.
- Terminator™ socket and wedge has “go” and “no go” holes to check for proper rope size.
- Attach wire rope clip to dead end of wire rope after assembling wire rope to wedge and socket.
- If dead end of wire rope is welded, seize end of wire rope and cut off weld before assembling to wedge and socket. Weld will not allow strands of wire rope to adjust around bend of wedge, resulting in high strands and wavy rope. This condition can seriously weaken attachment.

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 4-26 for the following procedure.

1. Assemble wire rope and wedge to socket so live end of wire rope is in a straight line with socket pin hole. Do not assemble WRONG as shown.
2. Allow dead end of wire rope to extend past end of socket amount shown.
3. Allow wire rope to assume its natural lay.
4. Pull against wedge and live end of wire rope enough to tighten wedge in socket.

   Use a brass hammer to seat wedge and wire rope as deep into socket as possible.
5. Attach a wire rope clip to dead end of wire rope using one of the RIGHT methods shown. Rope clip will aid in preventing wire rope from being pulled out of socket.

NOTE: Use Right Method A only if wire rope clip is small enough to be securely tightened to dead end. Right Method C is only for a Terminator wedge socket.

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

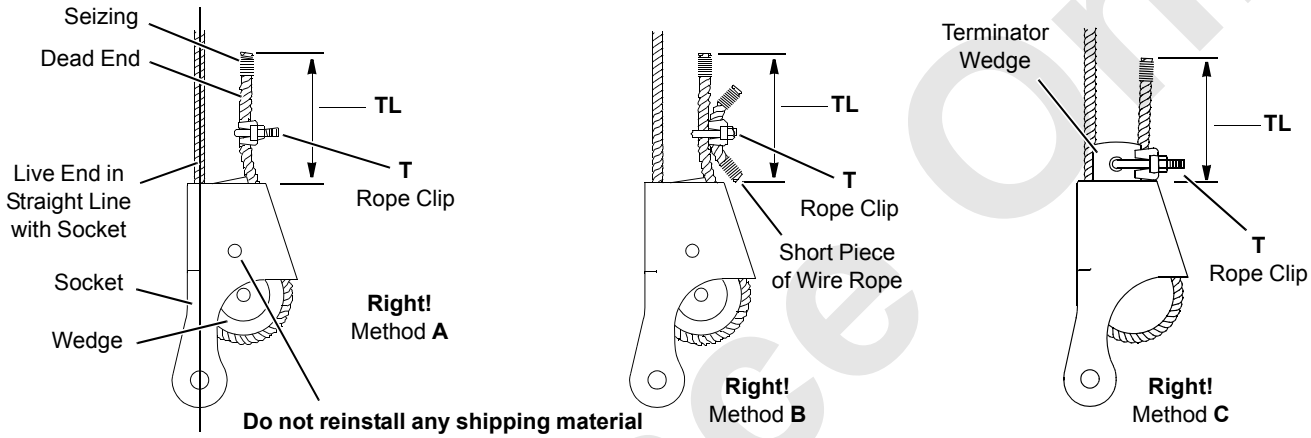
TL (Tail Length)

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

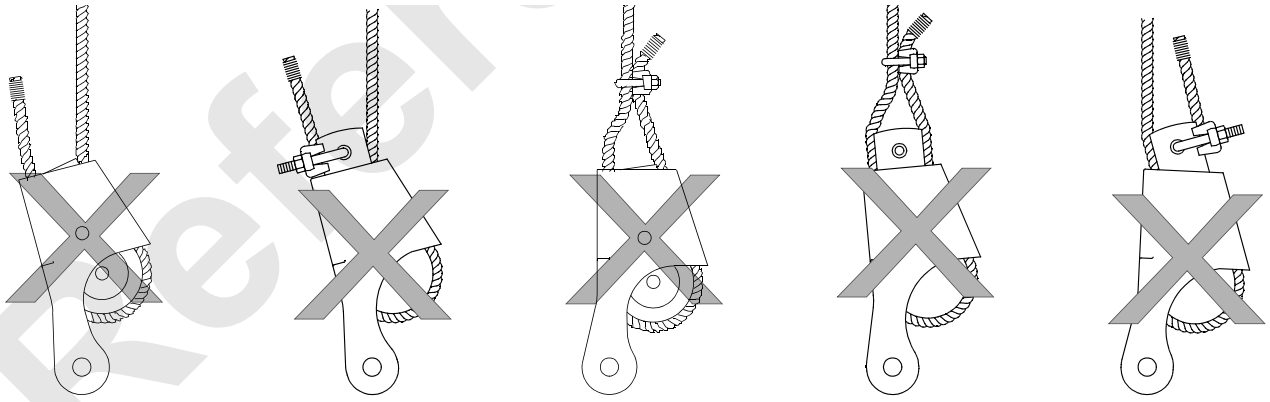
T (Rope Clip Nut Torque)

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

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



ALL ARE DANGEROUS AND PROHIBITED!



WRONG Rope Backward

WRONG Rope Backward

WRONG Dead End Clipped to Live End

WRONG Dead End Clipped to Live End

WRONG Wedge Backward

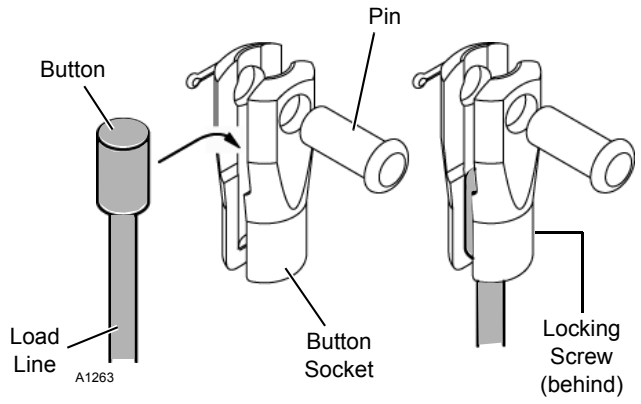
A925

FIGURE 4-25

Anchoring Wire Rope to Button Socket

See Figure 4-26 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.



Button Socket Assembly

FIGURE 4-26

Breaking in Wire Rope

After installing a new wire rope, break it in by operating it several times under a 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.

DRUM KICKER ADJUSTMENT

General

A drum kicker is provided on both flanges of the main load drum (Drum 1 in boom butt) to improve wire rope spooling for long boom lengths with small fleet angles where the wire rope might stack up along either drum flange.

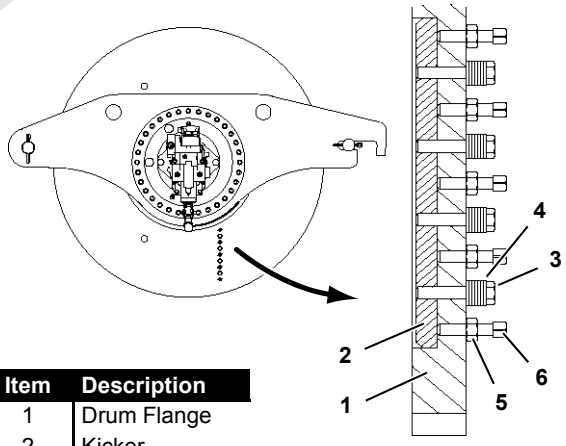
Observe the wire rope during initial break-in and periodically during operation. If the rope stacks up at either end of the drum, adjust the drum kickers.

Adjustment

See Figure 4-27 for the following procedure.

To move drum kickers (1) into the drum (take up space), proceed as follows:

1. Remove drum guard from both ends of drum.
2. Remove an equal number of washers (3) from both sides of kicker (1), one side at a time. Each washer allows kicker to move 0.098 in (2,5 mm).
3. Loosely reinstall cap screws (2) and remaining washers (3).
4. Loosen lock nuts (4) and adjust set screws (5) to move kickers (1) into drum.
5. Repeat steps 1-3 only enough to improve spooling. ***Moving drum kickers in too far can cause premature wire rope wear.***
6. Securely tighten set screws (5) and lock nuts (4).
7. Reinstall drum guards.



Item	Description
1	Drum Flange
2	Kicker
3	Cap Screw
4	Washers
5	Lock Nut
6	Set Screw

FIGURE 4-27

PAD EYE USAGE FOR WIRE ROPE REEVING

See Figure 4-28 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

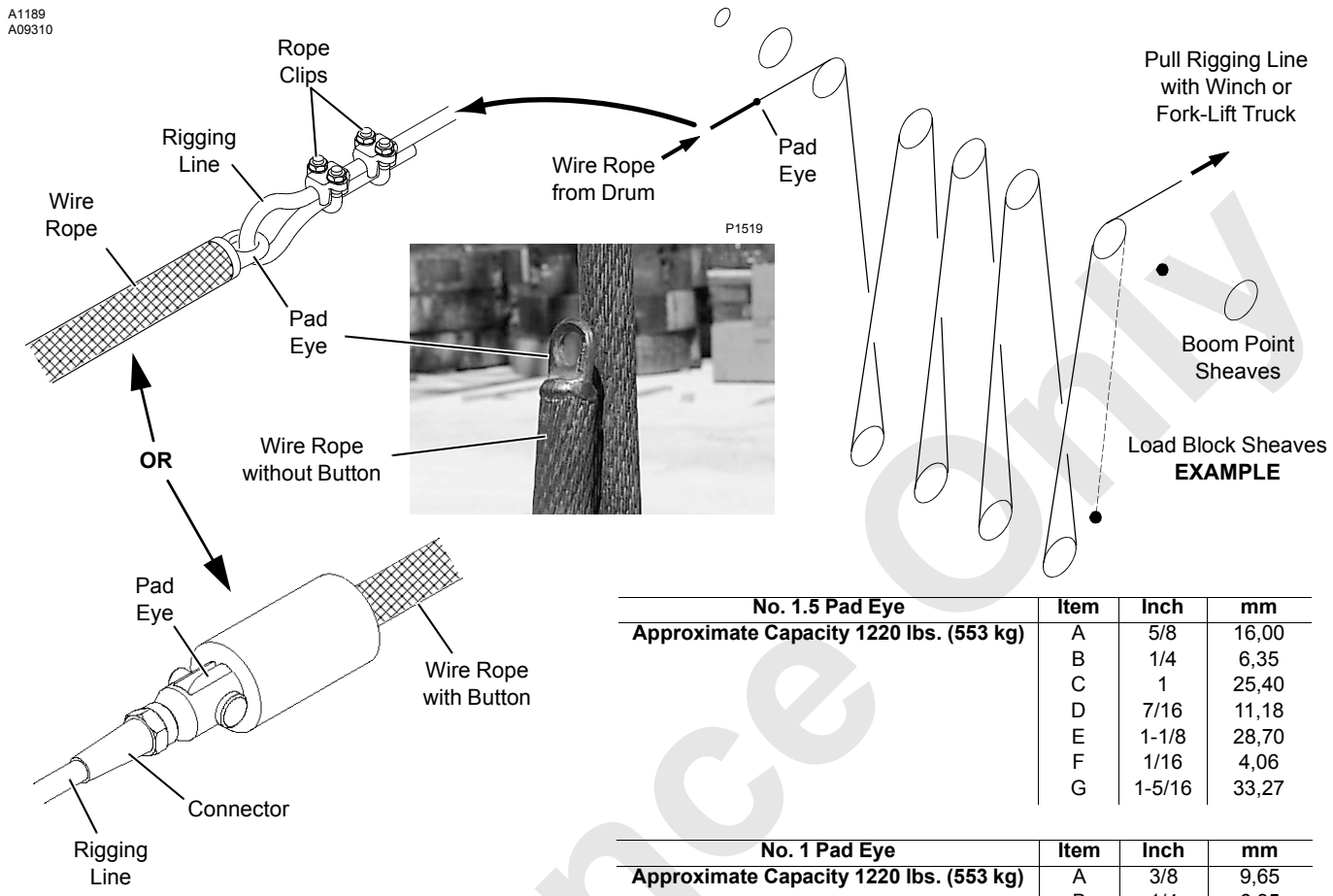
1. Do not exceed approximate capacities listed in Figure 4-28.
2. Make sure rigging line and attaching hardware (clips and rope connectors) are rated for the approximate capacities shown in Figure 4-28.
3. Inspect pad eye prior to each use. ***Replace it if:***
   - Any original dimensions have changed
   - Cracks or breaks exist in metal or weld

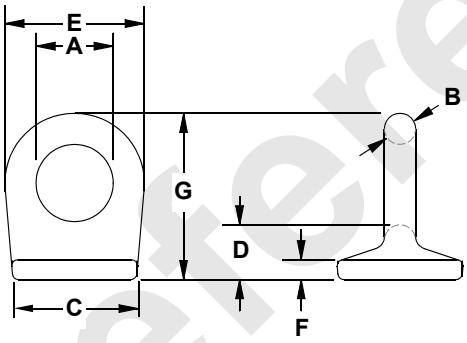
WARNING

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.





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

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

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

FIGURE 4-28

RIGGING WINCH OPERATION

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

Selecting Rigging Winch Mode

See Figure 4-29 and Figure 4-30 in the following procedure.

TO TURN RIGGING WINCH MODE ON —

1. Go to Function Mode screen in main display.
2. In **level 2**, use the select buttons to enter selected drum screen options. Select rigging winch data box (Figure 4-29).

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

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

Rigging Winch Mode

FIGURE 4-29

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

TO TURN RIGGING WINCH MODE OFF —

1. Go to Function Mode screen in main display.
2. In **level 2**, use the select buttons to enter selected drum options screen. Select rigging winch data box (Figure 4-29).
3. In **level 3**, enter data box and use the select buttons to ***turn OFF*** rigging winch.

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

Operating Rigging Winch

Free-Spool Operation

Past Production Figure 4-30

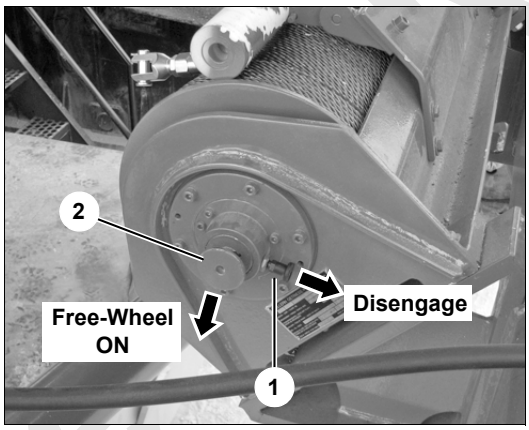
The winch has a free-wheel clutch which allows the drum barrel to be disconnected from the drive mechanism. This position allows the drum to be turned by hand.

TO TURN FREE-SPOOL ON —

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

TO TURN FREE-SPOOL OFF —

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



Item	Description
1	Locking Pin
2	Knob

FIGURE 4-30

Current Production Figure 4-31

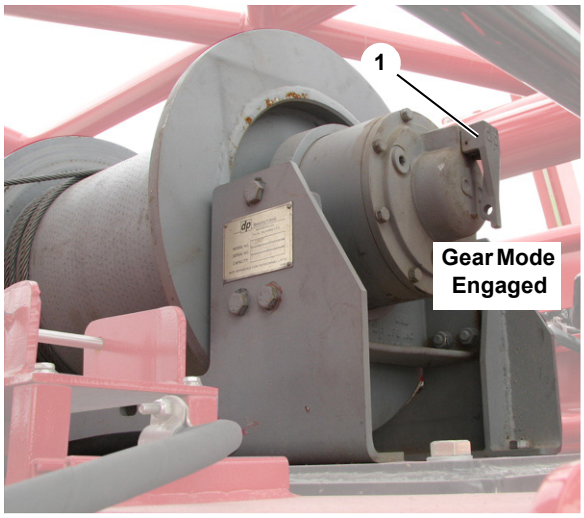
TO TURN FREE-SPOOL ON —

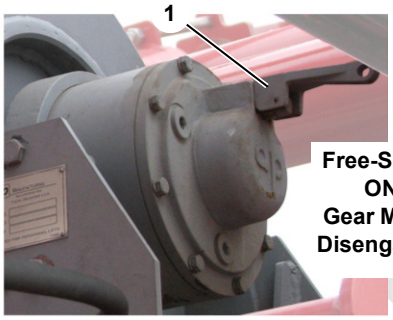
1. Winch must be "at rest" and have no load on cable.
2. Rotate gear shifting lever (1) 90° up.

TO TURN FREE-SPOOL OFF —

1. Winch must be "at rest" and have no load on cable.
2. Rotate gear shifting lever (1) 90° down.

Current Production Rigging Winch





Item	Description
1	Gear Shifting Lever

M102484

FIGURE 4-31

Power Operation

1. Turn free spool off and engage gear mode.
2. Turn on rigging winch mode.
3. GEAR ENGAGEMENT — ***slowly*** rotate rigging winch 90° in pay out direction by moving Drum 0 control handle forward and then ***stop*** rotation. ***Slowly*** rotate drum approximately 90° in the pay in direction by pulling back on Drum 0 control handle to ensure gears are fully engaged.
4. Pay out rigging line by moving Drum 0 control handle forward.
5. Reeve rigging line through block and boom point and connect to desired load line as shown in Rigging Winch Assembly drawing at end of this section.
6. Use engine throttle to snug up rigging line prior to paying out load line from selected load drum. Faulty operation will result if there is slack in rigging line before engaging automatic part of operation.

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

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

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

CAUTION!

Avoid Rigging Winch or Wire Rope Damage!

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

Structural damage to winch or rigging line will occur!

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

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

WARNING

Flying Object Hazard!

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

Lines could fly apart with explosive force and strike personnel.

9. Once load line is reeved through block and boom point:
   a. Move load drum control handle to off.

4

b. Pay out rigging line to slacken load line by pushing Drum 0 handle forward.

c. Disconnect rigging line from load line.

d. Haul in rigging line for storage on rigging winch by pulling Drum 0 control handle back.

e. Secure end of rigging line to boom for storage.

f. Connect load line to dead-end socket. See instructions in this section.

g. Turn OFF rigging winch mode.

REEVING – LOAD BLOCK

WARNING

Falling Load Hazard!

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

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

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

Load Block Identification

See the Luffing Jib Assembly Drawing at the end of this section for a complete list of load blocks 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 this section for instructions:

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

See Wire Rope Lubrication in Section 5 of this manual.

Guide Sheaves and Drums

See Figure 4-32 for identification of the load drums and guide sheaves.

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

Load Block Reeving

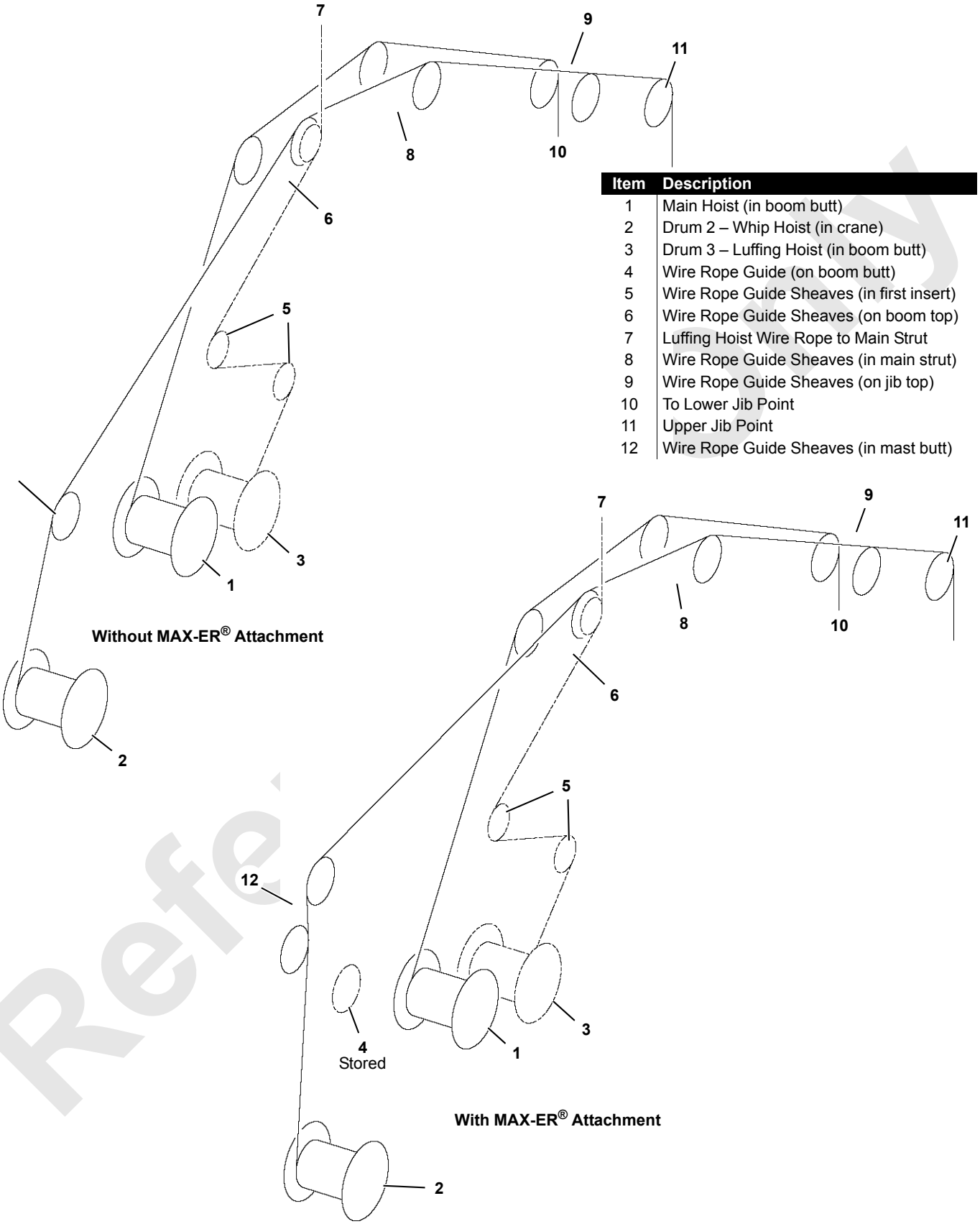
See Figure 4-33 for dead-end locations and components in jib points.

See Figure 4-34 for load block reeving. Reeving the load block in any manner other than shown can result in excessive block twist.

CAUTION

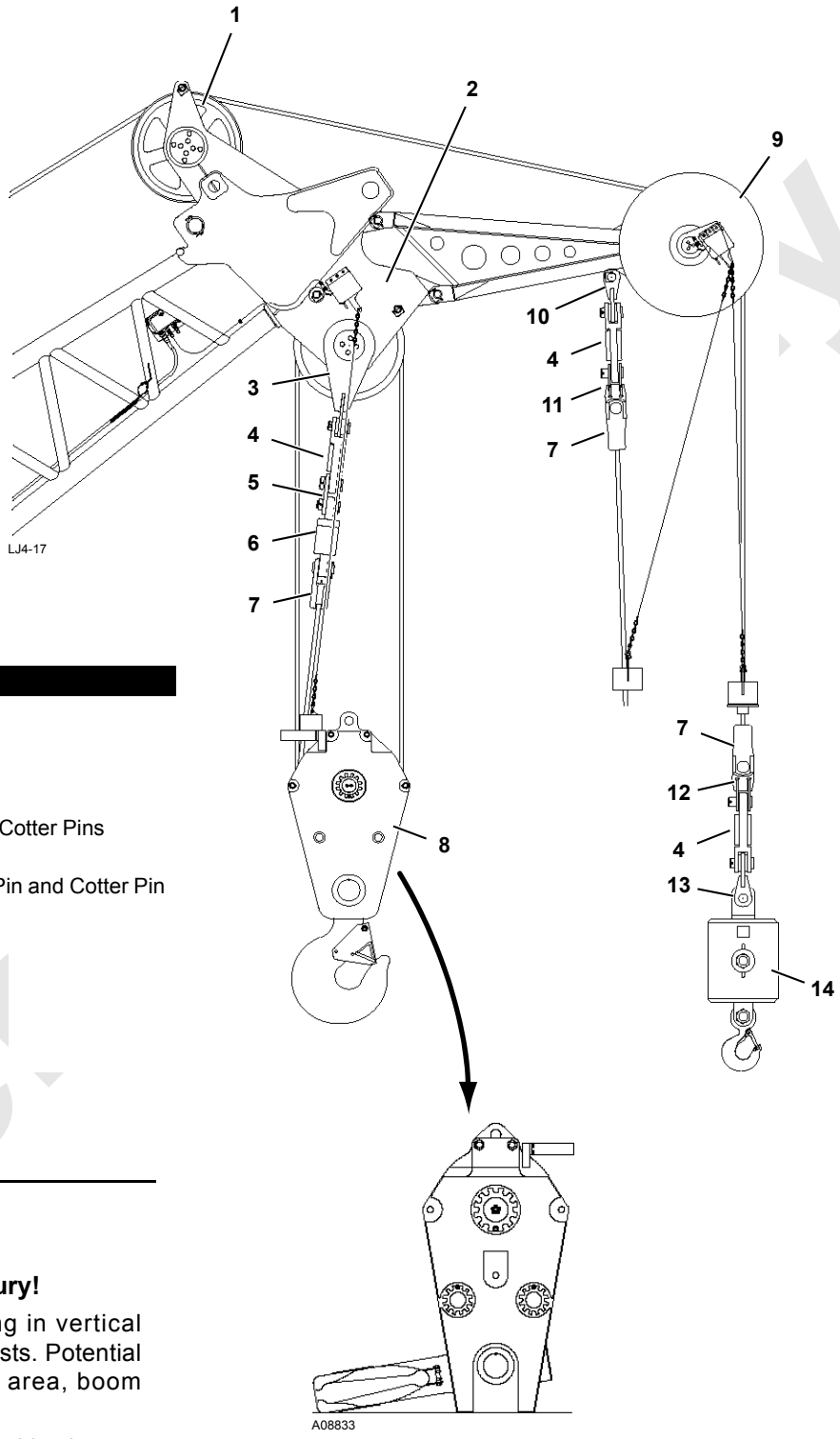
Wire Rope Damage!

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



Item	Description
1	Main Hoist (in boom butt)
2	Drum 2 – Whip Hoist (in crane)
3	Drum 3 – Luffing Hoist (in boom butt)
4	Wire Rope Guide (on boom butt)
5	Wire Rope Guide Sheaves (in first insert)
6	Wire Rope Guide Sheaves (on boom top)
7	Luffing Hoist Wire Rope to Main Strut
8	Wire Rope Guide Sheaves (in main strut)
9	Wire Rope Guide Sheaves (on jib top)
10	To Lower Jib Point
11	Upper Jib Point
12	Wire Rope Guide Sheaves (in mast butt)

FIGURE 4-32



Item	Description
1	Wire Rope Guide Sheaves
2	Lower Jib Point
3	Dead-End Link with Pin with Cotter Pin
4	Load Cell – 35,000 lb (13 063 kg)
5	Links with Collars, Retaining Pins, and Cotter Pins
6	Swivel
7	Button Socket – 1-1/8 in (28 mm) with Pin and Cotter Pin
8	Load Block
9	Upper Jib Point
10	Dead-End Link with Pin and Cotter Pin
11	Link with Pin and Cotter Pin
12	Link with Pin and Cotter Pin
13	Link with Pin and Cotter Pin
14	Hook and Weight Ball

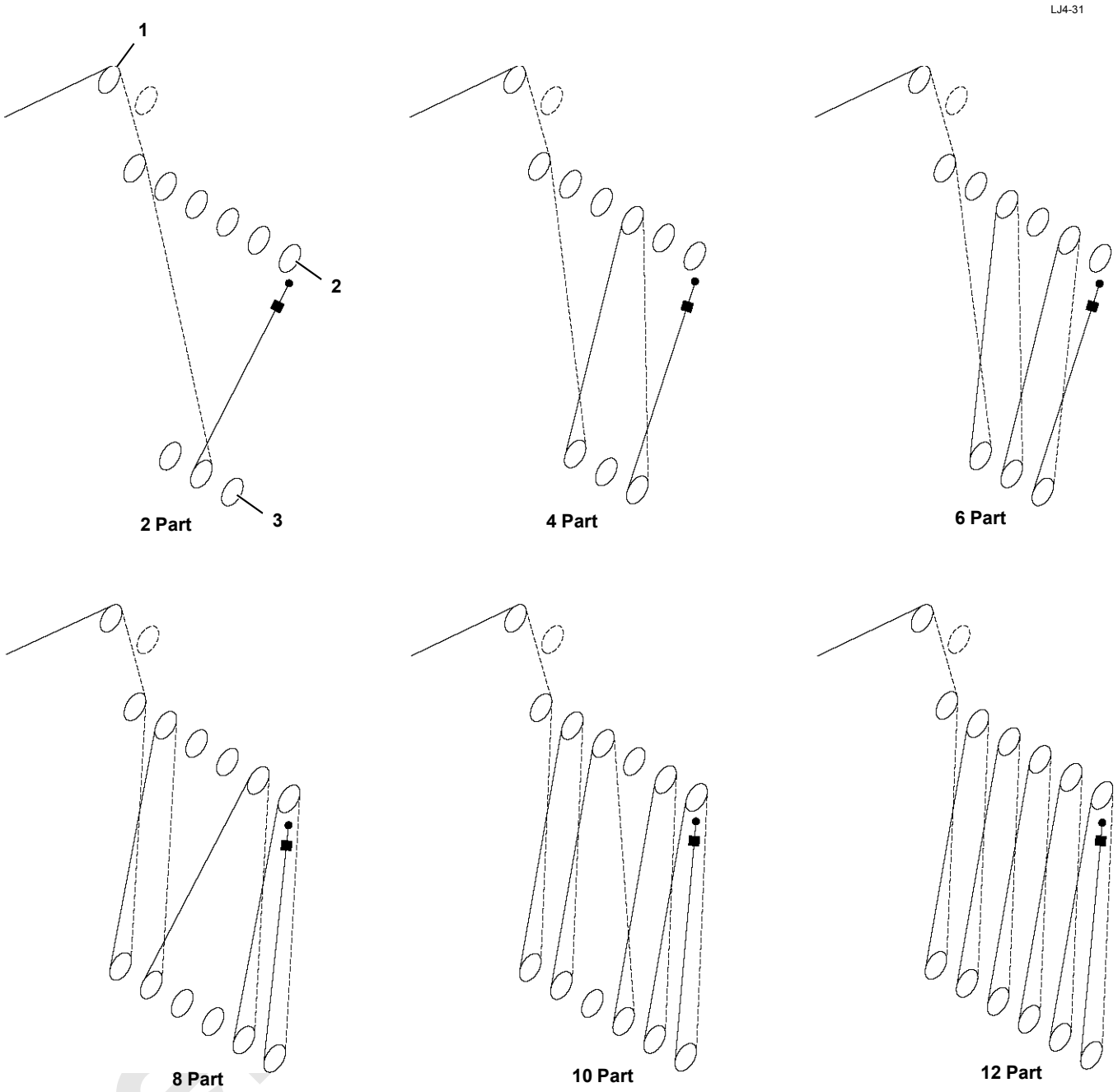
WARNING

Avoid Death or Serious Injury!

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

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

Figure 4-33



Item	Description
1	Wire Rope Guide Sheave
2	Lower Jib Point
3	Load Block
●	Dead-End Socket
■	Two-Block Weight

FIGURE 4-34

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SECTION 5
LUBRICATION

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SECTION 5
LUBRICATION

LUBRICATION

See F2109 at the end of this section.

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SECTION 6
MAINTENANCE CHECKLIST

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SECTION 6
MAINTENANCE

GENERAL MAINTENANCE

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

For maintenance and inspection of the following components, see 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 sensor is located inside the node controller mounted on the boom top and on the luffing jib top.

AUTOMATIC BOOM STOP ADJUSTMENT

Maximum Boom Angle

NOTE: Reference to limit switch LED is past production only. Current production limit switches do not have an LED installed.

Boom stop limit switch (5, 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 and listed in Table 6-1.

Operation

See Figure 6-2 for the following description.

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

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

WARNING

Falling Attachment Hazard!

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

Do not resume operation until problem has been corrected.

Maintenance

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

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

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

WARNING

Falling Attachment Hazard!

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

Table 6-1 — Automatic Boom Stop Angles

Angle A (see Figure 6-1)	
83° — #58 Boom without Luffing Jib 87° — #58 Boom with #59 Luffing Jib	For Cranes with a Boom Up Limit that ***Can be Bypassed***
84° — #58 Boom without Luffing Jib 88° — #58 Boom with #59 Luffing Jib	For Cranes with a Boom Up Limit that ***Cannot be Bypassed***
***** To determine if the boom up limit on you crane can be bypassed or not, perform Bypass Limit Test given below.	

Bypass Limit Test

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

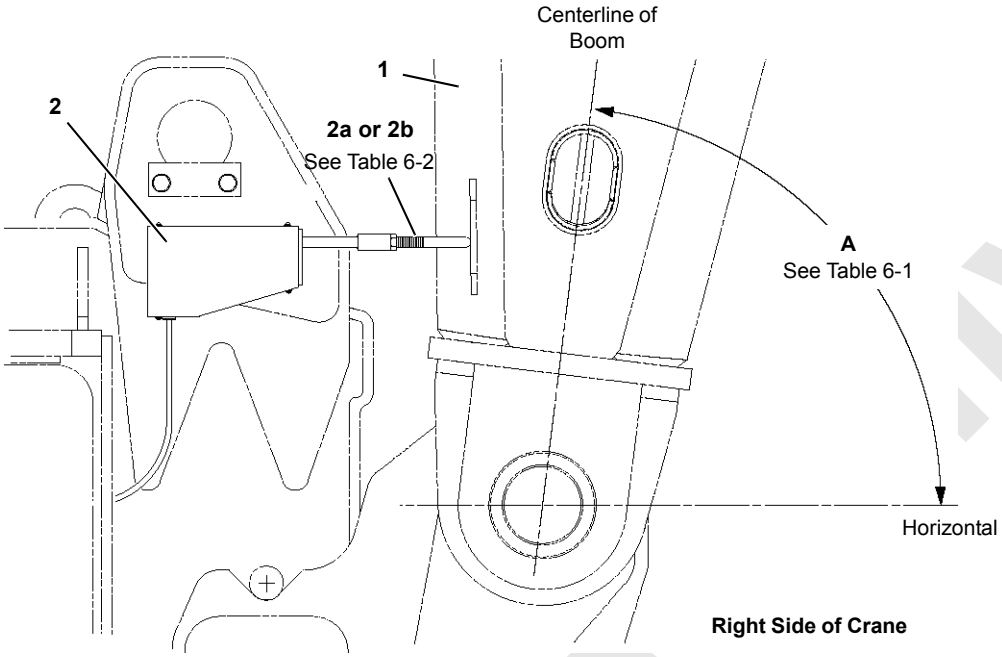
WARNING

Crush Hazard!

Maintain constant communication between operator and assistant during following steps.

Stay clear of moving parts.

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

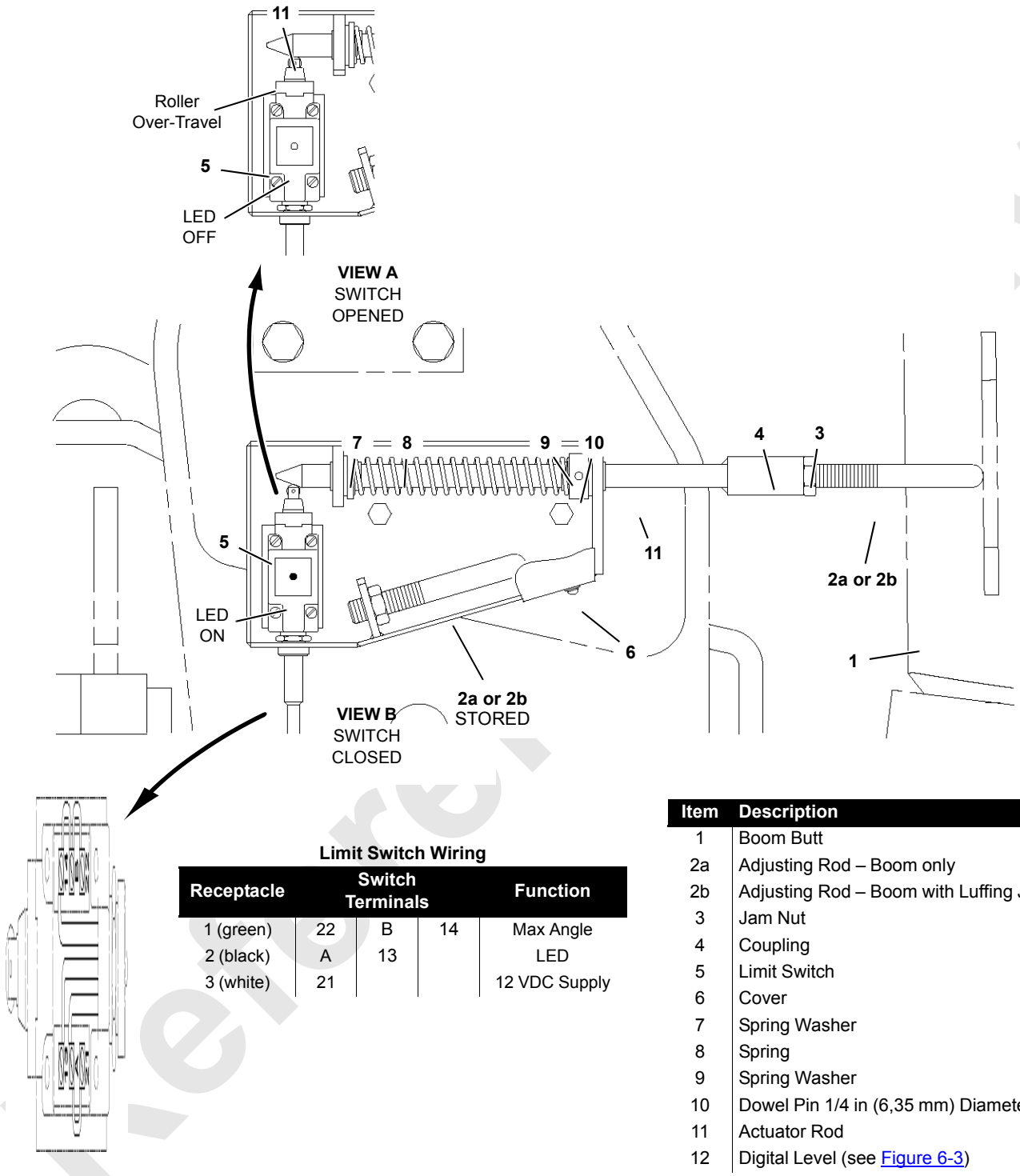


Item	Description
1	Boom Butt
2	Switch Assembly

FIGURE 6-1

Table 6-2 — Adjusting Rods

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



Limit Switch Wiring

Receptacle	Switch Terminals			Function
1 (green)	22	B	14	Max Angle
2 (black)	A	13		LED
3 (white)	21			12 VDC Supply

Item	Description
1	Boom Butt
2a	Adjusting Rod – Boom only
2b	Adjusting Rod – Boom with Luffing Jib
3	Jam Nut
4	Coupling
5	Limit Switch
6	Cover
7	Spring Washer
8	Spring
9	Spring Washer
10	Dowel Pin 1/4 in (6,35 mm) Diameter
11	Actuator Rod
12	Digital Level (see Figure 6-3)

FIGURE 6-2

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

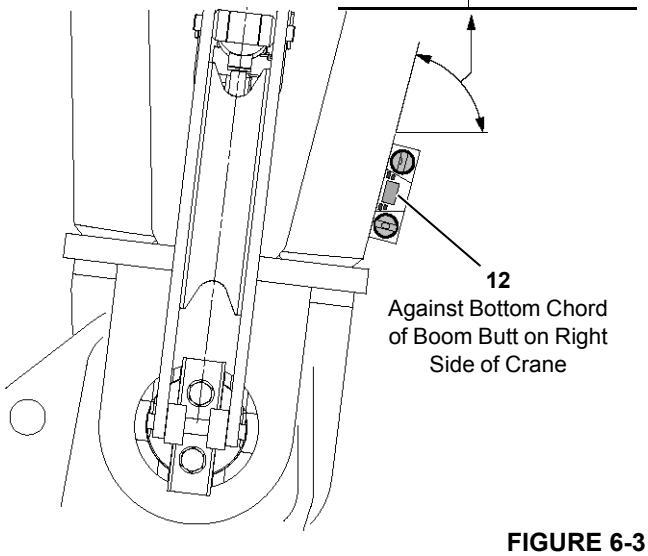


FIGURE 6-3

Adjustment

1. Park the crane on a firm level surface or level the crane by blocking under the crawlers.
2. Make sure the proper adjusting rod is installed (see Table 6-2):
3. Raise the boom to specified **Angle A** (Figure 6-1) while monitoring the angle on the mechanical indicator or on the operating conditions screen of the front-console display.
4. Verify that the boom is at proper Angle A:
   a. Place an accurate digital level (12) on the boom butt as shown in Figure 6-3. The corresponding **Digital Level Angle** should appear on the digital level.
   b. Raise or lower the boom as necessary.
5. If the boom stops at the specified angle, further adjustment is not needed.
   a. If the boom stops before reaching the specified angle, go to step 6.
   b. If the boom reaches the specified angle before it stops, go to step 7.

See Figure 6-2 for the remaining steps.

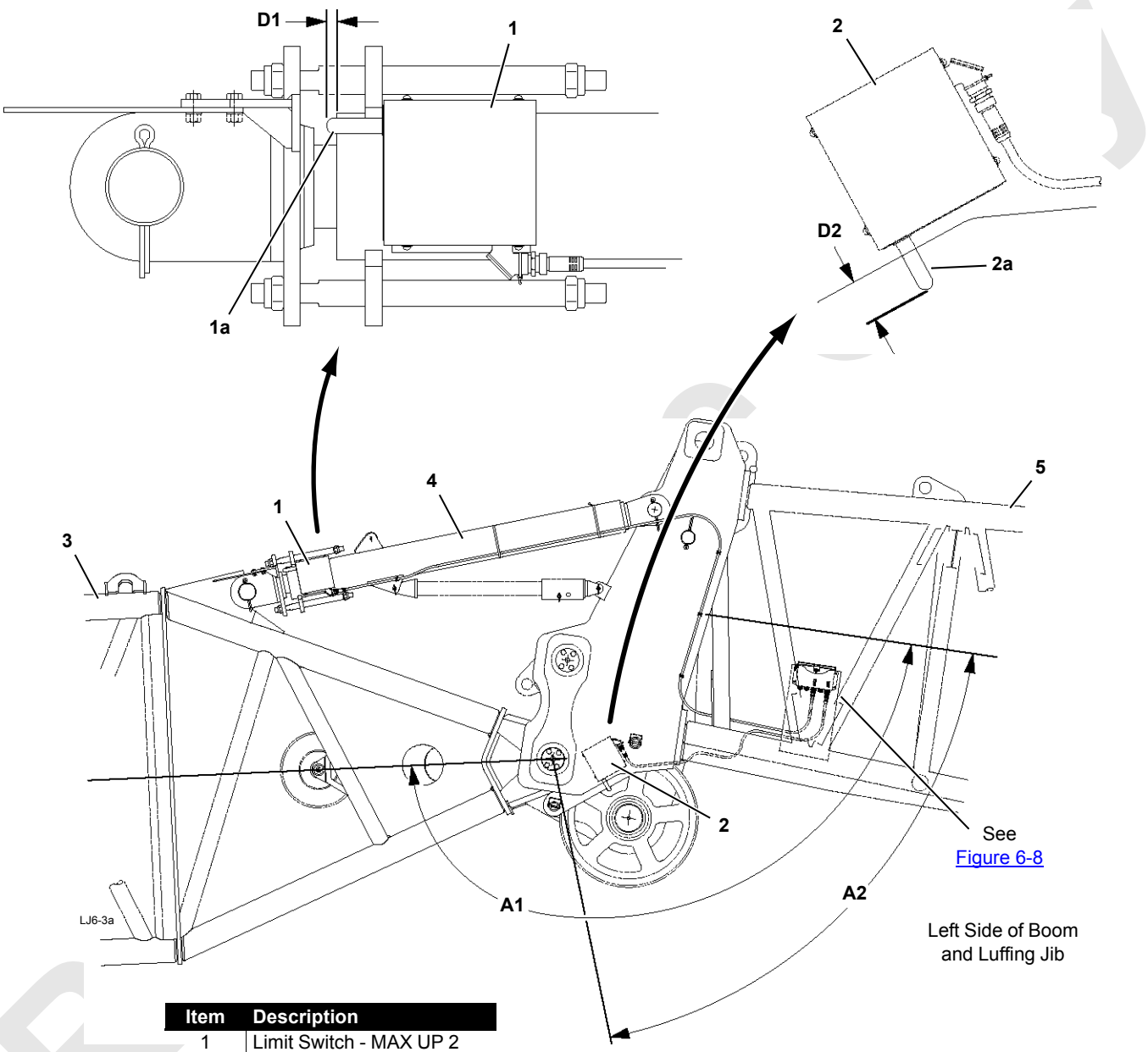
6. If the boom stops before reaching the specified angle:
   a. Loosen jam nut (3, View B).
   b. Turn adjusting rod (2a or 2b) all the way into coupling (4).
   c. Boom up slowly until the boom reaches the specified angle.
   d. Turn adjusting rod (2a or 2b) out against boom butt (1) until limit switch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

Actuator Rod Replacement

See Figure 6-2, View B for the following procedure.

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

Item	Description	Deactivated	Activated
D1	Edge of Actuator Rod to Edge of Jib Stop Tube	0.71 in (18,0 mm)	0.48 in (12,2 mm)
D2	Edge of Actuator Rod to Edge of Boom Top	2.22 in (56,3 mm)	1.99 in (50,5 mm)



Item	Description
1	Limit Switch - MAX UP 2
1a	Actuator Rod
2	Limit Switch - MAX DOWN
2a	Actuator Rod
3	Luffing Jib Butt
4	Jib Stop (Mechanical)
5	Boom Top

Item	Description
A1	Max Up 1 Angle = 169°
A2	Max Down Angle = 70°

FIGURE 6-4

JIB STOP ADJUSTMENT

WARNING

Falling Attachment Hazard!

Do not operate 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 three 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) – 169° 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 1.5° to MAXIMUM UP 2 limit.

- JIB MAXIMUM UP 2 (maximum angle) – 170.5° boom to luffing jib angle. This limit is controlled by limit switch (1, Figure 6-4).

- JIB MAXIMUM DOWN (minimum angle) – 70° 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.

  A minimum limit switch is provided as a backup to stop the jib if the programmed minimum limit fails.

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 ensure proper operation of the luffing jib stops:

- The jib stop cables must be connected to receptacles (7 and 8, Figure 6-9, View A).
- The luffing jib angles must be properly calibrated. See Rated Capacity Indicator/Limiter Operation Guide for instructions.
- The jib stop limit switches must be mounted properly.

Jib Maximum Up 1 and 2 Limit Checks

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. If necessary, adjust position of limit switch housing to obtain deactivated dimension.

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

2. Depress limit switch (1) actuator rod to activated Dimension D1 and hold. Listen for limit switch to "click" open (LED OFF).
3. Turn jib up limit bypass key clockwise and hold.
4. Pull 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 Checks

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. If necessary, adjust position of limit switch housing to obtain deactivated dimension.

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

2. Depress limit switch (2) actuator rod to activated Dimension D2 and hold. Listen for limit switch to "click" open (LED OFF – Past Production Only).
3. Turn jib up limit bypass key clockwise and hold.
4. Push 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 crane onto a firm level surface or level crane by blocking under crawlers.
2. Raise boom and luffing jib until boom is at 80°.
3. Monitor BOOM TO LUFFING JIB ANGLE on main display information screen while performing remaining steps.
4. SLOWLY raise luffing jib.
5. Luffing hoist must stop and be inoperable in up direction when boom to luffing jib angle is 169°.

6. Fault alarm should come on indicating JIB MAXIMUM UP 1 limit has been reached.
7. Turn normal limit bypass key clockwise to bypass MAXIMUM UP 1 limit.
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 170.5°.
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 luffing jib.
12. Luffing hoist must stop and be inoperable when boom to luffing jib angle is 70°.

    Turn normal limit bypass key clockwise to bypass minimum angle and lower jib. Luffing hoist must stop and be inoperable in down direction when boom to luffing jib angle is approximately 67°.

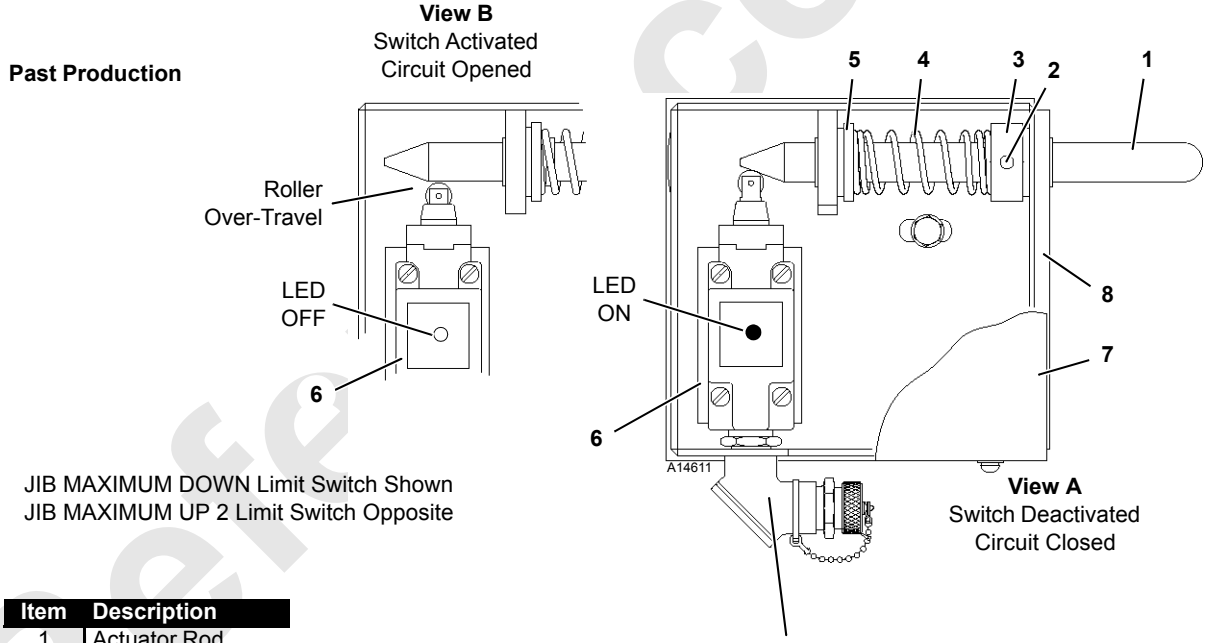
    If minimum stops do not operate properly, troubleshoot system.

Actuator Rod Replacement

See Figure 6-5 (Past Production) or Figure 6-6 (Current Production) for the following procedure.

NOTE: Reference to LED is past production only. Current production limit switches do not have an LED installed.

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 ensure there is over-travel as shown in View B.

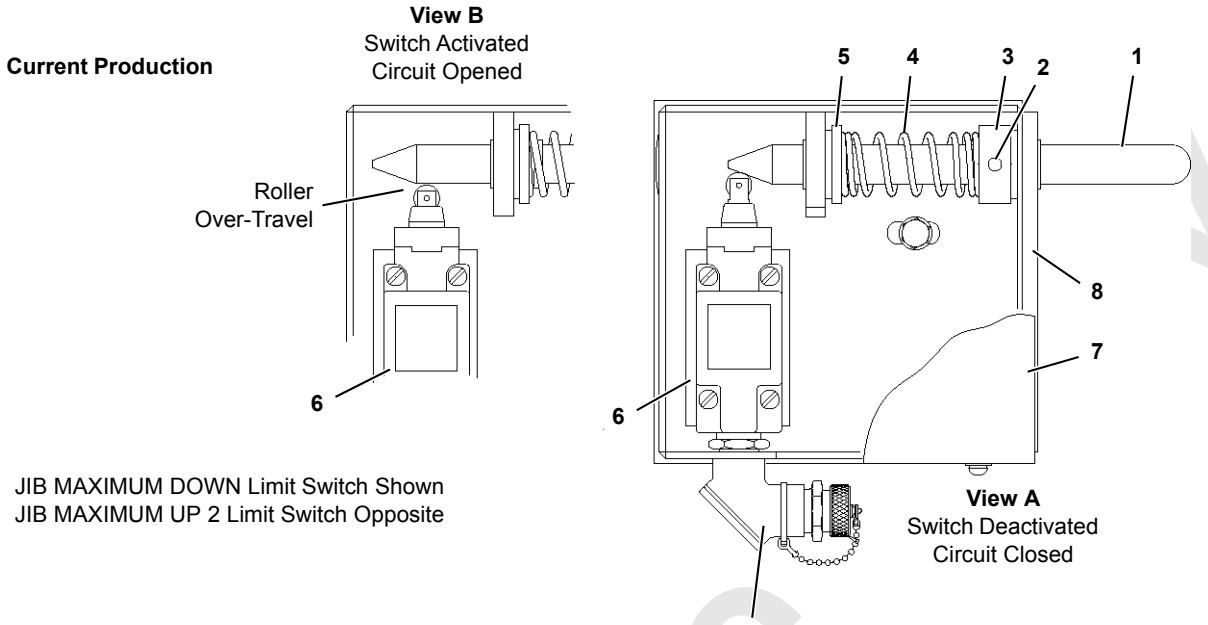


Item	Description
1	Actuator Rod
2	Dowel Pin
3	Spring Washer
4	Spring
5	Spring Washer
6	Limit Switch
7	Cover
8	Bracket Assembly

Limit Switch Wiring

Receptacle	Switch Terminals			Operation
1 (green)	22	B	14	Jib Max Up or Jib Max Down
2 (black)	A	13		LED
3 (white)	21			24 VDC Supply

FIGURE 6-5

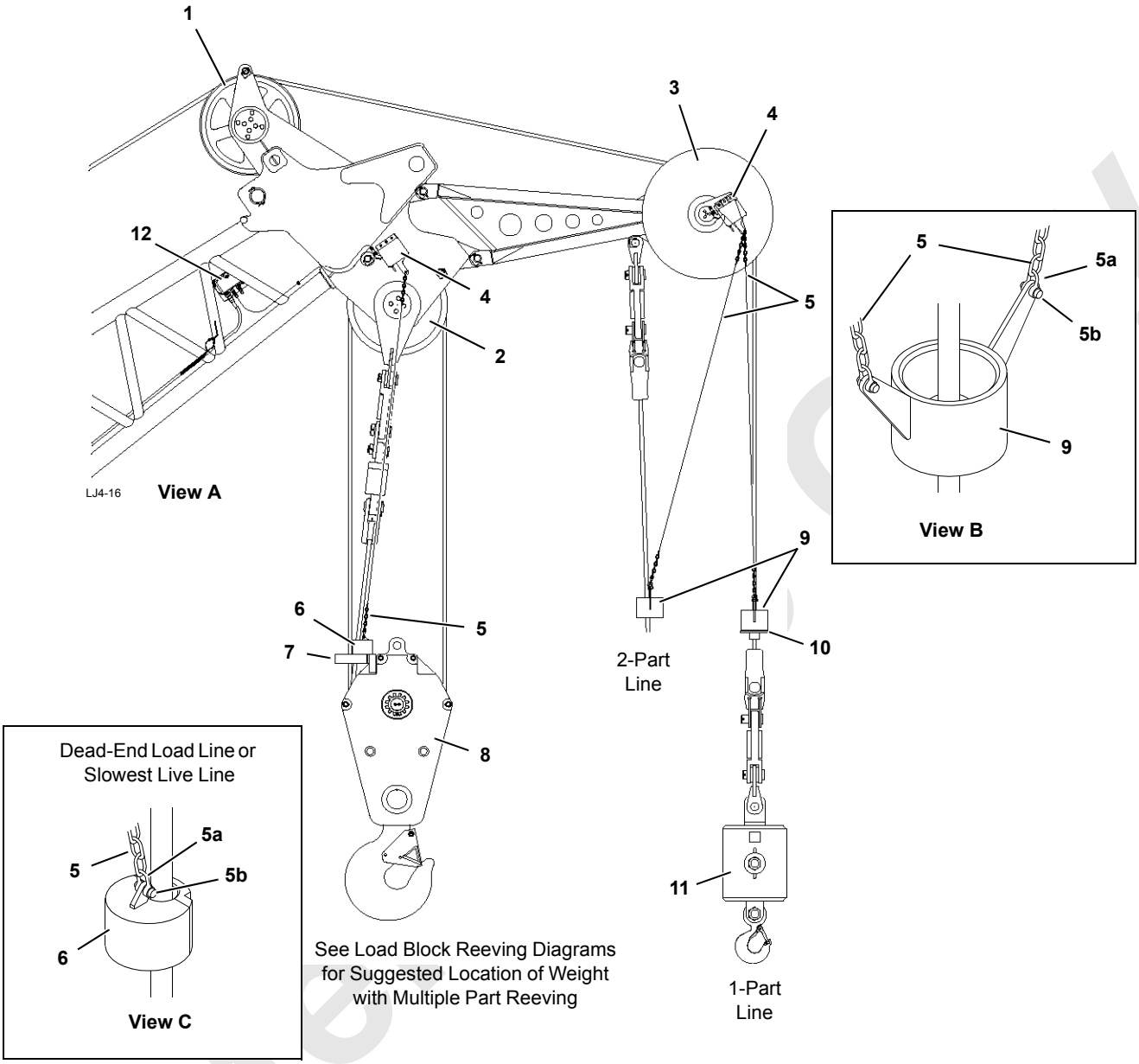


Limit Switch Wiring

Receptacle	Switch Terminals			Operation
1 (green)	22		14	Jib Max Up or Jib Max Down
2 (black)		13		GND
3 (white)	21			24 VDC Supply

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 6-6



Item	Description	Item	Description
1	Wire Rope Guide	6	Weight
2	Lower Boom Point	7	Lift Plate
3	Upper Jib Point	8	Load Block
4	Block-Up Limit Switch	9	Weight
5	Chain	10	Lift Block
5a	Shackle	11	Weight Ball
5b	Pin	12	Node Controller

FIGURE 6-7

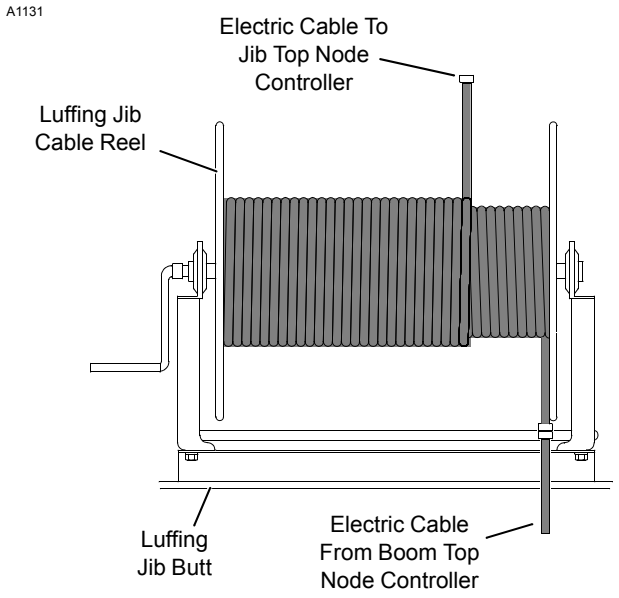


FIGURE 6-8

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 boom) 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 (Figure 6-7):

1. Jib top node controller.
2. Normally closed limit switch assembly fastened at either or both of the following locations:
   a. Lower jib point
   b. Upper 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 6-8) (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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Item	Description
1	Dust Cap (3 each)
2	Terminating Plug
3	Dust Cap
4	Terminating Plug
5	Boom Top Node Controller
6	Electric Cable Out to Jib
7	Luffing Jib Min Angle Limit
8	Luffing Jib Max Angle Limit
9	Jib Top Node Controller
10	From Luffing Jib Cable Reel
11	Block-Up Limit (Lower Point Jib)
12	Block-Up Limit (Upper Jib Point)
13	Wind Speed

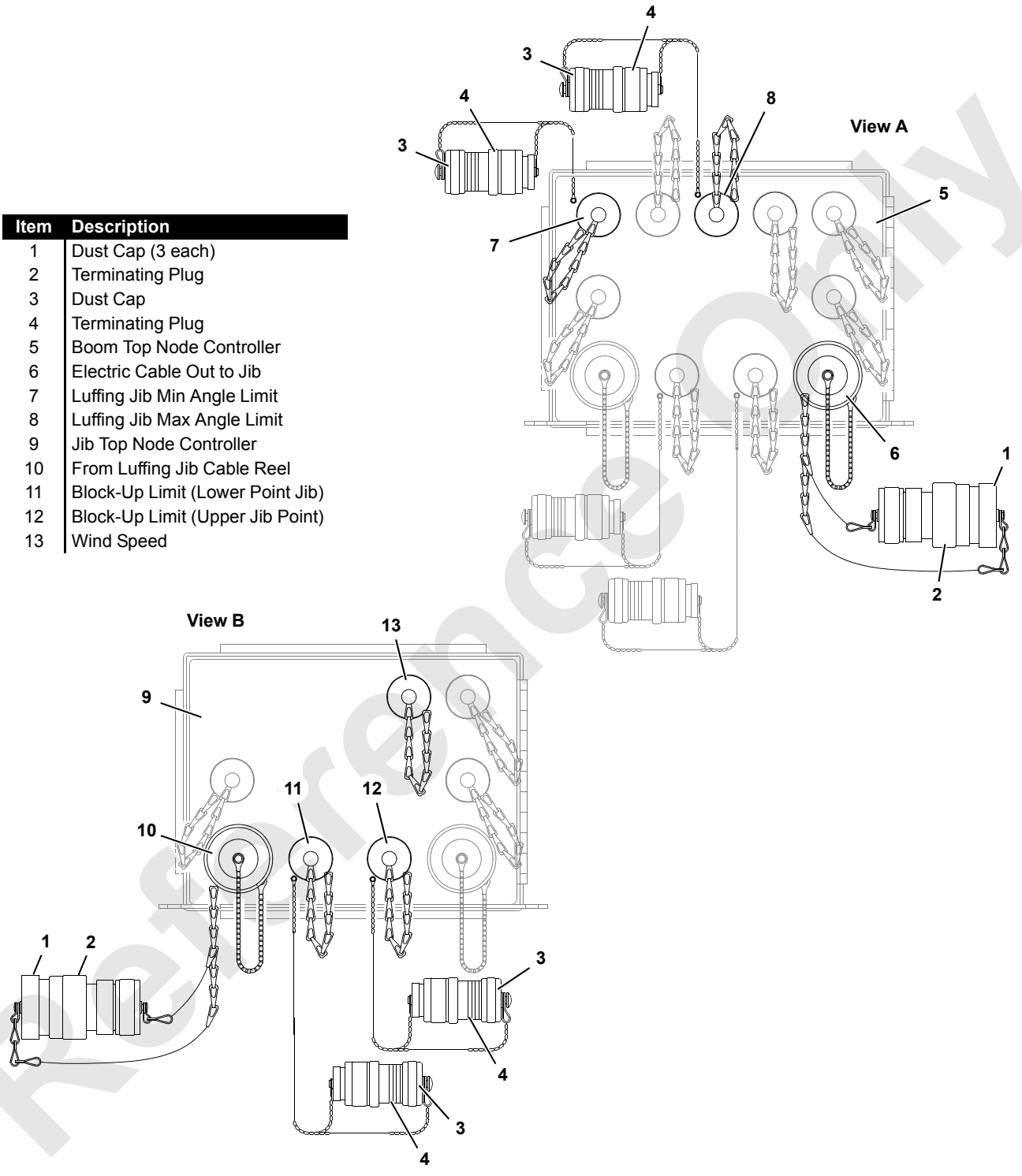

FIGURE 6-9

Disconnecting Block-Up Limits

See Figure 6-9 for the following procedures.

Failing to perform the following steps will prevent load drums from hoisting and 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 receptacles (11 and 12, View B).
2. If a limit switch cable is disconnected for any reason, corresponding terminating plug (4) must be connected to receptacle.
3. Always connect dust caps to ends of cables and terminating plugs not in use.

Removing Luffing Jib

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

1. Disconnect electric cable from cable reel at receptacle (6, View A) on boom top and at receptacle (10, View B) on jib top.
2. Connect dust caps to end of cables and coil them onto cable reel in jib butt.
3. Connect terminating plug (2, View A) to receptacle (6).
4. Connect terminating plug (2, View B) to receptacle (10).
5. Disconnect electric cables from jib stop receptacles (7 and 8, View A). Store cables.
6. Connect terminating plugs to jib stop receptacles (7 and 8, View A).
7. Connect dust caps to ends of cables and terminating plugs not in use.

Maintenance

CAUTION

Prevent Damage

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

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

1. Lower boom onto blocking at ground level and carefully inspect following items:
   - **a.** Inspect each limit switch lever and actuating lever (Figure 6-10) 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 (Figure 6-7) for freedom of movement on the load line.
   - **c.** Inspect each weight, each chain, each shackle and each connecting pin (Figure 6-7) 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 boom and jib and that cables are securely fastened to boom and jib with clips or nylon straps.
   - **f.** Check that all cables and terminating plugs (Figure 6-10) are securely fastened.
2. Test block-up limit controls for proper operation using either of following methods:
   - **a.** BOOM AND JIB LOWERED: Manually lift each weight — ***one at a time*** — while 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 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 6-10 for the following procedure.

NOTE: Past production shown, current production similar. Adjustment procedure applies to past and current production.

Lower 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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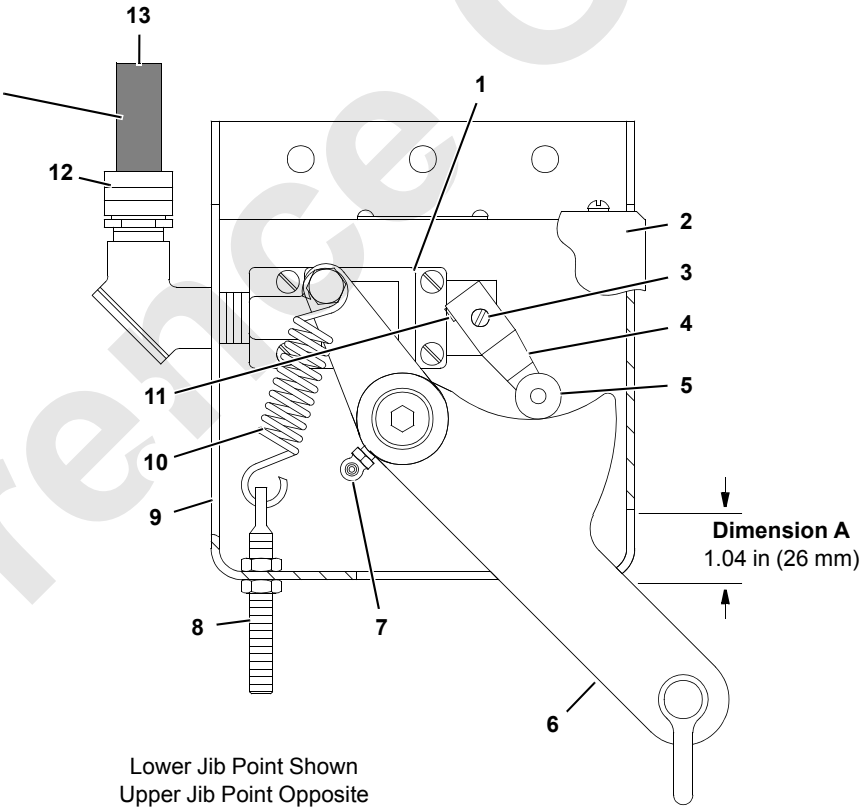
Limit Switch Wiring

Wire	Switch Terminals
Black	21
White	22

Item	Description
1	Limit Switch
2	Cover
3	Shaft
4	Limit Switch Lever
5	Roller
6	Actuating Lever
7	Grease Fitting
8	Adjusting Screw
9	Enclosure
10	Spring
11	Set Screw
12	Elbow with Cord Griper
13	From Jib Node Controller



Lower Jib Point Shown
Upper Jib Point Opposite

FIGURE 6-10

ALPHABETICAL INDEX

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