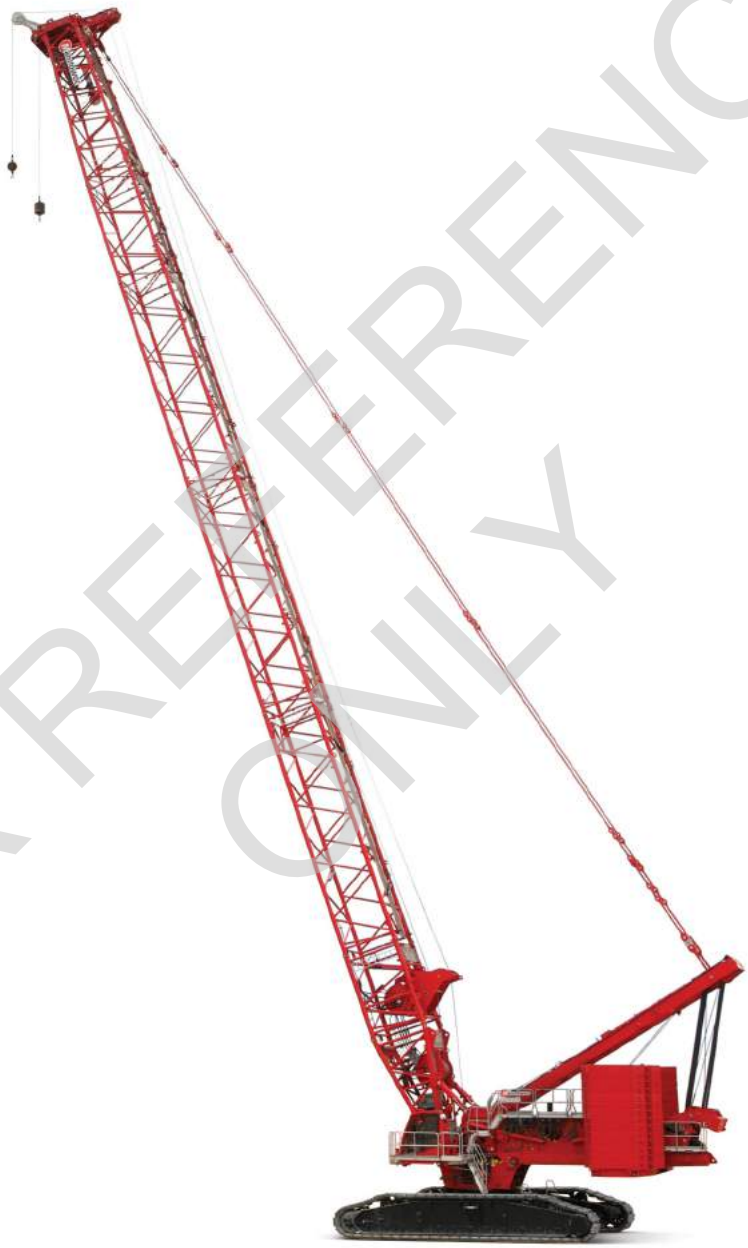
Manitowoc MLC650

Operator Manual
Luffing Jib Attachment



Grove Manitowoc National Crane Potain

Manitowoc®

WARNING

California Proposition 65

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

Always start and operate the engine in a well-ventilated area.

If in an enclosed area, vent the exhaust to the outside.

Do not modify or tamper with the exhaust system.

Do not idle the engine except as necessary.

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

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

California Spark Arrestor

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

81007557 REV D

OPERATOR MANUAL

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

MLC650

Luffing Jib Model Number

XXXXXRef

Luffing Jib Serial Number

This manual is divided into the following sections:

NOTICE

The serial number of the crane and applicable attachments (for example, a luffing jib or VPC-MAX™) is the only method a Manitowoc dealer or the Manitowoc Crane Care Lattice Team has of providing the correct parts and service information.

The serial number is located on a crane identification plate attached to the operator 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 a 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 the manuals supplied with crane and applicable attachments.
- Store crane manuals in the operator cab.
- If crane manuals are missing from the cab, contact a Manitowoc dealer for new ones.

Published 09-06-19, Control # 230-08

THE ORIGINAL LANGUAGE OF THIS PUBLICATION IS ENGLISH

See end of this manual for Alphabetical Index

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 1
INTRODUCTION

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

Published 09-06-19, Control # 230-08

1

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 and luffing jib weights.

OUTLINE DIMENSIONS

See the end of this section for outline dimensions.

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 Parts & Service > Service Support > Change of Ownership Form.
3. Complete the form.

MANITOWOC DEALER

For questions about this manual or the MLC650 crane, contact your Manitowoc dealer. If you do not know the contact information for your dealer, locate the Manitowoc dealer nearest you, as follows:

1. Go to ***www.manitowoccranes.com***
2. Go to Dealer Locater.
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 cab (see Figure 1-1) and to the attachments (i.e. luffing jibs) available for this crane.

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

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

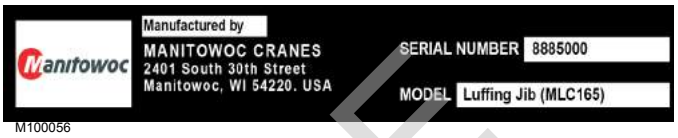


Figure 1-1

CRANE ORIENTATION

The terms RIGHT, LEFT, FRONT, and REAR used in this manual refer to the operator's right, left, front, and rear sides when seated in the operator cab (Figure 1-2).

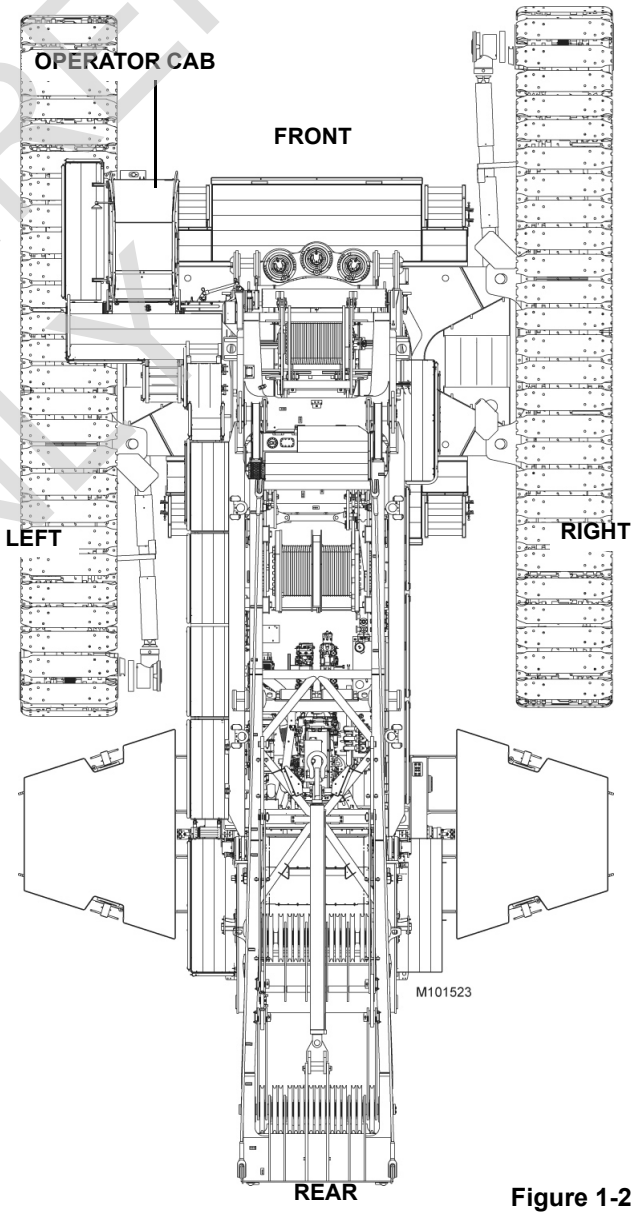
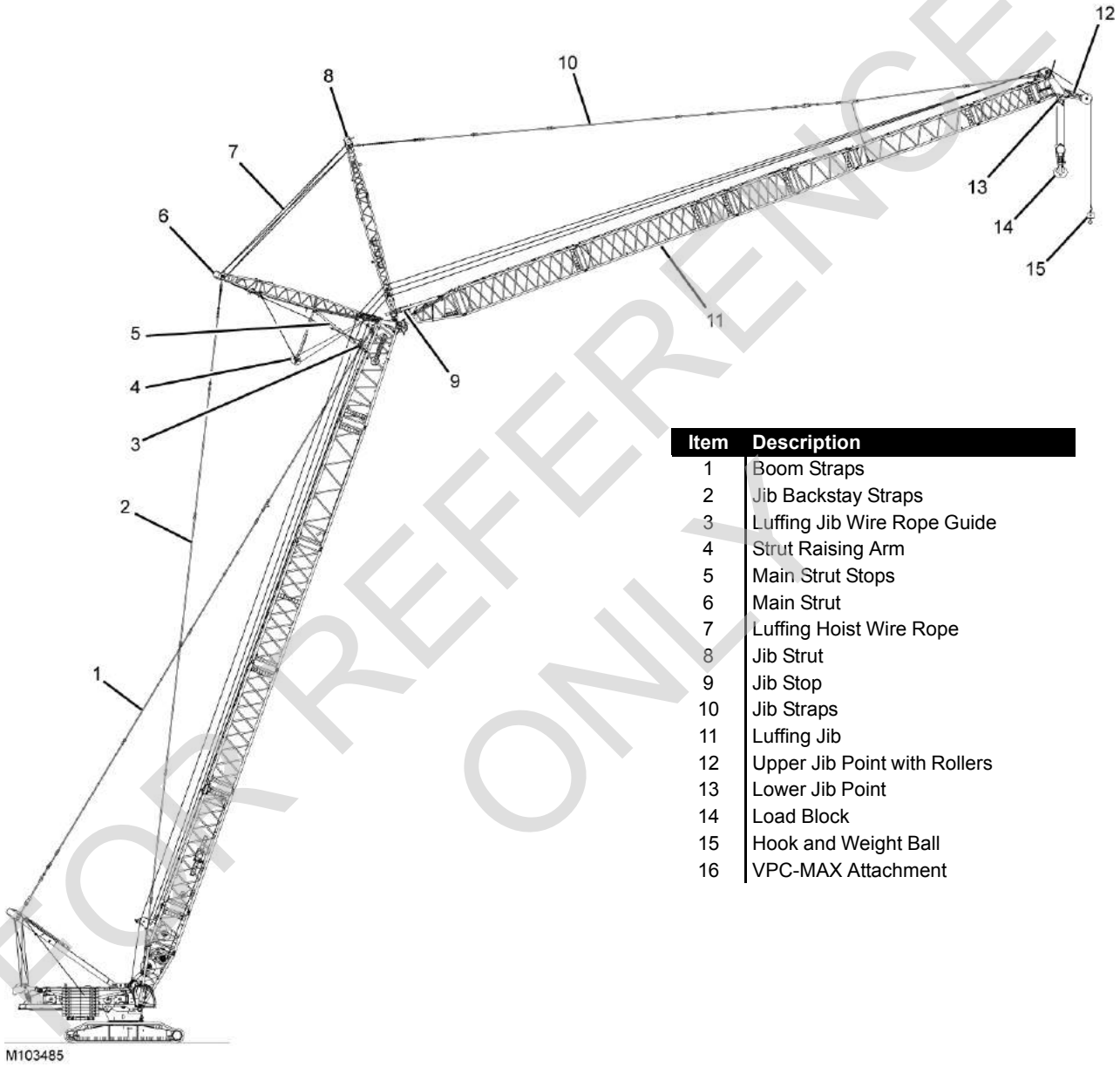


Figure 1-2

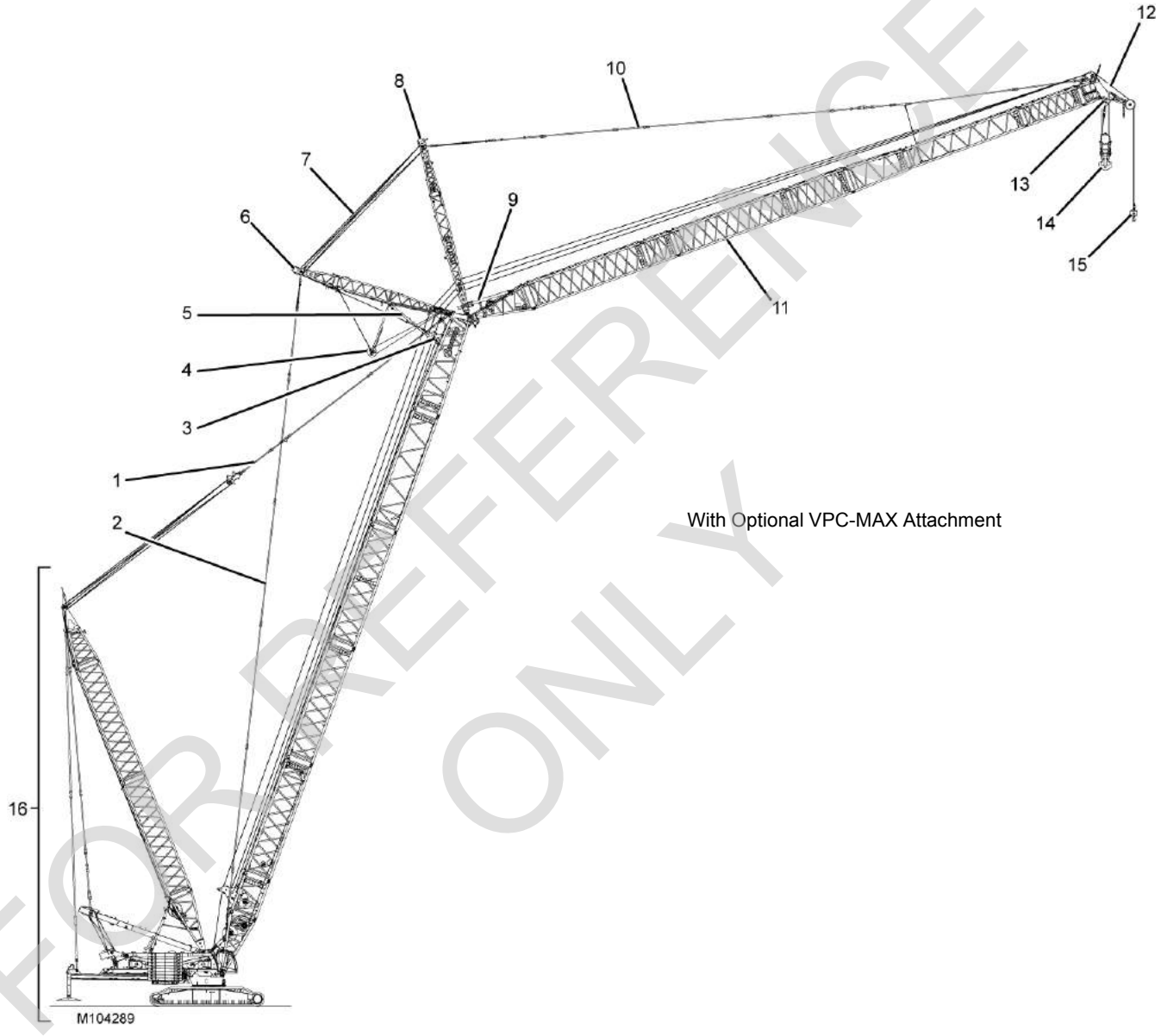
IDENTIFICATION AND LOCATION OF COMPONENTS

NOTE See MLC650 Crane Operator Manual for identification of crane and boom components.



Item	Description
1	Boom Straps
2	Jib Backstay Straps
3	Luffing Jib Wire Rope Guide
4	Strut Raising Arm
5	Main Strut Stops
6	Main Strut
7	Luffing Hoist Wire Rope
8	Jib Strut
9	Jib Stop
10	Jib Straps
11	Luffing Jib
12	Upper Jib Point with Rollers
13	Lower Jib Point
14	Load Block
15	Hook and Weight Ball
16	VPC-MAX Attachment

Figure 1-3



With Optional VPC-MAX Attachment

FIGURE 1-3 continued

VPC AND VPC-MAX

VPC™ and VPC-MAX™ are registered trademarks.

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, and so on	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

THIS PAGE INTENTIONALLY LEFT BLANK

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.

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

California Spark Arrestor

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

CONTINUOUS INNOVATION

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

Symbol Identification

Many of the symbols used in the safety and information signs and nameplates on this crane are identified in Table 2-1 on page 2-2 and Table 2-2 on page 2-3.

Table 2-1 Common Safety Symbols

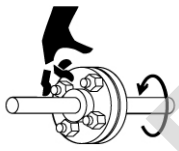
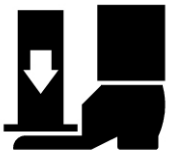
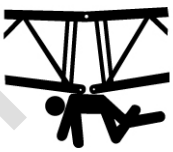
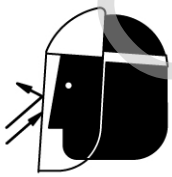
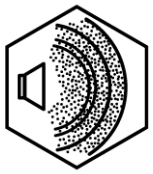
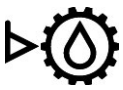
Cut or Crush Hazards					Cut Hazard
 M100090	 M100091	 M100066	 M100065	 M100069	 M100067
Crush Hazards					Fire Extinguisher
 M100070	 M100071	 M100072	 M100073	 M100074	 M100082
Fall Hazards			Falling Boom (Crush) Hazards		Explosion Hazard
 M100083	 M100084	 M100085	 M100068	 M100075	 M100080
Falling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

Table 2-1 Common Safety Symbols

Emergency Cab Exit				
 M102486				

Table 2-2 Miscellaneous Symbols

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

SAFETY AND INFORMATION SIGNS

Maintaining Signs

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

Ordering Signs

Order replacement safety and information signs from your Manitowoc dealer.

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

Item	Description
1	Operator's Cab Platform with Handrails
2	Carbody Platform (both ends and sides)
3	Ladder (both crawlers)
4	Left Front Ladders (2)
5	Rotating Bed Platform with Handrails (both side)
6	Engine Enclosure (non-skid)
7	Rear Folding Ladder (both sides)
8	Counterweight Tray and Boxes (non-skid)
9	Cab Ladder
10	Catwalk (each boom section)
11	Ladder (each boom section)

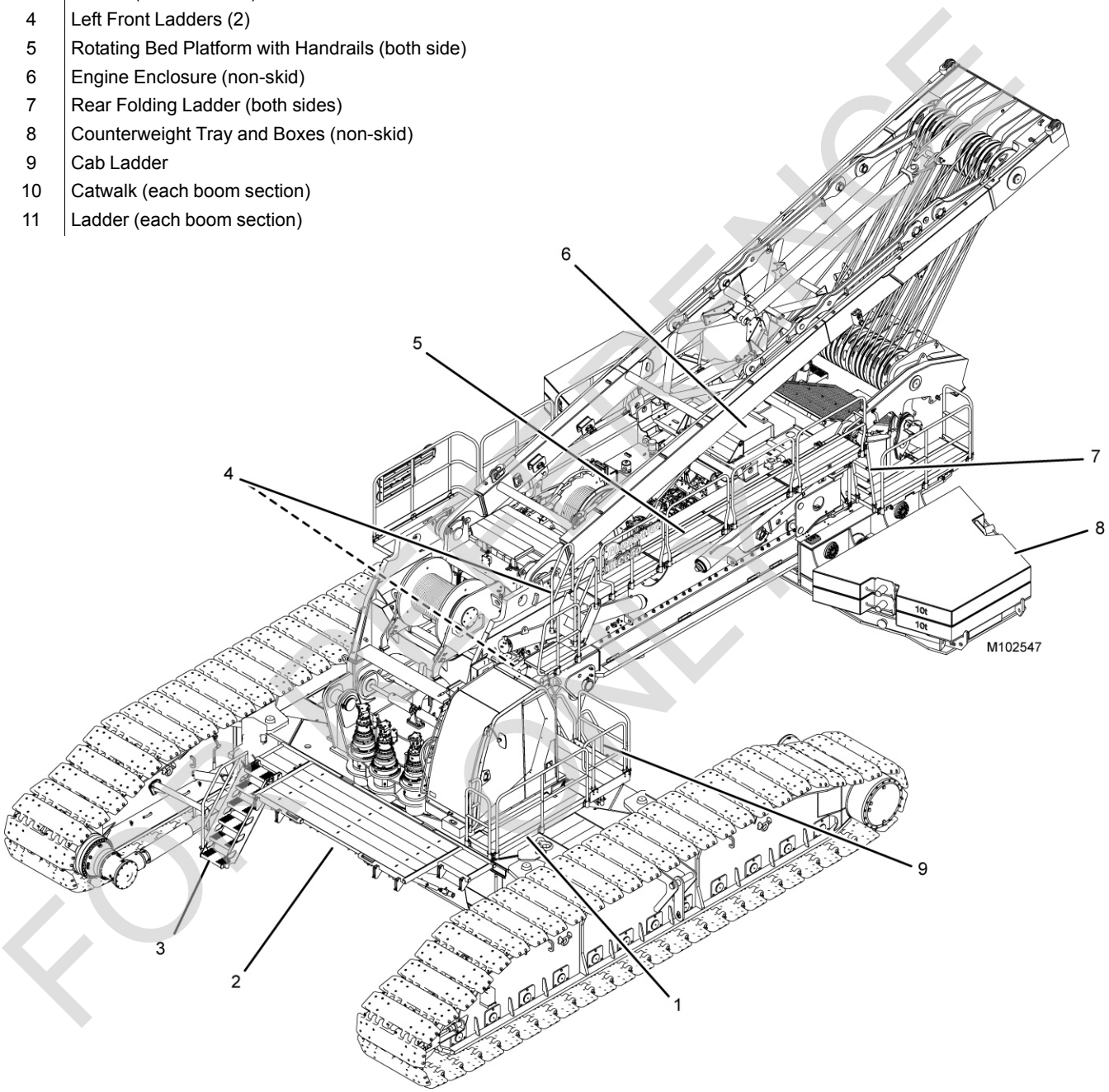


Figure 2-1. Crane Access Points

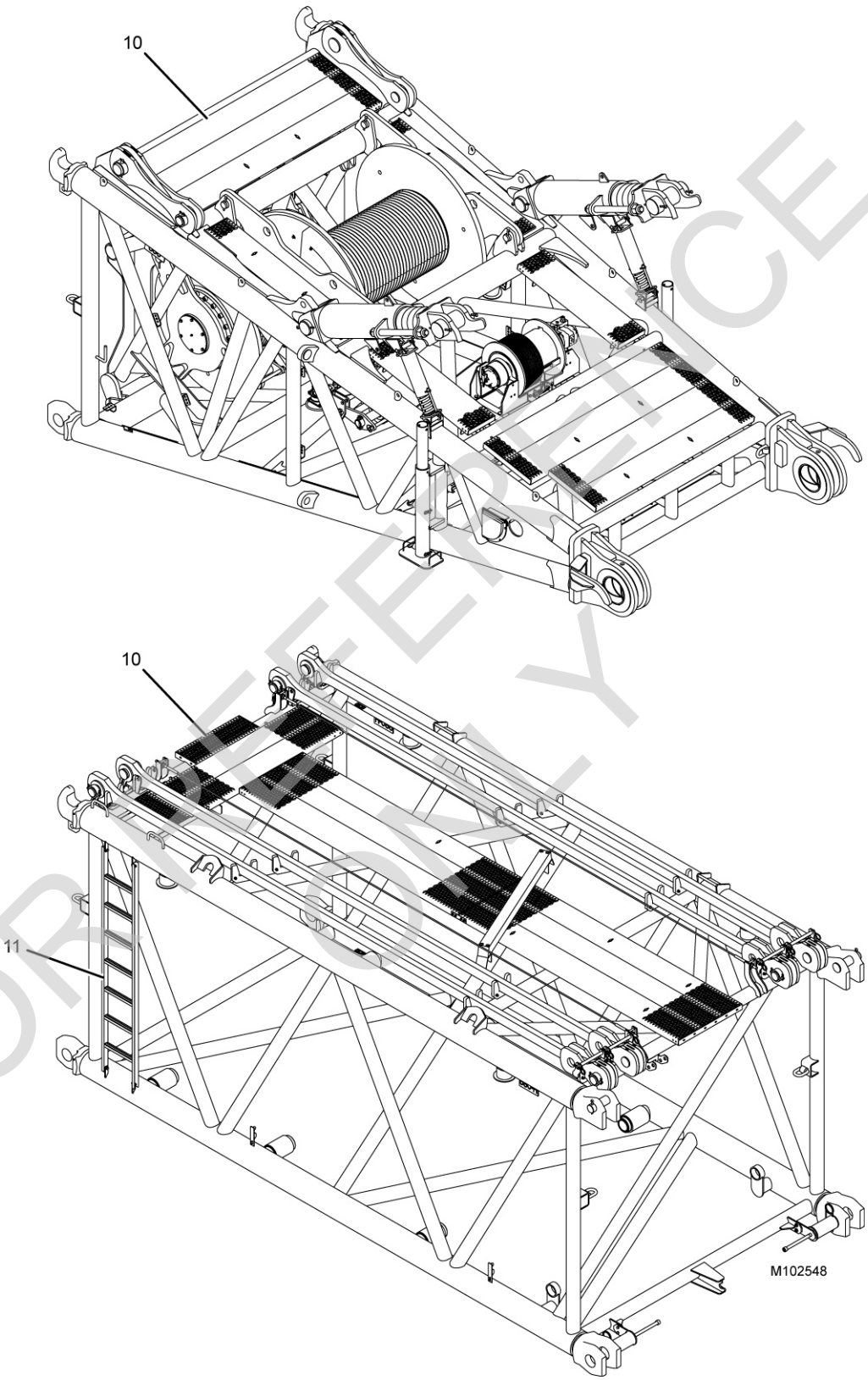


Figure 2-1 continued

CRANE ACCESS POINTS

WARNING

Crush Hazard!

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

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

To prevent death or serious injury:

- Barricade all accessible areas to the crane so personnel cannot be struck or crushed when the upperworks is swung.
- Do not climb onto or off the crane while the upperworks is being swung or the crane is being traveled.
- Signal the operator for permission to climb onto/off the crane.
- Operator: do not swing or travel while personnel are climbing onto or off the crane. Stop the swing and travel motions. Apply the swing brake and turn on travel park.
- Operator: Always sound the horn to alert personnel before you swing or travel.
- Automatic alarms will sound to alert personnel when the crane is swung or traveled and when the VPC™ (variable position counterweight) is moving.

NOTE If the swing, travel, and VPC 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 ladders and platforms at the locations shown in Figure 2-1 on page 2-4.

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

  This practice will prevent ground personnel from being crushed or electrocuted when they attempt to access personal belongings stored on the crane.
- Tools, oil cans, spare parts, and other necessary equipment must be stored in tool boxes or other appropriate locations. Do not allow these items to lie around loose in operator's 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.

GETTING ON OR OFF CRANE

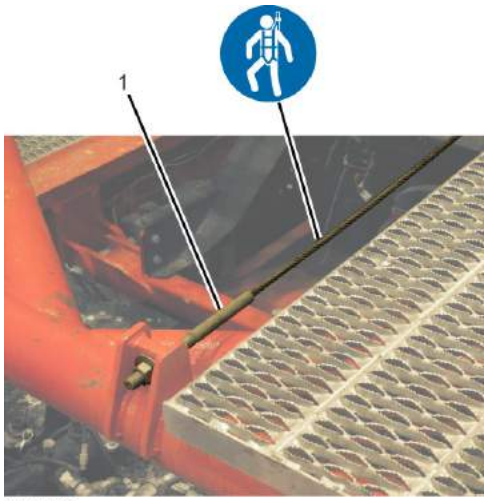
Personnel getting on and off the crane shall do so only at the ladders provided and only ***while the crane is parked***.

Never climb onto or off a moving crane. ***Climb onto and off the crane only when it is parked and only with the 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.

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

Item	Description
1	Lifeline
2	Anchor



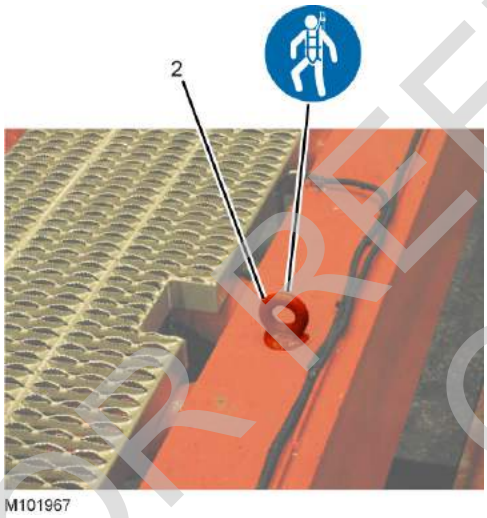


Figure 2-2. Fall Protection Lifeline and Anchor

PERSONAL FALL-PROTECTION

Manitowoc has provided lifelines and anchors throughout the crane and attachment (see Figure 2-2.) to which workers can attach their personal fall-protection equipment.

WARNING

Fall Hazard!

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

- Anchors and lifelines are designed to handle only one person at a time.
- Do not use anchors for lifting or pulling loads.

2

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.

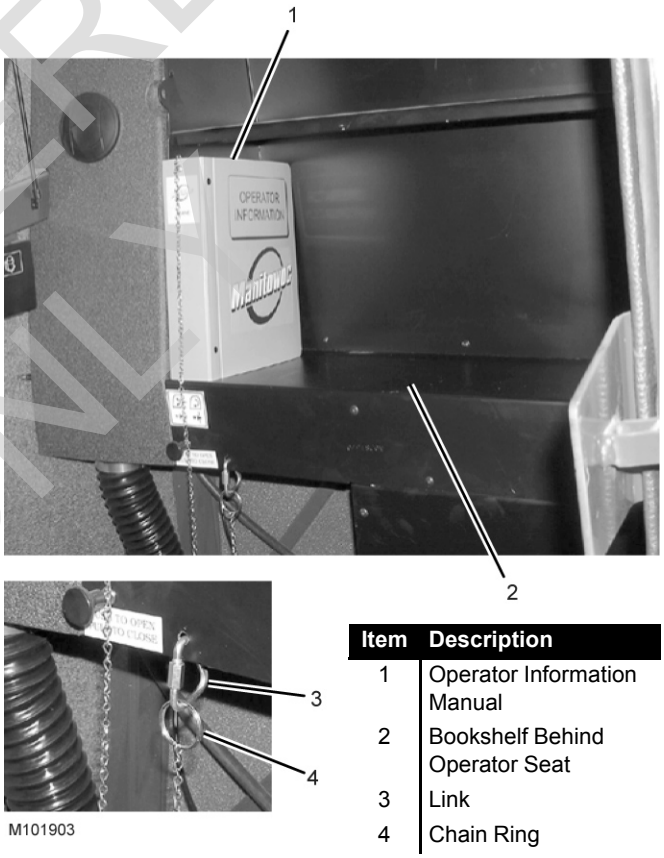
Do not operate crane or attachment if proper Capacity Chart is not in cab.

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.



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

Figure 2-3. Bookshelf in Cab

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

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

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

Operator Qualifications

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

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

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

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

Operator training and qualification is crane owner's responsibility.

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

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

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

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

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

Operator Conduct

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

4. The operator shall be thoroughly familiar with operation of the crane and its proper care. If adjustments or repairs are necessary or if there are known defects that impair safe operation, the crane must not be operated until unsafe conditions have been corrected.
5. If there is a warning sign at the start controls, the operator shall not start the engine until the warning sign has been removed by the person who installed it.
6. Before starting the engine, the operator shall make sure that:
   a. All daily inspection and maintenance services have been performed.
   b. All controls are in 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 the crane in no way substitutes for or lessens requirement that operator knowledge, experience, and judgment are required to ensure safe operation of the crane.

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

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

7. The operator shall test all controls, limits, and communication systems at the start of each shift. Any defects found 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 the crane and position upperworks so the crane does not interfere with operation of other equipment
    b. Apply travel and swing brakes or locking devices
    c. Land any attached load
    d. Lower the boom onto blocking at ground level or onto a boom rest if possible

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

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

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

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

13. The operator shall perform the following operations if power or a control function fails during operation:

a. Land all suspended loads, if possible, under brake or power control

b. Apply all brakes and locking devices

c. Move all controls to off

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

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

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

Never operate the crane during an electrical thunderstorm.

When a local weather storm warning exists (including electrical thunderstorm), stop operation and secure the crane. See step 12 on page 2-10.

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

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

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

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

b. If the wind exceeds 16 m/s (35 mph), land all loads and apply the drum brakes, lower the boom onto blocking at ground level or otherwise restrain it, and apply the swing and travel brakes and/or locks.

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

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

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

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

Handling Load

Size of Load

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

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

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

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

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

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

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

Attaching Load

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

a. Inspect each hook and latch before using

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

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

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

2. Only use slings and other rigging that are in safe operating condition and have a rating equal to or greater than the load to be lifted.
3. Do not wrap the load line around the load.
4. Use suitable protection between slings and any sharp edges on the load. When synthetic slings are used, the synthetic sling manufacturer's instructions, limitations, specifications, and recommendations must be followed.
5. Secure unused legs of a multi-leg sling before handling a load with one leg of sling.

Lifting/Moving Load

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

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

     The operator shall test the load drum brakes each time a load approaching the rated load is handled. Lift the load 76 to 152 mm (3 to 6 in) and fully apply the brakes — ***load must not lower through applied brakes.***
   - **j.** Unused load drums are parked (working and parking brakes applied; if equipped, drum pawls engaged).
   - **k.** All personnel are clear of the swing radius of the crane's counterweight.
2. While lifting or moving the load, the operator shall take the following precautions:
   - **a.** Accelerate and decelerate the load smoothly to avoid excessive stress on the boom and machinery
   - **b.** Avoid sudden starts and stops while swinging. Keep the swing speed under control to prevent the load from swinging out beyond the radius at which the load can be handled and to minimize the pendulum action of the load.
   - **c.** 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, boom, or any other part of the crane to contact obstructions
   - **g.** Do not use the crane to drag a load
   - **h.** Do not hoist, lower, or swing the load while personnel are on the load or the hook. See Personnel Handling in this section.
   - **i.** Avoid carrying the load over personnel. Loads which are suspended must be blocked or cribbed before personnel are allowed to work under or between them.
   - **j.** Before lifting a load which requires the use of outriggers (or anytime outriggers are used), fully extend the outrigger beams and jacks so the truck tires do not bear any load.

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

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

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

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

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

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

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

One designated person shall be responsible for operation when two or more cranes are used to lift the 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 must 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 remain on the respective drum (or as otherwise indicated in local, state, or federal regulations)

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

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

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

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

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

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

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

d. Secure the rotating bed against rotation except when it is necessary to negotiate a turn, and then only when the operator is seated at controls or the boom is supported on a dolly

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

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

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

b. Maintain specified tire pressures (truck cranes)

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

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 crane operator shall read and become thoroughly familiar with the appropriate Capacity Charts and Wire Rope Specification Charts.

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

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

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

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

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

To aid the operator in staying within the crane's Capacity Chart with the total applied load, Manitowoc recommends that its cranes be equipped with Rated

Capacity Indicators/Limiters to monitor the load on each load line.

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

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

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

SIGNALS

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

SAFETY DEVICES

WARNING

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

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

Manitowoc provides the following safety devices on its cranes.

1. Horn activated by a switch on the control console in the operator'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 the crane unless all applicable operational aids listed in this section are in proper working order, except:

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

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

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

Category 1 Operational Aids

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

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

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

   Temporary alternative measures if inoperative or malfunctioning:

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

   a. Measure radius using a tape measure

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

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

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

   d. Clearly mark the boom or luffing hoist cable (so it can easily be seen by a designated signal person)

at a point that gives the signal person sufficient time to signal the operator and have the operator stop the boom or jib within the minimum allowable radius

2. **Anti-Two-Block Device**

   Temporary alternative measures if inoperative or malfunctioning:

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

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

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

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

Category 2 Operational Aids

If a Category 2 operational aid is not working properly, it must be repaired no later than 30 calendar days after the deficiency occurs.

Exception: If the employer documents that he/she has ordered the necessary parts within 7 calendar days of the occurrence of the deficiency, and the part is not received in time to complete the repair in 30 calendar days, the repair must be completed within 7 calendar days of receiving the parts.

1. **Rated Capacity Indicator/Limiter**

   Temporary alternative measures if inoperative or malfunctioning:

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

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

2. **Boom Angle** or **Radius Indicator**

   Temporary alternative measures if inoperative or malfunctioning:

   a. Refer to the pendulum boom angle indicator on the boom butt (visible from operator'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 6 m (20 ft) to power sources up to 350 kV and greater distances for higher voltages unless the line's voltage is known [29CFR1910.180 and 29CFR1926.1400].

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

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

WARNING

Electrocution Hazard!

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

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

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

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

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

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

Set-Up and Operation

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

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

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

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 (for example, dust, dirt, moisture, etc.). The insulating characteristics of these devices can be compromised if not kept clean, free of contamination, and undamaged.
6. Proximity sensing and warning devices are available in different types. Some use boom point (localized) sensors and others use full boom length sensors. No warning may be given for components, cables, loads, and other attachments located outside of the sensing area. Reliance is placed upon the operator in selecting and properly setting the sensitivity of these devices.
7. Never rely solely on a device to protect you and your fellow workers from danger.

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

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

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

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

   If the dealer is not immediately available, contact 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 the Manitowoc Crane Care Lattice Team or your Manitowoc dealer.

REFUELING

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

FIRE EXTINGUISHERS

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

ACCIDENTS

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

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

Phone: 920-684-6621

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

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 the Manitowoc Crane Care Lattice Team.

SAFE MAINTENANCE

WARNING

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

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

Maintenance Instructions

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

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

Qualified person is defined as one who by reason of training and experience is thoroughly familiar with the crane's operation and required maintenance as well as the hazards involved in performing these tasks.

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

Safe Maintenance Practices

1. Perform the following steps (as applicable) before starting a maintenance procedure:
   a. Park the crane where it will not interfere with other equipment or operations
   b. Lower all loads to the ground or otherwise secure them against movement
   c. Lower the boom onto blocking at ground level, if possible, or otherwise secure the boom against dropping
   d. Move all controls to off and secure all functions against movement by applying or engaging all brakes, pawls, or other locking devices
   e. Stop the engine and render the starting means inoperative

f. Place a warning sign at the start controls alerting other personnel that the crane is being serviced and the engine must not be started. ***Do not remove sign until it is safe to return the crane to service.***

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

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

3. Wear clothing that is relatively tight and belted.

4. Wear appropriate eye protection and approved hard hat.

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

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

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

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

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

8. Pinch points are impossible to eliminate. Watch for them closely.

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

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

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

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

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

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

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

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

15. Stop the engine before refueling the crane.

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

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

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

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

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

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

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

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

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

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

- Disconnect all cables from batteries
- Disconnect output cables at engine junction box
- Attach the ground cable from the welder directly to the part being welded and as close to the weld as possible
- Do not weld on the engine or engine mounted parts (per engine manufacturer)

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

27. When assembling and disassembling booms, jibs, or masts on the ground (with or without support of boom

rigging pendants or straps), securely block each section to provide adequate support and alignment.

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

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

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

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

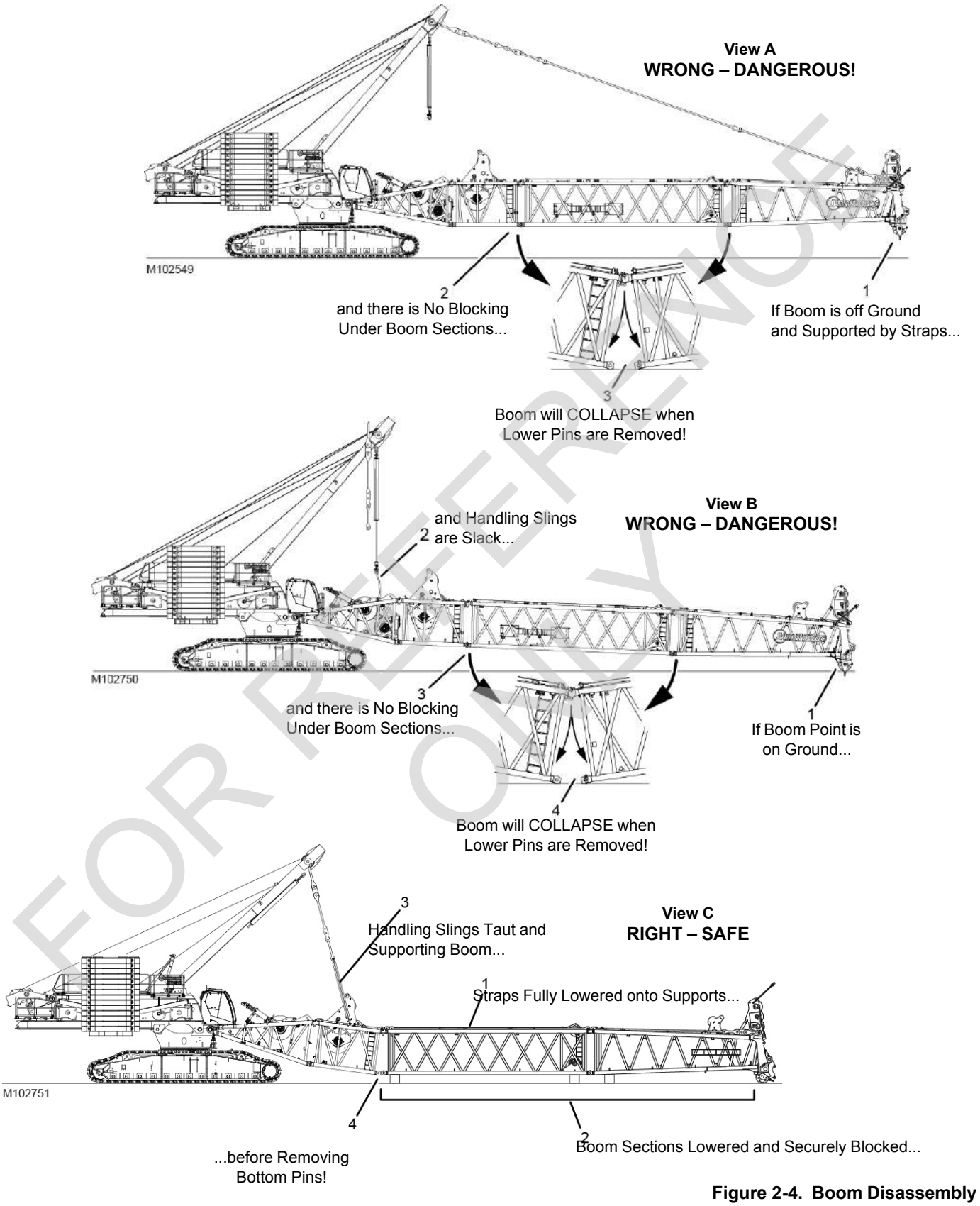


Figure 2-4. Boom Disassembly

BOOM DISASSEMBLY SAFETY

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

DANGER!

Collapsing Boom Hazard!

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

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

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

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

General

Safety decals (Figure 2-5) are placed near the connectors on the boom sections as shown on the Boom Disassembly Decal Drawing at the end of this section.

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

Location

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

Pin Removal

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

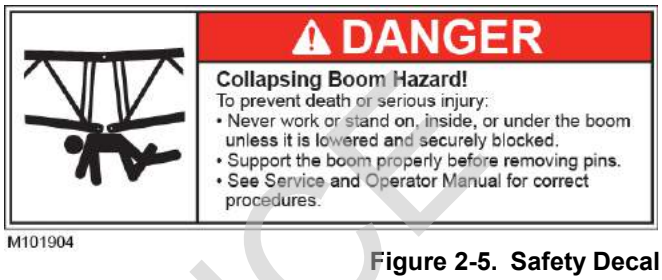


Figure 2-5. Safety Decal

Disassembly Precaution

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

DANGER

Collapsing Boom Hazard!

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

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

DANGER

Falling Boom Hazard!

Crane can tip or the boom can collapse if excess boom is cantilevered. Never cantilever more boom than allowed in rigging 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, aerial lift, elevating work platform or scaffold, would be more hazardous or is not possible because of structural design or work site conditions.***

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

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

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

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

  Cranes with outriggers or stabilizers must have them all extended and locked. All outriggers or stabilizers must be extended equally in accordance with the Capacity Charts and operating procedures.
- Handling personnel from a platform suspended by wire rope from a luffing jib is acceptable, but only when it is not possible to accomplish the task using a less hazardous means. The crane user and operator shall take into account hazards that may be present when using a luffing jib.
- Direct attachment of a personnel platform to a luffing jib is prohibited.
- The platform meets the requirements as prescribed by applicable standards and regulations.
- Applicable personal protection equipment is provided (for example, personal fall-protection system).

- For wire rope suspended platforms, the crane is equipped with a hook latch that can be closed and locked, eliminating the throat opening.
- The platform is properly attached and secure.
- Personnel platforms must not be used in winds exceeding 20 mph (9 m/s) at the hoisted platform height or in electric storms, snow, ice, sleet, or other adverse weather conditions which could affect the safety of personnel.
- Hoisting personnel within 6 m (20 ft) of a power line that is up to 350 kV or within 15 m (50 ft) of a power line that is over 350 kV is 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 the operator that the crane's capacity has been exceeded. When the capacity of a pedestal mounted crane is exceeded, the hook rollers or other structural components may break, before the load lines fail, causing the crane to separate from the pedestal.

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

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

WARNING

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

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

Pedestal Mounted Crane

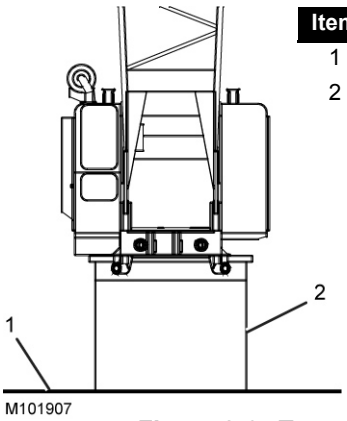
Also see ASME publication B30.8-2004, Floating Cranes and Derricks.

Definition

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

Examples

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

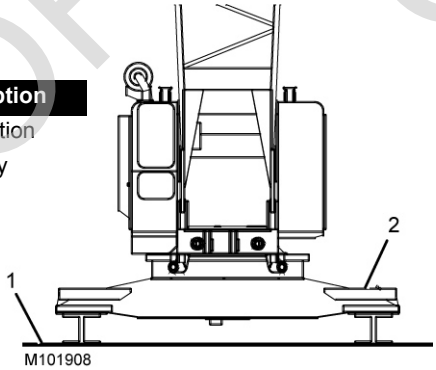


Item	Description
1	Foundation
2	Turret

Figure 2-6. Turret-Mounted Crane

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

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



Item	Description
1	Foundation
2	Carbody

Figure 2-7. Carbody-Mounted Crane

Barge Mounted Crane

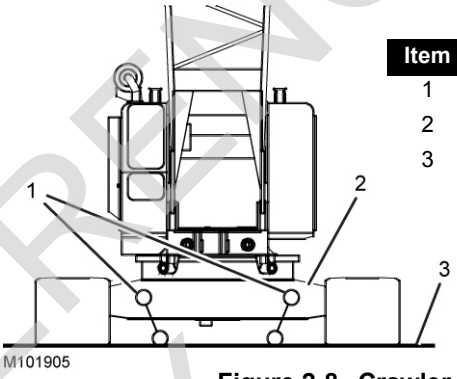
Definition

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

Examples

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

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

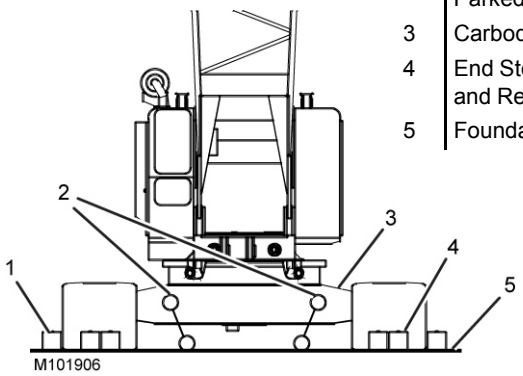


Item	Description
1	Tie-Downs
2	Carbody
3	Foundation

Figure 2-8. Crawler-Mounted Crane

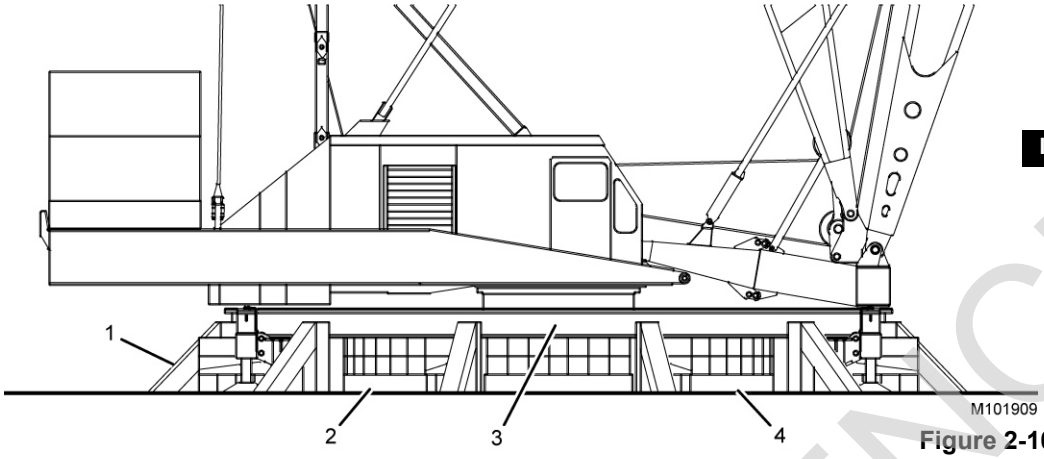
2. Crawler-mounted crane working on a timbered area of the barge, ship, or floating platform with the crawlers restrained by curbing and end stops (Figure 2-9). When not working, the crane carbody is anchored with tie-downs to the foundation. ***Traveling with load is not permitted***.

NOTE Manitowoc does not permit traveling on a barge deck with load.



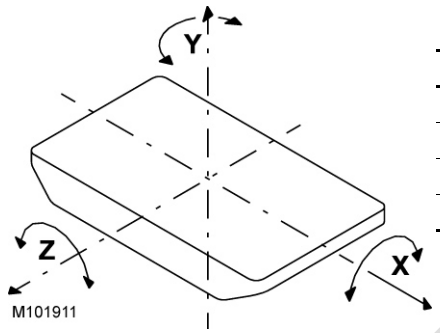
Item	Description
1	Curbing
2	Tie-Downs Required when Parked
3	Carbody
4	End Stop Front and Rear
5	Foundation

Figure 2-9. Crawler-Mounted Crane



Item	Description
1	Bracing
2	Ring Support
3	Ring Assembly
4	Foundation

Figure 2-10. RINGER-Mounted-Crane



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

Figure 2-11. Barge Dynamics

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

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

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

Capacity Charts for Barge Mounted Crane

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

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

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

Shock Loading Caused by Barge Dynamics

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

CAUTION

Structural Damage Hazard!

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

NOTE Manitowoc does not recommend crane operation under dynamic conditions.

Operation on Barge

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

WARNING

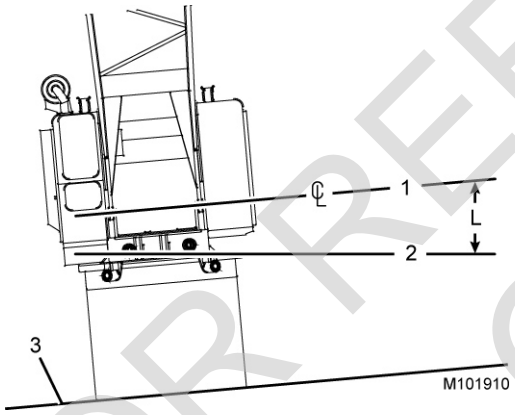
Tipping Crane Hazard!

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

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

Barge Mount Definitions

1. *Machine List*, as defined by Manitowoc, is the crane's out-of-level condition — from side-to-side — as measured by the angle between horizontal and a line drawn through the centerline of the crane's boom hinge pins (Figure 2-12). This out-of-level condition creates side load and affects the crane's lifting capacity.



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

Figure 2-12. Machine List

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

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

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

Inspection of Barge-Mounted Crane

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

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

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

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

Transporting Crane on Barge

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

SECTION 3
OPERATING CONTROLS AND PROCEDURES

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

Published 09-06-19, Control # 230-08

SECTION 3
OPERATING CONTROLS AND PROCEDURES

THIS SECTION STARTS ON THE NEXT PAGE

STANDARD HAND SIGNALS FOR CRANE OPERATION

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

Table 3-1 Standard Hand Signals for Crane Operation

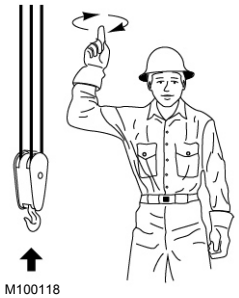
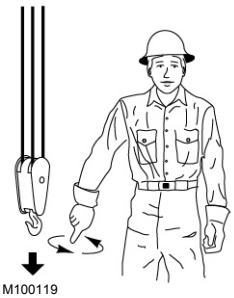
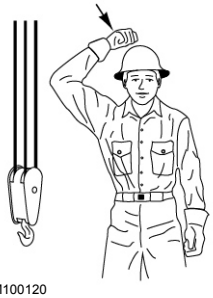
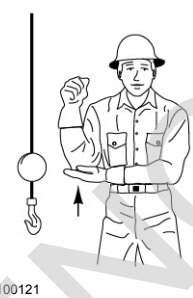
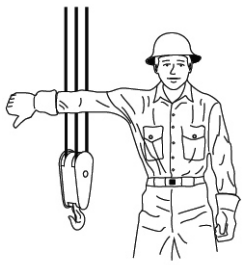
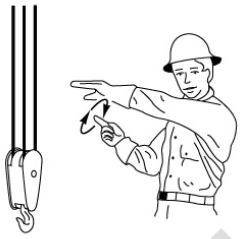
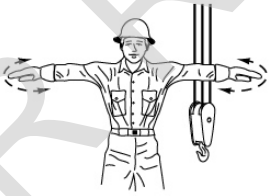
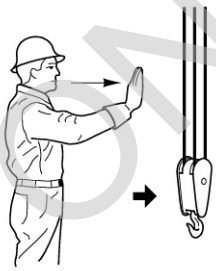
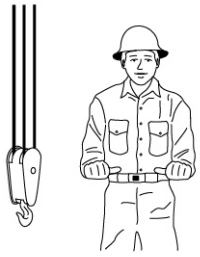
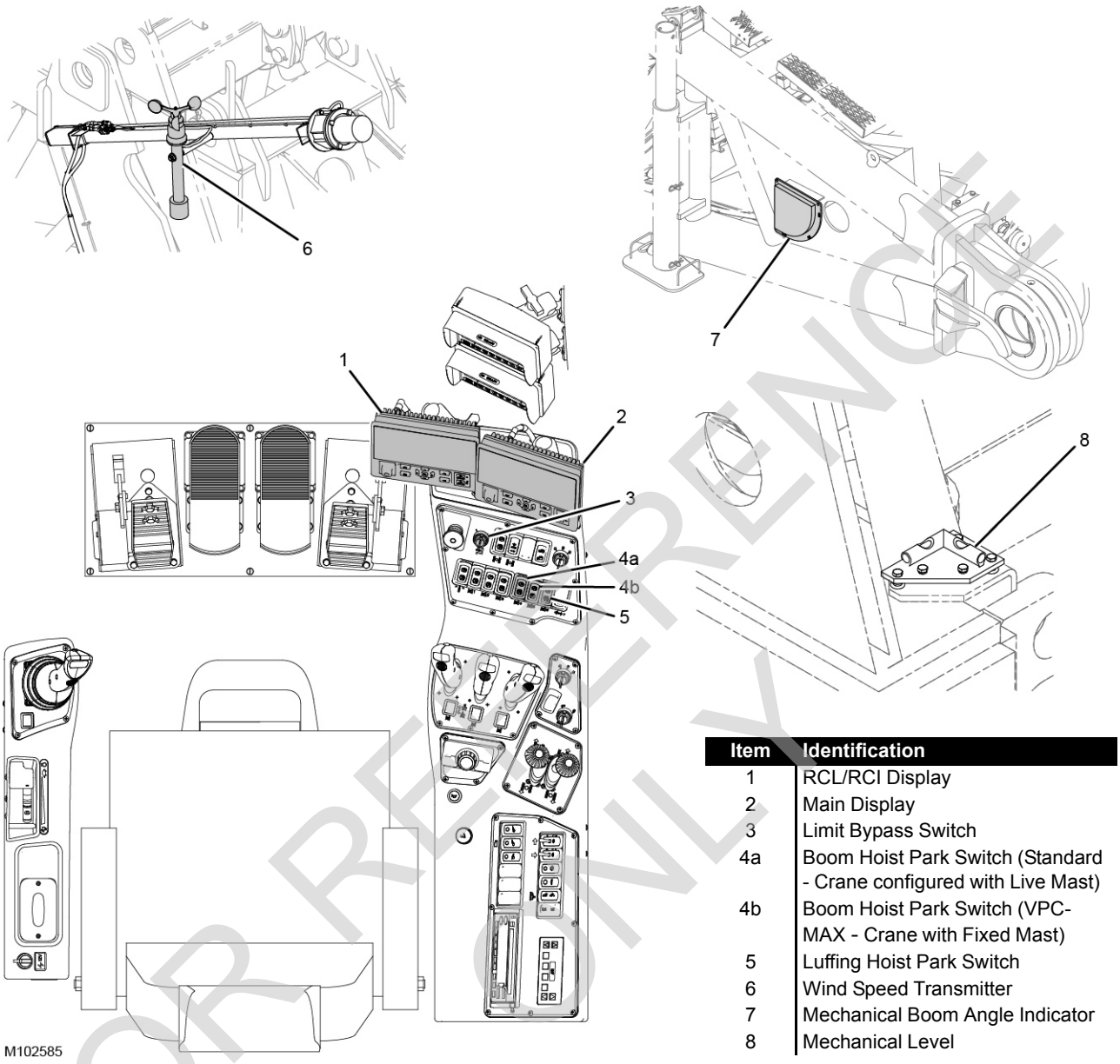
1	2	3	4	5
 M100118	 M100119	 M100120	 M100121	 M100122
6	**7**	**8**	**9**	**10**
 M100123	 M100124	 M100125	 M100126	 M100127
11	**12**	**13**	**14**	**15**
 M100128	 M100129	 M100130	 M100131	 M100132
16	**17**	**18**	**19**	**20**
 M100133	 M100134	 M100135	 M100136	 M100137

Table 3-1 Standard Hand Signals for Crane Operation

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 as shown in 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 Booms)—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.



Item	Identification
1	RCL/RCI Display
2	Main Display
3	Limit Bypass Switch
4a	Boom Hoist Park Switch (Standard - Crane configured with Live Mast)
4b	Boom Hoist Park Switch (VPC-MAX - Crane with Fixed Mast)
5	Luffing Hoist Park Switch
6	Wind Speed Transmitter
7	Mechanical Boom Angle Indicator
8	Mechanical Level

FIGURE 3-1

WARNING

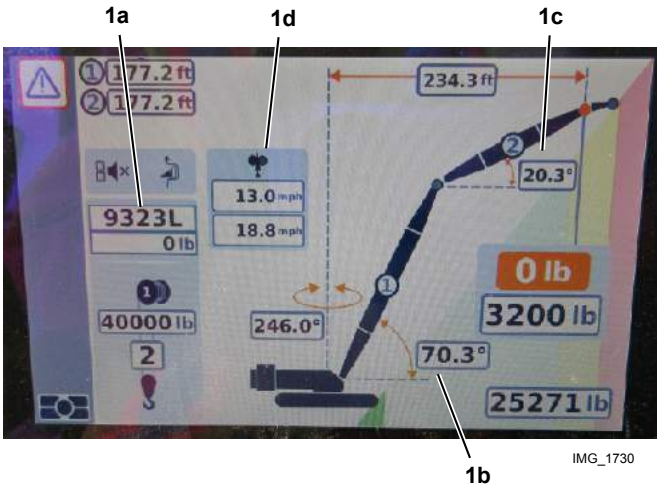
Prevent death or serious injury to personnel!

The luffing jib attachment must be installed and operated by experienced personnel trained in erection and operation of construction cranes. Those personnel shall read, understand, and comply with the instructions in this manual, in the Luffing Jib Assembly Drawings, in the Liftcrane Luffing Jib Capacity Charts, in the Crane Operator Manual, and in the VPC-MAX Operator Manual (if equipped).

GENERAL OPERATION

The instructions in this section supplement the operating control instructions in Section 3 of the MLC650 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 with important safety information



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

FIGURE 3-2

LUFFING JIB OPERATING CONTROLS

See Figure 3-1 for the location of controls.

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

Read and become thoroughly familiar with MLC650 RCL/RCI Operation Manual located in the Operator Information Manual in the operator's cab.

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

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

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

Boom Angle

See item 1b, Figure 3-2.

The angle between the centerline of the boom and horizontal (6, Figure 3-3). Monitor this angle when raising and lowering the boom during operation.

Luffing Jib Angle

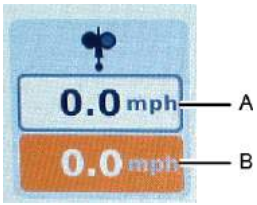
See item 1c, Figure 3-2.

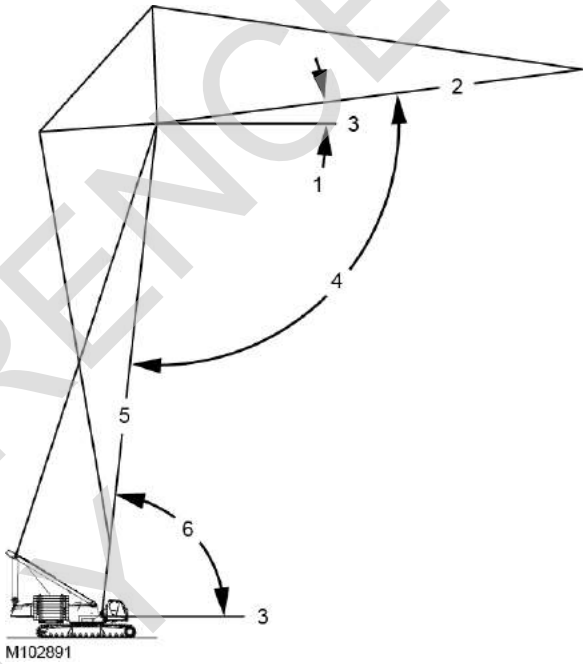
The angle between the centerline of the jib and horizontal (1, Figure 3-3). Monitor this angle when raising and lowering the jib during operation.

Wind Speed

See item 1d, Figure 3-2.

Shows the steady wind speed (A) and the maximum gust wind speed (B) at the luffing jib point. See Wind Conditions later in this section.





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

FIGURE 3-3

2 – Main Display

Read and become thoroughly familiar with the MLC650 Main Display Operation Manual located in the Operator Information Manual in the operator's cab.

The Main Display Working Screen shows information required to operate the crane and luffing jib, to include:

Boom to Luffing Jib Angle

Shows the angle between the centerline of the boom and the centerline of the jib (4, Figure 3-3 on page 3-5).

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

The Main Display Working Screen also shows the operating limits and system faults that may occur during operation.

3 – Limit Bypass Switch

This switch bypasses the limits identified in Table 3-2 on page 3-7.

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

RELEASE the key to ENABLE (activate) the operating limits. This position allows the limits to stop the functions in the normal manner.

Remove the key to prevent unauthorized operation.

4a – Drum 4 (Boom Hoist) Park Switch (Standard - Crane configured with Live Mast)

4b – Drum 5 (Boom Hoist) Park Switch (VPC-MAX - Crane configured with Fixed Mast)

5 – Drum 6 (Luffing Hoist) Park Switch

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

The handle locations can vary depending on operation. See Drum and Control Handle Identification on page 3-15.

6 – Wind Speed Transmitter

Sends wind speed information from the jib point to RCL/RCI Display.

7 – Mechanical Boom Angle Indicator

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

The boom's angle (1b, Figure 3-2 on page 3-5) is also shown on the RCL/RCI working screen.

8 – Mechanical Crane Level

The bubble level (Figure 3-4) indicates crane levelness from front-to-rear (2) and from side-to-side (3).

- The crane is level when the bubbles (1) are centered in the glass.
- The crane is approximately one percent of grade out of level in the corresponding direction when half of a bubble (1) is off center.

Crane levelness can also be viewed in 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.

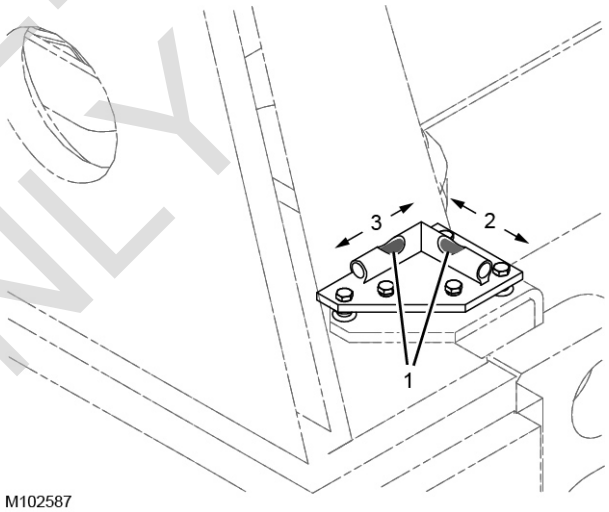


FIGURE 3-4

OPERATING LIMITS IDENTIFICATION AND OPERATION

The following table lists the operating limits this crane is equipped with and identifies which of those limits are bypassable. When a limit is reached, the operating limit fault is activated and the corresponding fault icon appears in the fault bar of the information screen in the main display (see Table 3-3 Operating Limits Description on page 3-8).

Table 3-2 Operating Limits Identification

Limit	Bypassable		Bypassable in Luffing Jib Setup Mode On [1]		Bypassable with External Override Switch [2]
	See 3 – Limit Bypass Switch, on page 3-6				
	Non-CE [3]	**CE** [3]	**Non-CE** [3]	**CE** [3]	**CE** [3]
Bail, Minimum (each drum)	No	No	No	No	No
Block Up (each drum)	Yes	Yes [4]	Yes	Yes	No
Boom Max Up	No	No	No	No	No
Function Diverted	No	No	No	No	No
Function Parked	No	No	No	No	No
Gantry Down	Yes	Yes	No	No	No
Inactive Control Station (CE only)	No	No	No	No	No
Luffing Jib Maximum Down 1	Yes	No	Yes	Yes	No
Luffing Jib Maximum Down 2	No	No	No	No	No
Luffing Jib Maximum Up 1	Yes	No	Yes	Yes	No
Luffing Jib Maximum Up 2	Yes [5]	No	Yes [5]	Yes [5]	No
Luffing Jib Stop Misaligned	Yes [7]	Yes [7]	Yes [5]	Yes [5]	No
Mast Arms Down	Yes	Yes	No	No	No
Mast Arms Up	Yes	Yes	No	No	No
Mast Too Far Back	Yes	Yes	No	No	No
Mast Too Far Forward	Yes	Yes	No	No	No
Mast (fixed) Stop	No	No	No	No	No
Operator Out of Seat	No	No	No	No	No
Pawl Engaged	No	No	No	No	No
Rated Capacity Indicator/Limiter	Yes	Yes [4]	Yes	Yes [4]	Yes [6]
Transducer Fault	No	No	No	No	No
Travel on Grade with VPC Unlocked	No	No	No	No	No
VPC Setup Prohibited	No	No	No	No	No
VPC Setup Required	No	No	No	No	No
VPC Sensor	No	No	No	No	No

[1] Use only for rigging. See Luffing Jib Mode Selection, on page 3-13.

[2] Cranes meeting European requirements (CE) are equipped with an RCI/RCL External Override Switch located outside the operator's cab. See MLC650 Rated Capacity Indicator/Limiter Operation Manual.

[3] CE = Cranes that comply with 2010 European requirements.

[4] 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).

[5] Only when boom is below 50°.

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

[7] Only when boom is below 30°.

The following table describes the operating limits this crane is equipped with. When a limit is reached, the operating limit fault is activated and the corresponding fault icon appears in the fault bar of the information screen in the main display.

Table 3-3 Operating Limits Description

Operating Limit	Icon
Bail, Minimum This limit stops the corresponding drum from lowering when there are three to four wraps of wire rope remaining on the drum. • The load can be raised after the limit is contacted. • This limit can only be bypassed by disconnecting the electric cable from the limit switch and connecting the shorting plug. **WARNING** **Falling Load Hazard!** When lowering a load below the minimum bail limit, do so slowly with extreme caution. Do not lower the load to the point where less than three full wraps of wire rope are on the drum. The wire rope could be pulled out of the drum allowing the load to fall.	 M102775
Block Up In the non-setup mode, this limit stops the boom or luffing jib from lowering and the load drum from hoisting when 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 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 the block-up limit, do so slowly with extreme caution to prevent two-blocking. Do not hoist the load above the minimum block clearance given in the Reeving Diagrams (see Section 4 of the MLC650 Operator Manual). Do not use the limit bypass switch to lower the boom or the luffing jib after the block-up limit is contacted, or two-blocking could occur. The load could fall.	 M102773
Boom Max Up This limit stops the boom when the boom is raised to one of the following maximum angles: 83° for boom only with VPC-MAX attachment 85° for boom only without VPC-MAX attachment 85° for boom with luffing jib and with or without VPC-MAX attachment The boom can be lowered after this limit is reached.	 M102777
Function Diverted This limit prevents Drums 1 and 3 from being operated at the same time. Drum 3 must be parked to operate Drum 1. Drum 1 must be parked to operate Drum 3.	 M102779

Operating Limit	Icon
Function Parked This limit prevents the selected crane function from being operated until the park switch is turned off (un-parked).	 M102772
Gantry Down With the Setup Mode ON, this limit stops the mast if the gantry is down during the following operations: • Booming down with the mast above 70°. • Booming up with the mast below 113°. With the Setup Mode OFF, this limit stops all booming when the gantry is down.	 M102287
Inactive Control Station This limit applies only to cranes meeting CE requirements. This limit prevents the cab controls from being operated when the remote control is being operated. The remote control has priority. Therefore, if the cab controls are being operated and the remote control becomes active, the cab controls will be disabled.	 M102791
Luffing Jib Maximum Down 1 (minimum working angle) This programmed limit stops the luffing jib from lowering when the boom-to-luffing jib angle is 70°. • The luffing jib can be raised after this limit is reached. • The limit bypass switch must be turned to the bypass position to lower the jib to the Luffing Jib Maximum Down 2 limit.	 M102792
Luffing Jib Maximum Down 2 (minimum angle) A limit switch stops the luffing jib from lowering when the boom-to-luffing jib angle is 68.5°. • This limit cannot be bypassed. • If this limit is contacted on cranes meeting CE requirements, the luffing jib cannot be raised until the limit is reset. See Resetting Luffing Jib Limits. **WARNING** **Falling Boom/Jib Hazard!** Do not lower the luffing jib below the minimum angle given in the Luffing Jib Raising (and lowering) Procedure chart. Structural damage could result, possibly causing the boom and luffing jib to collapse.	 M102781
Luffing Jib Maximum Up 1 (maximum working angle) This programmed limit stops the luffing jib when the boom-to-luffing jib angle is 171°. • The luffing jib can be lowered after this limit is reached. • The limit bypass switch must be turned to the bypass position to raise the jib an additional 0.5° to the Luffing Jib Maximum Up 2 limit. **WARNING** **Falling Boom/Jib Hazard!** Proceed slowly when operating the luffing jib above the Luffing Jib Maximum Up 1 limit. Do not raise the luffing jib above the Luffing Jib Maximum Up 2 limit. Structural damage will occur, possibly causing the boom and luffing jib to be pulled over backwards.	 M102782

Operating Limit	Icon
Luffing Jib Maximum Up 2 (maximum angle) A limit switch stops the luffing jib when the boom-to-luffing jib angle is 171.5°. • This limit cannot be bypassed. • If this limit is contacted on cranes meeting CE requirements, the luffing jib cannot be raised until the limit is reset. See Resetting Luffing Jib Limits.	 M102783
Luffing Jib Stop Misaligned This limit stops the corresponding hoist if: • You try to luff up when either jib stop positing cylinder is not fully extended. This limit can be bypassed only in the luffing jib setup mode if the boom angle is less than 50°. • You try to boom down or you try to luff up when either jib stop is fully extended and the boom angle is less than 30°.	 M103337
Mast Assist Arms Down With the Setup Mode ON, this limit stops the boom hoist if you attempt to raise the mast to vertical when the mast assist arms are down. **WARNING** **Falling Mast/Boom Hazard!** Prevent the mast from falling over backwards: • Fully raise the mast assist arms before raising the mast to vertical. The mast can fall over backwards if this precaution is not taken.	 M102799
Mast Assist Arms Up With the Setup Mode OFF, this limit stops the boom hoist if you attempt to raise the boom when the mast assist arms are up. **WARNING** **Falling Mast/Boom Hazard!** Prevent the mast and the boom from falling: • Fully lower the mast assist arms before raising the boom. The mast can buckle and collapse if it contacts the mast-assist arms with a fully rigged boom.	 M102798
Mast too Far Back This limit stops the boom hoist when the live mast is lowered rearward to 2°. Finish lowering the mast to the transport position (0°) manually with the switch on the remote control or on the right console in the cab.	 M102784
Mast too Far Forward The fault alarm for this limit is activated when the live mast is lowered forward to 158° during crane assembly and disassembly. **WARNING** **Falling Mast Hazard!** Do not lower the mast below the specified angle. Raise the live mast when this fault is activated. Further lowering is not approved - ***the mast could fall***.	 M102785

Operating Limit	Icon
Mast (fixed) Stop This limit stops boom hoist operation if the mast stop cylinders retract for any reason. The cylinders must be extended at all times.	 M103770
Operator Out of Seat This limit prevents the crane functions from being operated when the operator is out of the seat. Sit down in the seat to operate the crane functions.	 M102790
Pawl Engaged This limit prevents the drum from lowering until the pawl is disengaged from the ratchet. It may be necessary to hoist slightly to fully disengage the pawl.	 M102794
Rated Capacity Limiter This fault is activated for the following conditions. Take immediate corrective action. • Overload • Sensor fault • Out of the capacity chart (a condition that is not covered by the current capacity chart) • Unconfirmed or invalid RCL/RCI configuration.	 M102787
Transducer Fault In the setup mode, this limit stops operation if there is a transducer fault. Troubleshoot the hydraulic system using the screens in the Main Display to determine the faulty transducer. Take corrective action to correct the fault.	 M102793
Travel on Grade with VPC Unlocked (only for crane without VPC-MAX) This limit prevents travel on a grade greater than 7%. Always lock the VPC before traveling onto any grade.	 M103070
VPC Setup Required **NOTE** The VPC setup mode must be ON anytime the boom is suspended and operated out of the capacity chart. It is normal for the counterweight to move in or out when the VPC setup mode is on. This limit prevents the boom from being raised from ground level until the VPC Setup Mode is turned on. When the boom angle is out of the capacity chart, this limit stops the boom from being lowered until the VPC setup mode is turned on.	 M102795

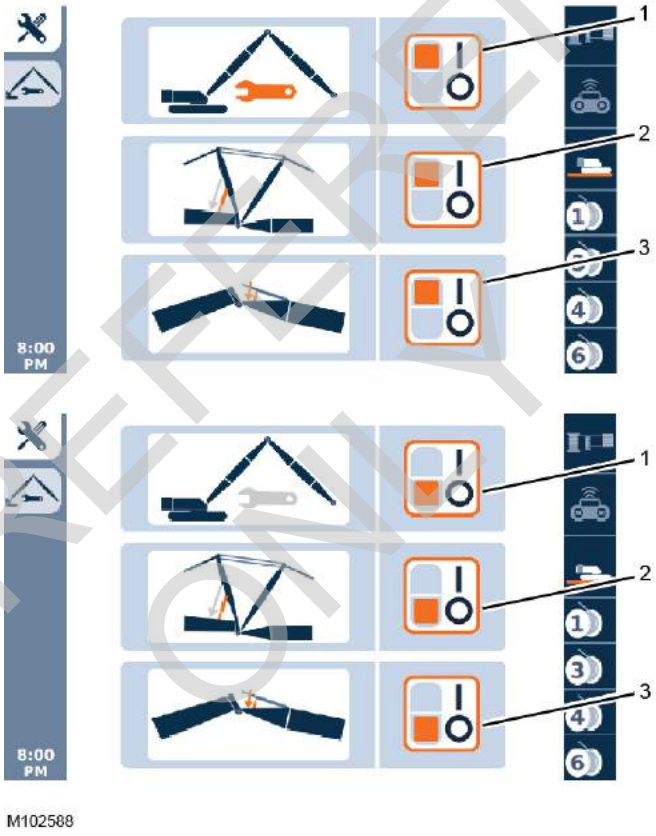
Operating Limit	Icon
VPC Setup Prohibited **NOTE** The VPC setup mode must be OFF anytime the boom is supported and operated within the capacity chart. When the boom angle is within the capacity chart, this limit stops the boom from being raised until the VPC setup mode is turned off.	 M102796
VPC Sensor This limit prevents operation if the VPC has not been properly calibrated or if there is a boom angle or jib angle sensor fault.	 M102797

LUFFING JIB MODE SELECTION

There are three luffing jib mode screens (View A, Figure 3-5). Refer to the MLC650 Main Display Operation Manual.

- Luffing Jib Setup Mode screen (1, View A, Figure 3-5)
- Strut Stop Mode screen (2, View A, Figure 3-5)
- Jib Stop Mode screen (3, View A, Figure 3-5)

NOTE: Refer to the MLC650 Main Display Operation manual for detailed instructions on Luffing Jib Mode Selection.



View A

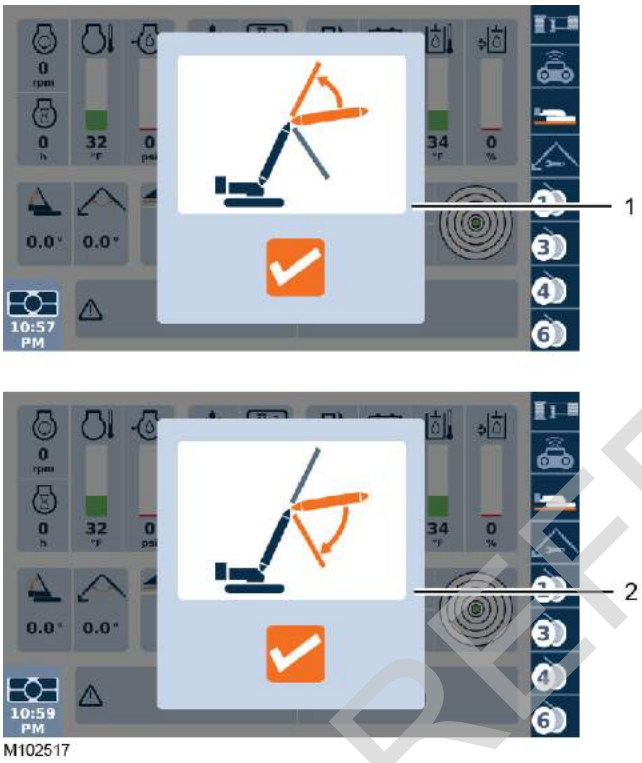
Item	Identification
1	Luffing Jib Setup Mode
2	Strut Stop Mode
3	Luffing Jib Stop Mode

FIGURE 3-5

RESETTING LUFFING JIB LIMITS

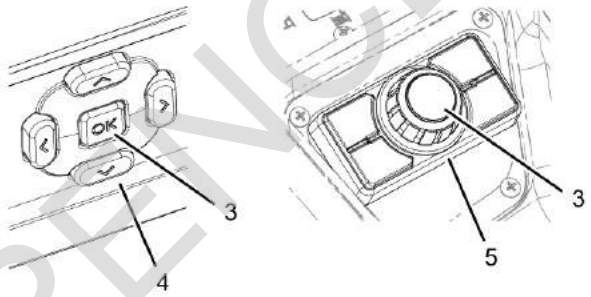
This procedure applies only to cranes meeting CE requirements. See Figure 3-6.

When the Luffing Jib Maximum Up 2 limit or the Luffing Jib Maximum Down 2 limit is contacted, operation will stop and the jib up prompt (1) or the jib down prompt (2) will appear in the main display.



When either prompt appears:

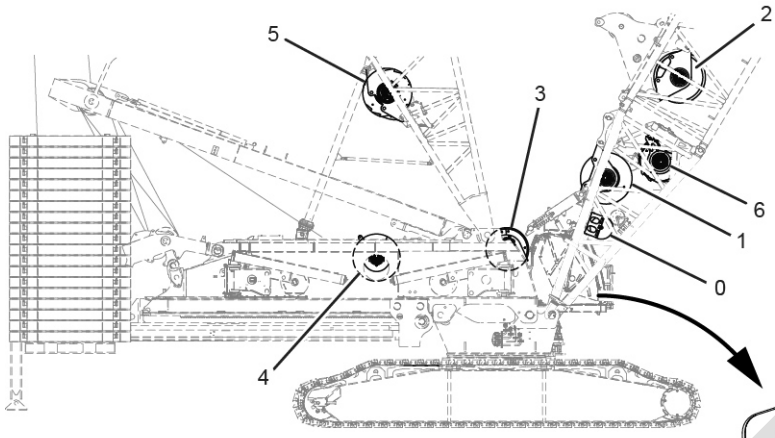
1. Release the control handle to off.
2. Press either select button (3) to reset the limit.
3. The prompt will go off and you will be able to operate the luffing jib in the opposite direction, down or up.



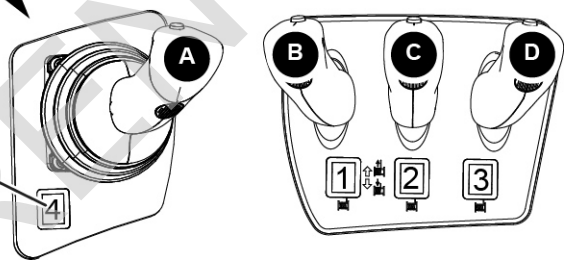
Drum	Description
1	Jib Up Prompt
2	Jib Down Prompt
3	Select Button
4	Main Display
5	Jog Dial on Right Console

FIGURE 3-6

DRUM AND CONTROL HANDLE IDENTIFICATION



Drum	Description
1	Main Hoist
2	Main Hoist (optional)
3	Whip Hoist
4	Boom Hoist (standard)
4	Mast Hoist (VPC-MAX)
5	Boom Hoist (VPC-MAX)
6	Luffing Hoist
0	Rigging Winch



NOTE: Drum numbers will change to match selected configuration.

M102586

Configuration	HANDLE A Controls Drum	HANDLE B Controls Drum	HANDLE C Controls Drum	HANDLE D Controls Drum
Crane Assembly (setup mode)	4	1	3	AC [5]
Crane Assembly (setup mode) (VPC-MAX)	4	1	3	5
Crane Assembly (setup mode) [1]	4	1	3	5
Crane Assembly (setup mode) [2]	4	1	2	AC [5]
Crane Assembly (setup mode) [2] (VPC-MAX)	4	1	2	5
Boom with or without Fixed Jib	4	1	2	3
Boom with or without Fixed Jib (VPC-MAX)	5	1	2	3
Boom with or without Luffing Jib and Fixed Jib	6	1	3	4
Boom with or without Luffing Jib and Fixed Jib [2]	6	1	2	4
Boom with or without Luffing Jib and Fixed Jib [3]	6	1	2	3
Boom with or without Luffing Jib and Fixed Jib (VPC-MAX)	6	1	3	5
Boom with or without Luffing Jib and Fixed Jib [2] (VPC-MAX)	6	1	2	5
Boom with or without Luffing Jib and Fixed Jib [4] (VPC-MAX)	6	1	2	3

1 Drum 2 parked and Drum 5 un-parked.

2 Drum 2 un-parked and Drum 3 parked.

3 Drum 2 un-parked, Drum 3 un-parked, and Drum 4 parked.

4 Drums 2 un-parked, Drum 3 un-parked, and Drum 5 parked.

5 AC = assembly cylinder. Handle D provides proportional control of the assembly cylinder in the live mast (self-erect option).

FIGURE 3-7

OPERATING PRECAUTIONS

1. Read and comply with the instructions in the Liftcrane Luffing Jib Capacity charts provided with the luffing jib attachment. Do not operate beyond the limits given in the capacity charts.

   Make sure the proper counterweight is installed on the crane.

2. Read and comply with the instructions in this manual and in the Crane Operator Manual.

3. Read and comply with the Maximum Allowable Travel Specifications in the Luffing Jib Capacity Chart Manual.

   For ***travel on grade***, the VPC Lockout Key Switch (on right console) must be in the LOCK position (not applicable to VPC-MAX).

WARNING

Tipping Crane Hazard

The crane can tip if the VPC (counterweight) is not locked, as follows, ***prior to traveling onto a grade***:

- Position the crane on a level surface.
- Unlock the VPC.
- Position the boom (and luffing jib if equipped) so it is facing the proper direction and is within the boom/jib angle range specified in the Maximum Allowable Travel Specifications chart.
- Lock the VPC.

The VPC must be locked before traveling on the grade. Do not change the boom/jib angle after the crane has been traveled onto the grade.

Do not exceed the grade specified in the Maximum Allowable Travel Specifications chart.

For cranes without VPC-MAX:

- The **Travel on Grade Permitted** icon will appear in the Information/ Notifications Bar of the RCL/RCI display when the VPC is locked and positioned for travel on a grade that corresponds to the current boom/jib angle. See Maximum Allowable Travel Specification chart for details.

- The **Travel on Grade Prohibited** icon will appear in the Information Bar of the RCL/RCI display if the VPC is locked and positioned such that travel on grade is not permitted. See Maximum Allowable Travel Specification chart for details.

- The **Travel on Grade with VPC Unlocked** fault will come on in the main display and travel will stop if the crane is traveled onto a grade greater than 7% with the VPC unlocked.

4. Make sure the luffing jib attachment is installed properly. Read and comply with the instructions in Section 4.

5. If required per the rigging drawing in use (boom and luffing jib), make sure the intermediate suspension is properly installed. Otherwise, damage to the boom and jib sections can occur.

   For some boom and luffing jib configurations, it is normal for the intermediate suspension to appear slack during boom and luffing jib raising and operation. If your intermediate suspension appears slack —

   - make sure it is installed in the proper location,
   - make sure the proper pendant buttons are pinned to the sockets,

   and continue operation.

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

   See the separate RCL/RCI Operation Manual for operation and calibration of the RCL/RCI.

7. Make sure the proper luffing jib capacity chart is selected in the RCL/RCI Display.

8. Raise and lower the luffing jib as instructed in Section 4.

9. Perform all operations with the 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 the attachment.

11. Observe warning in Figure 3-8 on page 3-17.

12. Do not operate the crane, to include raising the boom and jib from the ground level, if the wind exceeds the limits given in the capacity charts. Contact your local weather station for the wind velocity.

WARNING

Falling Boom and Jib Hazard!

Operator — be aware that side load conditions can cause the luffing jib backstay straps to contact the boom rigging (straps, equalizer, wire rope) while raising and lowering the boom during normal operation.

Do not allow the backstay straps to catch or hang-up on the boom rigging. Structural failure and collapse of the attachment could result.

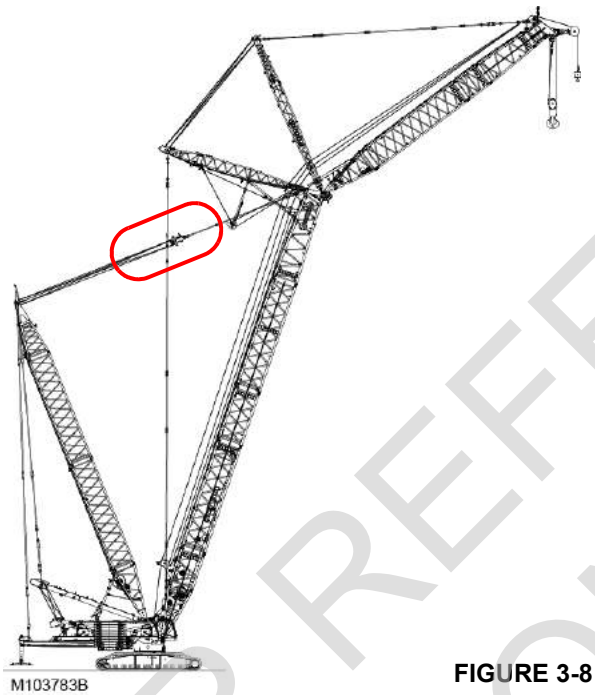


FIGURE 3-8

LEAVING CRANE UNATTENDED

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

WIND CONDITIONS

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

WARNING

Tipping Crane Hazard!

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

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

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

The wind speed at the boom or jib point can be greater than the 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:

The wind causes the load to swing forward past the allowable operating radius or sideways past either boom hinge pin.

For wind conditions specific to this crane, see the Wind Conditions chart at the end of this section or, if applicable, see the wind conditions in capacity charts provided with the crane and luffing jib.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 4
SET-UP AND INSTALLATION

TABLE OF CONTENTS

Published 09-06-19, Control # 230-08

SECTION 4
SET-UP AND INSTALLATION

GENERAL SETUP AND INSTALLATION

WARNING

Avoid Death or Serious injury!

Read and understand the instructions in this section before attempting to install or remove the 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 the moving parts.
- Maintain communication between the operator and the assemblers to avoid accidents.
- Keep unauthorized personnel well clear of the crane.

Falling Load Hazard!

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

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

This section contains installation and removal instructions for the #681-682 Luffing Jib Attachment available for the Model MLC650 without or with a VPC-MAX Attachment.

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

The instructions in this section assume that the crane, the VPC-MAX attachment (if equipped), and the 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 at the end of this section, 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 a firm, level, uniformly supporting surface and free of ground and overhead obstructions.

Level = 1% of grade or
0,30 m (1 ft) in 30,5 m (100 ft) or
13 mm (1/2 in) in 3,0 m (10 ft)

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

See the Luffing Jib Rigging drawing 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, and REAR used in this section refer to the operator's right, left, front, and rear sides when seated in the operator's cab looking forward.

- The operator's cab is on the front of the upperworks.
- The arrow fabricated onto the left-front corner of the carbody points toward the front of the carbody.

ACCESSING PARTS

WARNING

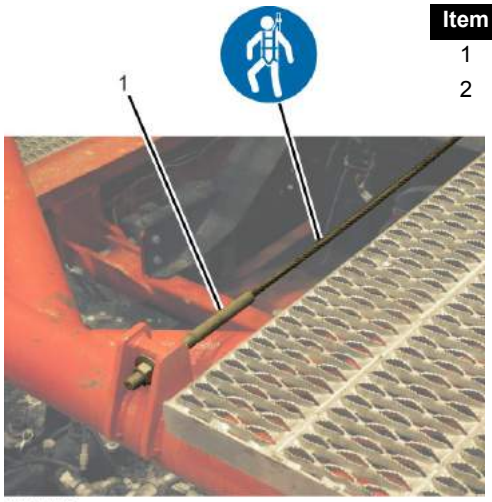
Fall Hazard!

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

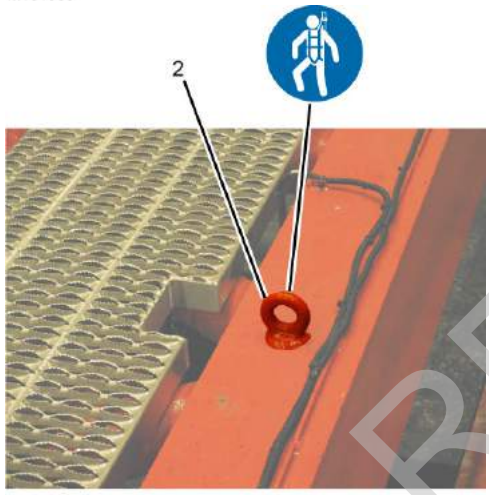
Adhere to local, state, and federal regulations for handling personnel and personnel fall protection.

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

Item	Description
1	Lifeline
2	Anchor



M101966



M101967

FIGURE 4-1

PERSONAL FALL-PROTECTION

Manitowoc has provided lifelines and anchors throughout the crane and attachment (see Figure 4-1) to which workers can attach their personal fall-protection equipment.

WARNING

Fall Hazard!

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

- The anchors and lifelines are designed to handle only one person at a time.
- Do not use the anchors for lifting or pulling loads.

CRANE WEIGHTS AND SHIPPING DATA

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

See the MLC650 Product Guide in Section 1 of the Crane Operator Manual for outline and shipping dimensions.

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 of this manual.

COUNTERWEIGHT REQUIREMENT

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

WARNING

Tipping Hazard!

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

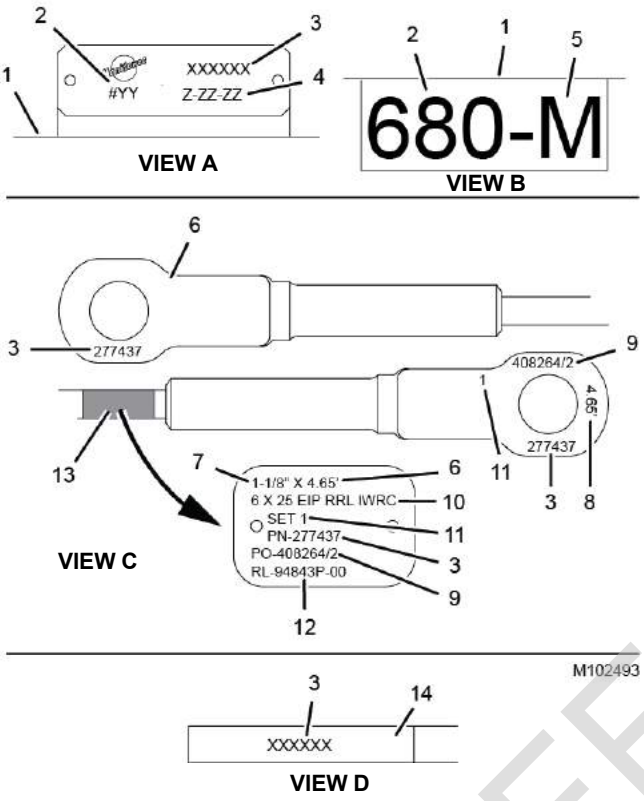
BLOCKED CRAWLERS

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

DANGER

Tipping Hazard!

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



Item	Description
2	Boom or Jib Number
3	Manitowoc Part Number
4	Manitowoc Manufacturing Code
5	Chord Identification: H = Heavy XH = Extra Heavy M = Medium
6	Pendant
7	Diameter
8	Length
9	Manitowoc Purchase Order Number
10	Wire Rope Type
11	Set Number
12	Manufacturer's Number
13	Aluminum Tag (if equipped)
14	Boom or Jib Strap

FIGURE 4-2

LUFFING JIB RIGGING DRAWING

See the end of this section for the Luffing Jib Rigging drawings. A separate drawing is provided for each configuration:

- MLC650 (without VPC-MAX)
- MLC650 VPC-MAX

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

Two tables are provided in the Luffing Jib Rigging drawing:

- One table lists the boom sections and the backstay straps required for various boom lengths.
- The other table lists the jib sections required for various jib lengths.

Make sure the proper table is referred to. Read and comply with all notes on the rigging drawing.

LUFFING JIB RAISING PROCEDURE

See the end of this section for Luffing Jib Raising (and lowering) Procedure charts. A separate chart is provided for each configuration:

- MLC650 (without VPC-MAX)
- MLC650 VPC-MAX

IDENTIFYING BOOM AND JIB COMPONENTS

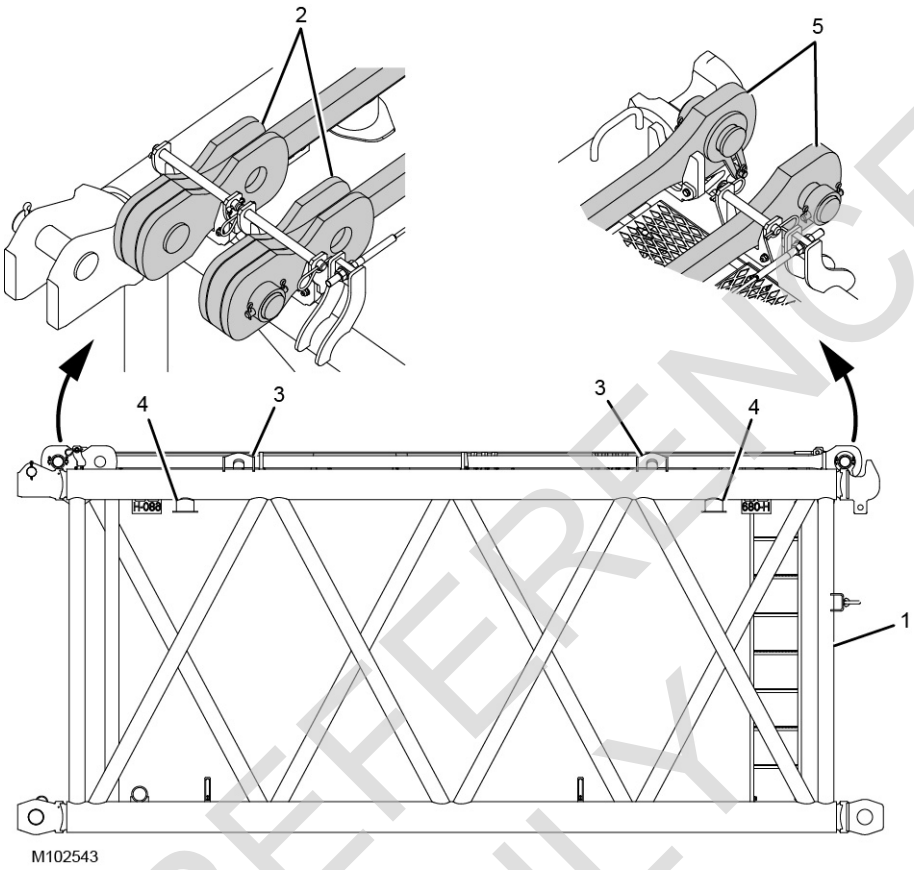
See Figure 4-2 for the following procedure.

The boom and jib sections are marked for proper identification as shown in View A. An identification plate is located near the top end of all four chords.

The boom and jib sections also have two chord identification plates as shown in View B. The plate is located on the top end of the right-top chord and the butt end of the left-top chord.

Pendants are marked for proper identification as shown in View C.

Straps and links are marked for proper identification as shown in View D.



Item	Description
1	Boom Section (typical)
2	Boom Links (stored)
3	Lifting Lug (4) (for shackles of sling hooks)
4	Lifting Lug (4) (synthetic sling posts)
5	Boom Straps and Luffing Jib Backstays (stored)

FIGURE 4-3

HANDLING COMPONENTS

See Figure 4-3 for the following:

Handle the boom and jib sections with care to avoid damaging the lacings and chords.

All boom and jib sections have lifting lugs (3 and 4) as shown.

WARNING

Falling Load Hazard!

The lifting lugs on each boom or jib section are designed only for lifting that section. Do not attempt to lift two or more boom or jib sections with the lifting lugs on one section. The lifting lugs may break allowing the boom or jib sections to fall.

When the lifting lugs are not used:

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

CAUTION

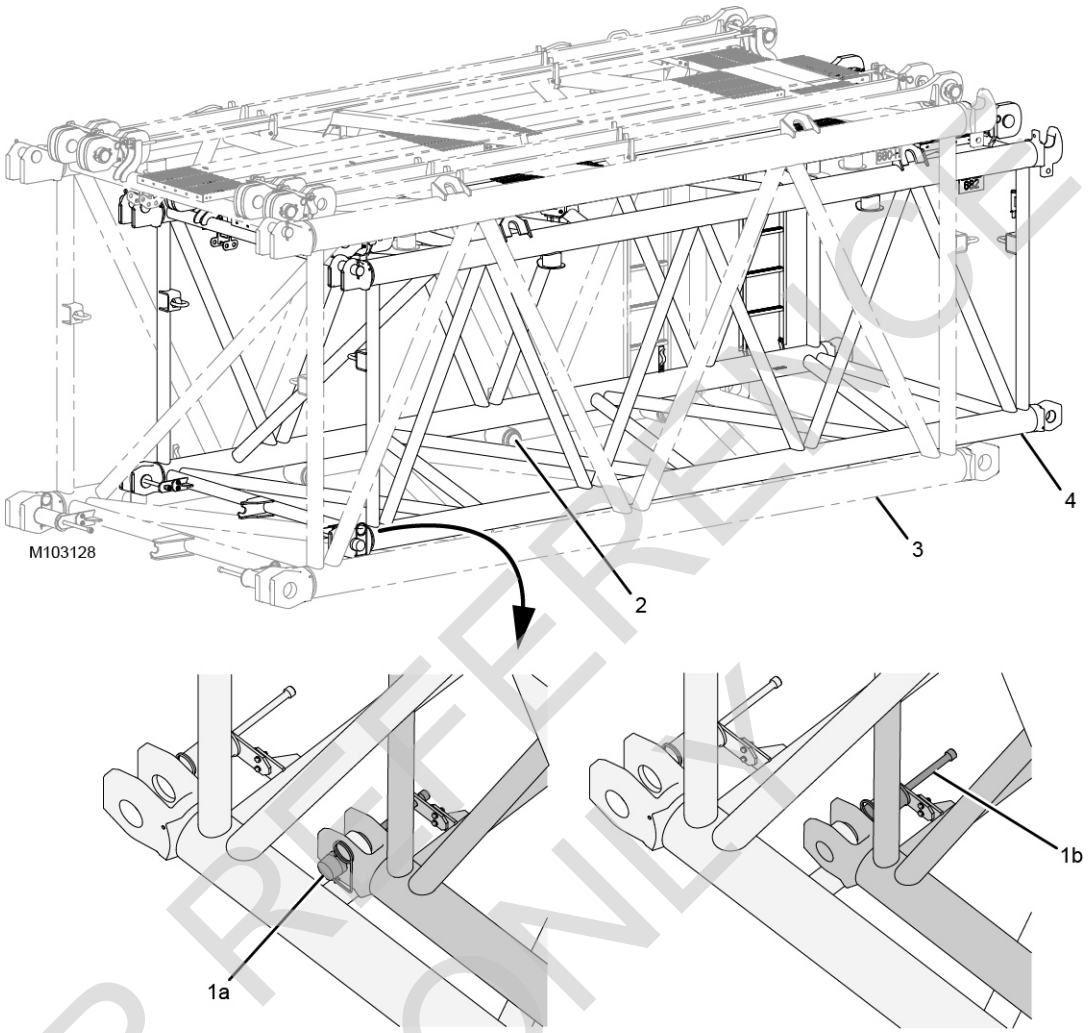
Lacing Damage!

Ensure the boom and jib straps and links are secured in the shipping position on the boom or jib sections during handling and transportation unloading.

WARNING

Personal Injury or Property Damage!

Ensure the boom and jib straps and links remain properly secured in the shipping position on the boom or jib sections during transportation loading or unloading and assembly or disassembly of the boom and jib. The straps and links could shift or fall resulting in personal injury or property damage if not properly secured.



Item	Description
1a	Lower Connector Pin and Safety Pin (shipping) (2 places)
1b	Lower Connector Pin and Safety Pin (stored) (2 places)
2	Roller (6)
3	#680 Boom Section
4	#682 Boom Section

FIGURE 4-4

SHIPPING JIB INSERTS

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

SHIPPING CRANE COMPONENTS

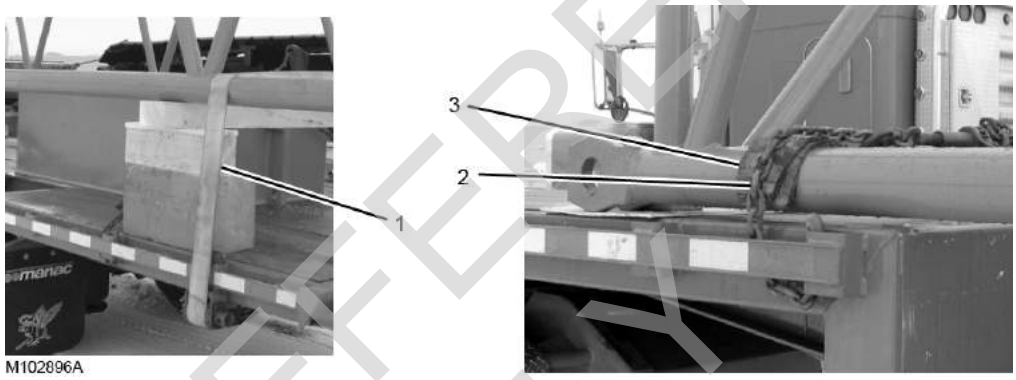
It is the owner/user's responsibility to ensure the following:

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

  Use nylon tie-downs to secure components as shown in Figure 4-5, 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 4-5, View B.

  When securing boom and jib 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.



View A View B

Item	Description
1	Nylon Tie-Down Wrapped Over Boom Chord
2	Chain Tie-Down Wrapped Over Boom Chord
3	Protective Covering (section of rubber tire)

FIGURE 4-5

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.

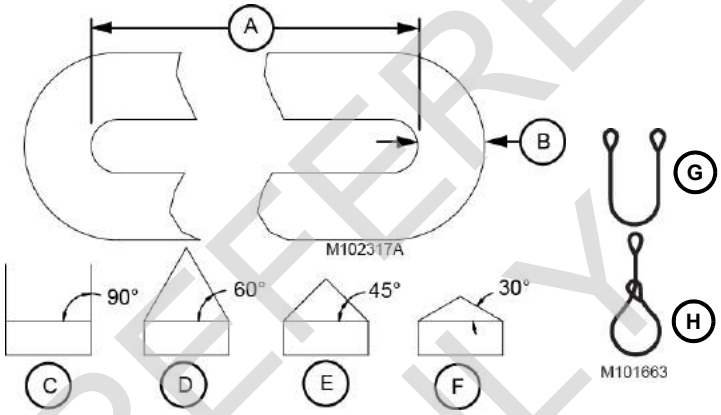
RETAINING CONNECTING PINS

Connecting pins are retained in various ways:

- Locking pins
- Safety Pins
- Lynch Pins
- Cotter pins
- Hair Pin Cotters

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

Sling # Part #	A m (ft)	B mm (in)	C kg (lb)	D kg (lb)	E kg (lb)	F kg (lb)	G kg (lb)	H kg (lb)
SL 1 (2) 81038731	3,30 (10.83)	70,00 (2.75)	45 360 (100,000)	39 281 (86,600)	32 069 (70,700)	22 680 (50,000)	90 718 (200,000)	36 287 (80,000)
SL 2 (2) 81038732	3,10 (10.30)	44,50 (1.75)	18 144 (40,000)	15 712 (34,640)	12 828 (28,280)	9 072 (20,000)	36 287 (80,000)	14 515 (32,000)
SL 3 (1) 81038797	1,60 (5.25)	31,80 (1.25)	9 072 (20,000)	7 856 (17,320)	6 414 (14,140)	4 536 (10,000)	18 144 (40,000)	7 257 (16,000)
SL 4 (4) 81040162	3,80 (12.50)	44, 50 (1.75)	11 340 (25,000)	9 820 (21,650)	8 017 (17,675)	5 670 (12,500)	22 680 (50,000)	9 072 (20,000)
SL 5 (1) 81040488	2,60 (8.50)	76,20 (3.00)	56 700 (125,000)	49 101 (108,250)	40 086 (88,375)	28 350 (62,500)	113 400 (250,000)	45 360 (100,000)
SL 6 (4) 81042116	5,00 (16.40)	54,00 (2.13)	31 751 (70,000)	27 497 (60,620)	22 448 (49,490)	15 876 (35,000)	63 503 (140,000)	25 401 (56,000)



Item	Description
G	Basket Hitch
H	Choker Hitch

Shackle # Part #	A mm (in)	B mm (in)	C mm (in)	D mm (in)	E mm (in)	F mm (in)	G mm (in)	H mm (in)	J mm (in)	K mm (in)
SH 1 (2) 81007187	325 (12.80)	70 (2.76)	70 (2.76)	254 (10.00)	434 (17.10)	150 (5.90)	70 (2.76)	105 (4.10)	70 (2.76)	185 (7.30)
SH 2 (4) 81024427	174,80 (6.88)	41,10 (1.62)	38,80 (1.53)	167,10 (6.58)	254 (10.00)	92.20 (3.63)	42,50 (1.67)	60 (2.36)	38 (1.50)	98,6 (3.88)
SH 3 (4) 81030038	225 (8.90)	57,30 (2.26)	45 (1.77)	177,80 (7.00)	313,7 (12.40)	106,40 (4.20)	50,80 (2.00)	73,20 (2.90)	45 (1.77)	127 (5.00)

Shackle Part #	Shackle Capacities Metric Ton (US Ton)
SH 1 (2) 81007187	55 t (60.60 USt)
SH 2 (4) 81024427	17 t (18.70 USt)
SH 3 (4) 81030038	40 t (44.00 USt)

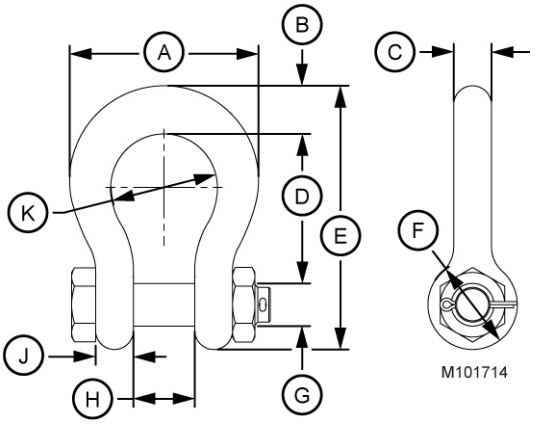


FIGURE 4-6

MANITOWOC SUPPLIED LIFTING SLINGS AND SHACKLES

Manitowoc has supplied the lifting slings and shackles shown in Figure 4-6.

The lifting slings and shackles are stored in the parts boxes (Figure 4-7) supplied with the MLC650.

M102312

FIGURE 4-7

PIN AND CONNECTING HOLE CLEANLINESS

To prevent dirt from damaging closely machined surfaces of pins and connecting holes, perform the following tasks each time the pins are installed:

- Thoroughly clean all pins and connecting holes.
- Apply a light coat of grease to all pins, contacting surfaces, and connecting holes.

CONNECTING/DISCONNECTING ELECTRIC CABLES

Always STOP ENGINE before connecting and disconnecting electric cables. The potential for damage to the electric components exists if the engine is not stopped.

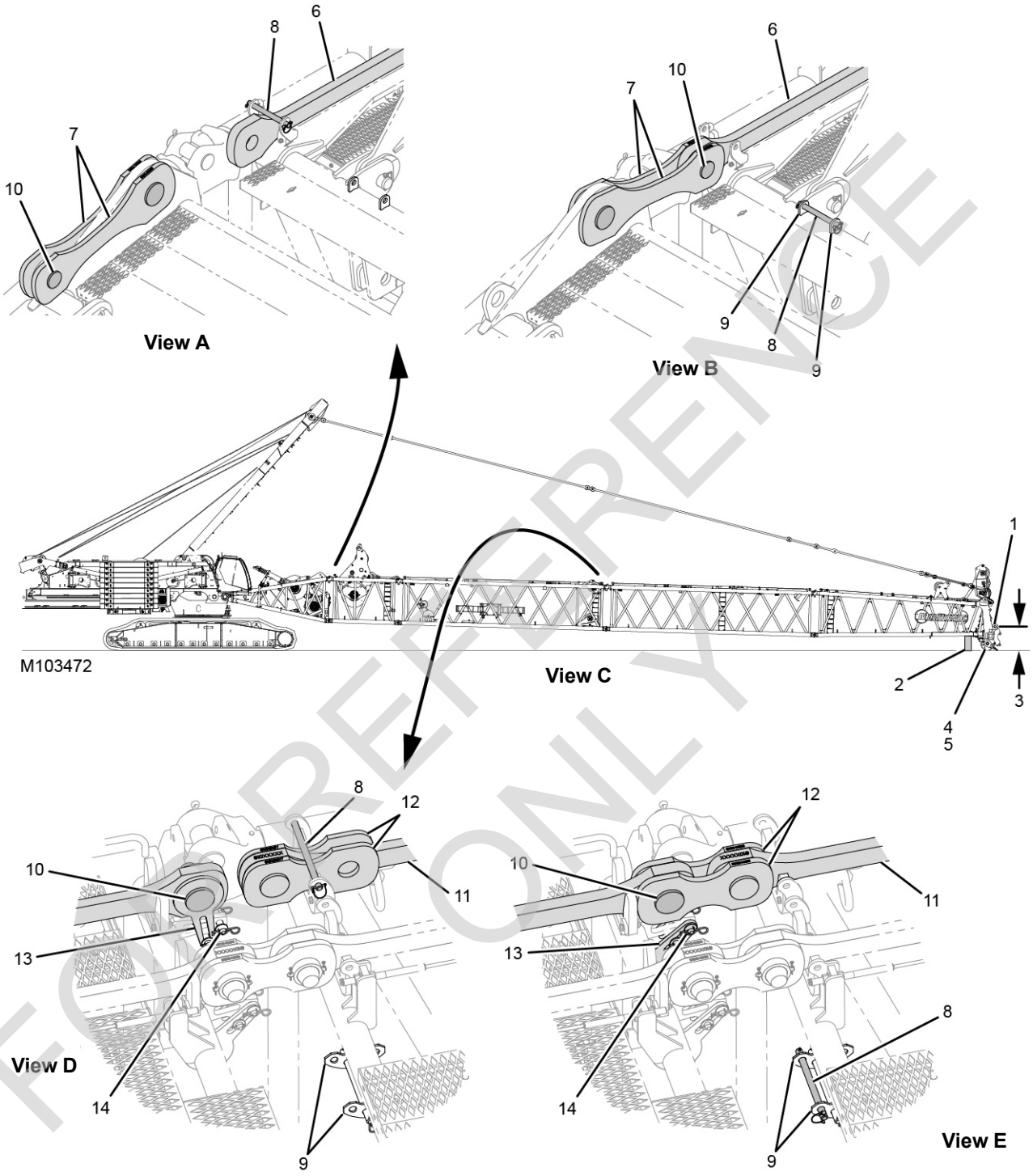
NOTE: To stop the engine if it was started from the remote control, turn the external engine switch COUNTER-CLOCKWISE to the STOP position.

To stop the engine if it was started from the cab, use the ignition switch in the cab.

CABLE CLEANLINESS

To prevent dirt from damaging electrical connectors:

- Thoroughly clean electric connectors before connecting them.
- Thoroughly clean protective caps before attaching them to cables.
- Do not drag electrical connectors or cables on the ground.
- Apply a light coat of silicone lubricant to the threads of all protective caps and connectors to help in preventing the threads from seizing.



Item	Description	Item	Description
1	Jib Butt Connecting Hole	8	Pin and Hair Pin Cotter (qty 2)
2	Blocking under the Boom Top	9	Pin Storage Bracket (qty 4)
3	Distance—1,7 m (5.6 ft)	10	Connecting Pin Assembly (qty 2)
4	Lower Boom Point (qty 3)	11	Strap (qty 2)
5	Boom Top	12	Link (qty 4)
6	Strap (qty 2)	13	Strap Storage Bracket (qty 2)
7	Link (qty 4)	14	Pin and Hair Pin Cotter (qty 2)

FIGURE 4-8

PREPARING THE CRANE FOR LUFFING JIB

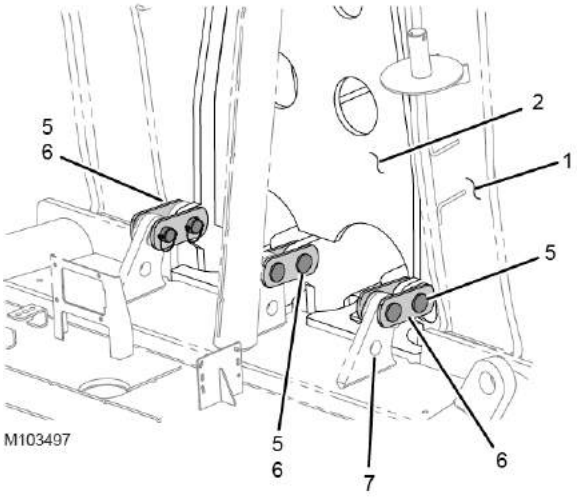
As stated earlier, the instructions in this section assume the boom and the VPC-MAX attachment (if equipped) are already installed.

See Figure 4-8 for the following procedure.

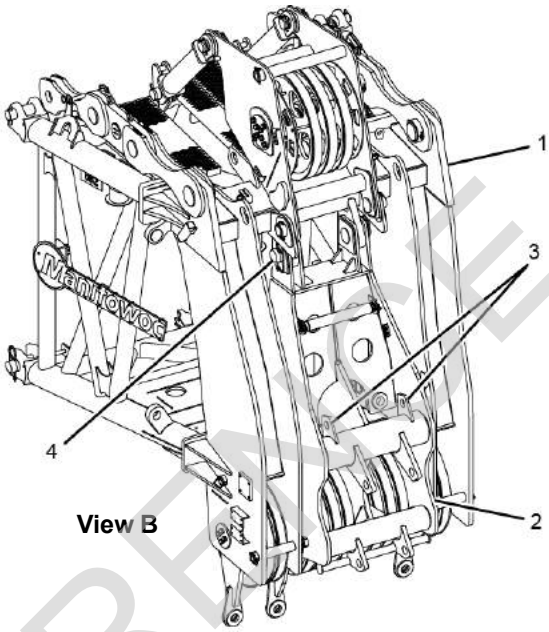
1. Set the automatic boom stop.
2. If blocking is required to raise and lower the luffing jib per the luffing jib raising and lowering procedure chart at the end of this section, proceed as follows:
   a. Position the crawlers so the front crawler rollers are under the boom end of the upperworks.
   b. Travel the crawler rollers onto blocking. See the capacity chart information folio in the Luffing Jib Capacity Chart Manual for blocking instructions.
3. Lower the boom until the jib butt connecting holes (1) are a distance (3) of approximately 1,7 m (5.6 ft) from the ground.
4. Install blocking under the boom top (2, View C).
5. If necessary, remove the load block (not shown) from the lower boom point (4).
6. If installed, remove the fixed jib or the upper boom point from the boom top. See Section 4 of the MLC650 Crane Operator Manual for details.
7. Remove the lower boom points from the boom top (5). See Section 4 of the MLC650 Crane Operator Manual for instructions.

NOTE: The two four-sheave boom points can be moved to the inside location after the eight-sheave boom point has been removed from the boom top.

8. If not already stored on the boom sections, install the backstay straps according to the Luffing Jib Rigging drawing at the end of this section.
9. At the boom butt, connect the backstay straps as follows:
   a. Remove the pin and hair pin cotters (8, View A) and store them in the pin storage brackets (9, View B).
   b. Remove the connecting pin assembly (10, View A).
   c. Rotate the links (7, View A) from the stored position to the working position and install the connecting pin assembly (10, View B) through the straps (6, View A) of the first boom insert.
   d. Repeat step a through step c for the other side of the boom butt.
10. At the top end of each insert, connect the backstay straps as follows:
    a. Remove the pin and hair pin cotters (8, View D) and store them in the pin storage brackets (9, View E).
    b. Remove the connecting pin assembly (10, View D).
    c. Rotate the strap storage bracket (13, View D) downward and secure it in the working position with the pin and hair pin cotter (14, View E).
    d. Rotate the links (12, View D) rearward from the shipping position to the working position.
    e. Install the connecting pin assembly into the strap (11, View E). The pin heads for the backstay straps must face in.
    f. Repeat step a through step e for the other straps at both ends of each boom section.



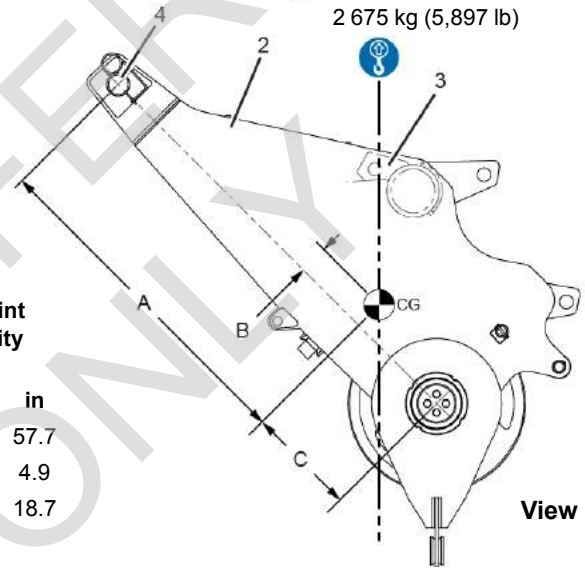
View A



View B

Item	Description
1	Jib Top
2	Lower Boom/Jib Point (8 sheave)
3	Lifting Lug (qty 2)
4	Pin with Safety Pin (qty 2)
5	Pin with Safety Pin (qty 6)
6	Link (qty 6)
7	Storage Holes (qty 3)

2 675 kg (5,897 lb)



View C

Lower Boom Point Centers of Gravity

Item	mm	in
A	1 466,0	57.7
B	125,0	4.9
C	475,2	18.7

FIGURE 4-9

WARNING

Crane Tipping Hazard!

To raise some boom and jib lengths, portions of the lower boom point must be removed.

Refer to the appropriate Liftcrane Boom or Jib Capacity Chart to determine lower boom point sheave requirements and deducts.

WARNING

Crush Hazard!

The lower boom/jib point can shift and crush your hand when removing the connecting pins (4). Properly support the lower boom/jib point, as follows, before removing the connecting pins.

- Lift the lower boom/jib point with shackles and lifting slings until the lifting slings are in a visual straight line drawn through the lower boom/jib point's center of gravity (CG, View C). ***Do not remove the connecting pins (4) until this step is performed***.

See Figure 4-9 for the following procedures.

Removing the Lower Boom Point from the Boom Top

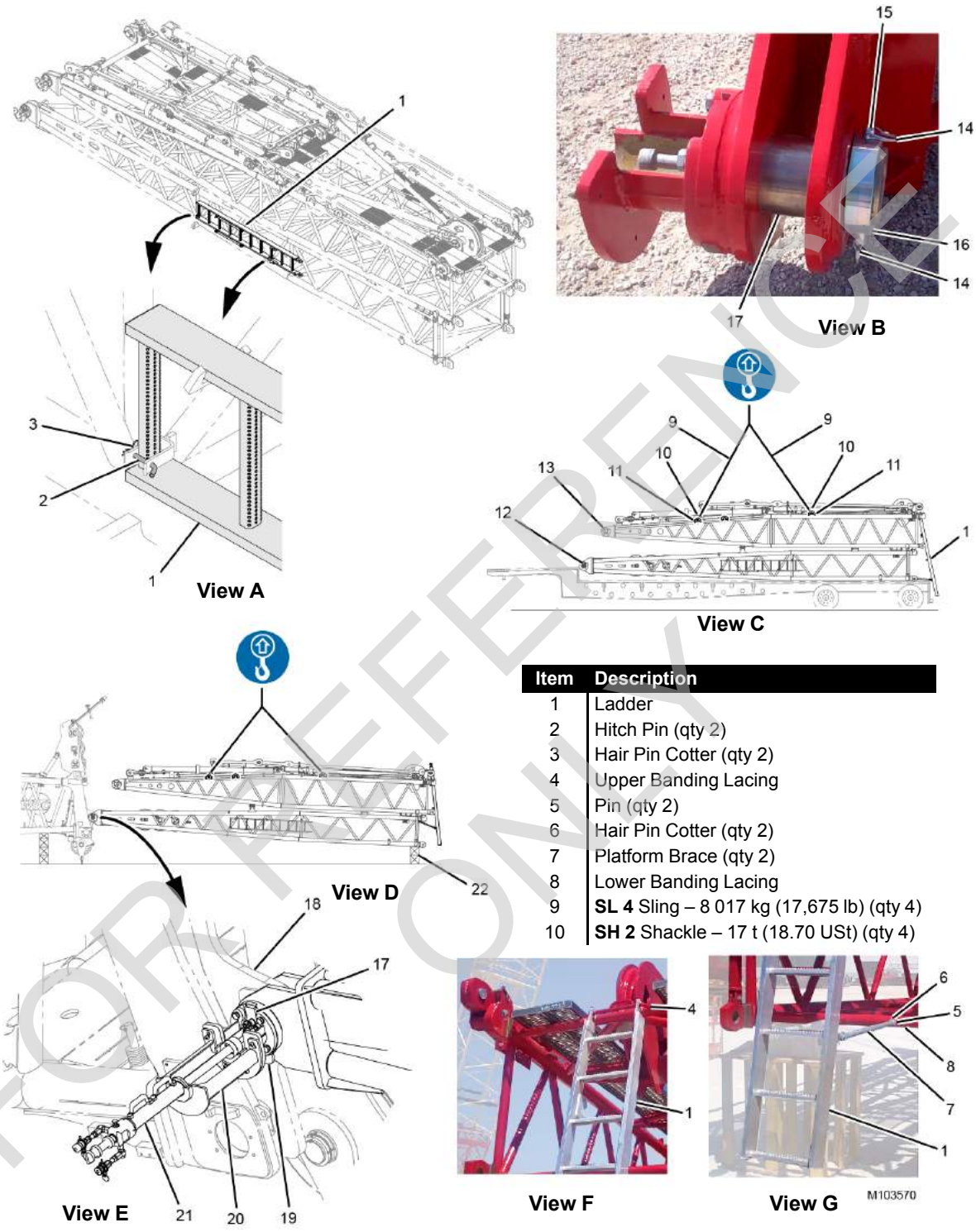
Refer to Section 4 of the MLC650 Crane Operator Manual for lower boom point removal and installation instructions.

Installing the Lower Boom/Jib Point in the Luffing Jib Top

1. Remove the connecting pins (4, View C) from the lower boom/jib point.
2. Using shackles, rig two lifting slings from an assist crane to the lifting lugs (3, View B) on the lower boom/jib point.
3. Lift the lower boom/jib point into position at the end of the jib top (1, View B) and install the connecting pins (4) with safety pins.
4. Lower the lower boom/jib point until the lifting slings are slack and disconnect the shackles and lifting slings.
5. Unpin the pins (5, View A) and the links (6) from the storage holes (7).
6. Pin the links (6, View A) to the lower boom/jib point (2) with the pins (5) and safety pins.

Removing the Lower Boom/Jib Point from the Jib Top

Reverse the installation steps. Adhere to the Crush Hazard Warning.



Item	Description
1	Ladder
2	Hitch Pin (qty 2)
3	Hair Pin Cotter (qty 2)
4	Upper Banding Lacing
5	Pin (qty 2)
6	Hair Pin Cotter (qty 2)
7	Platform Brace (qty 2)
8	Lower Banding Lacing
9	**SL 4** Sling – 8 017 kg (17,675 lb) (qty 4)
10	**SH 2** Shackle – 17 t (18.70 USt) (qty 4)

Item	Description	Item	Description
11	Lifting Lug (qty 4)	17	Hinge Pin (qty 2)
12	Jib Strut Butt	18	Boom Top
13	Main Strut Butt	19	Alignment Plate (qty 2)
14	Locking Pin (qty 4)	20	Pin Puller Cage (qty 2)
15	Two-hole Pin (qty 2)	21	Hydraulic Pin Puller
16	Collar (qty 2)	22	Blocking

FIGURE 4-10

INSTALLING THE LUFFING JIB

Installing The Jib Strut Butt

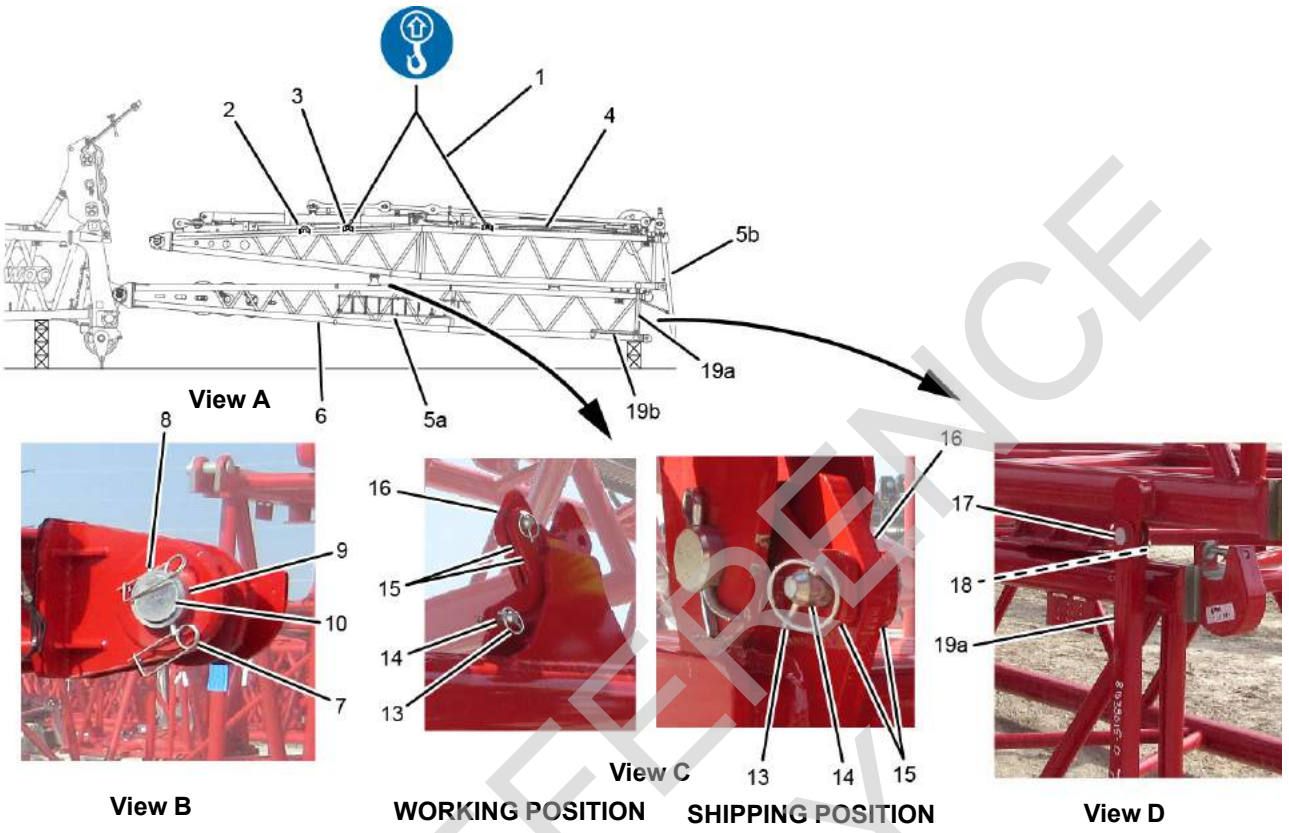
See Figure 4-10 for the following procedure.

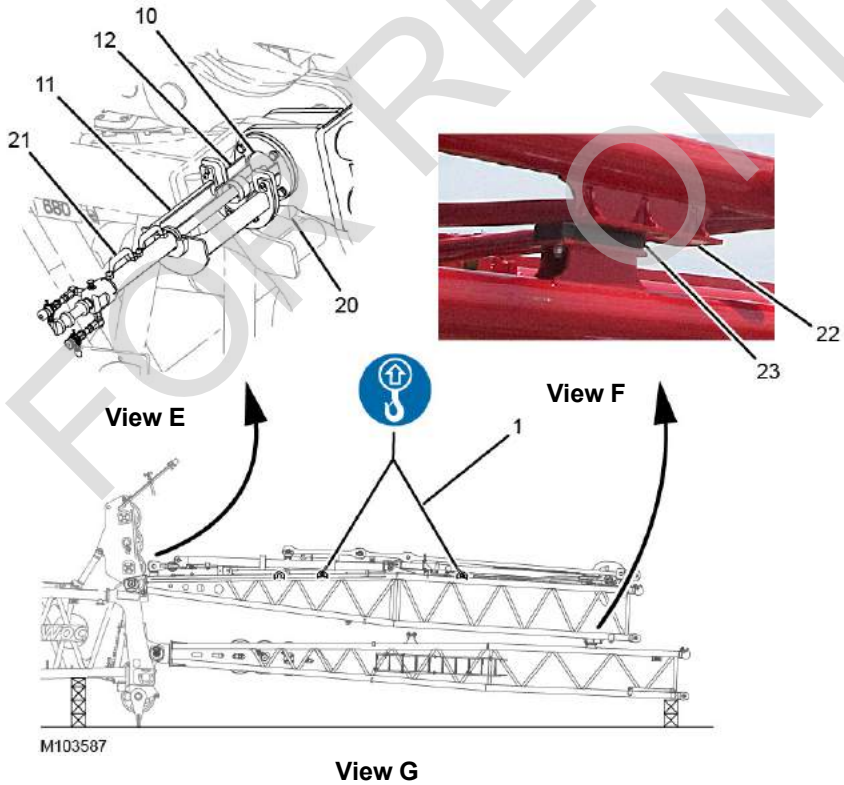
NOTE: The main strut butt and the jib strut butt are shipped as an assembled unit.

1. Remove the hitch pins (2) and hair pin cotters (3) from the jib strut butt (12) and remove the ladder (1, View A) from the shipping position.
2. Hook the ladder (1, View F) on the upper banding lacing (4).
3. Remove the pin (5) and hair pin cotter (6) from the platform brace (7) and move the brace to the working position on the lower banding lacing (8). Reinstall the pin and hair pin cotter. Repeat this step for the second platform brace.
4. Use the ladder to gain access to the top of the struts. Using four **SL 4** slings (9) and four **SH 2** shackles (10), attach the first pair of slings and shackles to the lifting lugs (11) closest to the butt end on the main strut butt (13). Attach the second pair of slings and shackles to the pair of lifting lugs at the opposite end of the main strut butt.
5. Remove the tie downs and blocking securing the struts to the trailer.
6. Using an assist crane, lift the struts off the trailer and remove the trailer from the area.

NOTE: The struts will hang at an approximate angle of 4°.

7. Lower the struts in front of the boom top and align the jib strut holes with the boom top holes.
8. Remove the locking pin (14), two-hole pin (15), and collar (16) from the hinge pin (17, View B) in the jib strut butt. Repeat this step for the other side.
9. Remove the hinge pin from the hole. Repeat this step for the other side.
10. Install the pin puller cage (20). Repeat this step for the other side.
11. Align the jib strut butt holes with the holes in the boom top (18), maintaining light contact with the alignment plate (19).
12. Install the hydraulic pin puller (21) to the pin puller cage and activate the pin puller to push the hinge pin into the hinge pin hole. Repeat this step for the other side.
13. Install the collar, two-hole pin, and locking pin on the hinge pin. Repeat this step for the other side.
14. Place blocking (22) under the jib strut butt to maintain an installation height of 61 cm (24 in).





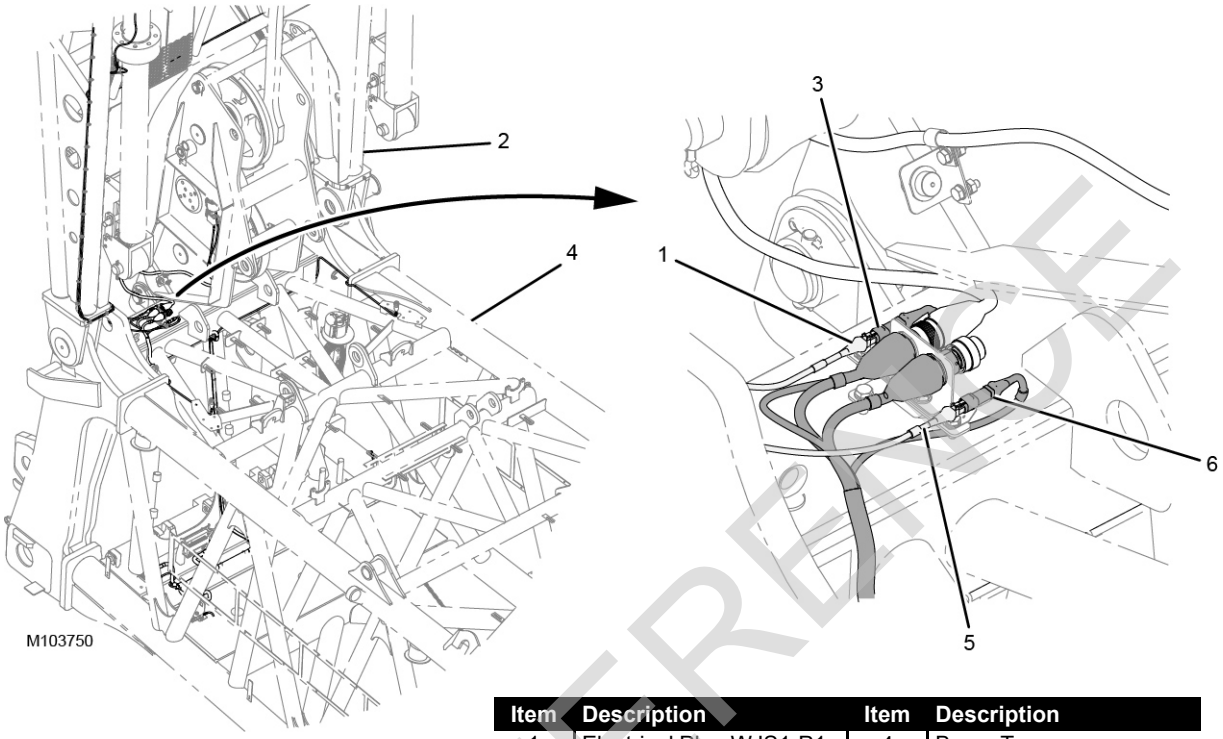
Item	Description
1	**SL 4** Sling – 8 017 kg (17,675 lb) (qty 4)
2	Butt End Lifting Lug (qty 2)
3	Middle Lifting Lug (qty 2)
4	Main Strut Butt
5a	Ladder (stored position)
5b	Ladder (working position)
6	Jib Strut Butt
7	Safety Pin (qty 4)
8	Two-hole Pin (qty 2)
9	Collar (qty 2)
10	Main Strut Hinge Pin (qty 2)
11	Pin Puller Cage (qty 2)
12	Main Strut Butt Hinge Assembly (qty 2)
13	Lynch Pin (qty 4)
14	Pin (qty 4)
15	Shipping Link (qty 4)
16	Pocket (qty 2)
17	Pin (qty 2)
18	Hair Pin Cotter (qty 2)
19a	Shipping Strut (working position) (qty 2)
19b	Shipping Strut (stored position) (qty 2)
20	Alignment Feature (qty 2)
21	Hydraulic Pin Puller
22	Resting Pad (qty 2)
23	Plastic Pad (qty 2)

FIGURE 4-11

Installing The Main Strut Butt

See Figure 4-11 for the following procedure.

1. Hoist down to allow slack in the **SL 4** slings (1, View A).
2. Remove the ladder (5a) from the side of the jib strut butt (6) and attach the ladder (5b) to the main strut butt (4) to gain access to the top of the main strut butt.
3. Move the **SL 4** slings and shackles from the butt end lifting lugs (2) and move the slings and shackles to the middle lifting lugs (3).
4. Remove the ladder (5b) from the main strut butt and secure it to the jib strut butt.
5. Remove the safety pin (7), two-hole pin (8), and collar (9) from the main strut hinge pin (10, View B) on the main strut butt. Repeat this step for the other side.
6. Remove the main strut butt hinge pin from the main strut butt hinge pin hole. Repeat this step for the other side.
7. Install the pin puller cage (11) to the main strut butt hinge assembly (12). Repeat this step for the other side.
8. Remove the lynch pins (13), pins (14), and shipping links (15) from the pocket (16). Move the shipping links to the working position (View C). Repeat this step for the other side.
9. Lift the main strut slightly with the assist crane and remove the pin (17) and the hair pin cotter (18) from the shipping strut (19a, View D). Rotate the strut from the shipping position to the working position, reinstall the pin and the hair pin cotter. Repeat this step for the other side.
10. Align the main strut butt hinge holes with the holes in the boom top. Allow the main strut butt hinge to make light contact with the alignment feature (20) while maintaining an installation angle of approximately 2º.
11. Using the hydraulic pin puller (21), push the hinge pins into the holes on the boom top.
12. Install the two-hole pin, collar, and safety pin in the main strut butt hinge pin. Repeat this step for the other side.
13. Remove the pin puller cages from the main strut butt.
14. Lower the main strut butt until the resting pad (22) makes contact with the plastic pad (23) on the jib strut butt.



Item	Description	Item	Description
1	Electrical Plug WJS1-P1	4	Boom Top
2	Main Strut Butt	5	Electrical Plug WJS2-P1
3	Electrical Plug WBT1-J8	6	Electrical Plug WBT1-J7

FIGURE 4-12

Installing The Main Strut Butt (continued)

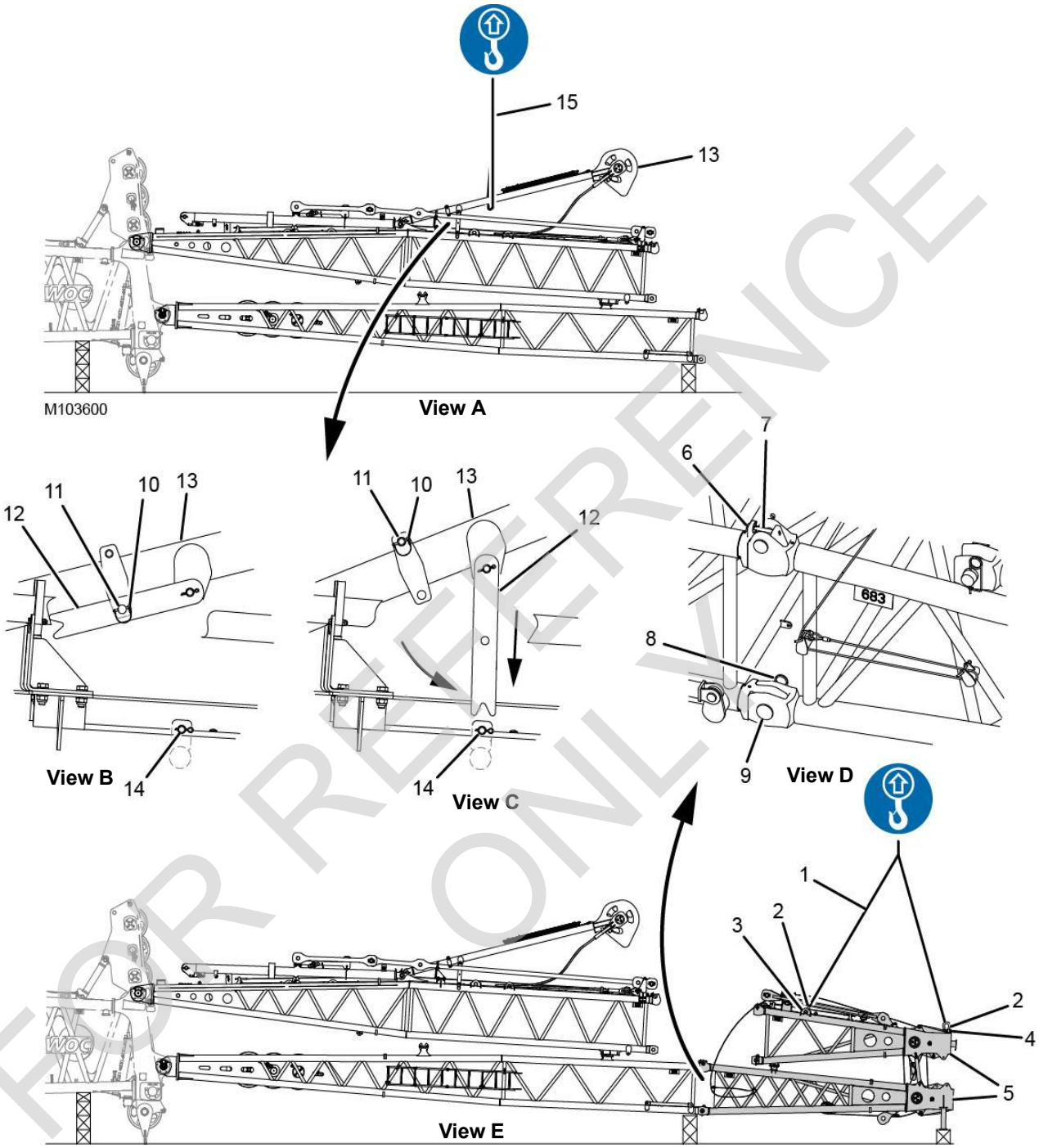
See Figure 4-12 for the remaining steps:

15. Connect electrical plug WJS1-P1 (1) on the main strut butt (2) to electrical plug WBT1-J8 (3) on the boom top (4).

16. Connect electrical plug WJS2-P1 (5) on the main strut butt to electrical plug WBT1-J7 (6) on the boom top.

17. Remove the slings and shackles from the lifting lugs on the main strut butt.

THIS PAGE INTENTIONALLY LEFT BLANK



Item	Description	Item	Description
1	**SL 4** Sling – 8 017 kg (17,675 lb) (qty 4)	9	Connecting Pin (qty 2)
2	**SH 2** Shackle – 17 t (18.70 USt) (qty 4)	10	Locking Pin
3	Lifting Lug (qty 2)	11	Pin (qty 2)
4	D-ring (qty 2)	12	Kickstand (qty 2)
5	Strut Top Assembly	13	Strut Raising Arm Assembly
6	Cotter Pin (qty 2)	14	Resting Pin (qty 2)
7	Pin (qty 2)	15	**SL 4** Sling – 22 680 kg (50,000 lb)
8	Safety Pin (qty 2)		

FIGURE 4-13

Erecting the Strut Raising Arm

See Figure 4-13 for the following procedure.

1. Remove the locking pin (10, View B) and the pin (11, View B) that lock the kickstand (12, View B) in the shipping position. Install the pin (11, View C) and locking pin (10, View C) in the working position. Repeat this step for the other side.
2. Using an assist crane and a **SL 4** sling (15), place a basket hitch under the crossbar of the strut raising arm assembly and lift the strut raising arm assembly (13, View A) to the setup position to deploy the kickstands.

NOTE: When the strut raising arm assembly (13, View C) is raised, the strut raising arm kickstands must align with the resting pins (14, View C) of the main strut butt assembly. Make sure that the strut raising arm kickstands are aligned before lowering the strut raising arm.

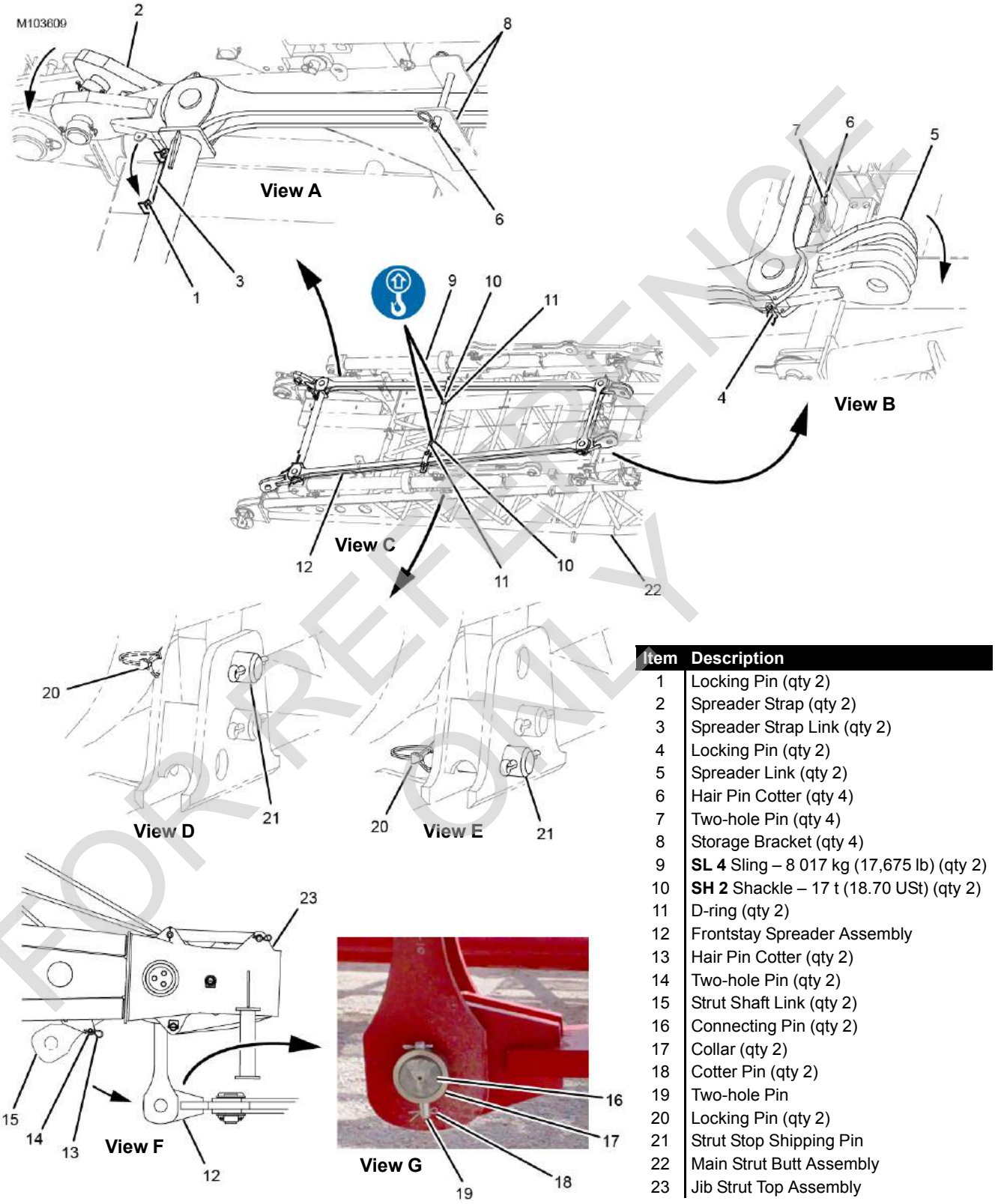
3. Lower the strut raising arm onto the resting pins.
4. Remove the sling from the strut raising arm assembly crossbar.

Installing the Jib Strut Top

See Figure 4-13 for the following procedure.

NOTE: Manitowoc reeves the jib strut top sheaves and the main strut top sheaves with a two-piece sucker line prior to shipping the strut top assembly (5).

1. Attach four **SL 4** slings (1) and four **SH 2** shackles (2) to the lifting lugs (3) and D-rings (4) on the jib strut top assembly (5).
2. Remove the cotter pin (6) and the pin (7), if installed, from the upper pin connector pocket. Repeat this step for the other side.
3. Remove the safety pin (8) and the lower connecting pin (9). Repeat this step for the other side.
4. Using an assist crane, lift the strut top assembly from the trailer. Remove the trailer from the area.
5. Align the upper connecting pin with the jib strut butt upper connector pocket. Lower the strut top assembly to engage the upper connecting pins in the jib strut butt.
6. Lower the strut top assembly until the lower connecting pin holes align.
7. Install the pin and cotter pin in the upper pin connector pocket. Repeat this step for the other side.
8. Install the lower connecting pin and the safety pin in the lower connecting pin hole. Repeat this step for the other side.
9. Remove the slings and shackles.



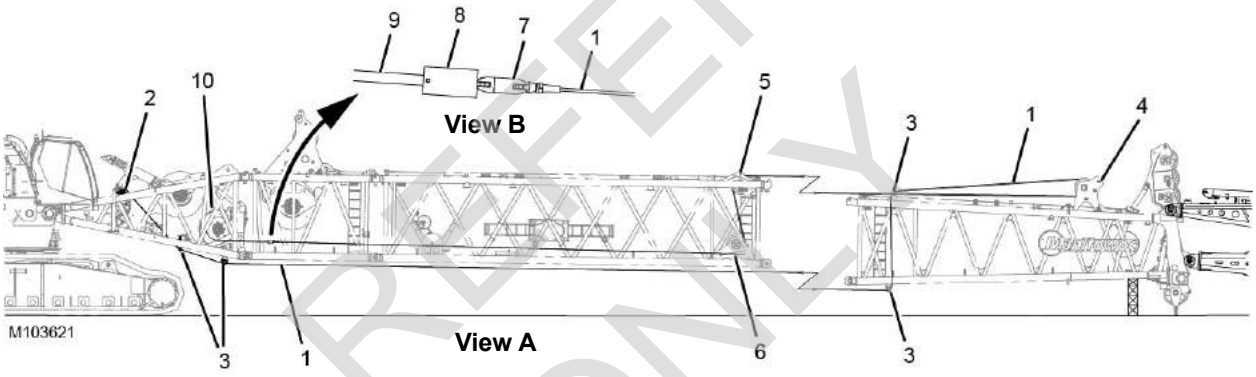
Item	Description
1	Locking Pin (qty 2)
2	Spreader Strap (qty 2)
3	Spreader Strap Link (qty 2)
4	Locking Pin (qty 2)
5	Spreader Link (qty 2)
6	Hair Pin Cotter (qty 4)
7	Two-hole Pin (qty 4)
8	Storage Bracket (qty 4)
9	**SL 4** Sling – 8 017 kg (17,675 lb) (qty 2)
10	**SH 2** Shackle – 17 t (18.70 USt) (qty 2)
11	D-ring (qty 2)
12	Frontstay Spreader Assembly
13	Hair Pin Cotter (qty 2)
14	Two-hole Pin (qty 2)
15	Strut Shaft Link (qty 2)
16	Connecting Pin (qty 2)
17	Collar (qty 2)
18	Cotter Pin (qty 2)
19	Two-hole Pin
20	Locking Pin (qty 2)
21	Strut Stop Shipping Pin
22	Main Strut Butt Assembly
23	Jib Strut Top Assembly

FIGURE 4-14

Installing the Frontstay Spreader Assembly

See Figure 4-14 for the following procedure.

1. Remove the locking pin (1) and position the spreader strap (2) in the working position. Position the spreader strap link (3) in the stored position. Repeat this step for the other side.
2. Remove the locking pin (4) and position the spreader link (5) in the working position. Reinstall the locking pin in the hole of the spreader link. Repeat this step for the other side.
3. Remove the hair pin cotters (6, View A and B) and two-hole pins (7) that secure the frontstay spreader assembly (12, View C). Place the pins in the lower holes of the storage bracket (8). Repeat this step for the other side.
4. Attach two **SL 4** slings (9) and two **SH 2** shackles (10) to the D-rings (11) located on the frontstay spreader assembly.
5. Using an assist crane, remove the frontstay spreader assembly from the main strut butt assembly (22).
6. Remove the hair pin cotter (13) and the two-hole pin (14) and move the strut shaft link (15) to the working position. Install the two-hole pin and the hair pin cotter in the hole above where it was removed. Repeat this step for the other side.
7. Place the frontstay spreader assembly in front of the jib strut top assembly and install the connecting pins (16) with the connecting pin head facing the outside of the jib strut top assembly. Repeat this step for the other side.
8. Install the collar (17), two-hole pin (19), and cotter pin (18). Repeat this step for the other side.
9. Remove the locking pin (20, View D) and the strut stop shipping pin (21, View D). Install the strut stop shipping pin (21, View E) in the working position and install the locking pin (20, View E). Repeat this step for the other side.



Item	Description
1	Rigging Line
2	Rigging Winch
3	Wire Rope Guide (qty 4)
4	Luffing Hoist Wire Rope Guide Sheave
5	Upper Luffing Hoist Wire Rope Guide Sheave
6	Lower Luffing Hoist Wire Rope Guide Sheave
7	Swivel
8	Button End
9	Luffing Hoist Wire Rope
10	Luffing Hoist Drum

FIGURE 4-15

Reeving the Strut Tops

CAUTION

Avoid Rigging Winch or Wire Rope Damage!

The rigging winch will not automatically pay out if the selected load drum control handle is pulled back to the haul-in position.

Structural damage to the winch and rigging line will occur!

If it is necessary to haul in the load line on the load drum when the load line is connected to the rigging line, pay out the rigging line with the Drum 0 control handle while hauling in the load line with the load drum control handle.

See Figure 4-15 for the following procedure.

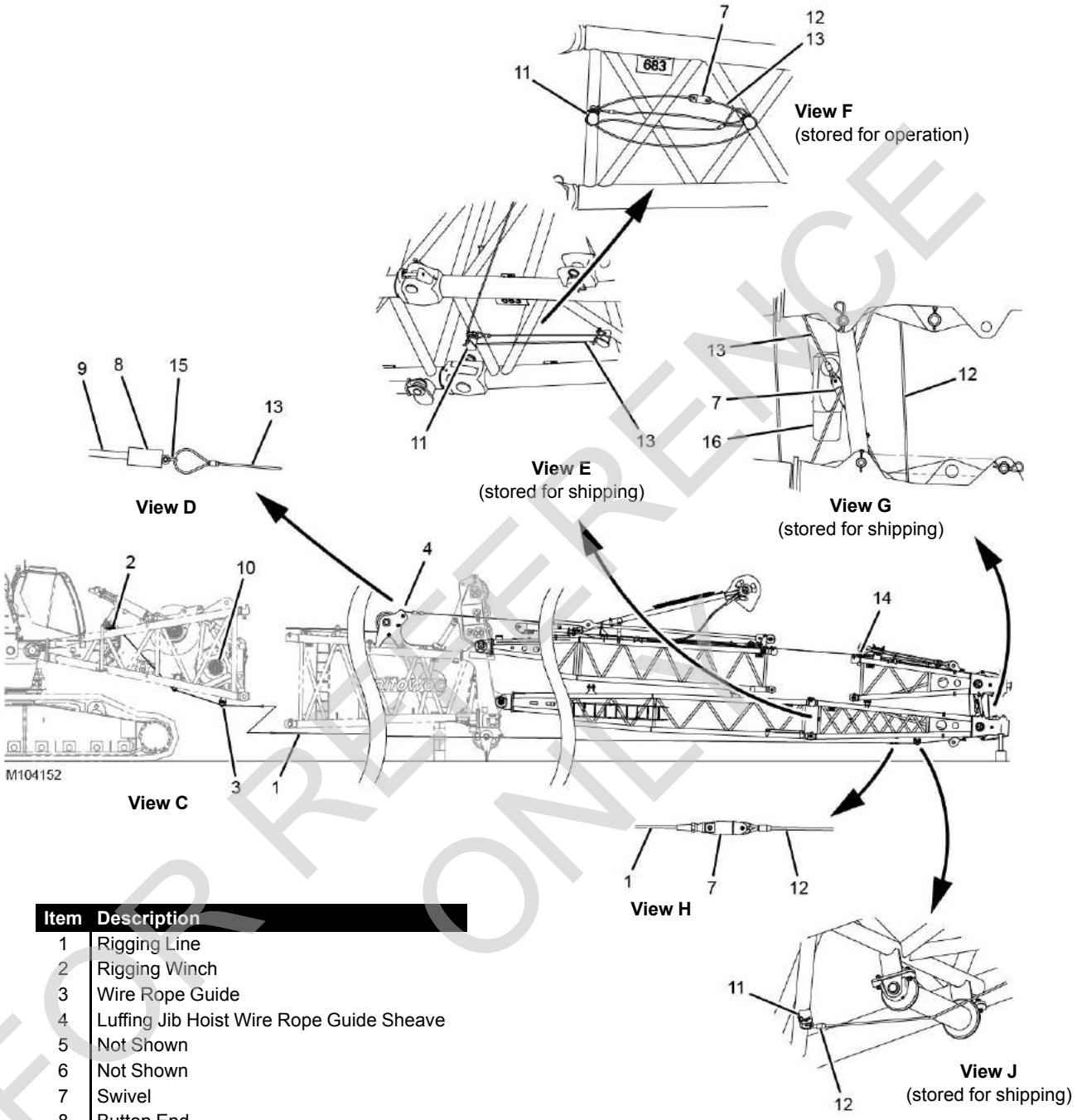
To pay out the rigging line (1) from the rigging winch (2), see Rigging Winch Operation, on page 4-132.

Reeving diagrams are provided in the Luffing Jib Rigging Drawing at the end of this section.

1. Move the wire rope guides (3, View A) to the working position.
2. While paying out the rigging line (1, View A), route the rigging line through the wire rope guides as follows:
   - Through the wire rope guides (3) located on the boom butt and the boom top
   - Over and under the luffing hoist wire rope guide sheave (4)
   - Over the upper luffing jib hoist wire rope guide sheave (5)
   - Through the 12M boom insert and under the lower luffing hoist wire rope guide sheave (6)
   - Through the boom sections to the luffing hoist drum (10)
3. Make sure the rigging line runs freely from the rigging winch to the luffing hoist drum without being hooked on or entangled with any part of the boom.
4. Using the swivel (7, View B), connect the rigging line (1) to the button (8) on the end of the luffing hoist wire rope (9).
5. Enable the Rigging Winch mode. See "Selecting Rigging Winch Mode" on page 4-132.
6. Operate the rigging winch to pay out the luffing hoist wire rope and haul in the rigging line.

   NOTE: Have an assistant observe the reeving process to prevent damage to components.
7. Continue to pay out the luffing hoist wire rope until it is pulled out to the top of the luffing hoist wire rope guide sheave (4) on the boom top.
8. Disable the Rigging Winch mode. See "Selecting Rigging Winch Mode" on page 4-132.
9. Disconnect the rigging line from the luffing jib line.
10. Move the rigging line to the underside of the boom.
11. Move the wire rope guides (3) on the boom top to the shipping position.

Continued on page 4-27.



Item	Description
1	Rigging Line
2	Rigging Winch
3	Wire Rope Guide
4	Luffing Jib Hoist Wire Rope Guide Sheave
5	Not Shown
6	Not Shown
7	Swivel
8	Button End
9	Luffing Hoist Wire Rope
10	Luffing Hoist Drum
11	Hitch Pin (2)
12	Sucker Line: 22,2 m (72 ft 10 in)
13	Sucker Line 38,7 m (127 ft)
14	Roller
15	Shackle
16	Button Socket

FIGURE 4-15 continued

12. Remove the hitch pin (11, View J) to disconnect the sucker line (12) from the storage lugs on the underside of the jib strut top. Reinstall the hitch pin in the lugs.

13. Attach the swivel (7, View H) on the rigging line (1) to the sucker line (12).

14. Remove the hitch pin (11, View E) to disconnect the sucker line (13) from the storage lugs on the side of the jib strut top. Reinstall the hitch pin in the lugs.

15. Uncoil the sucker line (13, View E) from the storage lugs, route the sucker line (13) over the roller (14) on the main strut top, and pull the sucker line to the luffing hoist wire rope guide (4, View C) on the boom top.

16. Connect the sucker line (13, View D) to the button (8) on the luffing hoist wire rope (9) with the shackle (15).

17. Make sure the rigging line and sucker lines run freely from the underside of the boom, through the strut top sheaves, to the boom top without being hooked on or entangled with any part of the attachment.

18. Enable the Rigging Winch mode. See "Selecting Rigging Winch Mode" on page 4-132.

NOTE: Have an assistant observe the reeving process to prevent damage to components.

19. Pay out the luffing hoist wire rope to reeve it through the strut top sheaves.

NOTE: For boom lengths less than 56 m, remove the sucker line (12) when it reaches the wire rope guide (3) in the bottom of the boom butt.

Pay out the rigging line (1) and reconnect it to the remaining sucker line (13).

20. Continue to pay out the luffing hoist wire rope until there is enough wire rope to manually reeve the last sheave and attach the luffing hoist wire rope to the dead end.

21. Disable the Rigging Winch mode. See "Selecting Rigging Winch Mode" on page 4-132.

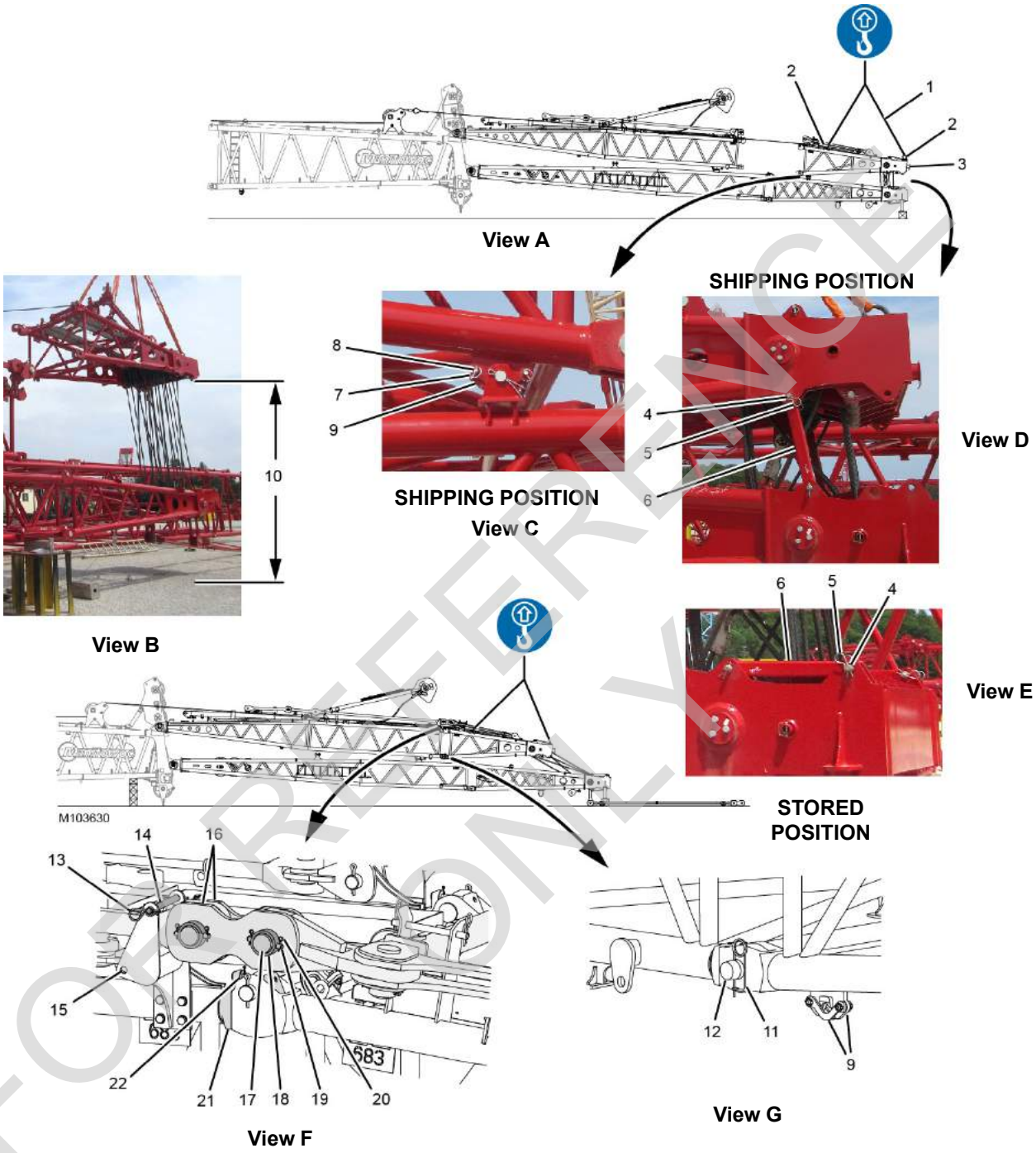
22. Disconnect and coil both sucker lines on the side of the jib strut top (View F).

23. Reeve the last sheave and anchor the button end of the luffing hoist wire rope to the button socket (16, View G) in the main strut top. See "Anchoring Wire Rope to Button Socket" on page 4-129.

24. Attach the button socket to the dead end.

25. Store the rigging line on the rigging winch.

26. Move the wire rope guides (3, View C) on the boom butt to the working position.



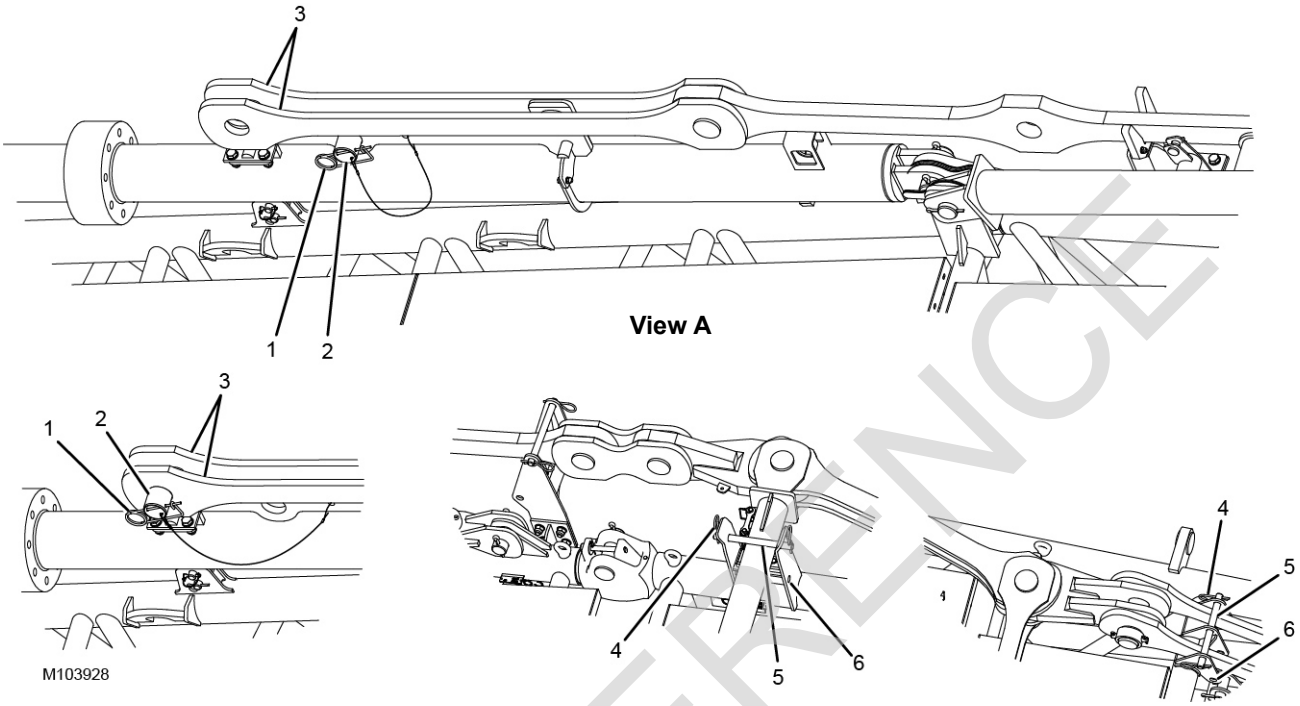
Item	Description	Item	Description	Item	Description
1	**SL 4** Sling – 8 017 kg (17,675 lb) (qty 4)	9	Shipping Link (qty 4)	17	Pin (qty 2)
2	**SH 2** Shackle – 17 t (18.70 USt) (qty 4)	10	Height—3,6 m (12 ft)	18	Collar (qty 2)
3	Main Strut Top	11	Safety Pin (qty 2)	19	Two-hole Pin (qty 2)
4	Pin (qty 2)	12	Connecting Pin (qty 2)	20	Cotter Pin (qty 2)
5	Hair Pin Cotter (qty 2)	13	Hair Pin Cotter (qty 2)	21	Hooked Connector (qty 2)
6	Shipping Strut (qty 2)	14	Pin (qty 2)	22	Pin (qty 2)
7	Lynch Pin (qty 4)	15	Pin Storage Location		
8	Pin (qty 4)	16	Strap Link (qty 4)		

FIGURE 4-16

Installing the Main Strut Top

See Figure 4-16 for the following procedure.

1. Using an assist crane, attach four **SL 4** slings (1) and four **SH 2** shackles (2) to the main strut top (3). Hoist just enough to support the main strut top so that the pins (4, View D) are loose.
2. Using a ladder or a boom lift, remove the hair pin cotter (5, View D) and the pin and lower the shipping strut (6, View D) to the stored position on the jib strut top (View E). Install the pin and the hair pin cotter to secure the strut support to the jib strut top. Repeat this step for the other side.
3. Remove the lynch pins (7) and the pins (8) to remove the shipping links (9, View C). Set aside the lynch pins, pins, and shipping links. Repeat this step for the other side.
4. Configure the RCL with the luffing jib specifications that will be used. See “Entering Luffing Jib Configuration” in the RCL/RCI Operation Manual.
5. Enable Luffing Jib Setup mode on the RCL. See “Bypassing Limits In Luffing Jib Mode” in Section 3 of this manual.
6. With the main strut top free of the jib strut, slowly pay out the luffing hoist wire rope while lifting the main strut top with the assist crane to a height (10) of 3,6 m (12 ft) from the ground surface.
7. Move the main strut top to the main strut butt and align the mounting holes.
8. Remove the cotter pin, washer, and pin (22) from both sides of the main strut butt top hooked connectors (21). Repeat this step for the other side.
9. Remove the safety pin (11) and connecting pin (12) from both sides of the main strut top. Repeat this step for the other side.
10. Align the main strut top upper connecting pins with the main strut butt top hooked connectors. Lower the main strut top to engage the upper connecting pins with the hooked connectors on the main strut butt.
11. Continue lowering the main strut top until the lower connecting holes align.
12. Install the connecting pins and the safety pins in the main strut butt. Repeat this step for the other side.
13. Install the cotter pin, washer, and pin (22) on both sides of the main strut butt top hooked connectors (21).
14. Remove the hair pin cotter (13) and the pin (14). Insert the pin into the pin storage location (15). Repeat this step for the other side.
15. Rotate the strap links (16) to the working position and install the pin (17) through the strap links into the front stay spreader assembly. Install the collar (18), two-hole pin (19), and cotter pin (20) onto the pin. Repeat this step for the other side.
16. Install the shipping links, pins, and lynch pins to the stored position (View G).
17. Remove the slings and shackles from the main strut top.



Item	Description
1	Safety Pin (qty 2)
2	Hold-down Pin (qty 2)
3	Adjustable Link (qty 2)
4	Hair Pin Cotter (qty 4)
5	Pin (qty 4)
6	Pin Storage Hole (qty 4)

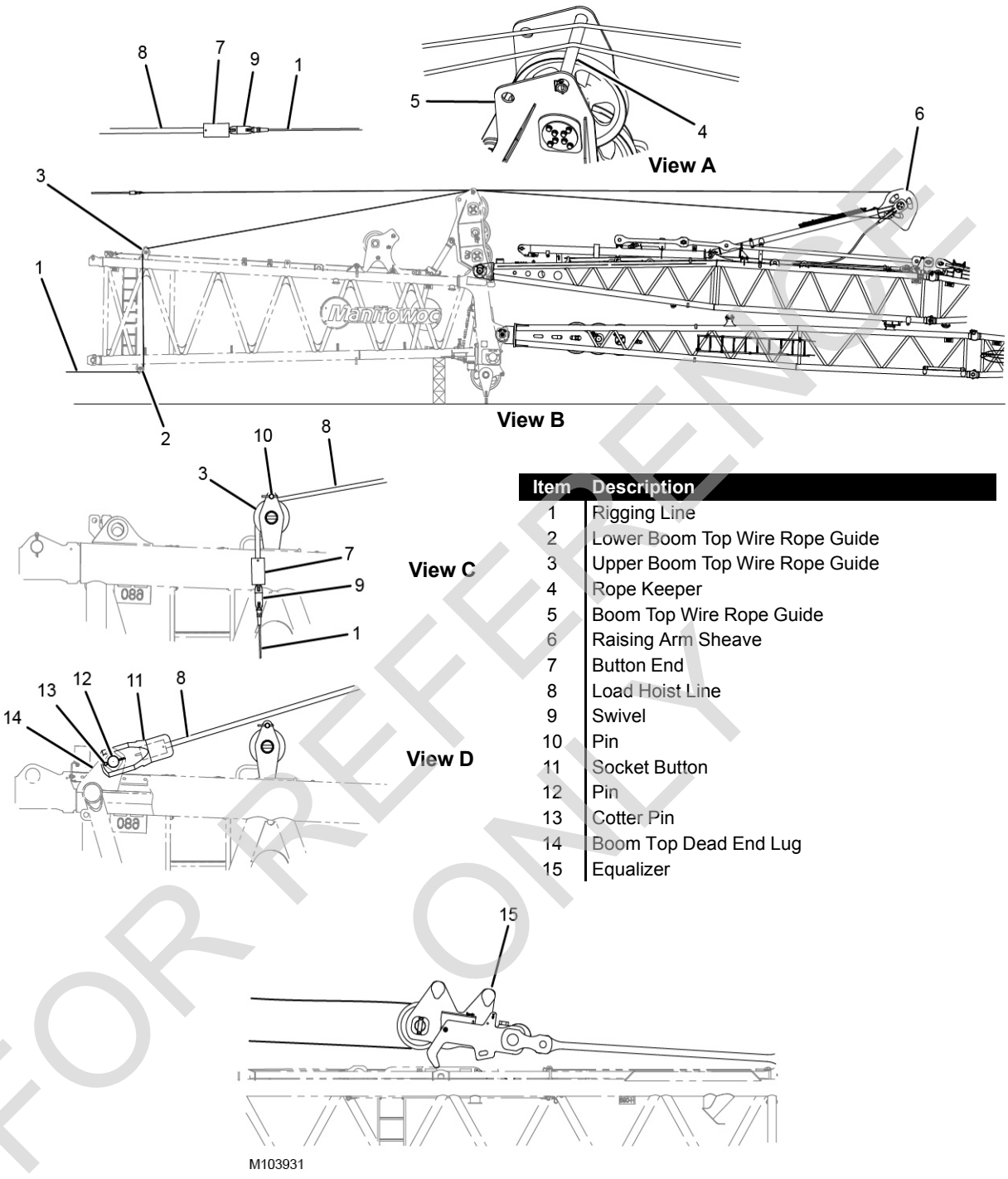
FIGURE 4-17

Preparing the Backstay Straps

See Figure 4-17 for the following procedure.

1. Remove the safety pin (1, View B) and hold-down pin (2, View B) from the adjustable link (3, View B) and move the hold-down pin and safety pin to the stored position (View A). Repeat this step for the other side.
2. Remove the hair pin cotters (4) and two-hole pins (5) on the right and left sides of the backstay strap. Install the two-hole pins in the pin storage holes (6).

THIS PAGE INTENTIONALLY LEFT BLANK



Item	Description
1	Rigging Line
2	Lower Boom Top Wire Rope Guide
3	Upper Boom Top Wire Rope Guide
4	Rope Keeper
5	Boom Top Wire Rope Guide
6	Raising Arm Sheave
7	Button End
8	Load Hoist Line
9	Swivel
10	Pin
11	Socket Button
12	Pin
13	Cotter Pin
14	Boom Top Dead End Lug
15	Equalizer

FIGURE 4-18

Reeving the Strut Raising Arm

See Figure 4-18 for the following procedure.

1. Reeve the strut raising arm using the following procedure depending on crane setup:

   a. Cranes without VPC-MAX:

      Route the rigging line (1, View B) around the lower and upper boom top wire rope guides (2 and 3, View B). Place the rigging line over the rope keeper (4), located on the boom top wire rope guide (5) and up through the bottom and around the top of the raising arm sheave (6). Route the rigging line back to the 4M insert or boom butt and attach it to the button end (7, View A) of the load hoist line (8, View A) using a swivel (9, View A).

   b. Cranes with VPC-MAX:

      Route the rigging line in the same manner as shown in substep a, while making the following changes regarding the equalizer (15):

      - For 44 to 56M boom lengths, reeve the load hoist line to the strut raising arm sheaves through the boom hoist reeving.
      - For boom lengths greater than 62M, raise the equalizer and reeve the load hoist line under the equalizer prior to reeving the strut raising arm sheaves.

CAUTION

Avoid Rigging Winch or Wire Rope Damage!

The rigging winch drum will not automatically pay out if the selected load drum control handle is pulled back to the haul-in position.

Structural damage to the winch and rigging line will occur!

If necessary, haul in the load line on the load drum when the load line is connected to the rigging line, and pay out the rigging line with the Drum 0 control handle while hauling in the load line with the load drum control handle.

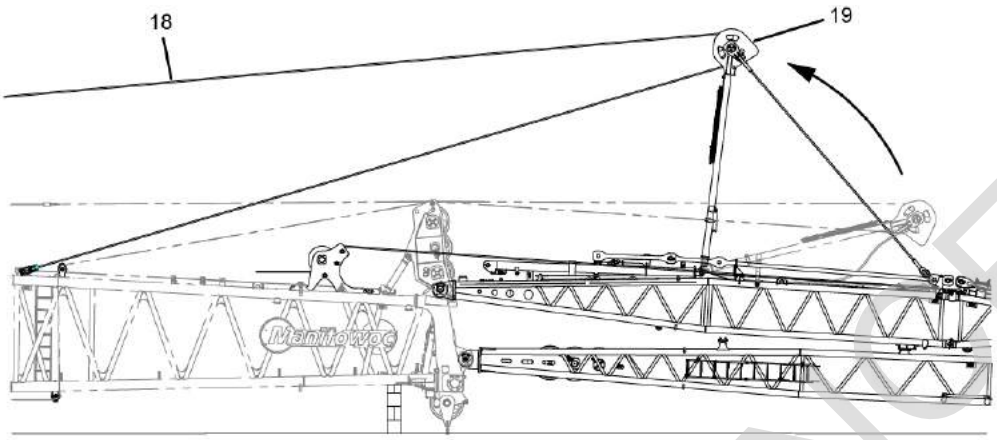
2. Enable Rigging Winch mode. See "Selecting Rigging Winch Mode" on page 4-132.

NOTE: Make sure an assistant observes all wire rope guides during the reeving process to prevent damage to the rigging line, the luffing hoist wire rope, and the wire rope guides.

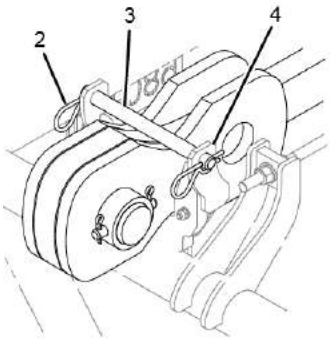
3. Pay out the load hoist line while in Rigging Winch mode to reeve the strut raising arm.

NOTE: The pin must be removed before the button end can pass over the upper boom top wire rope guide.

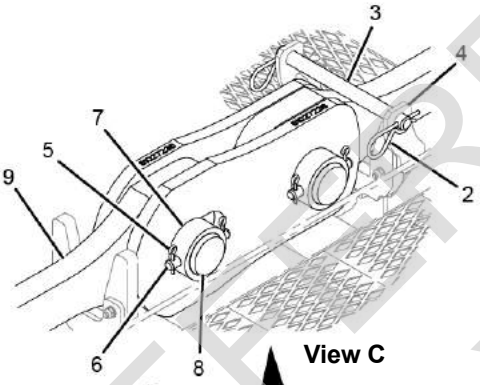
4. Remove the pin (10) and pull the button end of the load hoist line over the upper boom top wire rope guide to approximately half of the distance to the lower boom top wire rope guide.
5. Disable Rigging Winch mode. See "Selecting Rigging Winch Mode" on page 4-132.
6. Pay out the rigging hoist line and disconnect the load hoist line.
7. Return the rigging hoist line to the underside of the main boom.
8. Attach a socket button (11) to the button end of the load hoist line.
9. Install the pin (12) through the socket button and the boom top dead end lug (14). Install the cotter pin (13) in the pin.



View A

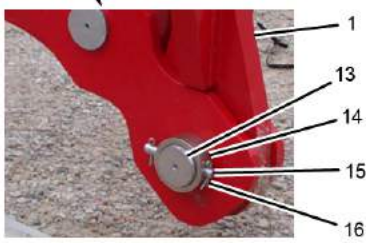


View B

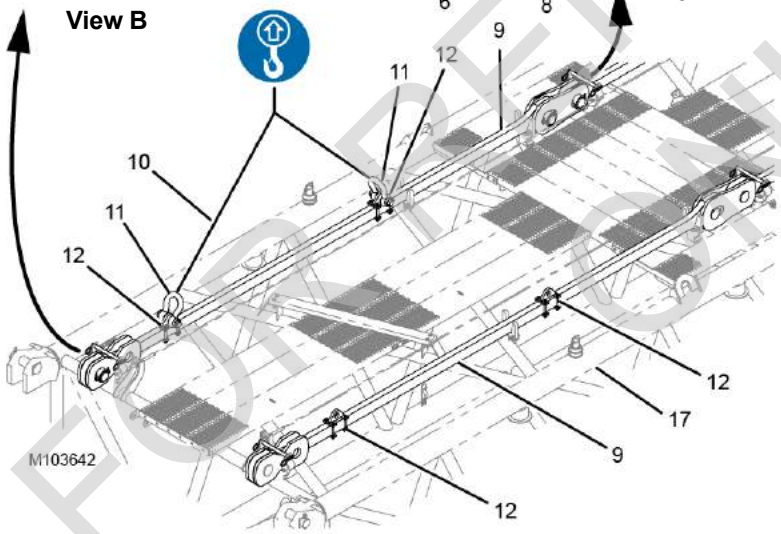


View C

View D



View E



Item	Description	Item	Description
1	Frontstay Spreader Assembly	11	**SH 2** Shackle – 17 t (18.70 USt) (qty 2)
2	Hair Pin Cotter (qty 4)	12	Lifting Lug (qty 4)
3	Pin (qty 4)	13	Connecting Pin (qty 2)
4	Storage Bracket	14	Collar (qty 2)
5	Cotter Pin (qty 2)	15	Two-hole Pin (qty 2)
6	Two-hole Pin (qty 2)	16	Cotter Pin (qty 2)
7	Collar (qty 2)	17	12M #680/681 Insert
8	Connecting Pin (qty 2)	18	Load Line
9	Short Strap (qty 2)	19	Strut Raising Arm
10	**SL 4** Sling – 8 017 kg (17,675 lb) (qty 2)		

FIGURE 4-19

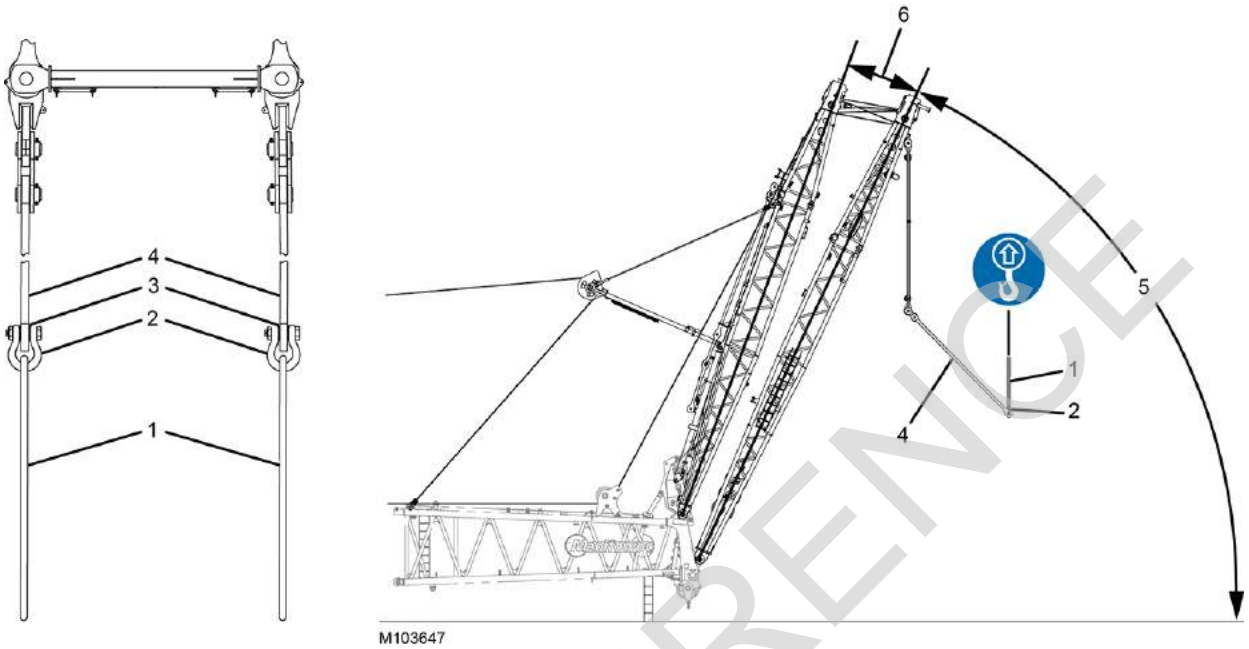
Attaching the 12M Straps to the Frontstay Spreader Assembly

See Figure 4-19 for the following procedure.

1. Slowly haul in the load line (18) on Drum 2 to raise the strut raising arm (19) until the raising arm pendants are tight.

NOTE: When using Drum 1 for strut raising, 74M of boom length is required for proper wrap on the 4M fleeting sheave. For boom lengths less than 74M, have an assistant monitor the rope wrap on the 4M fleeting sheave when using Drum 1 for strut raising. The rope will leave the sheave and return. The location of the fleeting sheave must be positioned to allow the rope to return to the sheave.

2. Using an assist crane, lift the frontstay spreader assembly (1) off the ground while hauling in the load hoist line to lift the struts. Raise the struts until the frontstay spreader assembly is clear of the ground surface.
3. Remove the hair pin cotter (2, View B) and the pin (3, View B) from the storage bracket (4, View B). Repeat this step for the other side.
4. Remove and set aside the cotter pin (5), two-hole pin (6), collar (7), and connecting pin (8) from the short strap (9, View C) of the 12M #680/681 insert (17). Repeat this step for the other side.
5. Using an assist crane, attach two **SL 4** slings (10) and two **SH 2** shackles (11) to the strap lifting lugs (12). Remove the strap from the 12M #680/681 insert. Repeat this step for the other side.
6. Insert the connecting pin (13), collar (14), two-hole pin (15), and cotter pin (16) to install the 12M strap to the frontstay spreader assembly (1). Repeat this step for the other side.



Item	Description
1	**SL 4** Sling – 8 017 kg (17,675 lb) (qty 2)
2	**SH 3** Shackle – 40 t (44.00 USt) (qty 2)
3	Bushing (qty 4)
4	Short Strap of the 12M #680/681 Insert (qty 2)
5	65° Angle
6	5° Maximum Angle

FIGURE 4-20

Raising the Strut Assemblies

NOTE: When using Drum 1 for strut raising, 74M of boom length is required for proper wrap on the 4M fleeting sheave. For boom lengths less than 74M, have an assistant monitor the rope wrap on the 4M fleeting sheave when using Drum 1 for strut raising. The rope will leave the sheave and return. The location of the fleeting sheave must be positioned to allow the rope to return to the sheave.

See Figure 4-20 for the following procedure.

1. Attach two **SL 4** slings (1) and two **SH 3** shackles (2) with the bushings (3) installed to the short straps of the 12M #680/681 insert (4).
2. Connect the slings to an assist crane to lift the 12M straps and slings away from the ground while raising the main strut and the jib strut.

CAUTION

Crane Damage!

Use extreme care to ensure that the load line spools properly onto the drum during the raising procedure.

Make sure the luffing hoist wire rope does not become slack during the raising procedure.

3. Raise the main strut and the jib strut by slowly hauling in the load line.
4. When the **SL 4** slings are clear of the ground, disconnect the slings from the assist crane.
5. Continue to raise the jib strut to an angle of 65° (5). A separation angle of no more than 5° (6) must be maintained between the main strut and the jib strut.

THIS PAGE INTENTIONALLY LEFT BLANK

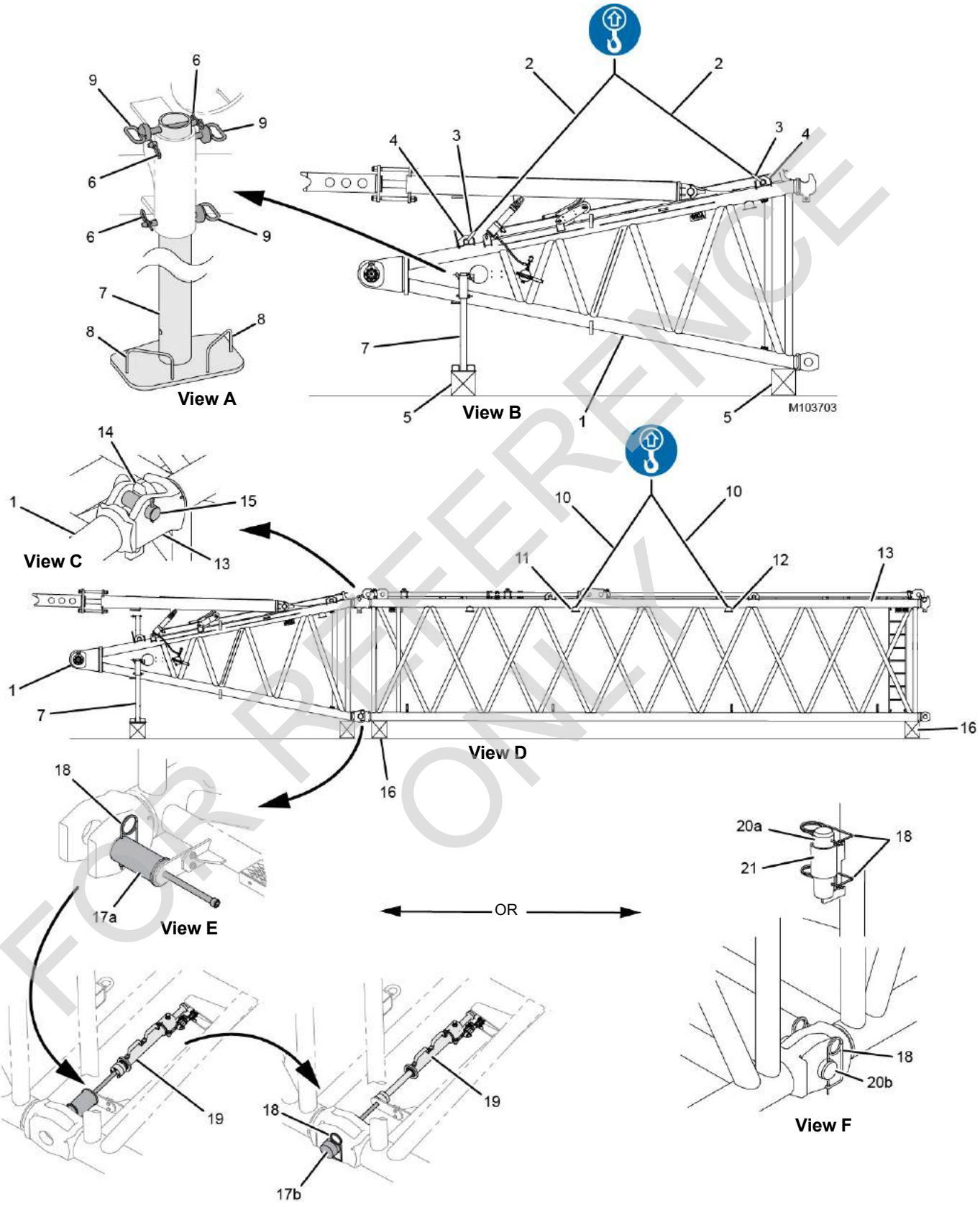


FIGURE 4-21

Legend for Figure 4-21

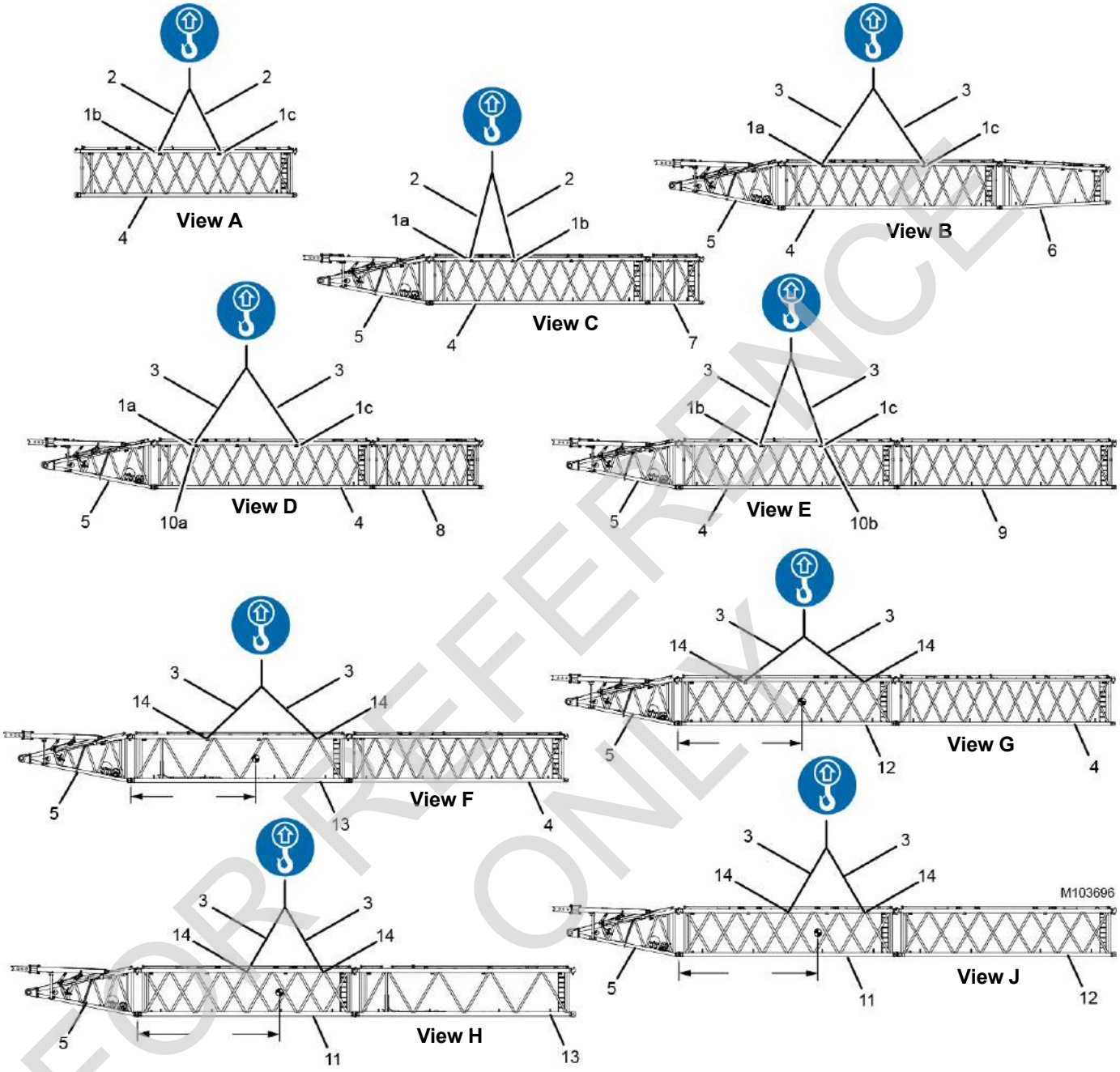
Item	Description
1	Jib Butt
2	**SL 4** Sling – 8 017 kg (17,675 lb) (qty 4)
3	**SH 2** Shackle – 17 t (18.70 USt) (qty 4)
4	Lifting Lug (qty 4)
5	Blocking (qty 4)
6	Hair Pin Cotter (qty 2)
7	Butt Support Pedestal (qty 2)
8	Handle (qty 4)
9	Hitch Pin (qty 6)
10	**SL 4** Sling – 8 017 kg (17,675 lb) (qty 4)
11	Lifting Lug Two (qty 2)
12	Lifting Lug Three (qty 2)
13	12M Insert Assembly
14	Hook End (qty 2)
15	Pin (qty 2)
16	Blocking (qty 4)
17a	Connecting Pin (qty 2 stored) (hydraulic)
17b	Connecting Pin (qty 2 installed) (hydraulic)
18	Safety Pin (qty 2 or 4)
19	Hand-Held Pin Puller
20a	Pin (qty 2 stored) (manual)
20b	Pin (qty 2 installed) (manual)
21	Storage Bracket (qty 2 each section)

Assembling the Jib Butt Assembly

The jib butt assembly consists of the jib butt and the first two inserts called for on the Luffing Jib Rigging Drawing in use and shown in Figure 4-22 on page 4-40. The jib butt assembly will be lifted in place and pinned to the boom top as an assembled unit.

See Figure 4-21 for the following procedure.

1. Remove the tie downs securing the jib butt (1, View B) to the trailer.
2. Attach four **SL 4** slings (2) and four **SH 2** shackles (3) to lifting lugs (4) on the jib butt. Using an assist crane, remove the jib butt from the trailer, and remove the trailer from the area.
3. Lower the top end of the jib butt onto the blocking (5).
4. Remove the hair pin cotter (6) and support the butt support pedestal (7, View A) by hand with the handles (8). Remove the hitch pin (9) and lower the butt support pedestal to the rigging position. Reinstall the hitch pin and hair pin cotter. Repeat this step for the other side of the jib butt.
5. Lower the butt support pedestals onto the blocking and remove the slings and shackles.
6. Make sure the jib butt is level front-to-rear and side-to-side.
7. Attach four **SL 4** slings (10) from an assist crane to the four lifting lugs on the 12M insert assembly (13). If the first insert is the #680/681 insert, use the four lifting lugs nearest the top end of the insert. Do not use the two lifting lugs nearest the butt end of the insert.
8. Lift the 12M insert into position and connect it to the jib butt by engaging the pins (15) on the insert with the hook ends (14) of the jib butt.
9. Lower the 12M insert until the lower pin holes are aligned.
10. If equipped with hydraulically connected bottom pins (17, View E):
    a. Remove the safety pin (18) from the shipping position in pin (17a).
    b. Install the pin (17b) using the hand-held pin puller (19).
    c. Install the safety pin (18) and remove the hand-held pin puller (19).
    d. Repeat this step for the other side of the jib butt.
11. If equipped with manually connected bottom pins (20, View F):
    a. Remove the pin (20a) from the storage bracket (21) on the adjacent section.
    b. Install the pin (20b) in the connecting holes between the sections.
    c. Install the safety pin (18).
    d. Repeat this step for the other side of the jib butt.
12. Lower the 12M insert (13) onto the blocking (16) at both ends of the insert and remove the slings from the 12M insert.
13. Install the next insert in proper sequence in the same manner the 12M insert was installed.



Item	Description	Item	Description	Item	Description
1a	Lifting Lug One (qty 2)	5	Jib Butt	10b	Sling Choke on Lifting Lug Three
1b	Lifting Lug Two (qty 2)	6	6M #681/682 Transition Insert	11	12M #680 Heavy Insert
1c	Lifting Lug Three (qty 2)	7	3M #681Insert	12	12M #680 Medium Insert
2	**SL 4** Sling – 8 017 kg (17,675 lb) (qty 4)	8	6M #681Insert	13	12M #680 Insert with Int, Suspension
3	**SL 3** Sling – 7 856 kg (17,320 lb) (qty 4)	9	12M #681 Insert	14	Sling Chocked as shown.
4	12M #680/681 Insert	10a	Sling Choke on Lifting Lug One		

FIGURE 4-22

Table 4-1 Luffing Jib Lifting Configurations

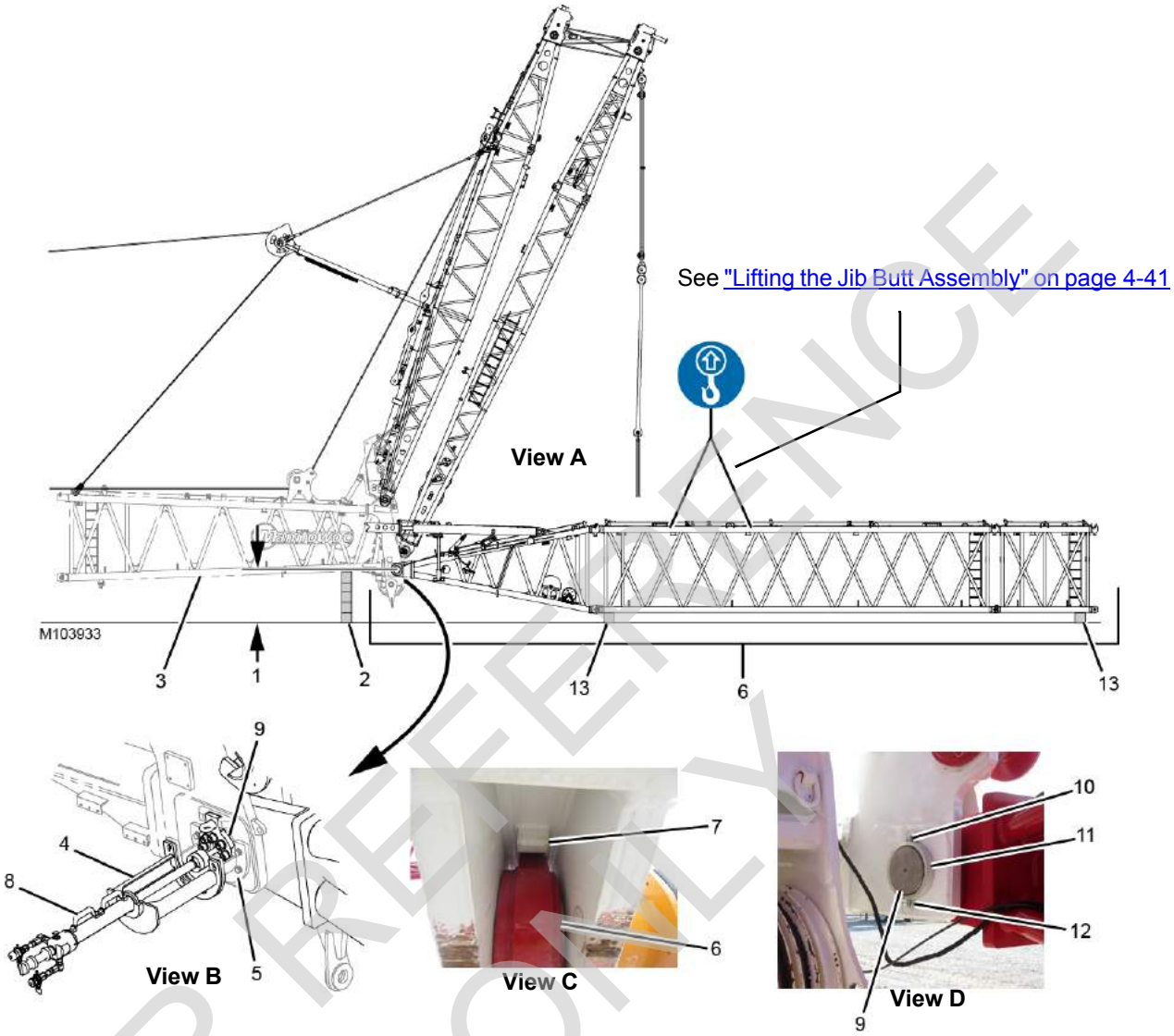
Lifting Configuration	Weight kg (lb)	Sling Number	Lifting Lug 1a	Lifting Lug 1b	Lifting Lug 1c
View B — Jib Butt, 12M #680/681 Insert, and 6M Transition Insert	16 072 (35,433)	**SL 3**	x		x
View C — Jib Butt, 12M #680/681 Insert, and 3M #681Insert	13 862 (30,560	**SL 4**			
View D — Jib Butt, 12M #680/681 Insert, and 6M #681 Insert	15 147 (33,394)	**SL 3**	x*		x
View E — Jib Butt, 12M #680/681 Insert, and 12M #681 Insert	17 448 (38,467)	**SL 3**		x	x*
View F — Jib Butt, 12M #680 Insert with Intermediate Suspension, and 12M #680/681 Insert	21 792 (71,496)	**SL 3**	All chocked as shown in Figure 4-22 on page 4-40.		
View G — Jib Butt, 12M #680M Insert, and 12M #680/ 681 Insert	18 861 (61,880)	**SL 3**			
View H — Jib Butt, 12M #680H Insert, and 12M #680 Insert with Intermediate Suspension	25 481 (83,599)	**SL 3**			
View J — Jib Butt, 12M #680H Insert, and 12M #680M Insert	22 550 (73,983)	**SL 3**			
*** Indicates a choke required at sling leg and lifting lug.**					

Lifting the Jib Butt Assembly

See Figure 4-22 and Table 4-1.

Prior to installing the jib butt assembly, make sure both jib stops are lowered to the shipping position. Lower the jib stops by depressing the needle valve located on the hydraulic support cylinder.

Depending of your jib configuration, connect the specified lifting slings from the assist crane to the specified lifting lugs/ locations shown in Views B through C.



Item	Description	Item	Description
1	Minimum Distance 1,7 m (5.58 ft)	8	Hydraulic Pin Puller
2	Blocking	9	Hinge Pin (qty 2)
3	Boom Top	10	Retaining Pin (qty 2)
4	Pin Puller Cage (qty 2)	11	Collar (qty 2)
5	Pin Puller Cage Saddle (qty 2)	12	Locking Pin (qty 2)
6	Jib Butt Assembly	13	Blocking
7	Alignment Feature (qty 2)		

FIGURE 4-23

Installing the Jib Butt Assembly

See Figure 4-23 for the following procedure.

NOTE: Luffing jib installation requires a minimum distance (1) of 1,7 m (5.58 ft) of blocking (2) under the boom top (3).

1. Using an assist crane, lift the jib butt assembly (6) into position at the end of the boom top. See "Lifting the Jib Butt Assembly" on page 4-41 for more information.
2. Install the pin puller cages (4) to the pin puller cage saddles (5) located on both sides of the boom top.
3. Install the luffing jib butt (6, View C) straight into the boom top. Use the alignment features (7) inside the boom top on both sides and align the hinge pin holes.
4. Install the hydraulic pin puller (8) to the pin puller cage and activate the hydraulic pin puller to install the hinge pin (9, View B) in the boom top. Repeat this step for the other side.
5. Install the retaining pin (10), collar (11), and locking pin (12) onto the hinge pin (9, View D). Repeat this step for the other side.
6. Lower the top end of the jib butt assembly (6) onto blocking (13) and disconnect the slings from the luffing jib butt assembly.

Removing the 12M Insert Roller Assembly

Avoid wire rope damage!

When using the #680 insert with intermediate suspension (item 13, Figure 4-22 on page 4-40), remove the wire rope roller, brackets, and mounting pins shown in Figure 4-24.

Store the parts in your parts box.

The roller, brackets, and mounting pins must be reinstalled if the insert is used for B10, B40, and B60 boom rigging.

Item	Description
1	Pin (qty 2)
2	Pin (qty 4)
3	Cotter Pin (qty 4)
4	Cotter Pin (qty 6)
5	Safety Pin (qty 2)
6	Roller
7	Bracket (right)
8	Bracket (left)

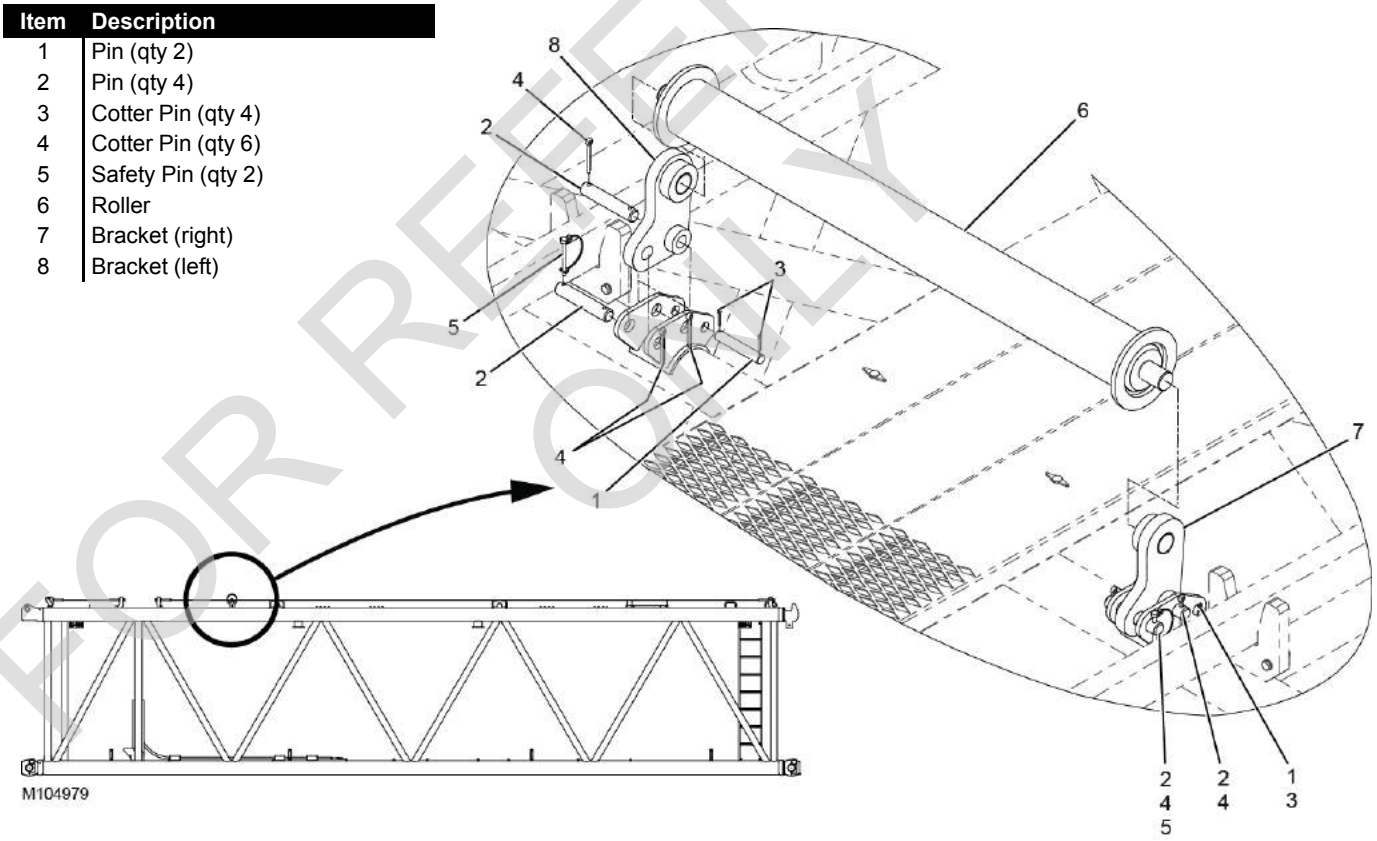
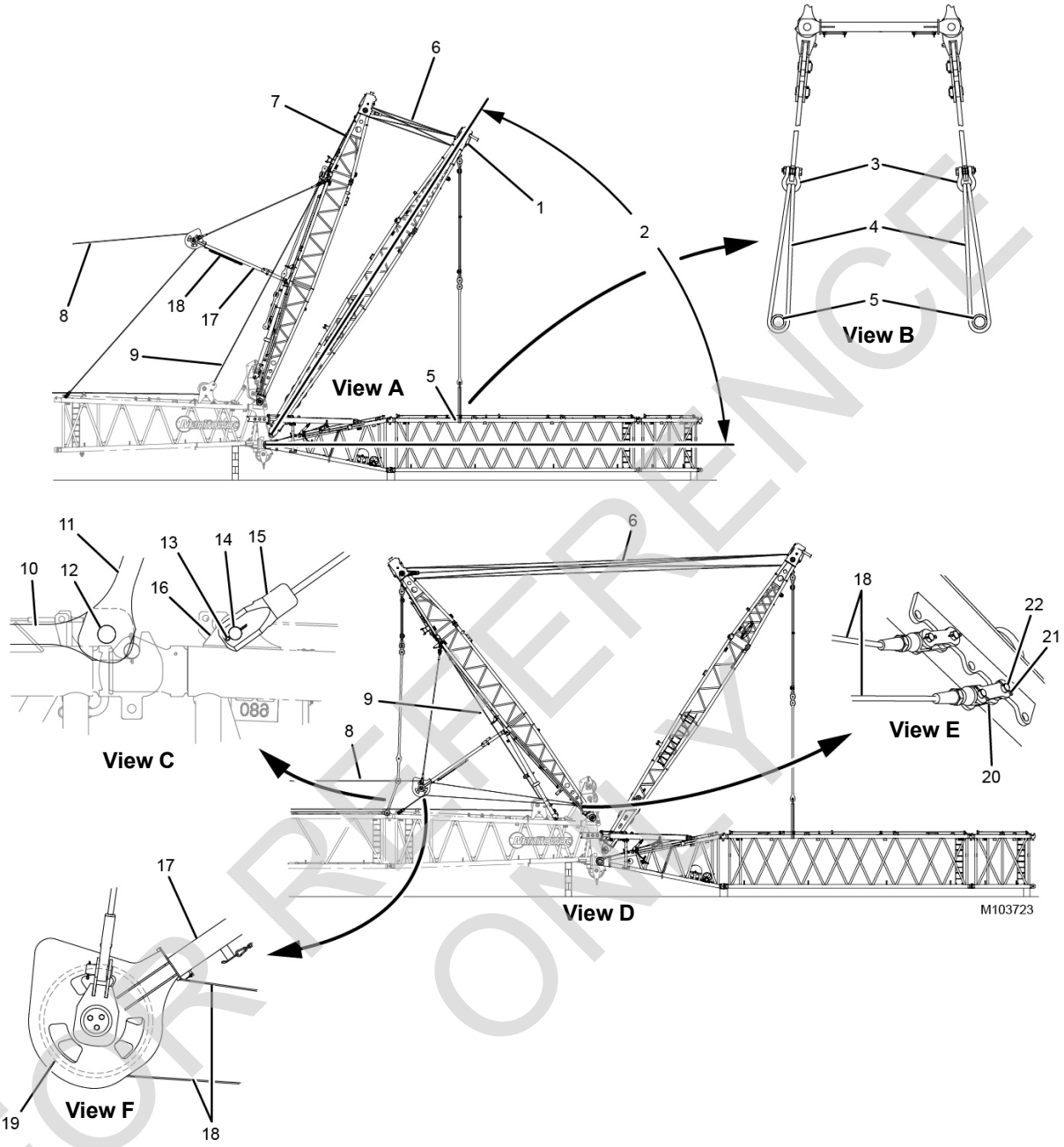


FIGURE 4-24



Item	Description	Item	Description
1	Jib Strut	12	Pin Assembly (qty 2)
2	57° Angle	13	Cotter Pin
3	**SH 3** Shackle – 40 t (44 USt) (qty 2)	14	Clevis Pin
4	**SL 4** Sling – 22 680 kg (50,000 lb) (qty 2)	15	Socket Button
5	12M Insert Chord (qty 2)	16	Dead End Lug
6	Luffing Hoist Reeving	17	Strut Raising Arm
7	Main Strut	18	Sucker Line
8	Load Hoist Wire Rope	19	Strut Raising Arm Sheave
9	Luffing Hoist Wire Rope	20	Clevis Link (qty 4)
10	Backstay Strap (qty 2)	21	Cotter Pin (qty 2)
11	Butt Link (qty 4)	22	Two-hole Pin (qty 2)

FIGURE 4-25

Using the Luffing Jib as a Hold Back

See Figure 4-25 for the following procedure.

1. Luff down the jib strut (1) to an approximately 57° angle (2).
2. Disassemble the **SH 3** shackles (3) and use the **SL 4** slings (4) to basket hitch the 12M insert chords (5). Reassemble the **SH 3** shackles.

CAUTION

Crane Damage!

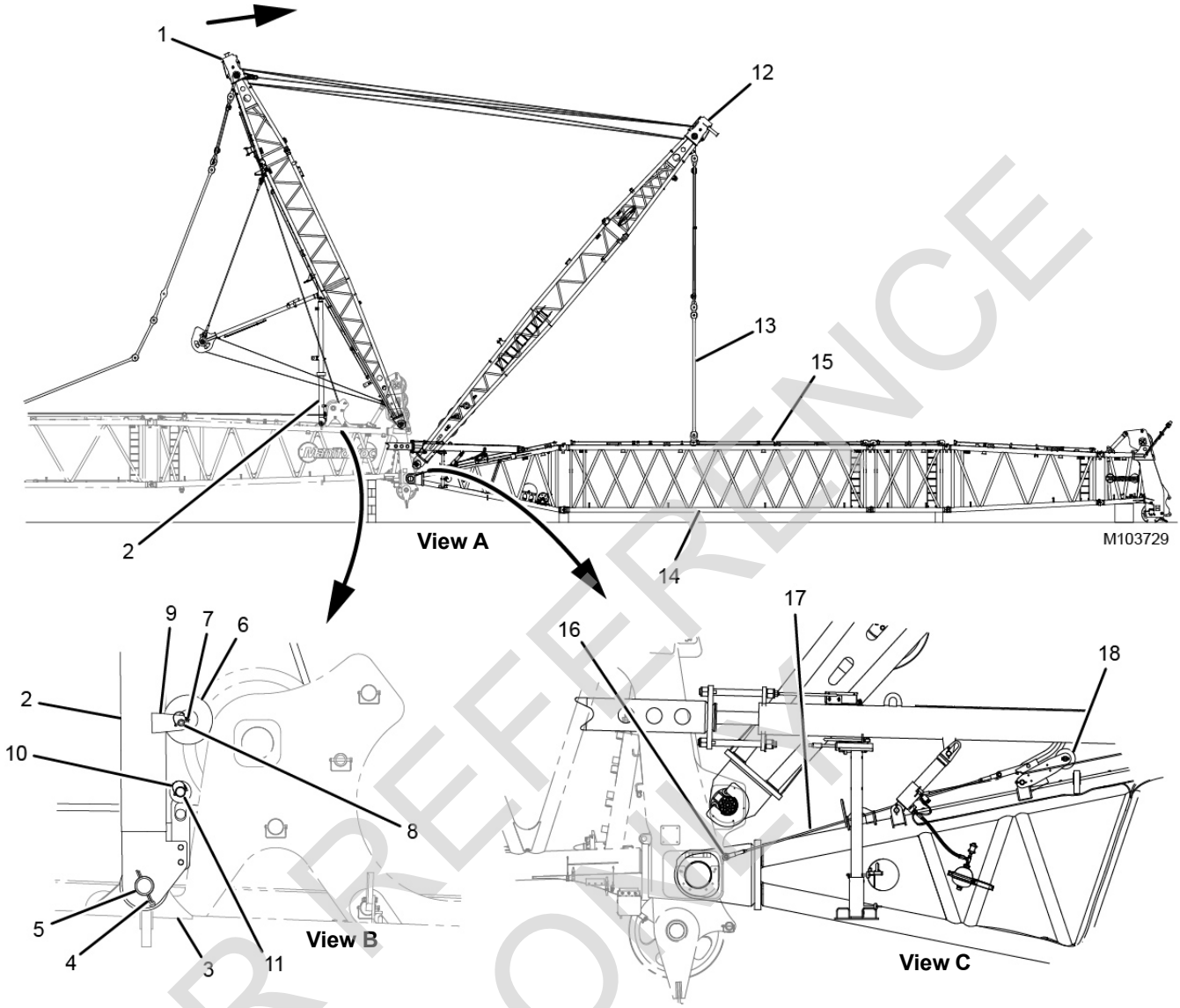
Make sure that the luffing hoist reeving (6, View A) and the slings do not become slack during the following steps of this procedure.

NOTE: When the main strut (7) moves over center, the control of the main strut angle changes from the load hoist wire rope (8, View A) to the luffing hoist wire rope (9, View A).

3. Haul in on the load hoist wire rope while paying out on the luffing hoist wire rope to raise the main strut over center.
4. When the main strut moves over center, continue hauling in on the load hoist wire rope and paying out on the luffing hoist wire rope, while making sure that the main strut stops roll along the boom top chord towards the main strut hinge until the backstay straps (10) and the butt links (11) can be connected.

NOTE: The strut stop guide roller will contact the front side of the attachment anchor on the boom top and kick inward, rolling along the boom top chord toward the main strut hinge.

5. Connect the backstay straps to the butt links using the pin assemblies (12). Repeat this step for the other side.
6. Remove the sucker line (18, View A) from its storage position and place it to the side for use later. If this is not done, the strut raising arm sheave (19) may be out of reach when disconnecting the load hoist wire rope (8, View D).



Item	Description	Item	Description
1	Main Strut	10	Locking Pin (qty 2)
2	Strut Stop (qty 2)	11	Two-hole Pin (qty 2)
3	Attachment Anchor (qty 2)	12	Jib Strut
4	Cotter Pin (qty 2)	13	12M Strap (qty 2)
5	Two-hole Pin (qty 2)	14	12M Insert
6	Strut Stop Guide Roller (qty 2)	15	12M Strap (qty 2)
7	Locking Pin (qty 2)	16	Boom Top Lug (qty 2)
8	Two-hole Pin (qty 2)	17	Jib Stop Pendant (qty 2)
9	Strut Stop Guide Roller Storage Bracket (qty 4)	18	Jib Stop Raising Roller (qty 2)

FIGURE 4-26

Installing the Main Strut Stops and Frontstay Strap Hookup

See Figure 4-26 for the following procedure.

1. Pay in the luffing hoist to pull the main strut (1) back toward center to move the strut stops (2, View B) to the attachment anchors (3).
2. Remove the cotter pin (4) and the two-hole pin (5) to remove the strut stop guide roller (6) from the bottom of the strut stop. Repeat this step for the other side.
3. Remove the locking pin (7) and two-hole pin (8) from the strut stop guide roller storage brackets (9). Repeat this step for the other side.
4. Install the strut stop guide roller into the roller storage brackets and install the two-hole pins and locking pins. Repeat this step for the other side.
5. Pay in or pay out the luffing hoist line as necessary to align the holes in the bottom of the strut stops with the holes in the attachment anchors. Install both of the two-hole pins and cotter pins.
6. Activate the strut stop hydraulic valve by turning on strut stop mode on the main display, allowing the strut stop cylinders to compress under the weight of the main strut. Pay out the luffing hoist slightly to compress the strut stop.
7. Remove the locking pin (10) and remove the two-hole pin (11) from the shipping position in the strut stop. Install the two-hole pin to the working position and install the locking pin. Repeat this step for the other side.
8. Deactivate the strut stop hydraulic valve by turning it off.

NOTE: See Main Display Operation Manual for more information.

WARNING

Crane Damage!

Prevent crane damage by making sure that both pendants are routed through the pendant guide brackets and that they are outside of the lifting lugs.

9. Attach the jib stop pendant (17) from the jib stop raising roller (18) to the boom top lug (16).

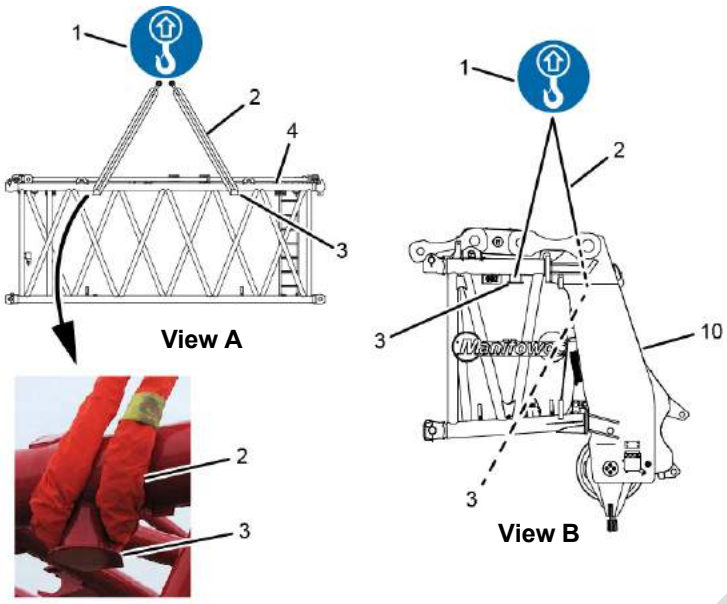
NOTE: The jib stop raising roller must be rotated away from the boom top.

See Figure 4-25 for the following steps.

10. Pay out the load hoist drum if necessary to slacken the load hoist wire rope and remove the cotter pin (13) and clevis pin (14) from the socket button (15).
11. Remove the socket button from the boom top dead end lug (16).
12. Remove the socket button from the button (not shown) on the end of the load hoist wire rope. Return the socket button to the lower boom point for assembly later.
13. Remove the load hoist line from the strut raising arm (17).
14. Retrieve the sucker line (18) and reeve it around the strut raising arm sheave (19).
15. Attach the end of the sucker line to the clevis link (20) located on the main strut by removing the cotter pin (21) and two-hole pin (22). Insert the two-hole pin through the end of the sucker line and through the clevis link. Repeat this step for the other side.

See Figure 4-26 for the remaining steps:

16. Luff down the jib strut (12) to remove the slings, shackles, and bushings from both sides of the 12M strap (13) and 12M insert (14) that were used during the hold-back procedure. Return the bushings to the stored position.
17. Connect the 12M strap (13) to the 12M strap (15) located on the 12M insert. Repeat this step for the other side.
18. Complete the luffing jib boom assembly per the luffing jib makeup table at the end of this section.



NOTE: The safety pins (6b) must be installed as shown in View C when the jib sections are assembled in the air. The safety pins do not need to be installed when the jib sections are assembled on the ground.

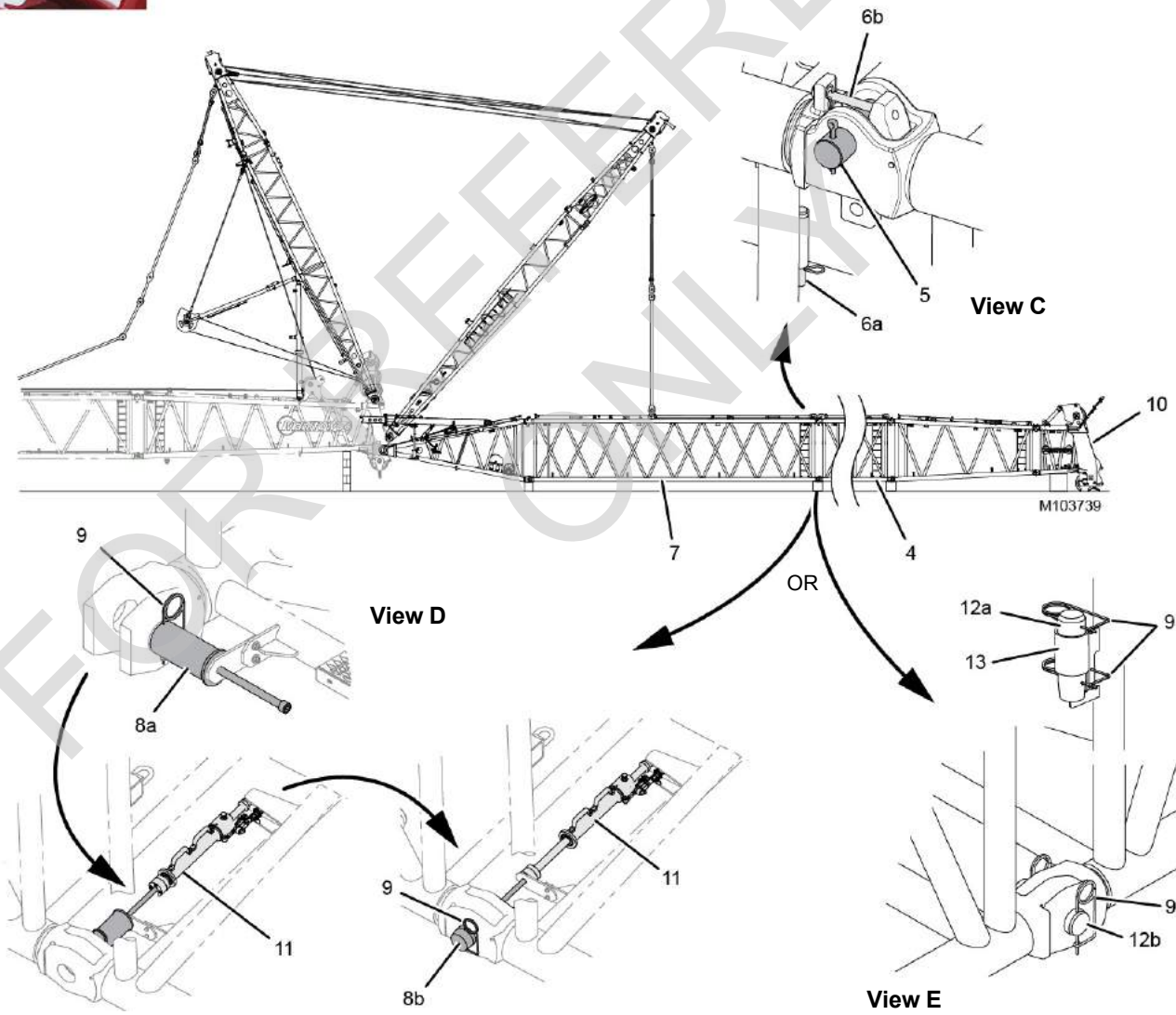


FIGURE 4-27

Item	Description
1	Assist Crane
2	**SL 4** Sling – 9 820 kg (21, 650 lb) (qty 4)
3	Lifting Lug (qty 4)
4	Jib Insert
5	Fixed Horizontal Pin (qty 2)
6a	Safety Pin (stored position) (qty 2) See NOTE
6b	Safety Pin (working position) (qty 2) See NOTE
7	12M #680/681 Insert
8a	Connecting Pin (stored position) (qty 2)
8b	Connecting Pin (working position) (qty 2)
9	Safety Pin (qty 2)
10	Jib Top
11	Hydraulic Pin Puller
12a	Pin (qty 2 stored) (manual)
12b	Pin (qty 2 installed) (manual)
13	Storage Bracket (qty 2 each section)

Installing the Jib Inserts

See Figure 4-27 for the following procedure.

NOTE: The jib inserts and jib top connect in the same manner. The handling of each insert may differ slightly between insert type, rigging arrangement, and configuration.

1. Remove the tie downs and blocking securing the jib insert to the trailer.
2. Using an assist crane (1, View A), attach the **SL 4** slings (2, View A) to the lifting lugs (3, View A) on the jib insert (4, View A).
3. Lift and remove the jib insert from the trailer and remove the trailer from the area.
4. Move the jib insert into position and engage the fixed horizontal pins (5) with the hooked connectors of the 12M #680/681 insert (7).
5. Lower the jib insert until the bottom connector holes are aligned.
6. If equipped with hydraulically connected bottom pins (8, View D):
   a. Remove the safety pin (9) from the shipping position in pin (8a).
   b. Install the pin (8b) using the hand-held pin puller (11).
   c. Install the safety pin (9) and remove the hand-held pin puller (11).
   d. Repeat this step for the other side of the jib butt.
7. If equipped with manually connected bottom pins (12, View E):
   a. Remove the pin (12a) from the storage bracket (13) on the adjacent section.
   b. Install the pin (12b) in the connecting holes between the sections.
   c. Install the safety pin (18).
   d. Repeat this step for the other side of the jib butt.
8. Place blocking under the top end of the insert. Lower the insert onto the blocking.
9. Only if the jib sections are being assembled in the air, remove the safety pins (6a) from the stored position and install the safety pins (6b) in the working position.

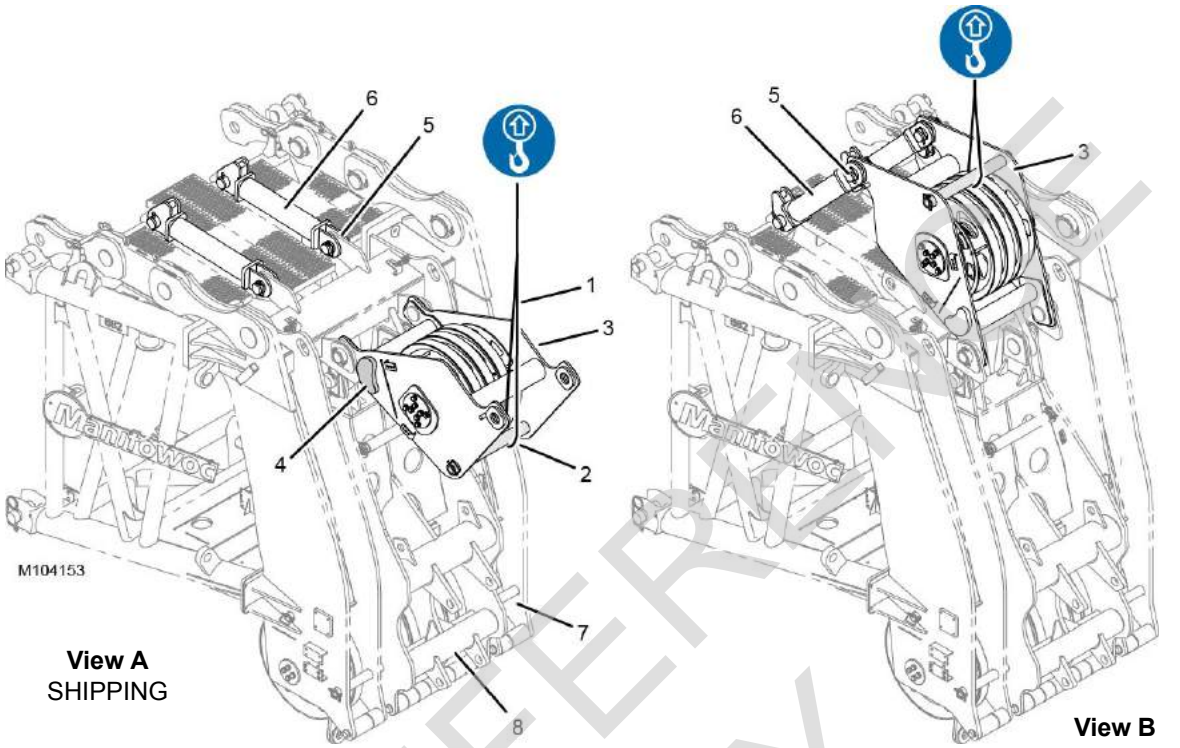
NOTE: The blocking can be moved from the end of one insert to the end of the next insert as the luffing jib is being assembled.

10. Disconnect the slings from the insert.
11. Repeat steps 1 to 9 until all inserts are installed in proper sequence according to the Luffing Jib Rigging drawing at the end of this section.

Installing the Jib Top

See Figure 4-27 for the following procedure.

1. Remove the tie downs and blocking securing the jib top (10) to the trailer.
2. Using an assist crane, attach the **SL 4** slings (2, View B) to the lifting lugs on the jib top.
3. Remove the jib top from the trailer and remove the trailer from the area.
4. Lift the jib top into position and engage the fixed horizontal pins with the hooked connectors on the insert.
5. Lower the jib top until the bottom connector holes are aligned.
6. Install the bottom pins in the same manner the bottom pins were installed for the inserts.
7. Place blocking under the jib top and lower the jib top onto the blocking.
8. Disconnect the slings from the jib top.



View A
SHIPPING

View B
WORKING

Item	Description
1	Synthetic Lifting Sling from Assist Crane
2	Wire Rope Guard
3	Jib Wire Rope Guide
4	Stop Block (2)
5	Pin with Safety Pins (2)
6	Strut (2)
7	Jib Top
8	Lower Jib Point

FIGURE 4-28

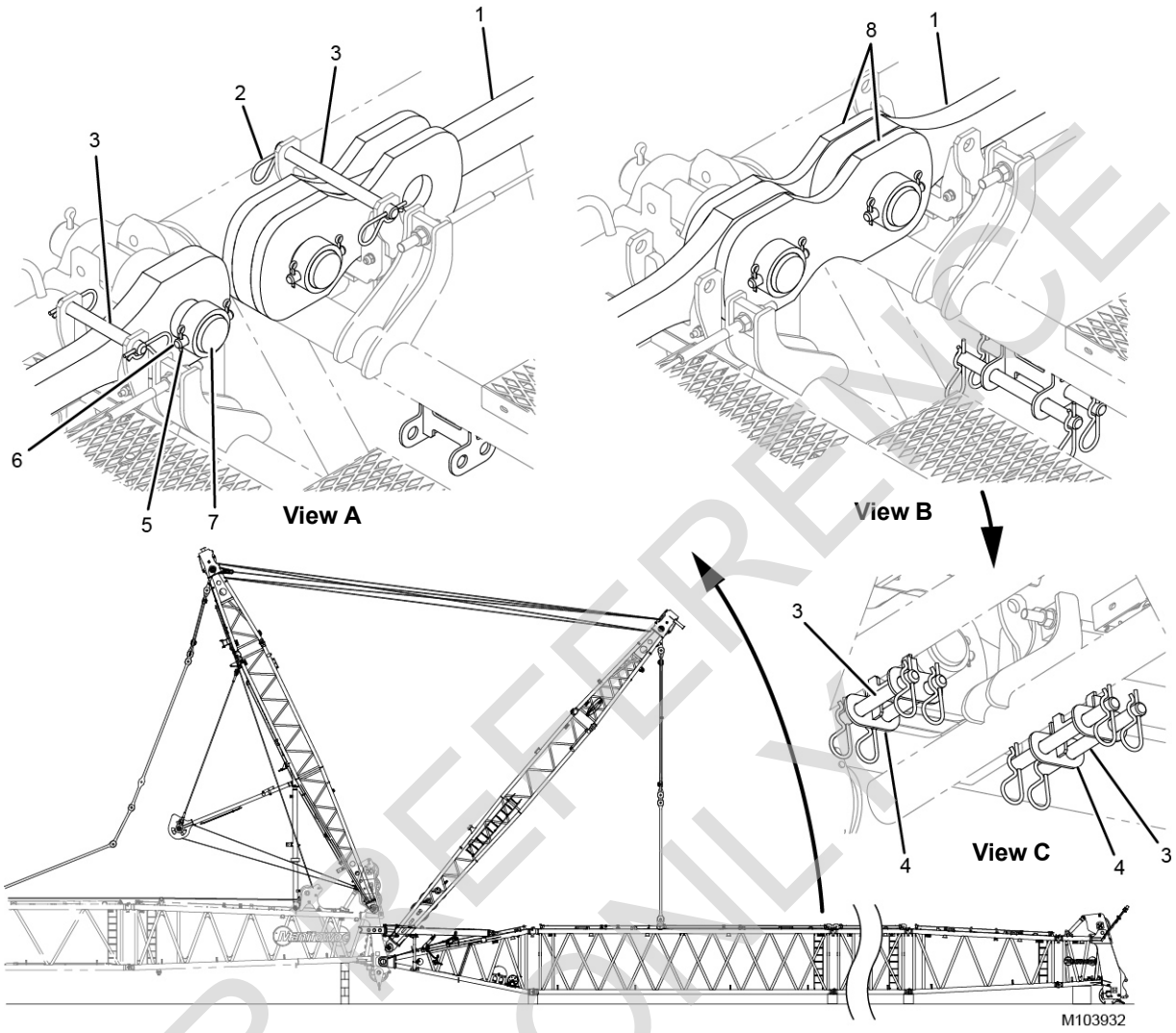
Raising the Jib Top Wire Rope Guide

See Figure 4-28 for the following procedure.

1. Attach a synthetic lifting sling (1, View A) from the assist crane to the wire rope guard (2) in the jib top wire rope guide (3).
2. Remove pins (5, View A) and raise the struts (6) by hand.
3. Raise the jib top wire rope guide (3< View B) to the working position.
4. Using pins (5, View B), pin the struts (6) to the jib top wire rope guide (3).
5. Disconnect the lifting sling.

Installing the Lower Boom/Jib Point

If not already done, install the lower jib point. See Installing the Lower Boom/Jib Point in the Luffing Jib Top, on page 4-13.



Item	Description	Item	Description
1	Jib Strap	5	Cotter Pin
2	Hair Pin Cotter	6	Two-hole Pin (qty 2)
3	Two-hole Pin	7	Connecting Pin (qty 2)
4	Storage Bracket (qty 2)	8	Link (qty 2)

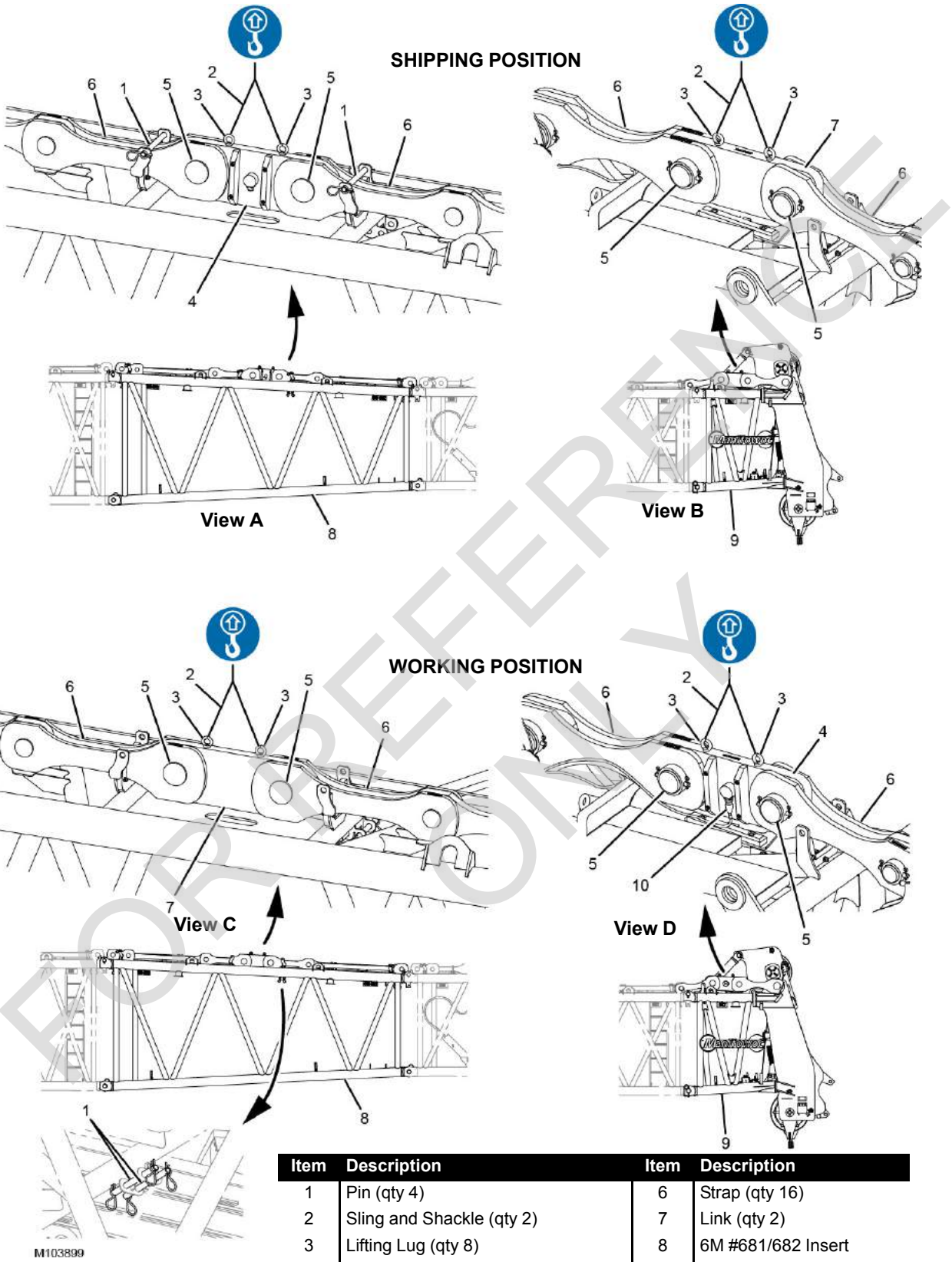
FIGURE 4-29

Connecting the Jib Straps between the Jib Sections

See Figure 4-29 for the following procedure.

NOTE: The jib straps (1) are secured to the jib sections as shown in View A.

1. Remove the hair pin cotter (2) and the two-hole pin (3). Store the hair pin cotter and the two-hole pin in the storage brackets (4).
2. Remove the cotter pin (5) and the two-hole pin (6) from the connecting pin (7).
3. Rotate the links (8) rearward from the shipping position to the working position (View B).
4. Install the connecting pin assembly in the reverse order of removal with the pin head facing out.
5. Repeat this procedure for the straps on both sides and at both ends of each jib section.



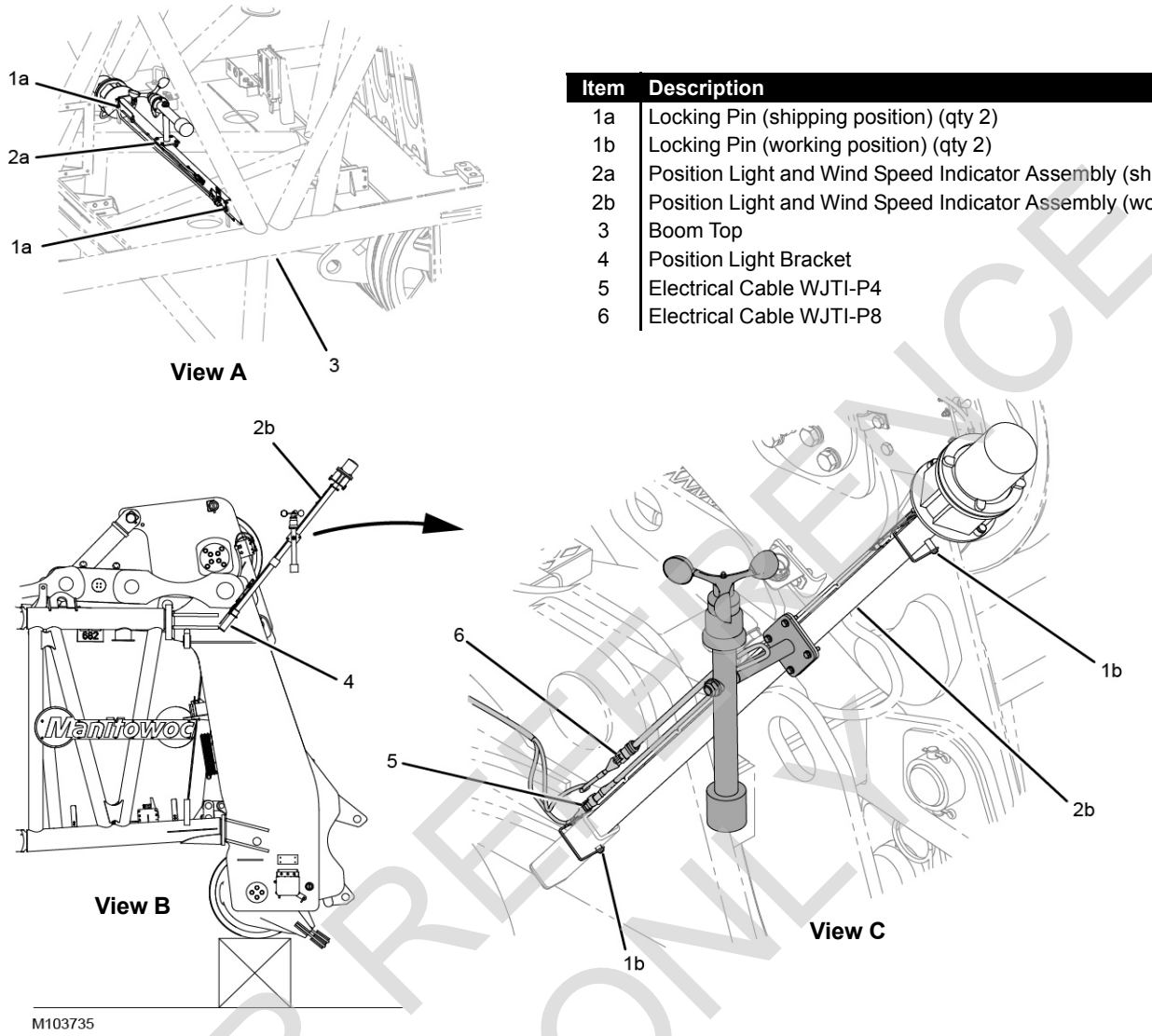
Item	Description	Item	Description
1	Pin (qty 4)	6	Strap (qty 16)
2	Sling and Shackle (qty 2)	7	Link (qty 2)
3	Lifting Lug (qty 8)	8	6M #681/682 Insert
4	Load Link (qty 2)	9	Jib Top
5	Connecting Pin Assembly (qty 8)	10	Harness Connector (qty 2)

FIGURE 4-30

Installing the Load Links

See Figure 4-30 for the following procedure.

1. Remove the hair pin cotters and pin (1, View A) and install them in the stored position (View E) if not already done.
2. Attach the appropriate slings and shackles (2, View A) to the lifting lugs (3, View A) on the load link (4, View A) located on the 6M #681/682 insert (8, View A). Hoist up to remove the slack in the slings.
3. Remove the connecting pin assemblies (5, View A) and set them aside for reassembly later.
4. Move the straps (6, View A) out of the way, if necessary, to remove the load link.
5. Using an assist crane, remove the load link from the 6M #681/682 insert. Place the load link to the side for reassembly later and remove the slings and shackles from the load link.
6. Attach the appropriate slings and shackles (2, View B) to the lifting lugs (3, View B) on the link (7, View B) located on the jib top (9, View B). Hoist up to remove the slack in the slings.
7. Remove the connecting pin assemblies (5, View B) and set them aside for reassembly later.
8. Move the straps (6, View B) out of the way, if necessary, to remove the link.
9. Using an assist crane, remove the link from the jib top.
10. Install the link (7, View C) to the straps (6, View C) located on the 6M #681/682 insert (8, View C).
11. Install the connecting pin assemblies (5, View C) in the straps and the link. Remove the slings and shackles from the lifting lugs on the link.
12. Attach the appropriate slings and shackles (2, View D) to the lifting lugs (3, View D) of the load link (4, View D) that has been previously removed from the 6M #681/682 insert (8, View A).
13. Install the load link to the jib top (9, View D) and install the connecting pin assemblies (5, View D) in the straps (6, View D).
14. Plug the wiring harness connector (10) into the load link electrical connector.
15. Repeat this procedure for the other side of the jib boom.



Item	Description
1a	Locking Pin (shipping position) (qty 2)
1b	Locking Pin (working position) (qty 2)
2a	Position Light and Wind Speed Indicator Assembly (shipping position)
2b	Position Light and Wind Speed Indicator Assembly (working position)
3	Boom Top
4	Position Light Bracket
5	Electrical Cable WJTI-P4
6	Electrical Cable WJTI-P8

FIGURE 4-3

Installing the Position Light and the Wind Speed Indicator

See Figure 4-31 for the following procedure.

- If the position light and wind speed indicator assembly (2a) is stored in the boom top (3), remove the locking pins (1a) and remove the assembly from the storage lugs on the boom top.
- If the position light and wind speed indicator assembly is attached in the working position on the boom top, disconnect the electrical cables and remove the assembly from the boom top.

1. Insert the position light and wind speed indicator assembly (2b, View C) into the position light bracket (4) on the right side of the jib top and install the locking pins (1b).
2. Connect electrical cable WJTI-P8 (6) from the jib top to the electrical cable from the position light.
3. Connect electrical cable WJTI-P4 (5) from the jib top to the electrical cable from the wind speed indicator.

THIS PAGE INTENTIONALLY LEFT BLANK

Item	Description
1	Electrical Cable WBR3
2	Electrical Cable WJB3
3	Electrical Cable WJR3
4	Cable Reel
5	Camera Cable WJT3
6	Cable Clip
7	Camera Mounting Pad
8	M12x30 Bolt (qty 4)
9	Camera
10	Eye Bolt

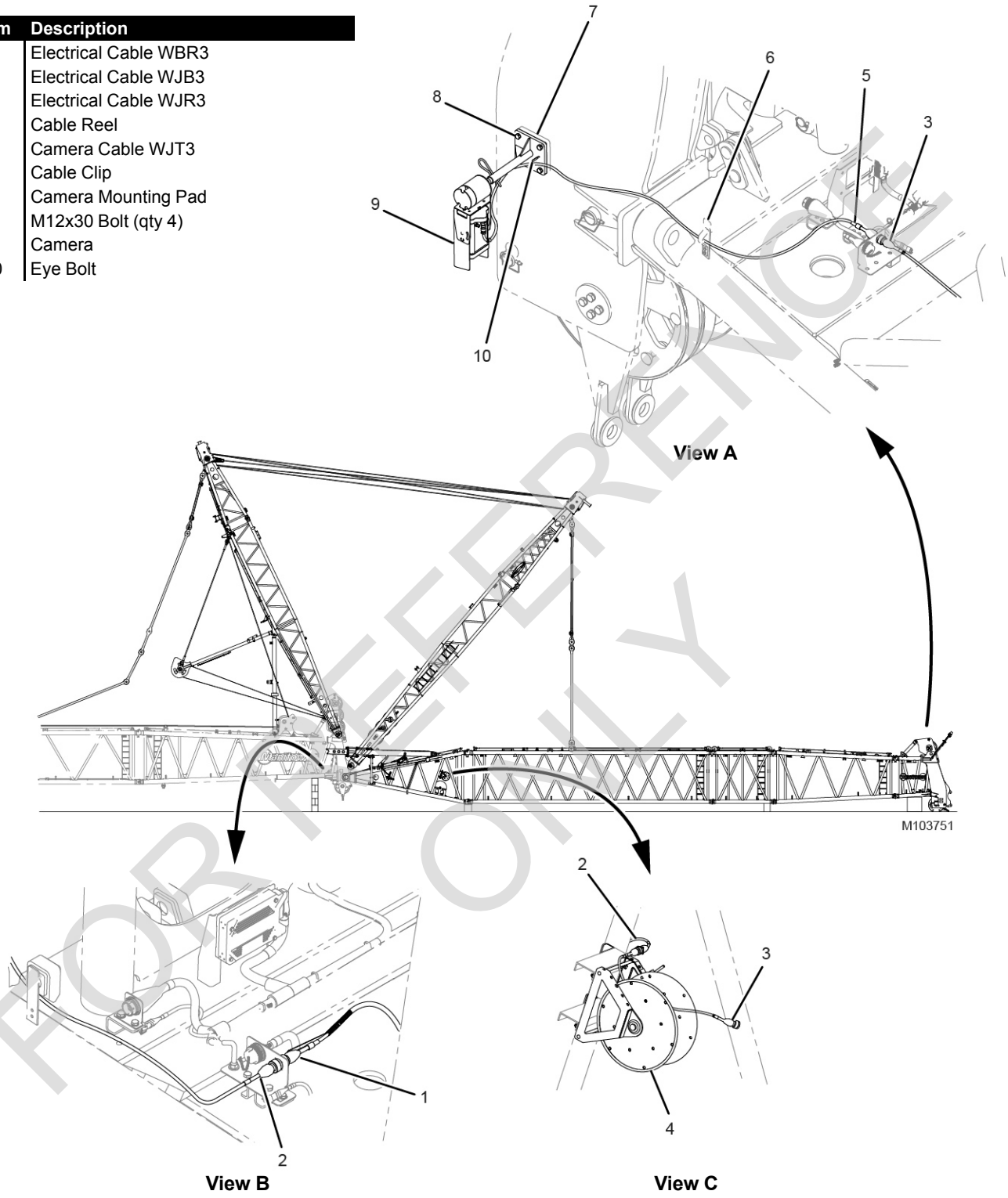


FIGURE 4-32

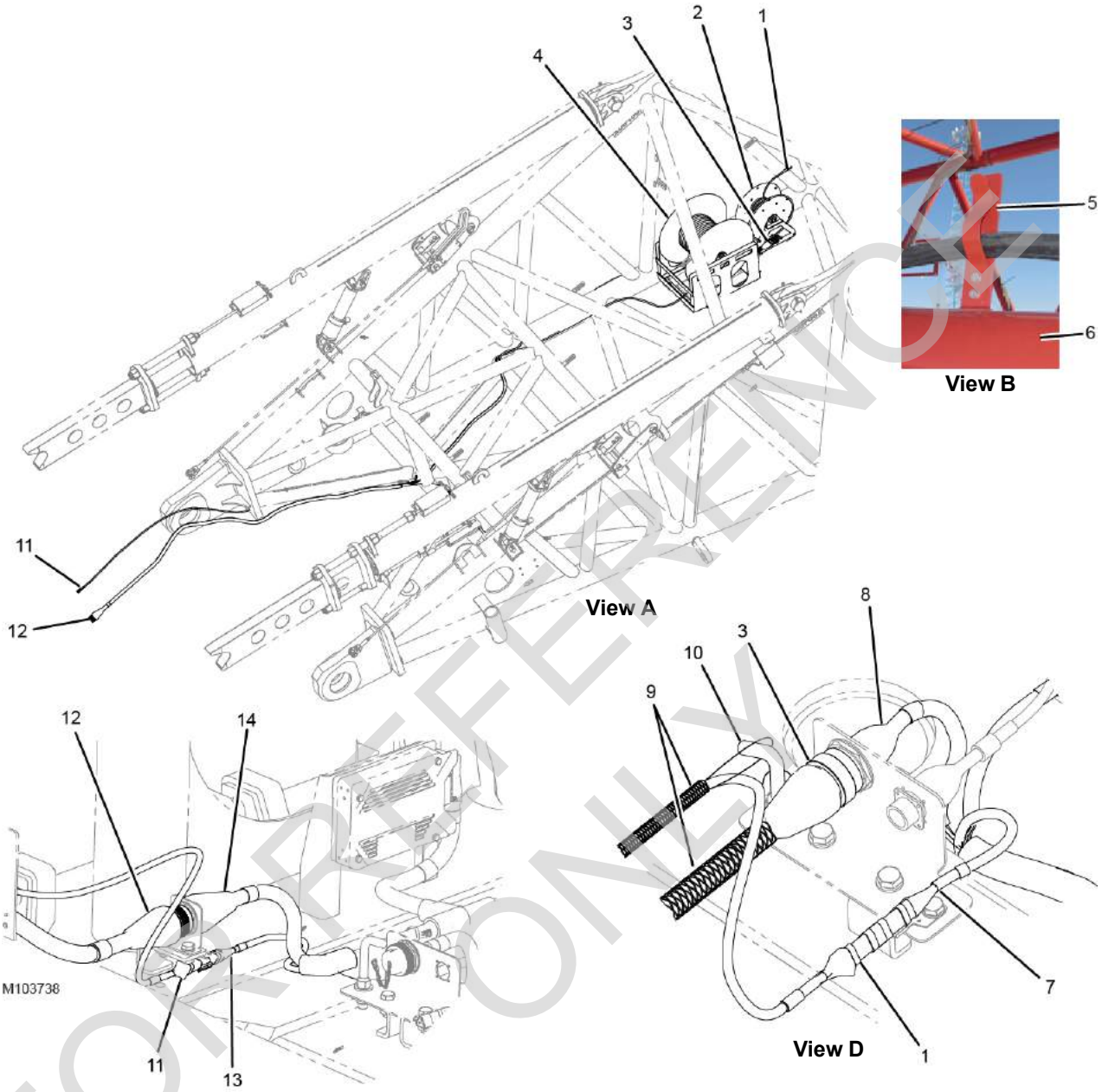
Installing the Jib Top Camera

See Figure 4-32 for the following procedure.

1. Remove the camera (9) from storage in the job box or from the side of the boom top.
2. Attach the camera bracket to the camera mounting pad (7) using four M12x30 bolts (8).

NOTE: Make sure that the security chain from the camera is attached to the eye bolt (10).

3. Connect electrical cable WJB3 (2, View B) from the cable reel (4) to electrical cable WBR3 (1).
4. Pull out electrical cable WJR3 (3, View C) from the cable reel to the jib top electrical connector bracket.
5. Secure the cable in the cable clips on the bottom left chord of the jib sections.
6. Secure the camera cable in the cable clip (6) on the side of the jib top and connect camera cable WJT3 (5) to electrical cable WJR3 (3, View A).
7. Make sure that the camera moves freely.



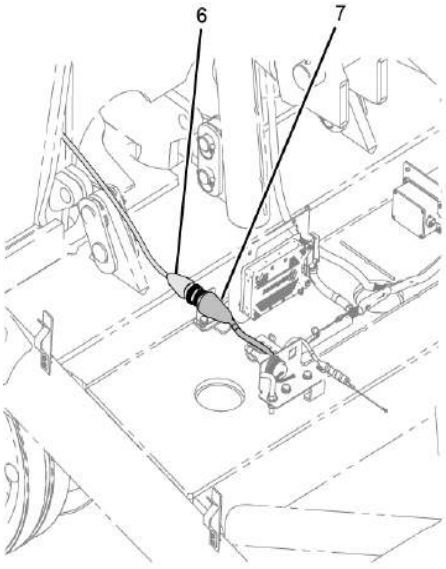
Item	Description
1	Electrical Cable WN100000
2	Cable Reel
3	Electrical Cable WJR1
4	Cable Reel
5	Cable Clip (qty varies)
6	Jib Insert (qty varies)
7	CAN NET IN Electrical Plug WJT1-J3
8	Electrical Plug WJT1-J1
9	Strain Relief (qty 2)
10	J-bolt
11	Electrical Cable WJB2-P1
12	Electrical Cable WJB1-P1
13	CAN NET OUT Electrical Cable WBT1-J6
14	Electrical Plug WBT1-J2

FIGURE 4-33

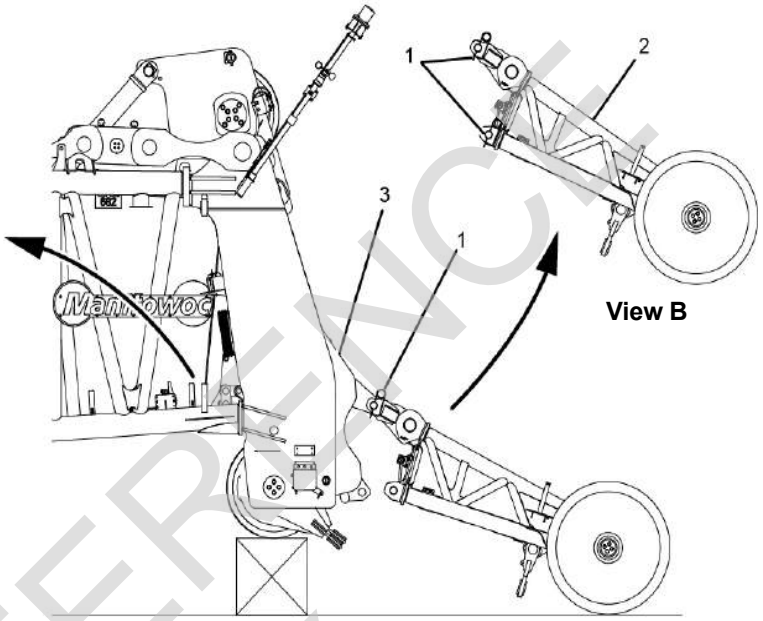
Connecting the Luffing Jib Electrical Cables

See Figure 4-33 for the following procedure.

1. Pull out electrical cable WN100000 (1, View A) from the cable reel (2) in the jib butt.
2. Pull out electrical cable WJR1 (3, View A) from the cable reel (4) in the jib butt.
3. Pull the cables all the way to the jib top.
4. Secure the cables in the cable clips (5) on the jib inserts (6).
5. Disconnect the CAN terminator (not shown) from CAN NET IN electrical plug WJT1-J3 (7) and connect the dust cap to the terminator.
6. Connect electrical cable WN100000 to electrical plug WJT1-J3.
7. Connect electrical cable WJR1 to electrical plug WJT1-J1 (8).
8. Connect the strain reliefs (9) to the J-bolt (10).
9. Disconnect and uncoil electrical cables WJB2-P1 (11) and WJB1-P1 (12) from the storage brackets on the jib butt.
10. At the boom top, perform the following steps:
    a. Disconnect the CAN terminator (not shown) from CAN NET OUT electrical cable WBT1-J6 (13). Connect the dust cap to the terminator.
    b. Connect electrical plug WJB2-P1 (11) from the jib butt to CAN NET OUT electrical cable WBT1-J6.
    c. Connect electrical cable WJB1-P1 (12) from the jib butt to electrical plug WBT1-J2 (14).



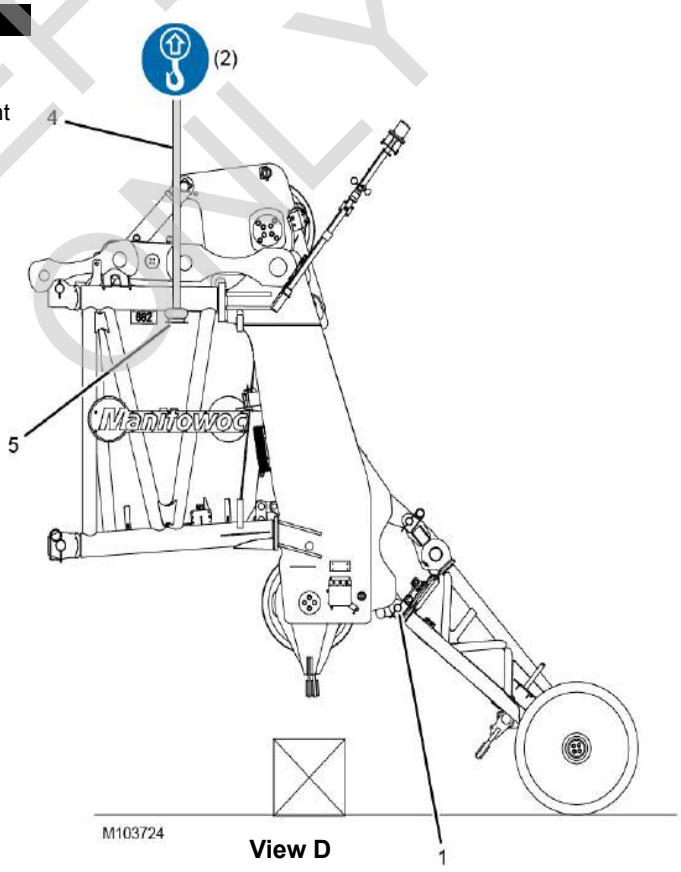
View A



View B

View C

Item	Description
1	Safety Pin (qty 4)
2	Upper Boom Point
3	Eight-sheave Lower Boom Point
4	Sling (qty 2)
5	Lifting Lug (qty 2)
6	Electrical Cable
7	Electrical Connector



View D

FIGURE 4-34

Installing the Upper Boom Point

NOTE: An assist crane capable of lifting half the weight of the luffing jib is required for this procedure.

The upper boom point must be equipped with four rollers.

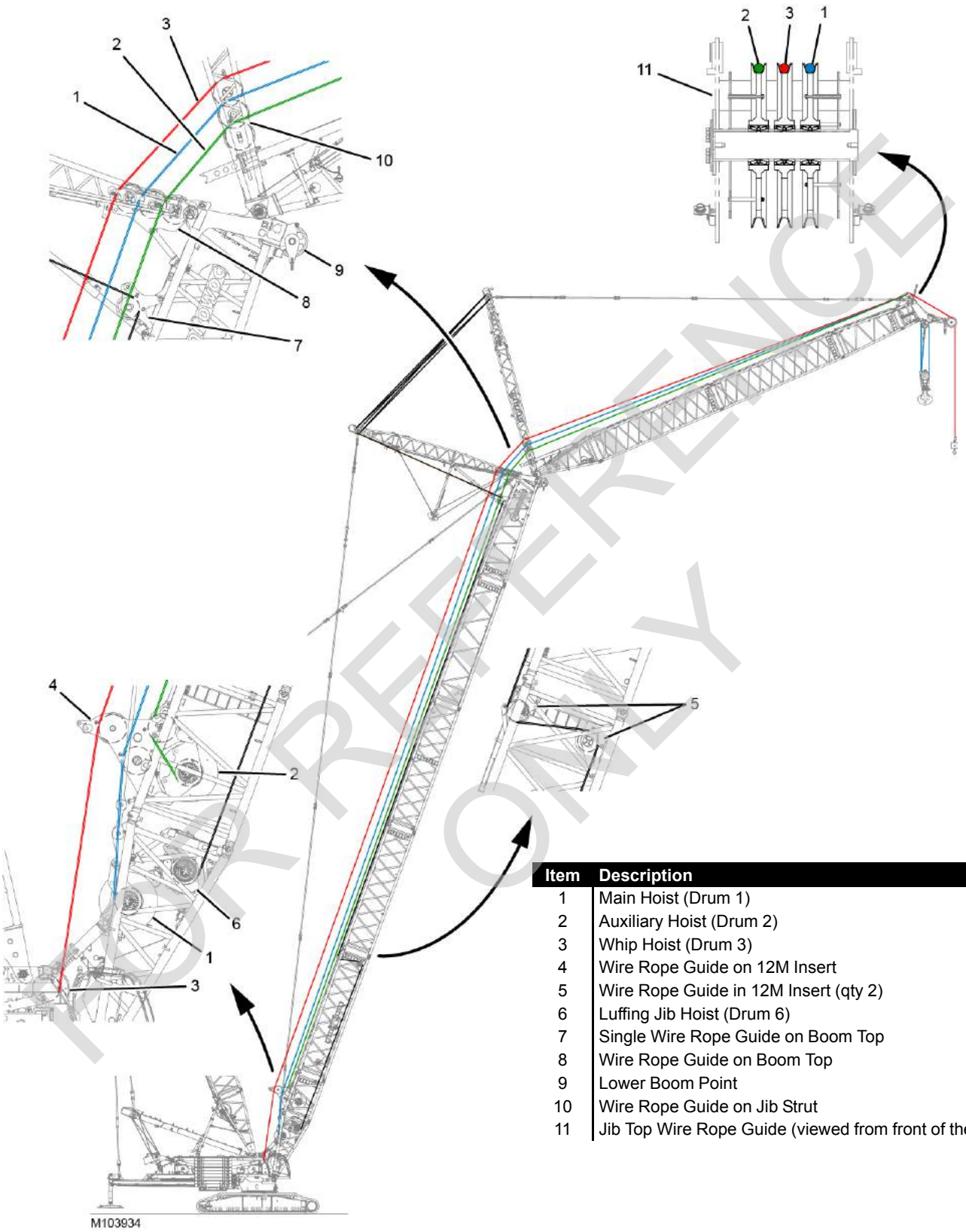
See Figure 4-34 for the following procedure.

1. Remove the two-hole pins and safety pins (1, View B) from the upper boom point (2).
2. Position the upper boom point at the end of the jib top.

NOTE: A second crane or a forklift truck can be used for this step.

3. Align the upper holes in the upper boom point with the holes in the eight-sheave lower boom point (3) and install the upper two-hole pins and safety pins.
4. Attach appropriate slings (4) from the assist crane to the lifting lugs (5) on the jib top.
5. Lift the jib top until the lower holes in the upper boom point are aligned with the holes in the eight-sheave lower boom point.
6. Install the lower two-hole pins and safety pins (1, View D).
7. Lower the jib top until the rollers are on the ground and there is slack in the slings.
8. Remove the slings.
9. Connect the electrical cable (6) from the upper boom point to the electrical connector (7) in the jib top.

NOTE: The electrical cable is stored on brackets on the left side of the upper boom point.



Item	Description
1	Main Hoist (Drum 1)
2	Auxiliary Hoist (Drum 2)
3	Whip Hoist (Drum 3)
4	Wire Rope Guide on 12M Insert
5	Wire Rope Guide in 12M Insert (qty 2)
6	Luffing Jib Hoist (Drum 6)
7	Single Wire Rope Guide on Boom Top
8	Wire Rope Guide on Boom Top
9	Lower Boom Point
10	Wire Rope Guide on Jib Strut
11	Jib Top Wire Rope Guide (viewed from front of the jib top)

FIGURE 4-35

Routing the Load Lines to the End of the Luffing Jib

See Figure 4-35 for the following procedure.

1. Route the load lines through the proper guide sheaves on the boom insert, boom top, main strut, jib strut, and jib top.
2. Pull the load lines approximately 12,2 m (40.31 ft) past the end of the jib top wire rope guide (11) and lay them on the ground.
3. Once the wire rope is routed through the guide sheaves, install all the rope guard pins, bars, and rollers to retain the wire rope on the sheaves.

NOTE: Wire rope and sheaves can be damaged if the rope is not properly retained on the sheaves.

The load block(s) and/or the hook and hook-and-weight balls will be installed after the boom and jib are jackknifed to the required angle.

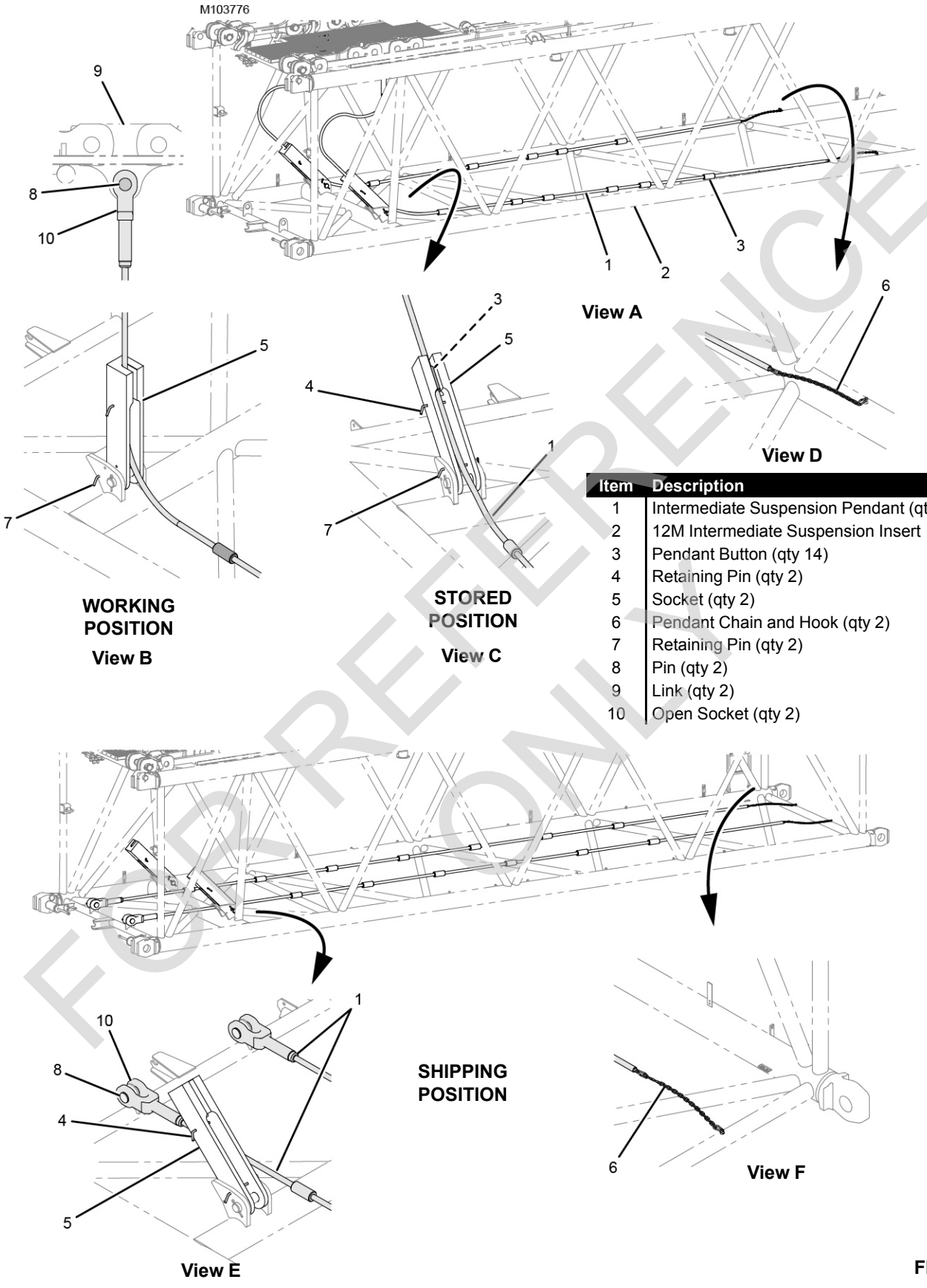
WARNING

Falling Wire Rope Hazard!

For long boom and short jib combinations, the wire rope on the boom side of the attachment can overhaul the unsecured wire rope on the jib side of the attachment.

The wire rope could fall off the boom.

Securely fasten the load lines to the jib point before raising the attachment.



Item	Description
1	Intermediate Suspension Pendant (qty 2)
2	12M Intermediate Suspension Insert
3	Pendant Button (qty 14)
4	Retaining Pin (qty 2)
5	Socket (qty 2)
6	Pendant Chain and Hook (qty 2)
7	Retaining Pin (qty 2)
8	Pin (qty 2)
9	Link (qty 2)
10	Open Socket (qty 2)

FIGURE 4-36

Preparing the Intermediate Suspension Pendants

See Figure 4-36 for the following procedure.

NOTE: The intermediate suspension pendants (1, View E) and rigging components are pre-assembled and shipped in the 12M intermediate suspension insert (2).

Each intermediate suspension pendant is equipped with multiple pendant buttons (3, View A). The pendant buttons are numbered.

1. Make sure the 12M intermediate suspension insert is installed at the proper location on the boom.
2. Refer to the Boom Rigging drawing at the end of this section to determine the pendant button number (see A, Figure 4-37) that must be pinned to the socket (5, View E).

NOTE: Each rigging drawing will have a different table included with that rigging drawing.

3. Disconnect the pendant chain and hook (6, View F) from the lacing on the insert.
4. Remove the pin (8, View E) from the open socket (10, View E), align the open socket with the link (9), and insert the pin (8, View B) to secure the pendant to the link.
5. Remove the retaining pin (4, View E) from the shipping position.
6. Pull the intermediate suspension pendant (1, View C) toward the boom butt until the proper pendant button (3, View C) can be placed in the socket (5, View C).
7. Reinstall the retaining pin (4, View C), locking the button in place.
8. Remove the retaining pin (7, View C).
9. Raise the socket and reinstall the retaining pin (7, View B).

NOTE: The socket will rest on the bracket. When the link is raised, it will automatically raise the socket into the working position.

10. Connect the pendant chain and hook (6, View D) to the closest point on the chord to remove the slack from the pendant.
11. Verify that the slack in the pendant chain will allow the socket to pivot into the stored position.
12. Repeat step 3 through step 11 for the other intermediate suspension pendant.

Reference of a Boom Makeup Table on Boom Rigging Drawing

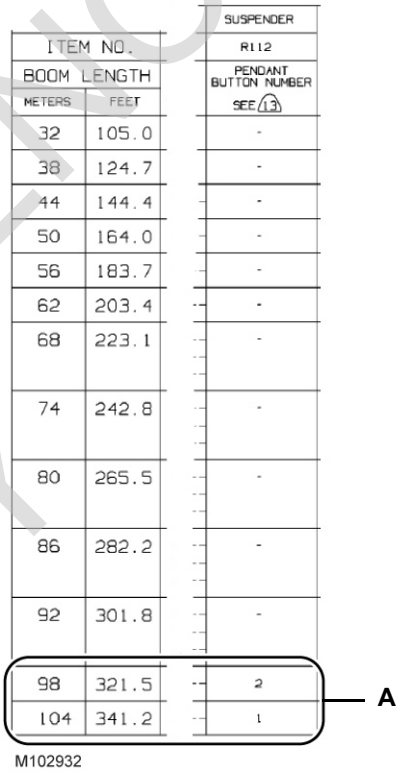


FIGURE 4-37

PRE-RAISING CHECKS

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

- ☐ All installation steps given in this section have been performed.
- ☐ The boom and jib inserts are installed in the proper sequence according to the corresponding Luffing Jib Rigging drawing.
- ☐ The boom, jib, and backstay straps are installed in the proper sequence and unpinned from the storage positions.
- ☐ All connecting pins are installed and properly retained.
- ☐ The boom and luffing hoist wire rope is anchored properly to the drums, spooled tightly onto the drums, and engaged with the proper sheaves. Make sure all rope guard pins, bars, and rollers are installed to retain the wire rope in the sheaves.
- ☐ The main strut is raised and the strut stops are pinned in the operating position.
- ☐ The luffing jib angle sensor is functioning properly and within range (see MLC650 Main Display Operation Manual).
- ☐ The load lines are anchored properly to the drums, spooled tightly onto the drums, and engaged with the proper sheaves. Make sure all rope guard pins, bars, and rollers are installed to retain the wire rope on the sheaves.
- ☐ The load lines going to the jib point are securely attached to the end of the jib so the load lines cannot fall off the jib and the boom.
- ☐ All safety devices are installed, electric cables are connected, and limit switches are functional and properly adjusted as instructed in Section 6 of this manual. Make sure boom stop is set at proper angle.
- ☐ All limit switches on boom butt have been checked and adjusted as instructed in Section 6 of this manual.
- ☐ The proper amount of crane counterweight is installed.
- ☐ All lubrication points are greased.
- ☐ The Luffing Jib Raising Procedure chart has been read and thoroughly understood.
- ☐ The proper Liftcrane Luffing Jib Capacity chart has been selected and confirmed in the RCL/RCI display.
- ☐ The wind is within the allowable limits for raising the boom and jib. See the Wind Conditions chart at the end of Section 3.
- ☐ The jib stop raising pendants are pinned to the lugs on the boom top.
- ☐ The jib stop raising roller is flipped forward over center (away from boom top) as shown in View A, Figure 4-38 on page 4-70.

WARNING

Falling Boom And Jib Hazard!

To operate the luffing jib, select the proper Liftcrane Luffing Jib Capacity chart in the RCL/RCI display. Operating the luffing jib with any other type of chart selected is prohibited.

The luffing jib limits are disabled if a Liftcrane Luffing Jib Capacity chart is not selected. The boom and jib could be pulled over backward.

RAISING THE BOOM AND LUFFING JIB

The following procedure applies to the MLC650 with or without VPC-MAX attachment.

See the Luffing Jib Raising Procedure chart at the end of this section for the following:

- Crane counterweight requirements
- Maximum boom and jib lengths that can be raised or lowered in the following positions:
  - Over the end of blocked crawlers
  - Over the end or side of unblocked crawlers
- The boom-to-luffing jib angle to which the boom and jib must be raised

DANGER

Moving Part Hazard!

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

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

WARNING

Tipping Hazard!

Determine the boom-to-luffing jib angle to which the boom and jib must be positioned before the jib can be raised (see the Luffing Jib Raising Procedure chart at the end of this section). The crane will tip or structural damage will result if the boom and jib are not at the specified angle.

- Monitor the boom-to-luffing jib angle in the Crane Status Bar of the main display as the boom and jib are raised (see the MLC650 Main Display Operation Manual).
- Monitor the boom angle and the luffing jib angle in the Working Screen of the RCL/RCI display.

The crane must remain in line with the crawlers when raising the boom and jib over blocked crawlers until the operating radius and crane configuration is within the 360° capacity chart.

NOTE: The following limits are indicated on the main display during the raising procedure:

- Block Up—This fault goes off once the boom and luffing jib are raised and the load lines/ block up limit chains are hanging freely.
- Luffing Jib Max Up 1 and Max Up 2—These faults go off once the boom-to-luffing jib included angle is less than 171°.

See Section 3 of this manual for instructions on bypassing the limits in the Luffing Jib Setup mode.

CAUTION

Avoid Crane Damage!

Anytime the luffing jib point rollers are in contact with the ground during the raising procedure, release the swing brake.

Do not, under any condition, allow the boom-to-luffing jib angle to become less than 70°.

WARNING

Tipping Hazard!

Refer to the tables in the Luffing Jib Raising Procedure chart to determine how much “Weight Under Load Point” can be lifted during the raising procedure. Where no weight is given, the load block, hook-and-weight balls, and slings must remain on the ground until the combined weights are within the rated capacity of the Liftcrane Luffing Jib Capacity chart in use.

WARNING

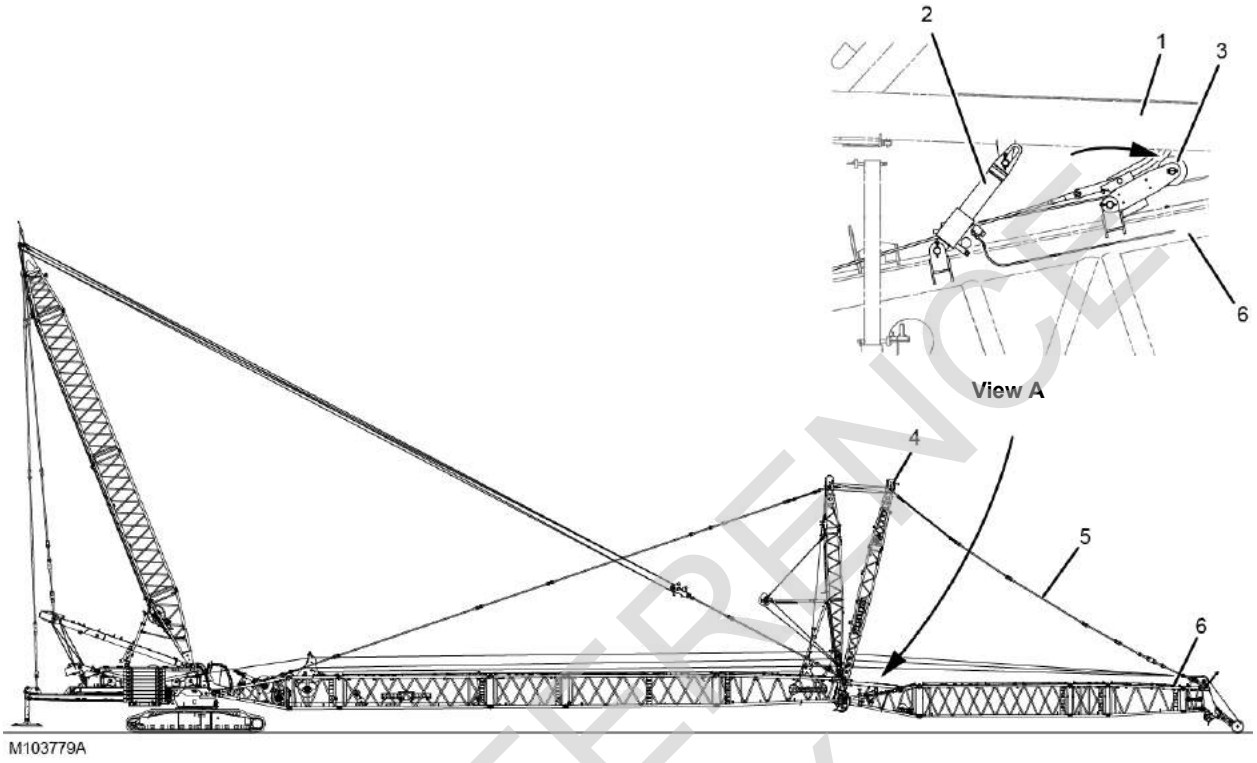
Falling Boom and Jib Hazard!

Make sure the proper counterweight is installed.

If equipped with a VPC-MAX attachment, refer to the tables in the Luffing Jib Raising Procedure chart to determine the required counterweight position that allows raising the boom and jib length in use.

The counterweight position must be selected in the Configuration Screen of the RCL/RCI display.

The counterweight position selection may be changed either when the jib is on the ground or when the jib is within the operating range of the capacity chart.



Item	Description
1	Jib Stop (qty 2)
2	Jib Stop Support Cylinder (qty 2)
3	Jib Stop Roller Bracket (2)
4	Jib Strut
5	Jib Straps
6	Jib
7	Jib Point Rollers
8	Boom
9	Boom-to-Luffing Jib Angle
10	Backstay Straps
11	Load Block/Hook-and-Weight Ball

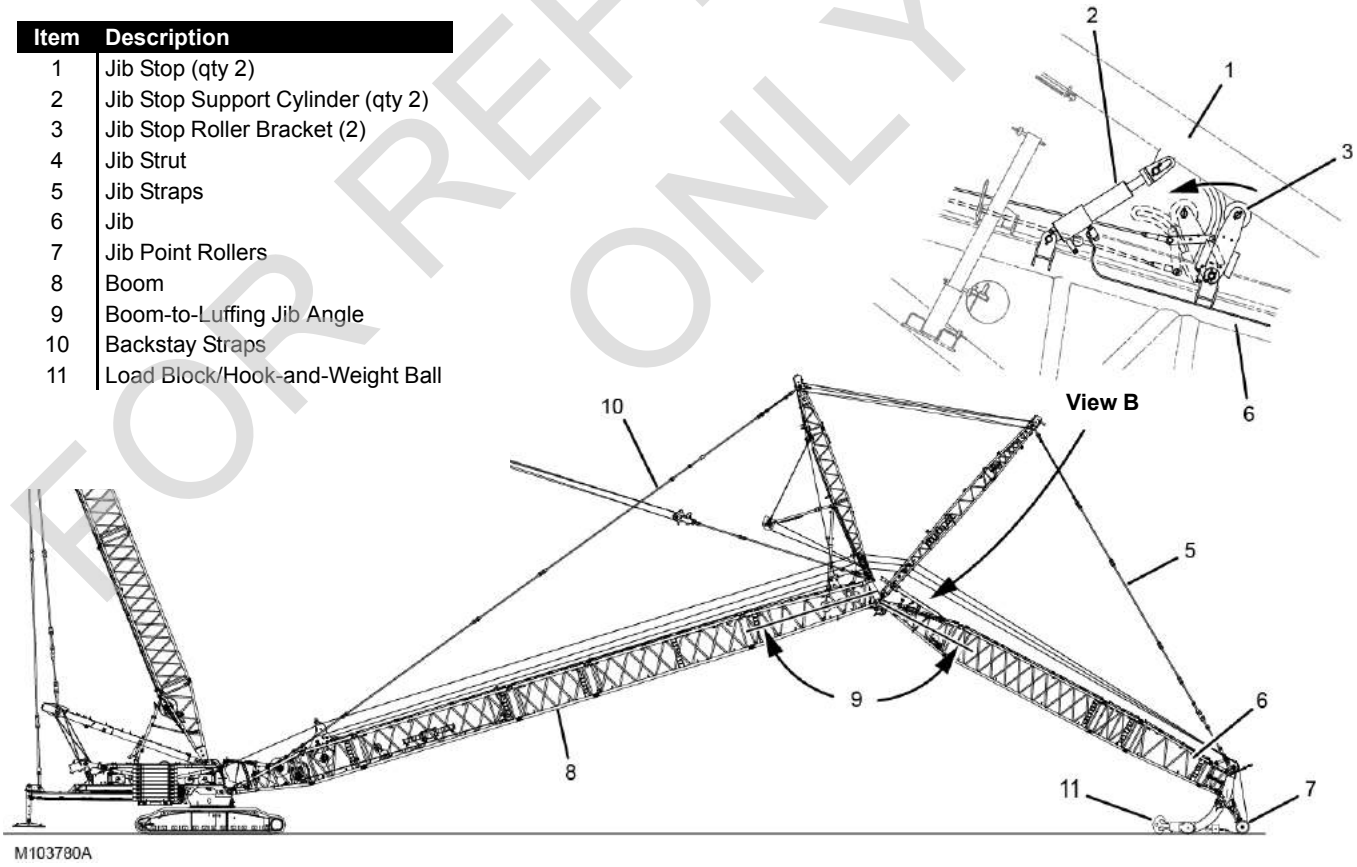


FIGURE 4-38

See Figure 4-38 for the following steps.

1. Turn off swing park in the cab to release the swing brake anytime the jib point rollers are on the ground.
2. Refer to View A and make sure:
   a. The jib stops (1) are resting on the fully retracted jib stop support cylinders (2).
   b. The jib stop roller brackets (3) are rotated forward.
   c. If necessary, perform the procedure for "Resetting the Jib Stop Raising Roller" on page 4-86.

WARNING

Falling Load Hazard!

The load lines going up the boom can overhaul the load lines going down the jib. Make sure the load lines are securely fastened to the jib point so the load lines can not fall off the boom during the raising procedure.

3. Make sure the load lines are fastened to the jib point. See "Routing the Load Lines to the End of the Luffing Jib" on page 4-65.
4. Determine the boom-to-luffing jib angle before the jib can be raised. See the Luffing Jib Raising Procedure chart at the end of this section.
5. Luff up to raise the jib strut (4) until the jib straps (5) are clear of the strap supports on the jib (6).
6. If equipped with intermediate suspension, watch the pendants closely. Do not allow the pendants to get caught on the insert or the load lines as the boom and jib rise.
7. Slowly boom up and luff down to raise the boom and jib to the required boom-to-luffing jib angle (9).
8. The jib point rollers (7) will roll along the ground as the boom (8) and jib (6) are jackknifed into position.
9. Pay out the load lines so they do not become taut as the boom and jib rise.
10. Operator and signal person: watch the jib straps (5) and the backstay straps (10) along the left side of the boom and jib. Both sets of straps tighten as the boom and jib rise. Also, observe the following during this procedure:
    - Luff down so the jib straps float up and down above the strap supports on the jib.
    - Make sure an assistant checks that the load lines are clear of the jib point rollers.
    - Use the limit bypass switch to luff down if the block up limit comes on.
    - When the boom to luffing jib angle is 135°, make sure the jib stop roller brackets (3, View B) get pulled over center toward the boom (8), completing the jib stop positioning sequence.

WARNING

Falling Jib Hazard!

Never allow the boom-to-luffing jib angle (9) to become less than 70°. Structural damage to the jib butt will occur, possibly causing the jib and/or boom to collapse.

Do not raise the boom and jib off the ground until the jib stops are properly positioned as shown in View B. The jib stops will not operate properly, possibly resulting in loss of stability.

Falling Load Hazard!

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

11. Once the boom and jib are at the proper boom-to-luffing jib angle or the jib is vertical (whichever occurs first), proceed as follows:
    a. Luff up until the jib straps (5) start to go into tension and stop.
    b. Boom up to raise the jib point rollers (7) to a convenient height off the ground.
    c. Install the load block (11) and/or the hook-and-weight ball.
       - See "Load Line Reeving" on page 4-134
       - See "Installing the Boom Block Up Limit Components" on page 4-75

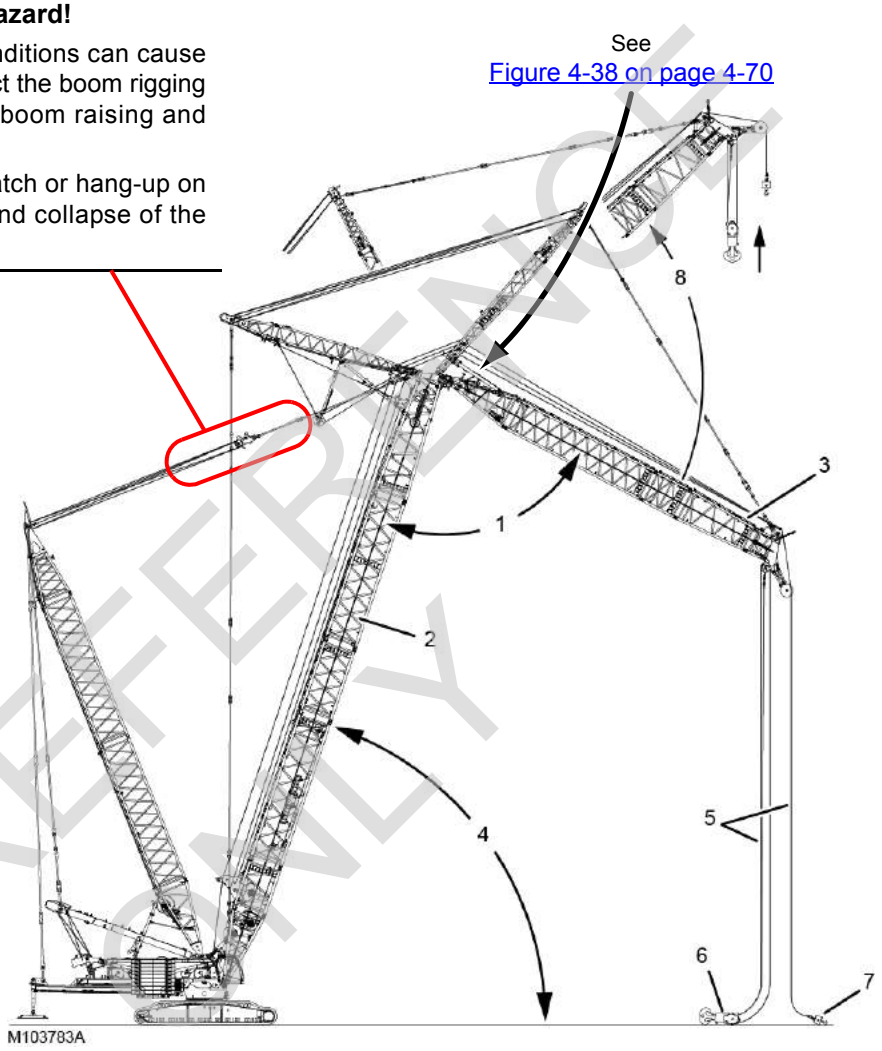
Continued on next page.

WARNING

Falling Boom and Jib Hazard!

Operator: be aware that side load conditions can cause the luffing jib backstay straps to contact the boom rigging (straps, equalizer, wire rope) during boom raising and lowering operations.

Do not allow the backstay straps to catch or hang-up on the boom rigging. Structural failure and collapse of the attachment could result.



Item	Description
1	Boom-to-Luffing Jib Angle
2	Boom
3	Jib
4	85° Boom Angle
5	Load Lines
6	Load Block
7	Hook-and-Weight Ball
8	Jib at Required Operating Angle

FIGURE 4-39

See Figure 4-39 for the remaining steps.

12. Boom up to raise the boom (2) and the jib (3) until the boom reaches 85° (4) or the operating radius is within the capacity chart and the jib is above horizontal.

13. If the boom-to-luffing jib angle (1) is greater than 135°, luff down until the angle is 135° and verify the following (see View B, Figure 4-38 on page 4-70.

- **a.** Both jib stop raising rollers have raised the boom stops so the jib stop support cylinders are fully extended.
- **b.** Both jib stop roller brackets have flipped rearward over center (towards boom top) so the pendants are slack.

14. Unless otherwise specified in the Luffing Jib Raising Procedure chart, pay out the load lines (5) to keep the load block (6) and the hook-and-weight ball (7) on the ground.

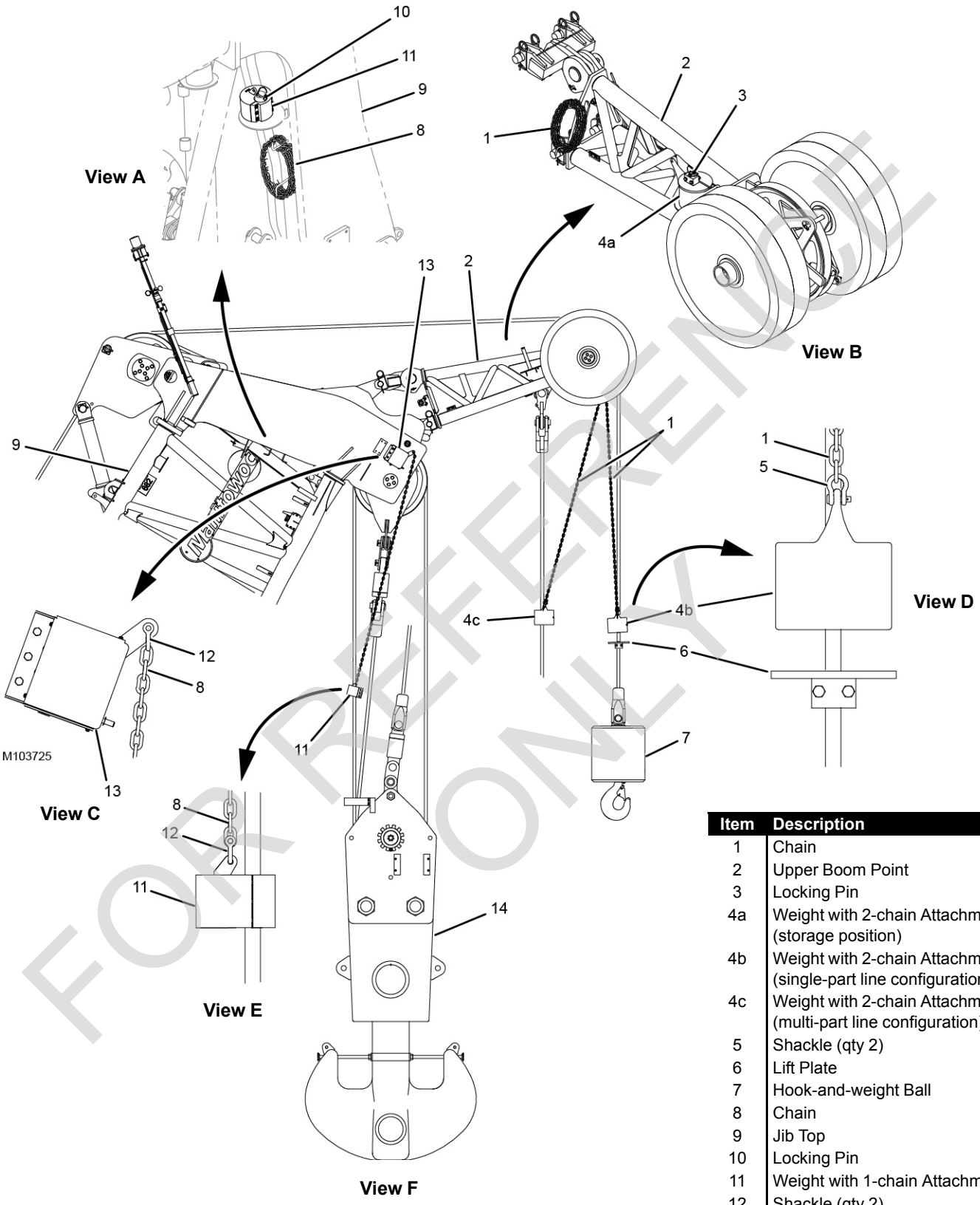
WARNING

Falling Load Hazard!

Do not lift the load blocks and/or the hook-and-weight balls off the ground until the boom has been raised to the desired operating angle and the jib has been positioned at the required operating radius for the load to be handled. Structural damage can occur and the attachment can collapse if this precaution is not followed.

15. Lift the load block (6) and/or the hook-and-weight ball (7) to the desired position. Travel forward as required so the load block and/or the hook-and-weight ball are directly below the jib point before lifting them.

16. The luffing jib radius must be within the capacity chart before swinging over the side of the machine.



Item	Description
1	Chain
2	Upper Boom Point
3	Locking Pin
4a	Weight with 2-chain Attachments (storage position)
4b	Weight with 2-chain Attachments (single-part line configuration)
4c	Weight with 2-chain Attachments (multi-part line configuration)
5	Shackle (qty 2)
6	Lift Plate
7	Hook-and-weight Ball
8	Chain
9	Jib Top
10	Locking Pin
11	Weight with 1-chain Attachment
12	Shackle (qty 2)
13	Limit Switch
14	Load Block

FIGURE 4-40

INSTALLING THE BOOM BLOCK UP LIMIT COMPONENTS

See Figure 4-40 for the following procedure.

1. Remove the chain (1, View B) from its storage location on the upper boom point (2, View B).
2. Remove the locking pin (3).
3. Remove the weight with 2-chain attachments (4a) from its storage position on the upper boom point.
4. Attach the chain to the upper boom point as shown, making sure the ends of the chain are even.
5. With a single-part line configuration, install the weight with 2-chain attachments (4b) over the load line.

   With a multi-part line configuration, install the weight with 2-chain attachments (4c) on the dead end side of the load line.
6. Using the shackles (5), attach the ends of the chain to the weight with 2-chain attachments.
7. If using a single-part line configuration, attach the lift plate (6) to the load line.
8. Attach the hook-and-weight ball (7) to the load line.
9. Remove the chain (8, View A) from its storage location on the jib top (9, View A).
10. Remove the locking pin (10) from the weight with 1-chain attachment (11, View A) on the jib top.
11. Remove the weight with 1-chain attachment from the jib top.
12. Using one of the shackles (12, View C), attach the chain to the lever on the limit switch (13, View C).
13. Install the weight with 1-chain attachment over the load line.
14. Using the other shackle, attach the end of the chain to the weight with 1-chain attachment.
15. Attach the load block (14) to the load line.

THIS PAGE INTENTIONALLY LEFT BLANK

LOWERING THE BOOM AND LUFFING JIB

The following procedure applies to the MLC650 with or without VPC-MAX attachment.

See the Luffing Jib Raising Procedure chart at the end of this section for the following:

- Crane counterweight requirements
- Maximum boom and jib lengths that can be lowered in the following positions:
  - Over the end of blocked crawlers
  - Over the end or side of unblocked crawlers
- The boom-to-luffing jib angle to which the boom and jib must be lowered

DANGER

Moving Part Hazard!

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

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

WARNING

Tipping Hazard!

Determine the boom-to-luffing jib angle to which the boom and jib must be positioned before the jib can be lowered (see the Luffing Jib Raising Procedure chart at the end of this section). The crane will tip or structural damage will result if the boom and jib are not at the specified angle.

- Monitor the boom-to-luffing jib angle in the Crane Status Bar of the main display as the boom and jib are lowered (see the MLC650 Main Display Operation Manual).
- Monitor the boom angle and the luffing jib angle in the Working Screen of the RCL/RCI display.

NOTE: The following limits are indicated on the main display during the lowering procedure:

- Block Up
- Luffing Jib Max Up 1 and Max Up 2

See Section 3 of this manual for instructions on bypassing the limits in the Luffing Jib Setup mode.

CAUTION

Avoid Crane Damage!

Anytime the luffing jib point rollers are in contact with the ground during the lowering procedure, release the swing brake.

Do not, under any condition, allow the boom-to-luffing jib angle to become less than 70°.

WARNING

Tipping Hazard!

Refer to the tables in the Luffing Jib Raising Procedure chart to determine how much “Weight Under Load Point” can be lifted during the lowering procedure. Where no weight is given, the load block, hook-and-weight balls, and slings must be lowered to the ground before lowering the boom and jib.

WARNING

Falling Boom and Jib Hazard!

Make sure the proper counterweight is installed.

If equipped with a VPC-MAX attachment, refer to the tables in the Luffing Jib Raising Procedure chart to determine the required counterweight position that allows lowering the boom and jib length in use.

The counterweight position must be selected in the Configuration Screen of the RCL/RCI display.

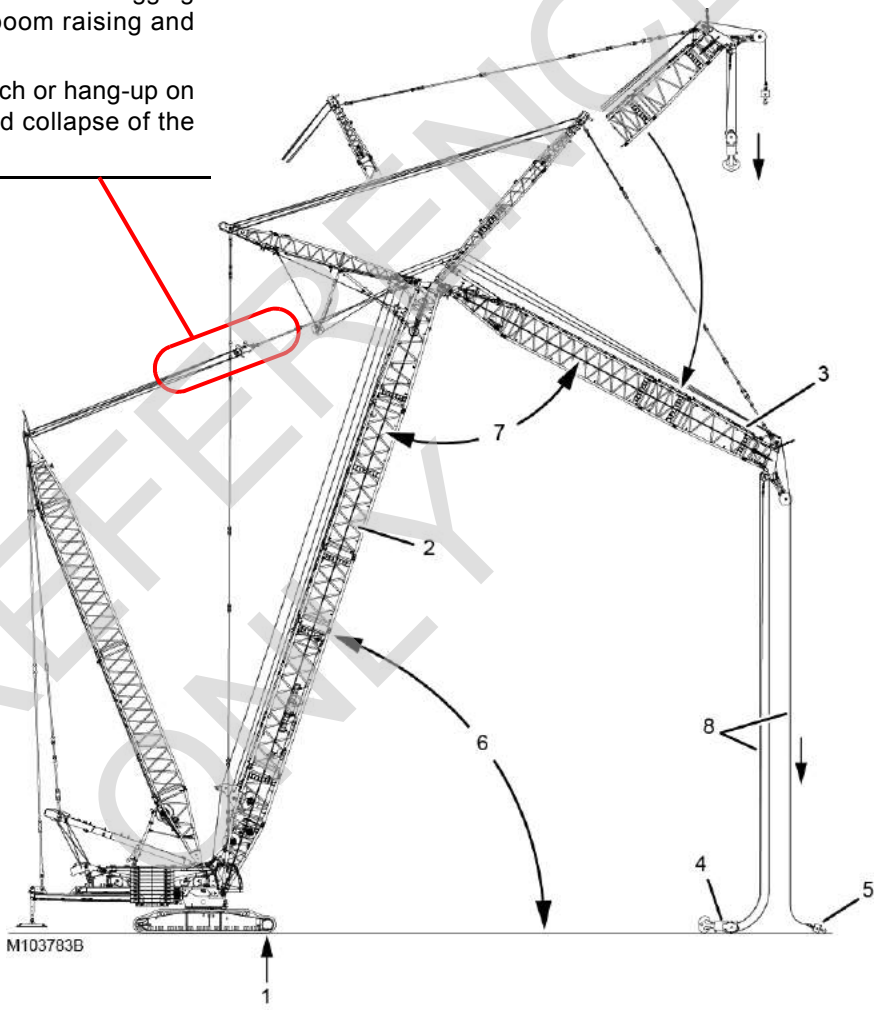
The counterweight position selection may be changed either when the jib is on the ground or when the jib is within the operating range of the capacity chart.

WARNING

Falling Boom and Jib Hazard!

Operator: be aware that side load conditions can cause the luffing jib backstay straps to contact the boom rigging (straps, equalizer, wire rope) during boom raising and lowering operations.

Do not allow the backstay straps to catch or hang-up on the boom rigging. Structural failure and collapse of the attachment could result.



Item	Description
1	Blocking
2	Boom
3	Jib
4	Load Block
5	Hook-and-Weight Ball
6	85° Boom Angle
7	Boom-to-Luffing Jib Angle
8	Load Lines

FIGURE 4-41

See Figure 4-41 for the following procedure.

1. If necessary, travel the ends of the crawlers under the boom onto blocking (1).

   See Blocked Crawlers, on page 4-2.

WARNING

Tipping Crane Hazard!

Unless otherwise specified in the Luffing Jib Raising Procedure chart, lower the load block and/or the hook-and-weight ball to the ground before lowering the boom and jib. Tipping can occur if this precaution is not observed.

2. If necessary, swing the boom (2) and jib (3) slightly to either side of center and lower the load block (4) and/or the hook-and-weight ball (5) to the ground. Then swing the boom and jib to the required position with relation to the crawlers.

DANGER

Tipping Crane Hazard!

Do not lower the boom and jib to the ground until the boom is positioned at the minimum angle of 85° and the jib is positioned at the specified boom-to-luffing jib angle. The crane will tip, or structural damage will occur, possibly causing the attachment to collapse.

The jib stop will not operate properly if this precaution is not observed.

3. Position the boom (2) at the 85° angle (6).
4. Lower the jib until the boom-to-luffing jib angle (7) reaches the value specified in the Luffing Jib Raising Procedure chart.
5. Slowly lower the boom until the upper jib point is at a convenient height above the ground.

   If necessary, use the limit bypass switch to lower the boom if the block up limit is on.
6. Make sure the load lines (8) do not become entangled while lowering the boom.

WARNING

Falling Wire Rope Hazard!

For long boom and short jib combinations, the wire rope on the boom side of the attachment can overhaul unsecured wire rope on the jib side of the attachment. The wire rope could fall off the boom. Securely fasten the load lines to the jib point before removing the load block and/or the hook-and-weight ball.

7. Remove the load block (4) and/or the hook-and-weight ball (5):
   a. Remove the block up limit weights and chains. See Removing the Block Up Limit Components, on page 4-85.
   b. Securely fasten the load lines to the jib point so the load lines cannot fall off the boom and jib.

NOTE: It is not necessary to remove the load block and/or hook-and-weight ball if the crane is not being disassembled.

Continued on next page.

Item	Description
1	Jib Point Rollers
2	Boom
3	Luffing Jib
4	135° Angle
5	Jib Straps
6	Backstay Straps
7	Boom Butt
8	Jib Top

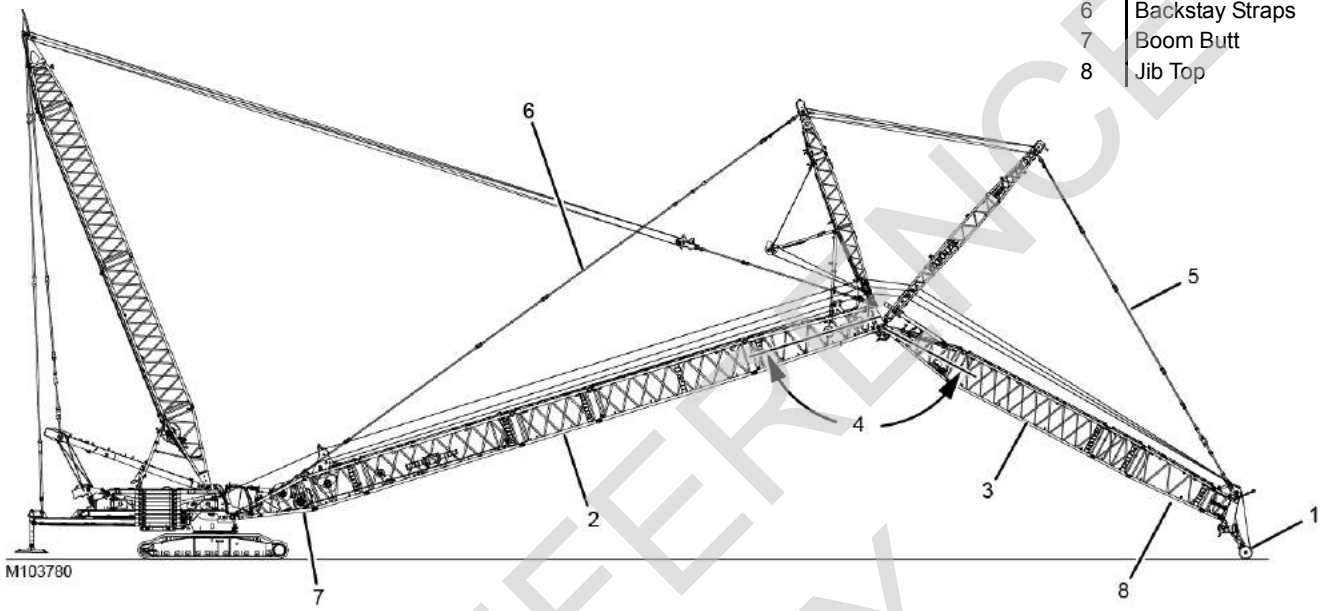


FIGURE 4-42

See Figure 4-42 for the following steps.

8. Lower the boom (2) until the jib point rollers (1) contact the ground. If the jib (3) is hanging vertically, raise the jib a few degrees forward of vertical.

9. Turn off swing park in the cab to release the swing brake.

WARNING

Tipping Hazard!

If the luffing jib fails to roll forward during step 10, lock the counterweight (using VPC Lockout Switch in cab) until the boom-to-luffing jib angle is 135°.

The jib point rollers must remain on the ground with the jib straps slack.

Once the boom-to-luffing jib angle is 135°, unlock the counterweight and continue booming down. Failing to lock and unlock the counterweight as instructed may result in loss of machine stability.

10. Continue to lower the boom so the jib rolls forward along the ground. If the luffing jib fails to roll forward, it will be necessary to use an outside assist until the jib can roll forward on its own.

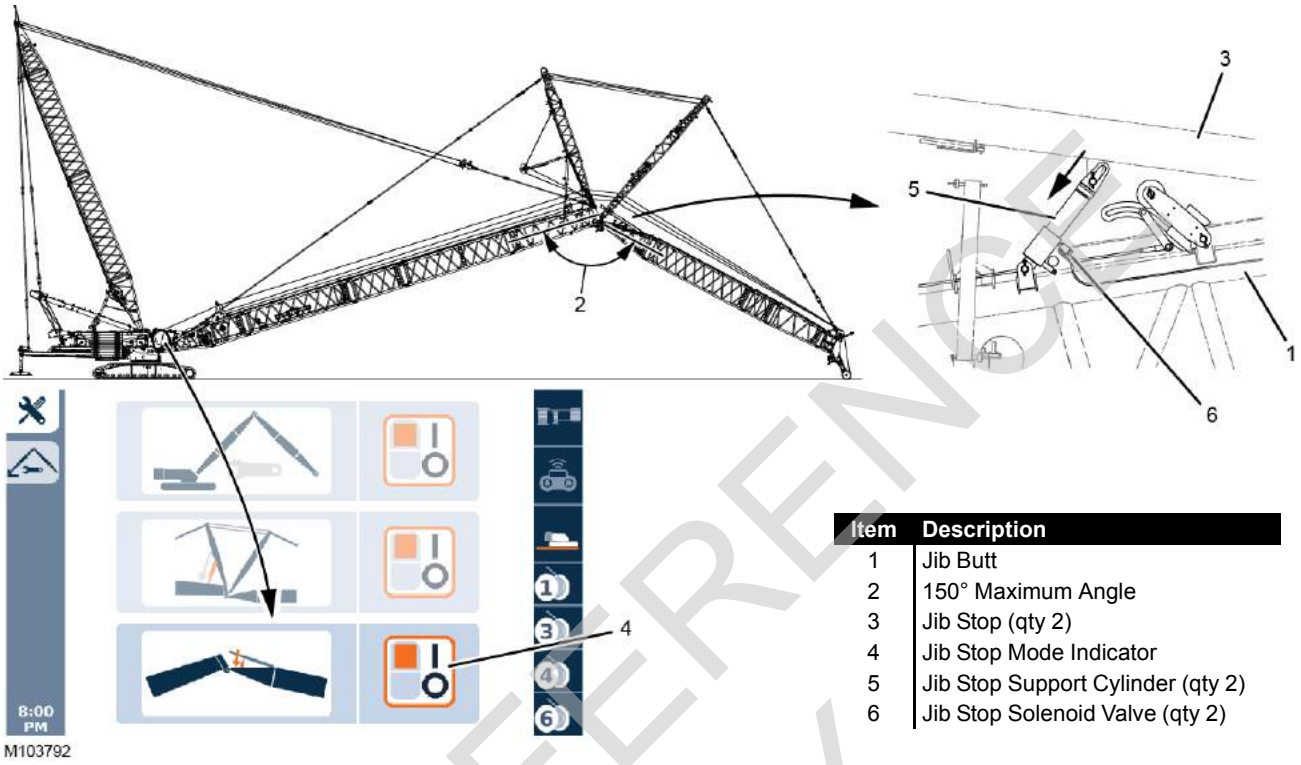
11. Use extreme care not to roll over the load lines.

12. Pay out the load lines so they do not become taut as the boom and jib lower.

13. The jib straps (5) and the backstay straps (6) slacken as the boom and jib lower. The operator and signal person need to observe the backstay straps and the jib straps along the left side of the boom and jib as they lower:

- Allow the backstay straps to float up and down above the strap supports at the top end of the boom butt (7).
- Allow the jib straps to float up and down above the strap supports at the butt end of the jib top (8).

NOTE: Use the limit bypass switch to luff down if the block up limit is on.



Item	Description
1	Jib Butt
2	150° Maximum Angle
3	Jib Stop (qty 2)
4	Jib Stop Mode Indicator
5	Jib Stop Support Cylinder (qty 2)
6	Jib Stop Solenoid Valve (qty 2)

FIGURE 4-43

See Figure 4-43 for the following steps.

WARNING

Falling Jib Hazard!

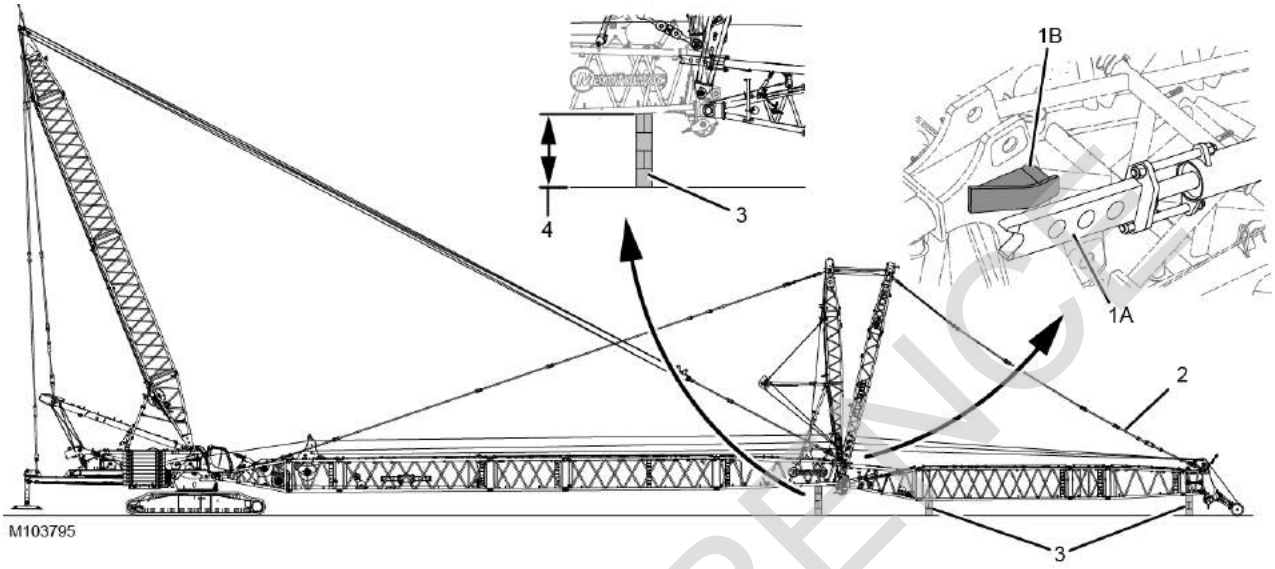
Do not under any condition allow the boom-to-luffing jib angle to become greater than 150° before turning on the jib stop mode. The jib stop could engage the boom top during the lowering procedure and cause the jib to collapse.

14. Continue to lower the boom and jib until the boom-to-luffing jib angle reaches a maximum of 150°.

15. STOP. Turn the jib stop mode to ON (4) in the mode selection screen of the main display. This step will activate the jib stop solenoid valves (6), and the jib stop support cylinders (5) will fully retract under the weight of the jib stops (3).

NOTE: In case of electrical failure, the jib stop solenoid valves (6) can be mechanically actuated to lower the jib stops. Contact the Manitowoc Crane Care Lattice Team for the manual override procedure.

Continued on next page.



Item	Description
1A	Jib Stop (qty 2)
1B	Jib Stop Lug (qty 2)
2	Jib Straps
3	Blocking (qty varies)
4	1,7 m (5.6 ft) Height

FIGURE 4-44

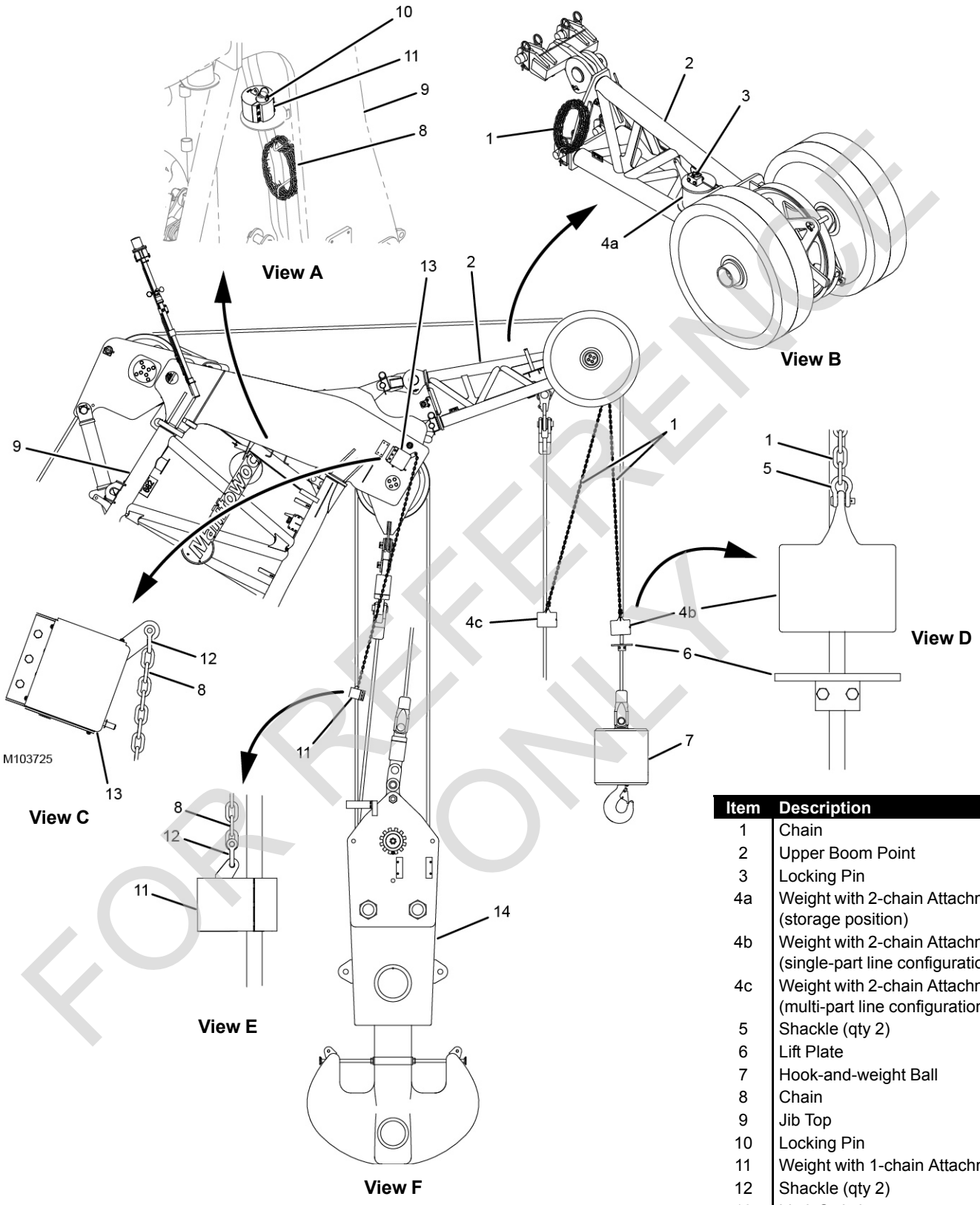
See Figure 4-44 for the remaining steps:

16. Continue to lower the boom and jib while an assistant makes sure the jib stops (1A) are fully lowered and will pass under the jib stop lugs (1B) on the boom top.

NOTE: If equipped with intermediate suspension, watch the pendants closely. They must lower into the insert smoothly without catching on the insert or the load lines as the boom and jib lower.

17. Place blocking (3) under the jib and slowly continue the lowering procedure until the jib is at a 1,7 m (5.6 ft) height (4) and the insert straps are resting on the supports on the jib sections.

THIS PAGE INTENTIONALLY LEFT BLANK



Item	Description
1	Chain
2	Upper Boom Point
3	Locking Pin
4a	Weight with 2-chain Attachments (storage position)
4b	Weight with 2-chain Attachments (single-part line configuration)
4c	Weight with 2-chain Attachments (multi-part line configuration)
5	Shackle (qty 2)
6	Lift Plate
7	Hook-and-weight Ball
8	Chain
9	Jib Top
10	Locking Pin
11	Weight with 1-chain Attachment
12	Shackle (qty 2)
13	Limit Switch
14	Load Block

FIGURE 4-45

REMOVING THE BLOCK UP LIMIT COMPONENTS

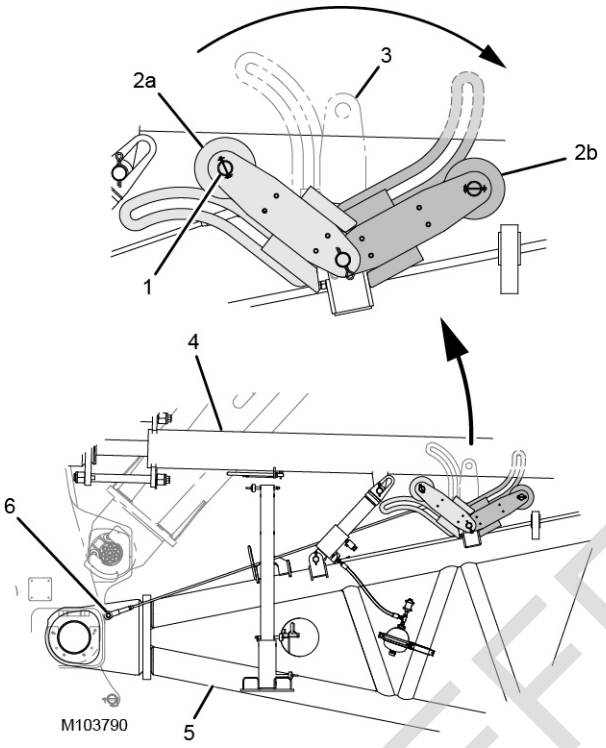
See Figure 4-45 for the following procedure.

1. Remove the load block (14) from the load line.
2. Remove the shackle (12, View E) and the chain (8, View E) from the weight with 1-chain attachment (11, View E).
3. Remove the weight with 1-chain attachment from the load line.
4. Remove the shackle and chain from the lever on the limit switch (13, View C).
5. Install the weight with 1-chain attachment to the jib top (9, View A).
6. Install the locking pin (10) to the weight with 1-chain attachment on the jib top.
7. Install the chain in its storage location on the jib top.
8. Remove the hook-and-weight ball (7) from the load line.
9. If using a single-part line configuration, remove the lift plate (6) from the load line.
10. Remove the shackles (5) and chain (1, View F) from the weight with 2-chain attachments.
11. Remove the weight with 2-chain attachments from the load line.

NOTE: With a single-part line configuration, the weight with 2-chain attachments (4b) is over the load line. With a multi-part line configuration, the weight with 2-chain attachments (4c) is over the dead end side of the load line.

12. Remove the chain from the upper boom point.
13. Install the weight with 2-chain attachments (4a) in its storage position on the upper boom point (2, View B).
14. Install the locking pin (3).
15. Install the chain in its storage location on the upper boom point.

LUFFING JIB DISASSEMBLY



Item	Description
1	Locking Pin Assembly (qty 2)
2a	Jib Stop Raising Roller (working position) (qty 2)
2b	Jib Stop Raising Roller (stored position) (qty 2)
3	Raising Roller Bracket (qty 2)
4	Jib Stop (qty 2)
5	Jib Butt
6	Jib Stop Pendant (qty 2)

FIGURE 4-46

Resetting the Jib Stop Raising Roller

See Figure 4-46 for the following procedure.

NOTE: Each time the jib is lowered, step 1 through step 5 must be performed.

1. Lower the boom and luffing jib to the required angle. Refer to the Luffing Jib Raising Procedure chart.
2. Remove the locking pin assembly (1).
3. Remove the jib stop raising roller (2a) from the jib stop raising roller bracket (3).
4. Rotate the jib stop raising roller bracket away from the butt end of the jib butt (5) and past the jib stop (4).
5. Install the jib stop raising roller (2b) in the jib stop raising roller bracket and secure with the locking pin assembly.

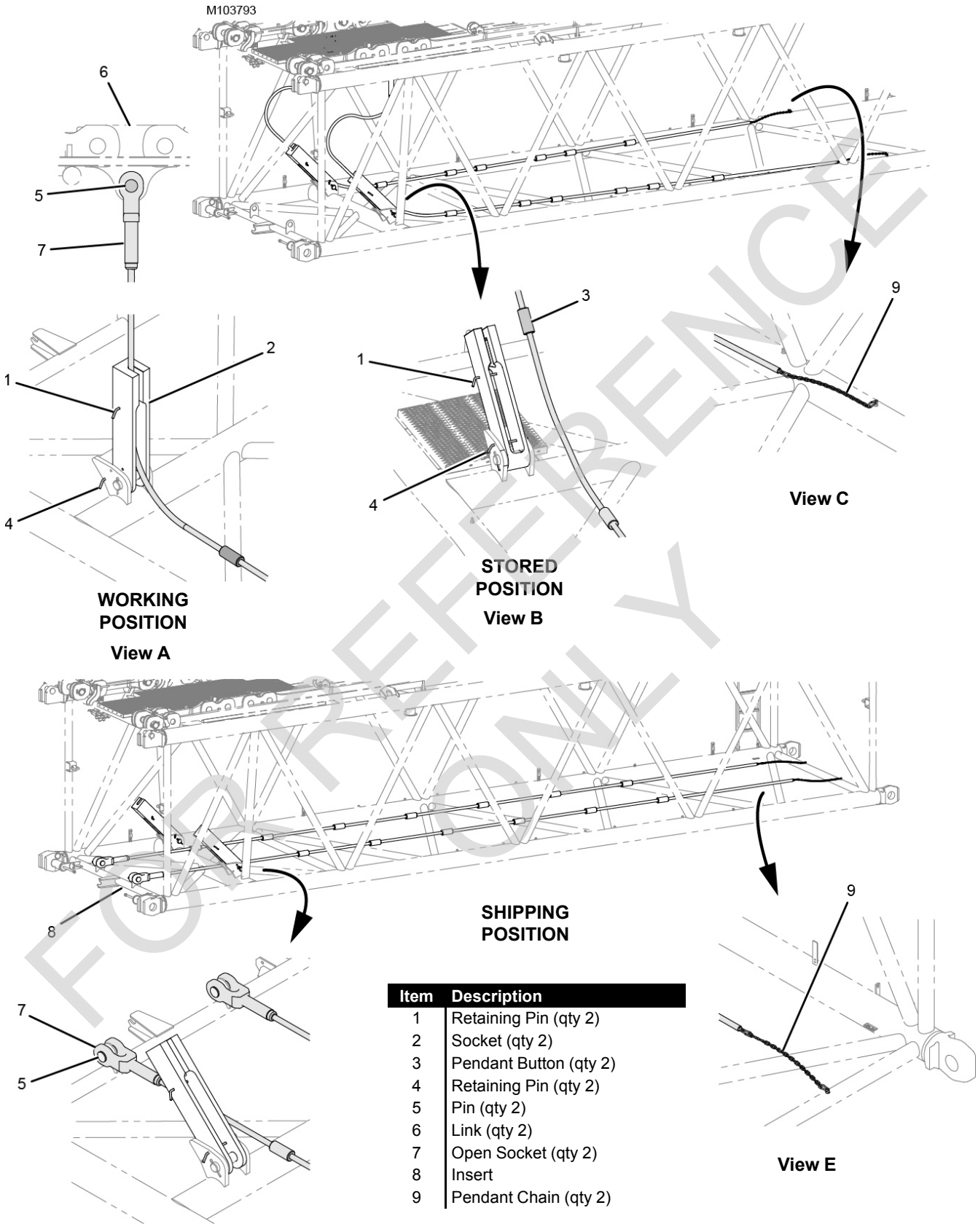
NOTE: The following steps need to be completed if the jib is being removed.

6. Remove the jib stop pendant (6) from the boom top lug.

NOTE: Leave the jib stop pendant hanging until the jib butt pin is removed. Secure the pendant to the lug on the pin.

7. Repeat step 2 through step 6 for the other side of the luffing jib.

THIS PAGE INTENTIONALLY LEFT BLANK



Item	Description
1	Retaining Pin (qty 2)
2	Socket (qty 2)
3	Pendant Button (qty 2)
4	Retaining Pin (qty 2)
5	Pin (qty 2)
6	Link (qty 2)
7	Open Socket (qty 2)
8	Insert
9	Pendant Chain (qty 2)

FIGURE 4-47

Removing the Intermediate Suspension Pendants

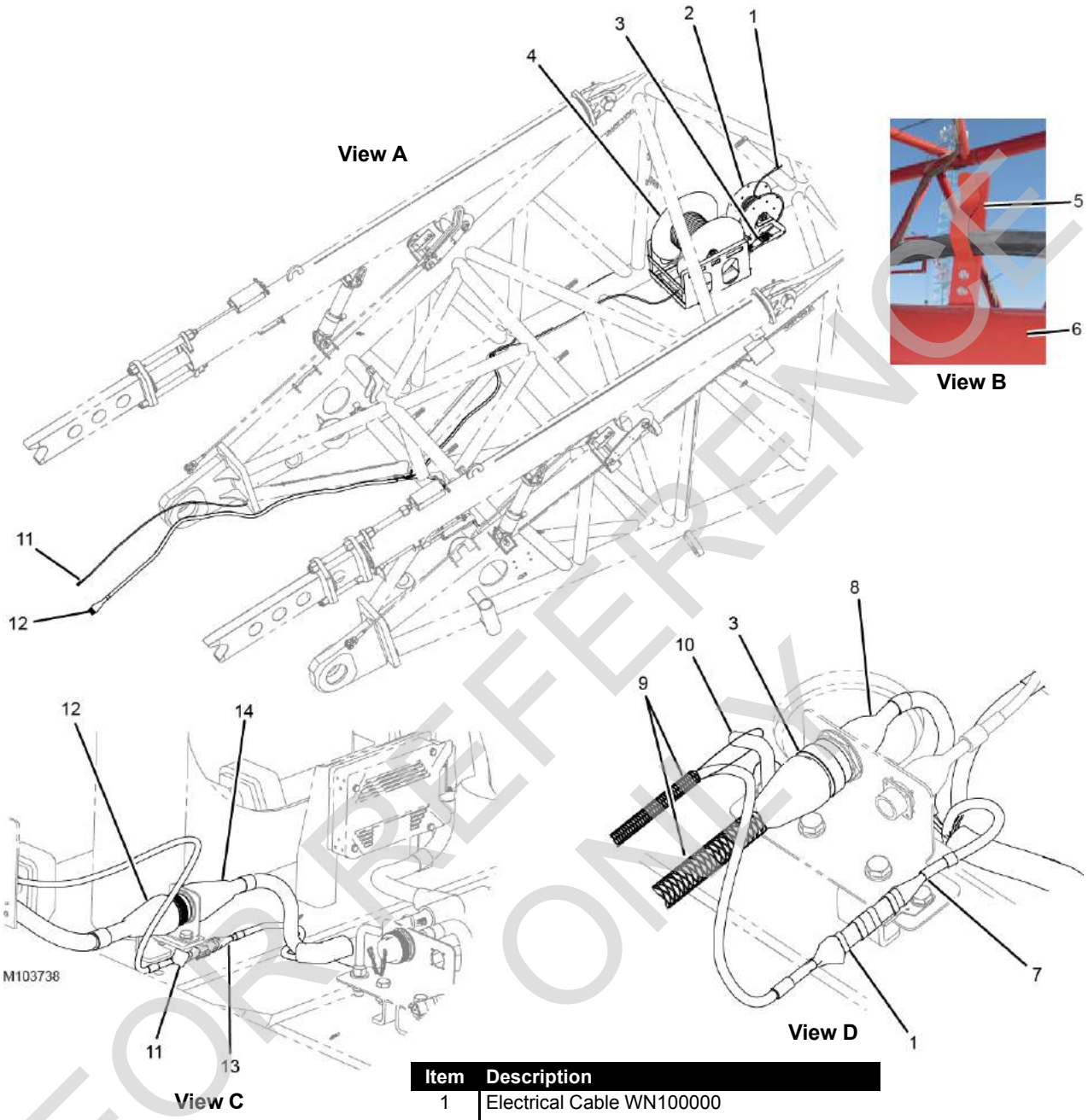
See Figure 4-47 for the following procedure.

1. Remove the retaining pin (1, View A) from the socket (2). Slide the intermediate suspension pendant button (3, View B) down and out from the socket. Reinstall the retaining pin (1, View B).
2. Remove the retaining pin (4, View A) and place the socket in the stored position (View B). Reinstall the pin (4, View B).
3. Remove the pin (5, View A) connecting the open socket (7, View A) to the link (6).
4. Place the open socket (7, View D) on the storage lug on the insert (8). Secure with a pin (5, View D).
5. Remove the pendant chain (9, View C) from the chord.
6. Connect the pendant chain (9, View E) to the lacing on the insert.
7. Repeat this procedure for the other side of the insert.

Removing the Load Lines from the End of the Jib

See "Removing the Block Up Limit Components" on page 4-85 for the following procedure.

1. Remove the block up limit components attached to the load lines.
2. Disconnect any button sockets, swivels, or links connected to the load lines.
3. Wind the load lines onto the drums and secure them for shipping.
4. Store the button sockets, swivels, links, and connecting pins in the parts box.



Item	Description
1	Electrical Cable WN100000
2	Cable Reel
3	Electrical Cable WJR1
4	Cable Reel
5	Cable Clip (qty varies)
6	Jib Insert (qty varies)
7	CAN NET IN Electrical Plug WJT1-J3
8	Electrical Plug WJT1-J1
9	Strain Relief (qty 2)
10	J-bolt
11	Electrical Cable WJB2-P1
12	Electrical Cable WJB1-P1
13	CAN NET OUT Electrical Cable WBT1-J6
14	Electrical Plug WBT1-J2

FIGURE 4-48

Disconnecting the Jib Electrical Cables

See Figure 4-48 for the following procedure.

1. At the boom top, perform the following steps:
   a. Disconnect electrical cable WJB1-P1 (12, View C) from electrical plug WBT1-J2 (14).
   b. Disconnect electrical plug WJB2-P1 (11, View C) from CAN NET OUT electrical cable WBT1-J6 (13).
   c. Disconnect the dust cap from the terminator. Connect the CAN terminator (not shown) to CAN NET OUT electrical cable WBT1-J6.
2. Coil the electrical cables WJB2-P1 (11, View A) and WJB1-P1 (12, View A) onto the storage brackets on the jib butt.
3. Disconnect the strain reliefs (9) from the J-bolt (10).
4. Disconnect electrical cable WJR1 (3, View D) from electrical plug WJT1- J1 (8, View D) on the jib top.
5. Disconnect electrical cable WN100000 (1, View D) from CAN NET IN electrical plug WJT1-J3 (7, View D) on the jib top.
6. Remove the dust cap from the CAN terminator (not shown), and connect the CAN terminator to CAN NET IN electrical plug WJT1-J3.
7. Remove the cables from the cable clips (5) on the jib inserts (6).
8. Reel in electrical cable WJR1 to the cable reel (4) in the jib butt.
9. Reel in electrical cable WN100000 to the cable reel (2) in the jib butt.

Item	Description
1	Electrical Cable WBR3
2	Electrical Cable WJB3
3	Electrical Cable WJR3
4	Cable Reel
5	Camera Cable WJT3
6	Cable Clip (qty varies)
7	Camera Mounting Pad
8	M12x30 Bolt (qty 4)
9	Camera
10	Eye Bolt

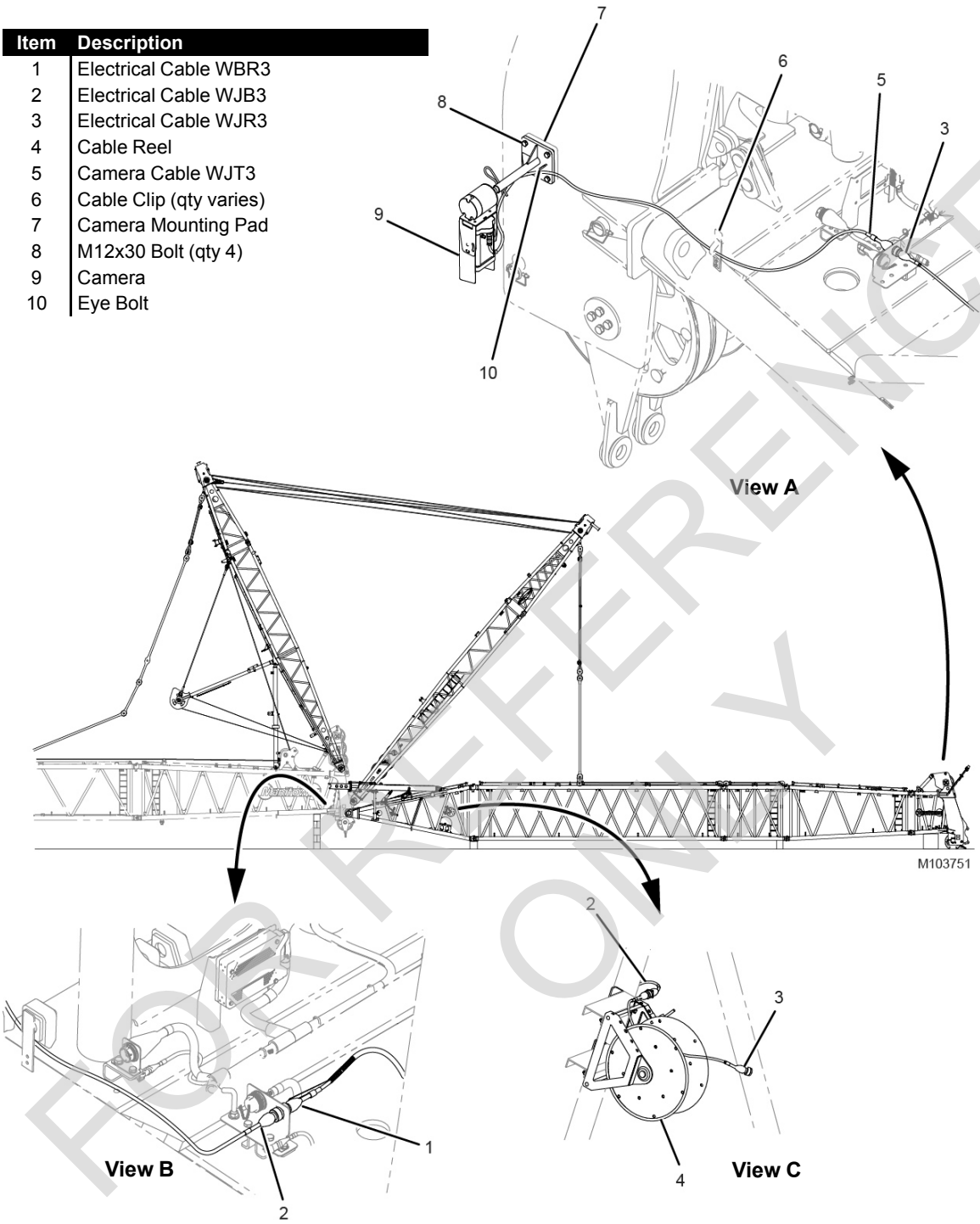


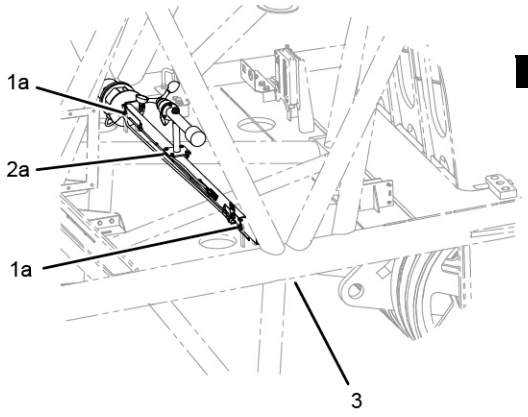
FIGURE 4-49

Removing the Jib Top Camera

See Figure 4-49 for the following procedure.

1. Disconnect the camera cable (5) from electrical cable WJR3 (3).
2. Remove the electrical cable from any cable clips (6) and reel in the electrical cable from the jib top electrical connector bracket to the cable reel (4).
3. Disconnect electrical cable WJB3 (2, View B) from electrical cable WBR3 (1, View B).
4. Remove the four M12x30 bolts (8) from the camera mounting pad (7). Remove the camera assembly, wind up the camera cable, and place it in the job box.

NOTE: The security chain from the camera (9) should remain connected to the eye bolt (10).



Item	Description
1a	Locking Pin (shipping position) (qty 2)
1b	Locking Pin (working position) (qty 2)
2a	Position Light and Wind Speed Indicator Assembly (shipping position)
2b	Position Light and Wind Speed Indicator Assembly (working position)
3	Boom Top
4	Position Light Bracket
5	Electrical Cable WJT1-P4
6	Electrical Cable WJT1-P8

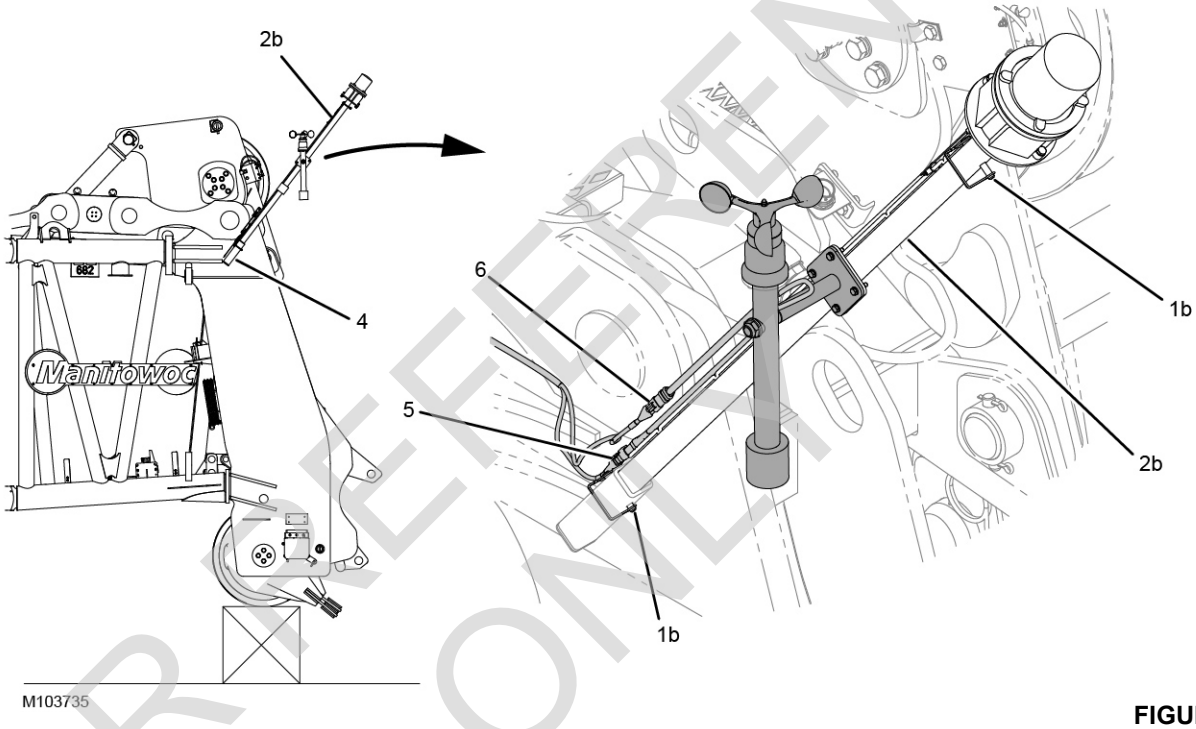
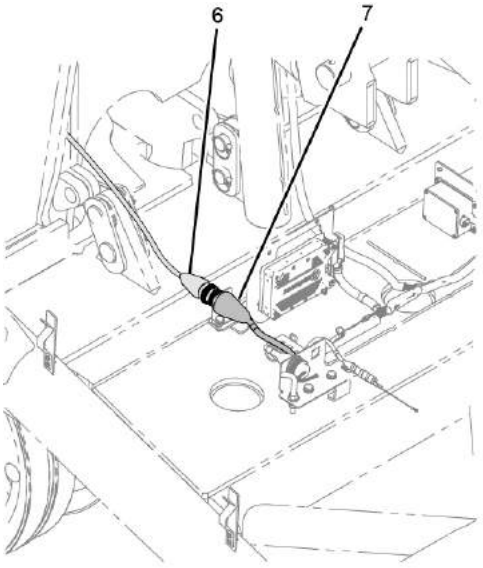


FIGURE 4-50

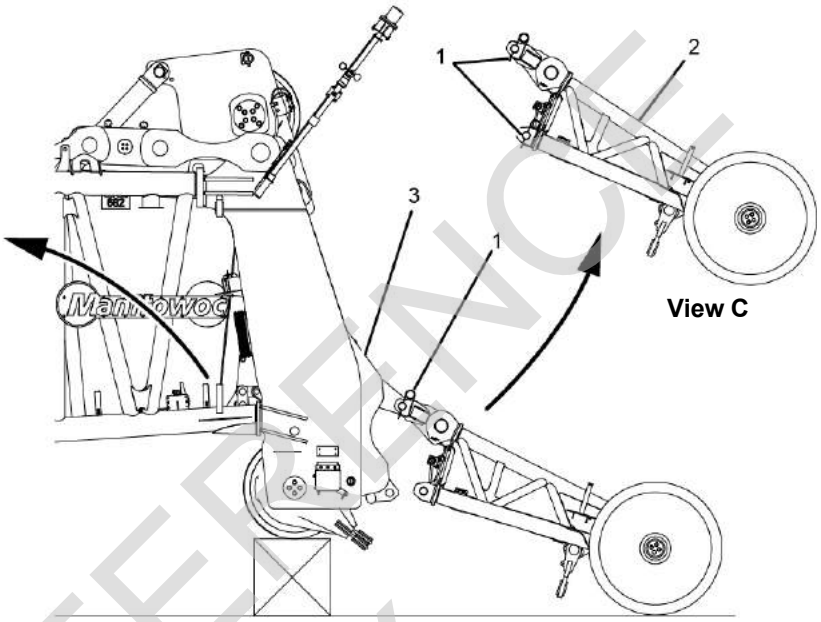
Removing the Position Light and Wind Speed Indicator

See Figure 4-50 for the following procedure.

1. Disconnect the electrical cable WJT1-P4 (5) on the jib top from the electrical cable on the wind speed indicator.
2. Disconnect the electrical cable WJT1-P8 (6) on the jib top from the electrical cable on the position light.
3. Remove the locking pins (1b) from the position light and wind speed indicator assembly (2b) and from the position light bracket (4) on the jib top.
4. Store the position light and wind speed indicator assembly (2a) on the boom top (3) and secure the assembly to the storage lugs using the locking pins (1a).



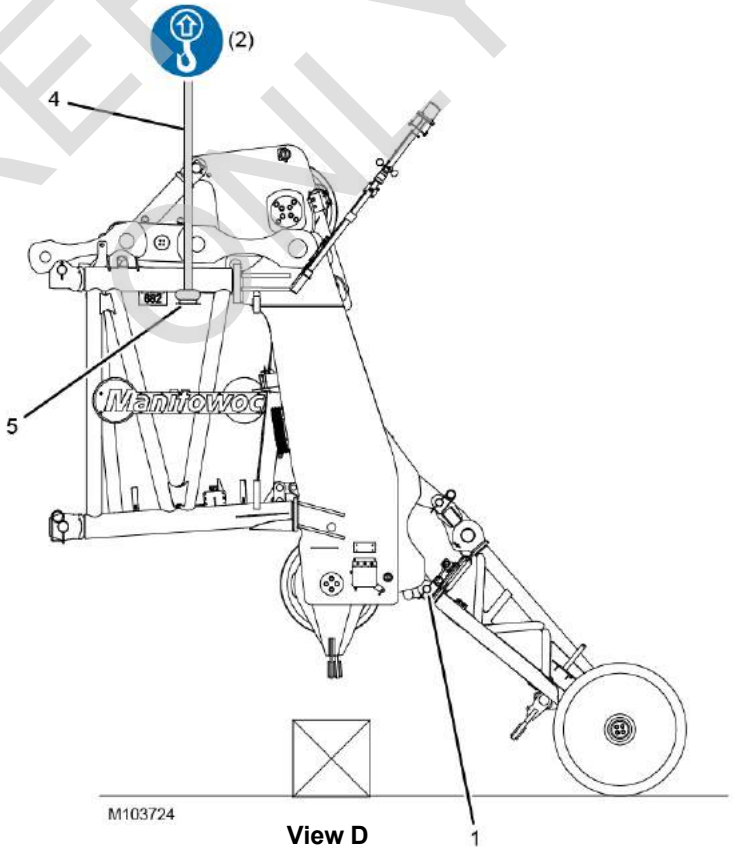
View A



View C

View B

Item	Description
1	Safety Pin (qty 4)
2	Upper Boom Point
3	Eight-sheave Lower Boom Point
4	Sling (qty 2)
5	Lifting Lug (qty 2)
6	Electrical Cable
7	Electrical Connector



View D

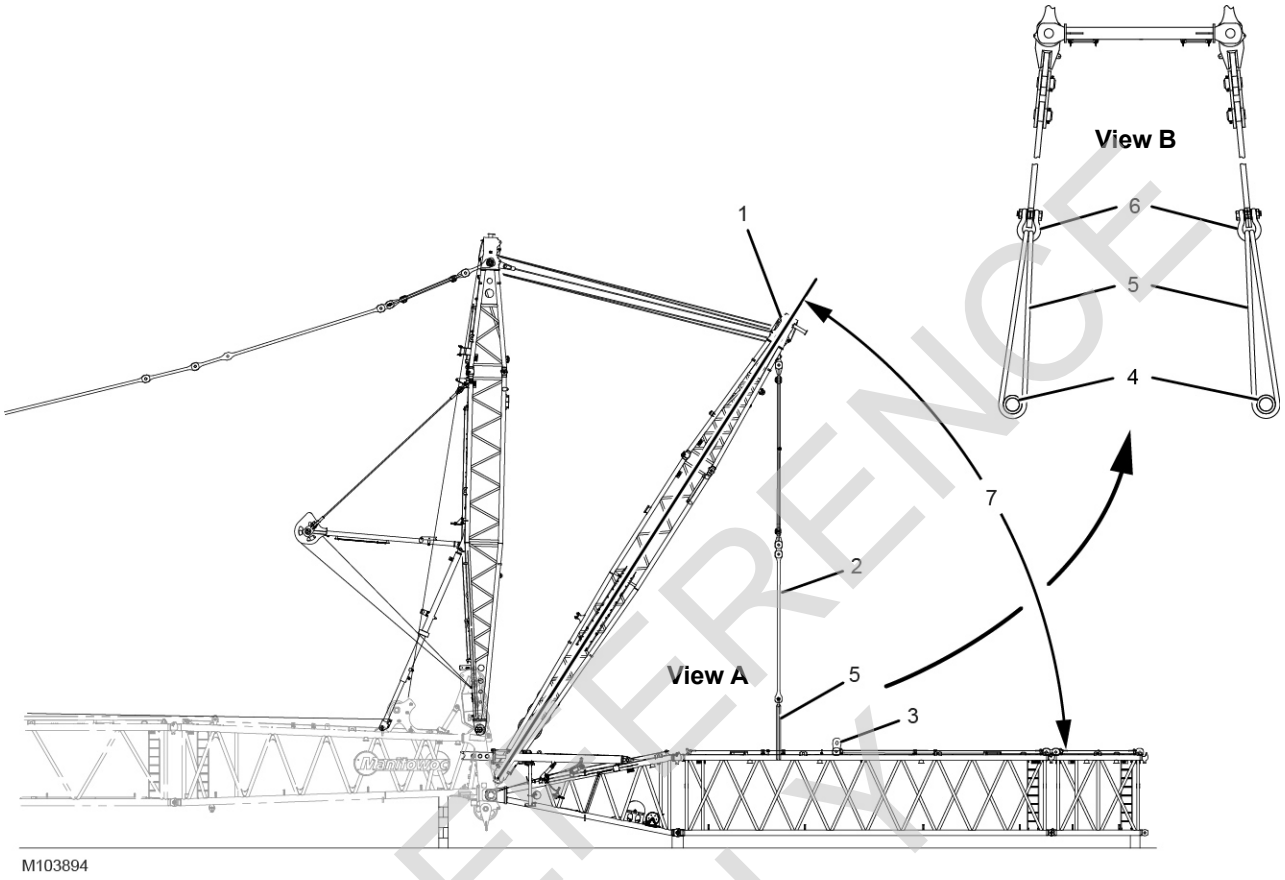
FIGURE 4-51

Removing the Upper Boom Point

NOTE: An assist crane capable of lifting half the weight of the luffing jib is required for this procedure.

See Figure 4-51 for the following procedure.

1. Disconnect the electrical cable (6) on the upper boom point from the electrical connector (7) on the jib top.
2. Store the electrical cable on the left side of the upper boom.
3. Attach appropriate slings (4) from the assist crane to the lifting lugs (5) on the jib top.
4. Slightly raise the jib top and remove the lower two-hole pins and safety pins (1, View D).
5. Lower the jib top, placing a block under the jib top.
6. Using a second crane or a forklift truck, attach an appropriate sling to the upper boom point (2) and slightly raise the upper boom point just enough to take slack out of the sling.
7. Remove the two-hole pins and safety pins (1, View B) from the upper boom point (2).
8. Remove the upper boom point and prepare for shipping.



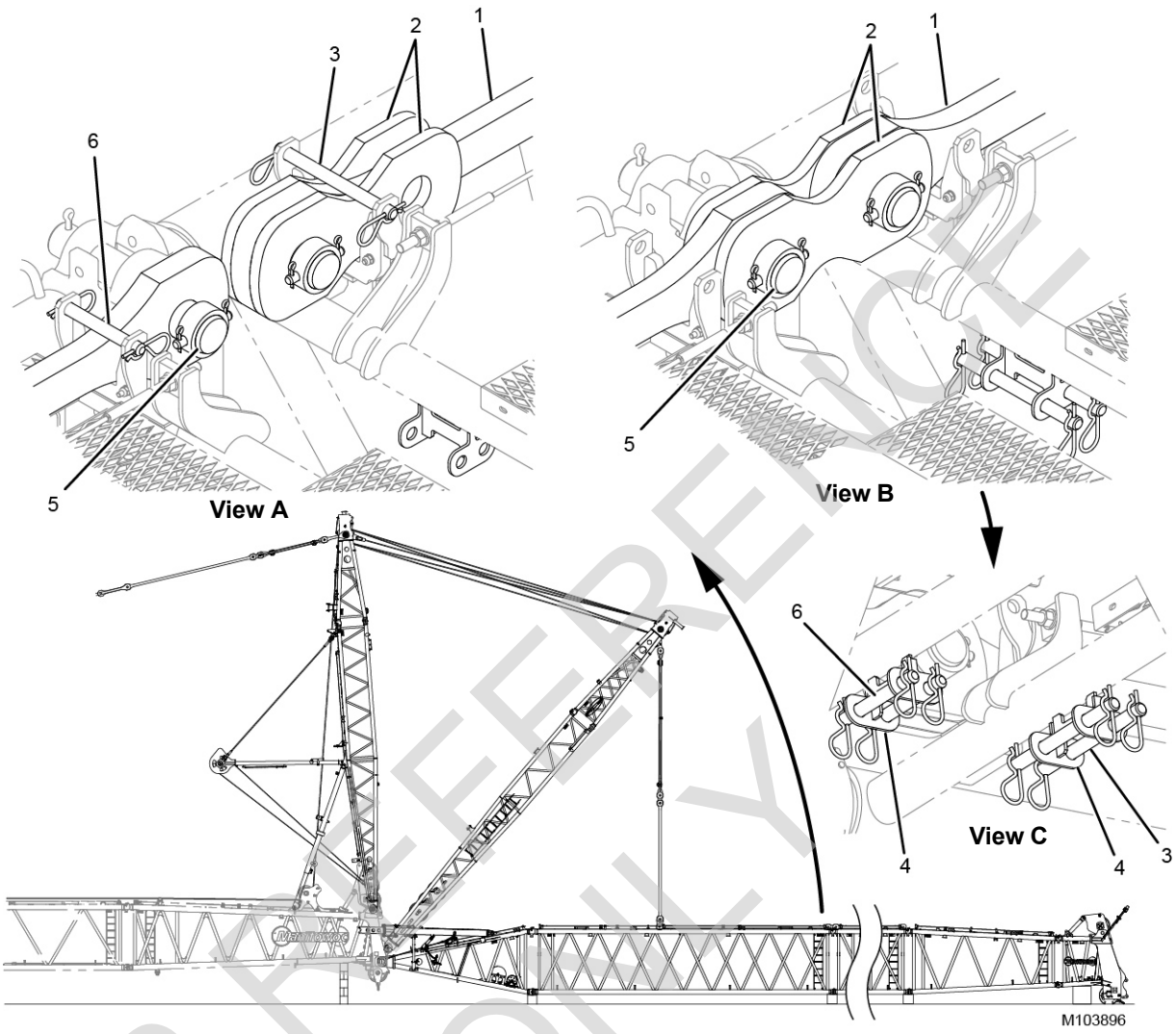
Item	Description
1	Jib Strut
2	Short 12M Strap (qty 2)
3	12M Strap Link (qty 4)
4	12M #680/681 Insert Chord (qty 2)
5	**SL 4** Sling – 22 680 kg (50,000 lb) (qty 2)
6	**SH 3** Shackle – 40 t (44 USt) (qty 2)
7	57° Angle

FIGURE 4-52

Jib Strut Tie-off

See Figure 4-52 for the following procedure.

1. Lower the jib strut (1) as needed to disconnect the short 12M straps (2) from the 12M strap links (3).
2. Place a basket hitch around the 12M #680/681 insert chord (4) using an **SL 4** sling (5, View B). Repeat this step for the other side.
3. Install the end of the **SL 4** sling onto the **SH 3** shackle (6) and attach the shackle to the 12M strap using two bushings (not shown). Repeat this step for the other side.
4. Raise the jib strut to a 57° angle (7) to put tension on the **SL 4** slings.



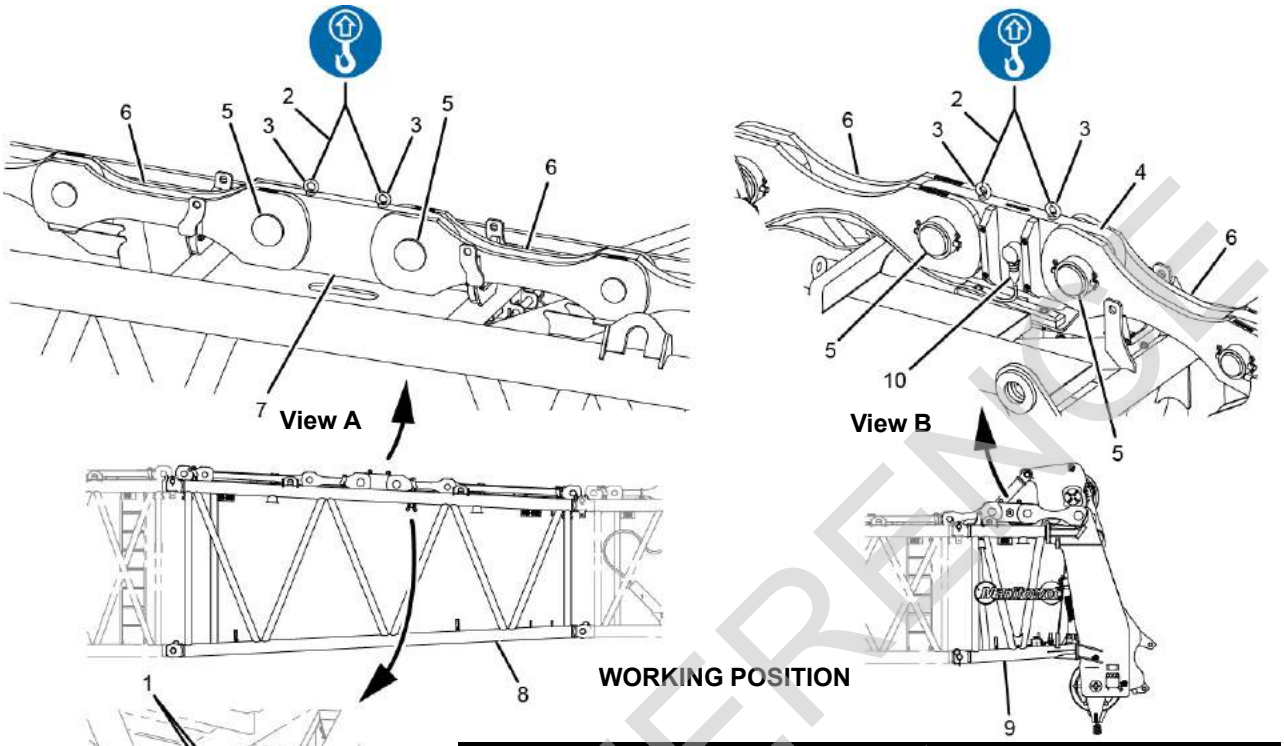
Item	Description	Item	Description
1	Jib Strap (qty 2)	4	Storage Bracket (qty 2)
2	Link (qty 2)	5	Connecting Pin Assembly (qty 2)
3	Two-hole Pin (qty 2)	6	Two-hole Pin (qty 2)

FIGURE 4-53

Disconnecting the Jib Straps between the Jib Sections

See Figure 4-53 for the following procedure.

1. Remove the connecting pin assembly (5, View B) from the link (2, View B).
2. Rotate the link (2, View B) from the working position to the shipping position (View A).
3. Reinstall the connecting pin assembly (5, View A) to the jib strap for shipping.
4. Remove the two-hole pins (3 and 6, View C) from the storage brackets (4) and place them in the working position (View A), securing the jib strap and link.
5. Repeat this procedure for the other side.



Item	Description	Item	Description
1	Hair Pin Cotter and Pin (qty 4)	6	Strap (qty 16)
2	Sling and Shackle (qty 2)	7	Link (qty 2)
3	Lifting Lug (qty 8)	8	6M #681/682 Insert
4	Load Link (qty 2)	9	Jib Top
5	Connecting Pin Assembly (qty 8)	10	Harness Connector (qty 2)

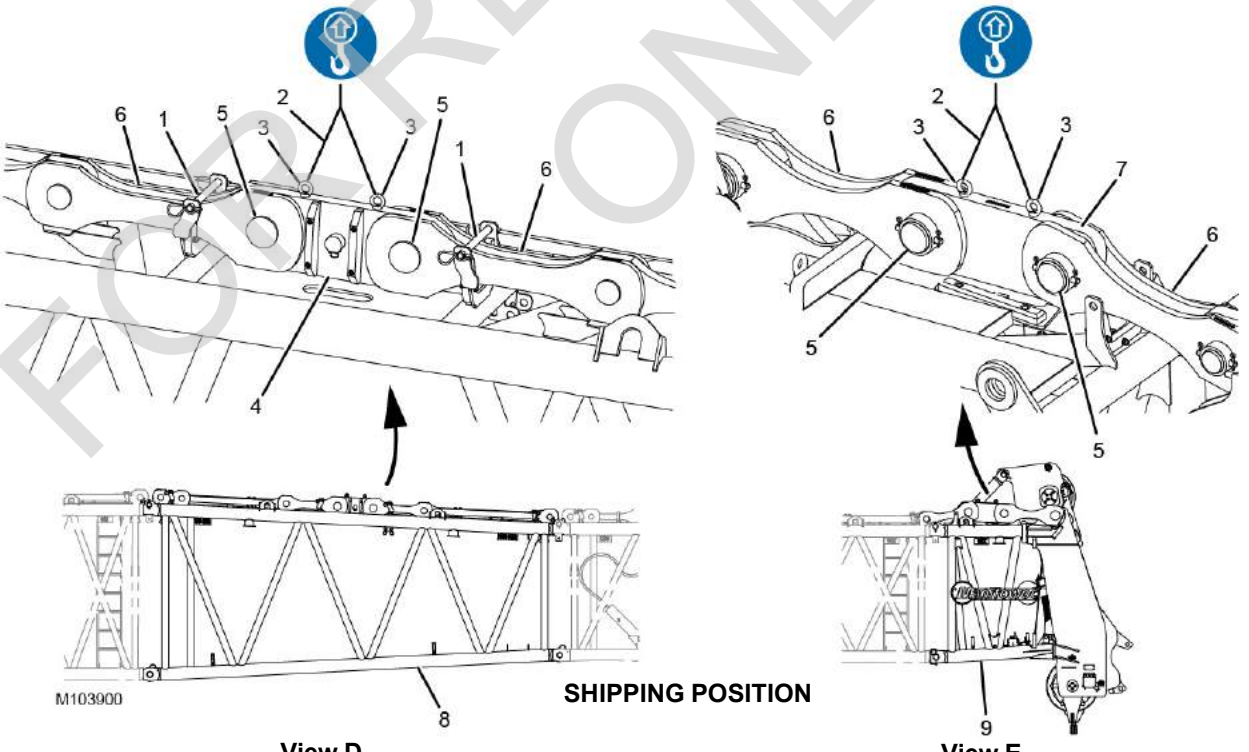


FIGURE 4-54

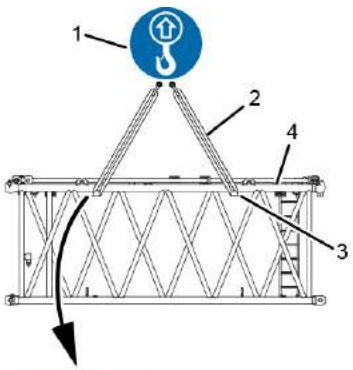
Removing the Load Links

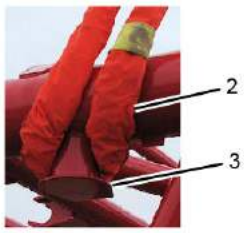
See Figure 4-54 for the following procedure.

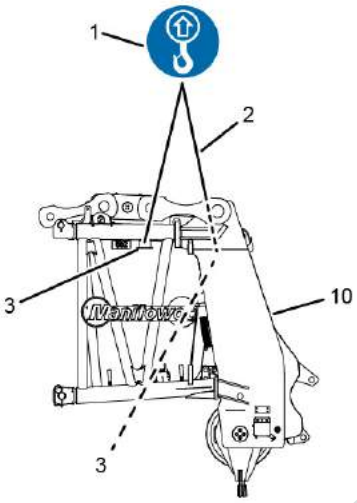
NOTE: This procedure only needs to be completed if the luffing jib is being disassembled.

1. Disconnect the wiring harness connector (10) from the load link (4, View B).
2. Attach the appropriate slings and shackles (2, View B) to the lifting lugs (3, View B) on the load link. Hoist up to remove the slack in the slings.
3. Remove the connecting pin assemblies (5, View B) from the straps (6, View B) and load link. Set the connecting pin assemblies to the side for reassembly later.
4. Move the straps out of the way, if necessary, to remove the load link from the jib top (9, View B).
5. Using an assist crane, remove the load link from the jib top and set it to the side for installation later. Remove the slings and shackles from the lifting lugs.
6. Attach the appropriate slings and shackles (2, View A) to the lifting lugs (3, View A) on the link (7, View A) located on the 6M #681/682 insert (8, View A). Hoist up to remove the slack in the slings.
7. Remove the connecting pin assemblies (5, View A) from the straps (6, View A) and link. Set the connecting pin assemblies to the side for reassembly later.
8. Move the straps out of the way, if necessary, to remove the link.
9. Using an assist crane, remove the link from the 6M #681/682 insert.
10. Using an assist crane, install the link (7, View E) on the jib top (9, View E).
11. Install the connecting pin assemblies (5, View E) in the straps (6, View E) and the link. Remove the slings and shackles from the lifting lugs on the link.
12. Attach the appropriate slings and shackles (2, View D) to the lifting lugs (3, View D) of the load link (4, View D) that has been previously removed from the jib top (9, View B).
13. Using an assist crane, install the load link to the 6M #681/682 insert (8, View D).
14. Install the connecting pin assemblies (5, View D) in the straps (6, View D) and the link.
15. Remove the slings and shackles from the lifting lugs on the link.
16. Remove the hair pin cotters and pins (1, View C) from the stored position and install the hair pin cotters and pins (1, View D) to the shipping position.
17. Repeat this procedure for the other side of the luffing jib.

Item	Description
1	Assist Crane
2	**SL 4** Sling – 9 820 kg (21,650 lb) (qty 4)
3	Lifting Lug (qty 4)
4	Jib Insert
5	Fixed Horizontal Pin (qty 2)
6a	Safety Pin (stored position) (qty 2)
6b	Safety Pin (working position) (qty 2)
7	12M Insert
8a	Connecting Pin (stored position) (qty 2)
8b	Connecting Pin (working position) (qty 2)
9	Safety Pin (qty 2)
10	Jib Top
11	Hydraulic Pin Puller
12a	Pin (qty 2 stored) (manual)
12b	Pin (qty 2 installed) (manual)
13	Storage Bracket (qty 2 each section)



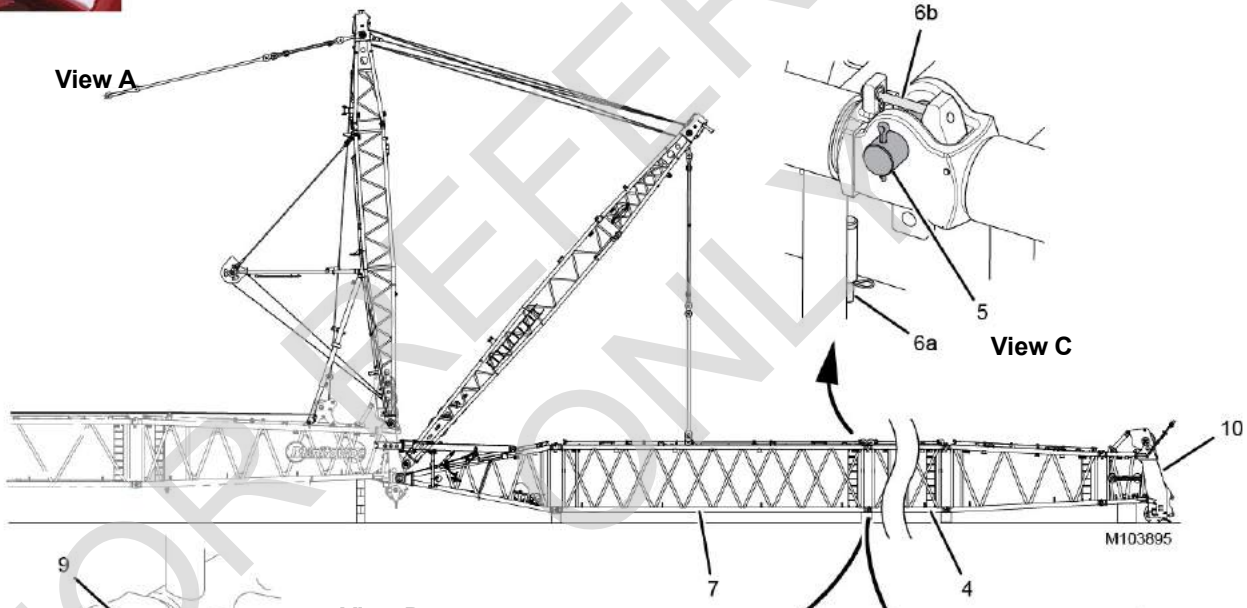




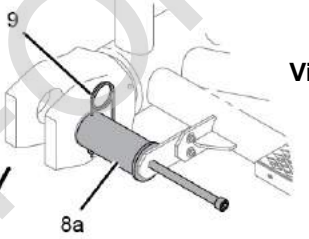
View B

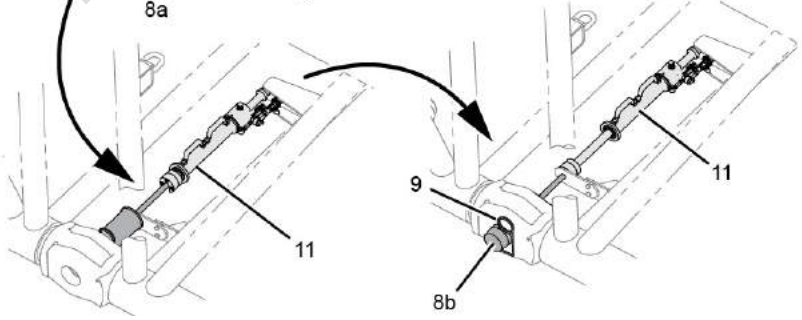
View A

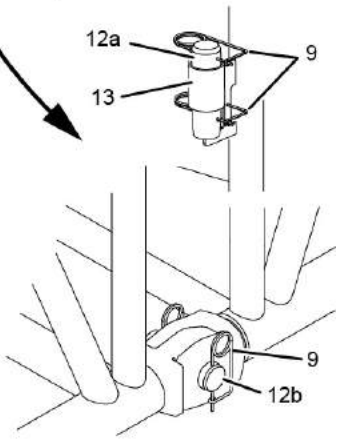
View C



View D







View E

FIGURE 4-55

Removing the Jib Top

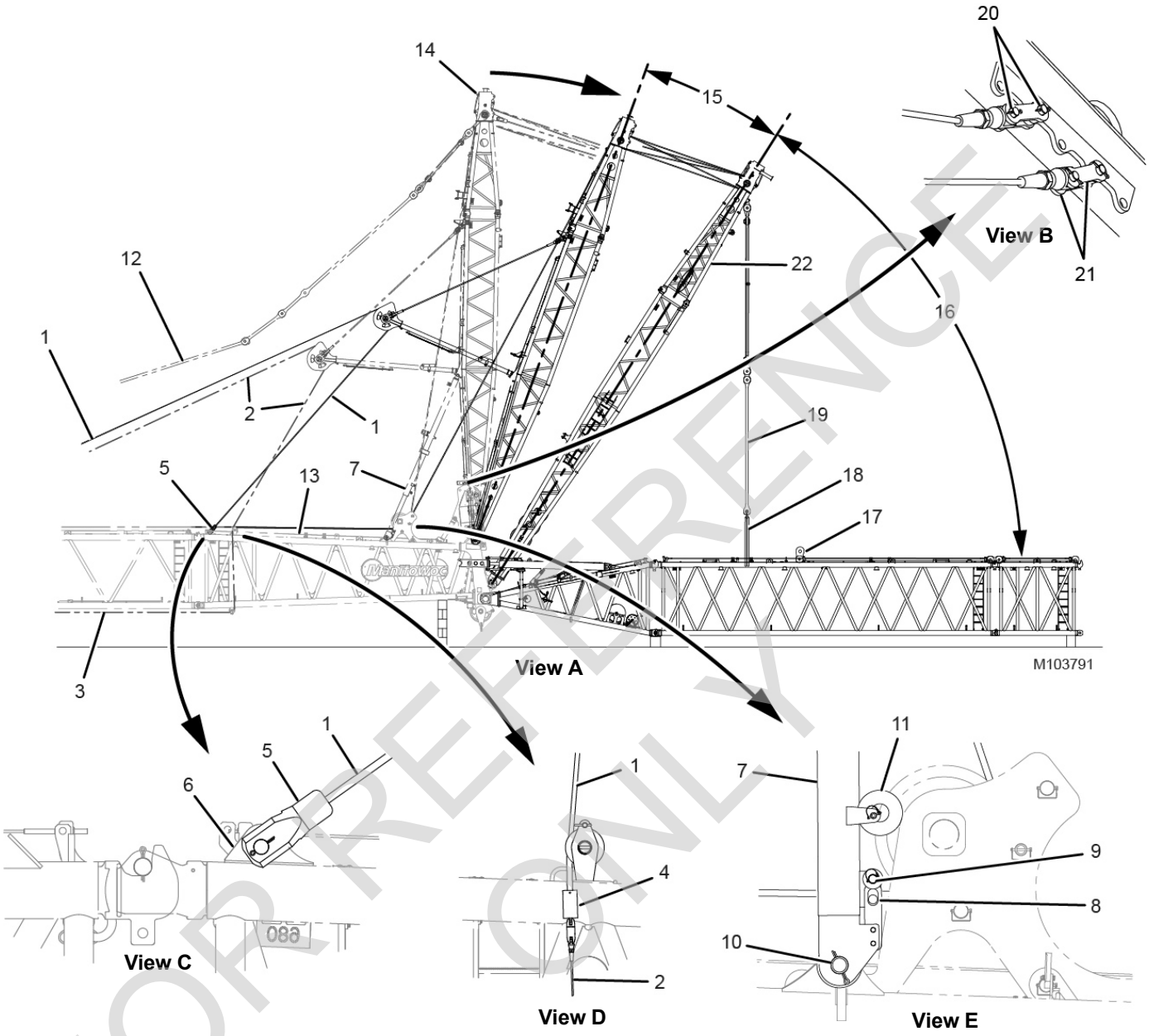
See Figure 4-55 for the following procedure.

1. If desired, lower the jib top wire rope guide to the shipping position. Reverse the steps for Raising the Jib Top Wire Rope Guide, on page 4-51.
2. Attach the **SL 4** slings (2, View B) to the hook of an assist crane (1, View B) and to the lifting lugs (3, View B) on the jib top (10, View B).
3. Move the safety pins from the working position (6b) to the stored position (6a).
4. If equipped with hydraulically connected bottom pins (8, View D):
   a. Remove the safety pins (9) from the connecting pins (8b).
   b. Slightly raise the jib top until the slings are taut.
   c. Using the hydraulic pin puller (11), remove the connecting pins (8a) from the bottom connector holes.
   d. Install the safety pins (9) in the connecting pins (8a) and remove the hand-held pin puller (11).
5. If equipped with manually connected bottom pins (12, View E):
   a. Remove the safety pins (9) from the connecting pins (12b).
   b. Slightly raise the jib top until the slings are taut.
   c. Remove the connecting pins (12b).
   d. Install the connecting pins (12a) and the safety pins (9) in the storage brackets (13) on the adjacent section.
6. Remove the jib top and prepare for it shipping.

Disassembling the Jib Inserts

See Figure 4-55 for the following procedure.

1. Attach the **SL 4** slings (2, View A) to the hook of an assist crane (1, View A) and to the lifting lugs (3, View A) on the jib insert (4, View A).
2. Move the safety pins from the working position (6b) to the stored position (6b).
3. Remove the bottom connecting pins in the same manner they were removed for the boom top.
4. Remove the jib insert and prepare it for shipping.
5. Repeat the procedure for the remaining jib inserts — up to the last two inserts next to the jib butt — and prepare them for shipping.
6. ***DO NOT remove the last two inserts next to the butt.*** The jib butt and last two inserts will be removed as an assemble unit later in this procedure.



Item	Description	Item	Description	Item	Description
1	Load Line Wire Rope	9	Cylinder Rod Retaining Pin (qty 2)	17	12M Connector Link (qty 4)
2	Sucker Line	10	Two-hole Pin (qty 2)	18	**SL 4** Sling – 8 017 kg (17,675 lb) (qty 2)
3	Rigging Line Wire Rope	11	Strut Stop Guide Roller (qty 2)	19	Short 12M Strap (qty 2)
4	Button End	12	Backstay Strap (qty 2)	20	Pin Assembly (qty 4)
5	Socket Button	13	Boom Top	21	Clevis Link (qty 4)
6	Boom Top Bracket	14	Main Strut	22	Jib Strut
7	Strut Stop (qty 2)	15	Main Strut Angle		
8	Cylinder Rod Retaining Pin Hole (qty 2)	16	57° Angle		

FIGURE 4-56

Reeving the Main Strut Raising Arm and Disconnecting the Main Strut Stops

See Figure 4-56 for the following procedure.

1. Remove the pin assemblies (20) to remove the sucker line from the clevis links (21) located on the main strut (14).
2. Attach the load line wire rope (1, View A) to the end of the sucker line (2, View A) that is reeved over the top of the raising arm sheave.
3. Attach the other end of the sucker line to the rigging line wire rope (3).
4. Enable Rigging Winch mode. See "Selecting Rigging Winch Mode" on page 4-132.

CAUTION

Avoid Rigging Winch or Wire Rope Damage!

The rigging winch drum will not automatically pay out if the selected load drum control handle is pulled back to the haul-in position.

Structural damage to the winch and rigging line will occur!

If it is necessary to haul in the load line on the load drum when the load line is connected to the rigging line, pay out the rigging line with the Drum 0 control handle while hauling in the load line with the load drum control handle.

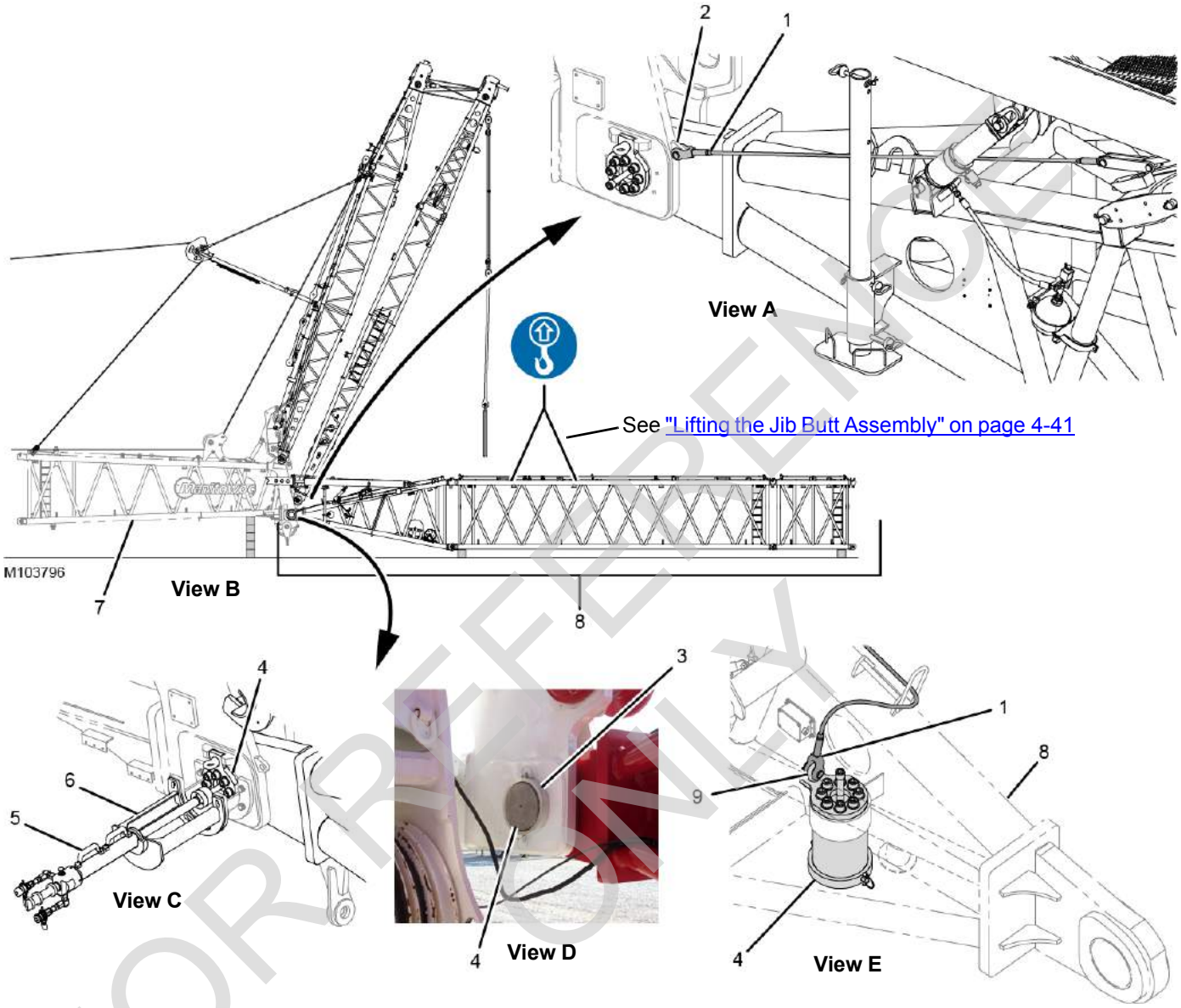
5. Pay out on the load hoist drum until the button end (4) is approximately halfway to the lower boom top wire rope guide (not shown).
6. Disable Rigging Winch mode. See "Selecting Rigging Winch Mode" on page 4-132.
7. Disconnect the load line wire rope from the sucker line wire rope and attach the socket button (5, View C) to the button end. Remove the sucker line and return it to the shipping position.
8. Connect the socket button to the boom top bracket (6).

CAUTION

Crane Damage!

Make sure that the luffing hoist reeving, load line wire rope, and slings do not become slack during the following steps of this procedure.

9. Activate Strut Stop mode on the main display (see the MLC650 Main Display Operation Manual) and haul in the load line wire rope while luffing down to retract the strut stops (7, View E) until the cylinder rod retaining pin holes (8) are aligned.
10. Remove the cylinder rod retaining pin (9) assemblies and install them in the cylinder rod retaining pin holes.
11. As necessary, pay out the load line wire rope while luffing up, removing the weight of the main strut from the two-hole pins (10).
12. Remove the two-hole pins from both sides of the main strut stops. Pay out the load hoist wire rope while luffing up to raise the main strut stops to install the strut stop guide rollers (11).
13. Make sure the main strut stops move toward the hinge area while hauling in the load line wire rope and while luffing down to disconnect the backstay straps (12). Disconnect the backstay straps and secure the straps to the boom top (13).
14. Raise the main strut and pay out on the load line until the main strut angle (15) is approximately 5° greater than the jib strut angle of 57° (16).
15. Pay out the load line to release the tension on the short 12M straps (19) to remove the **SL 4** slings (18).



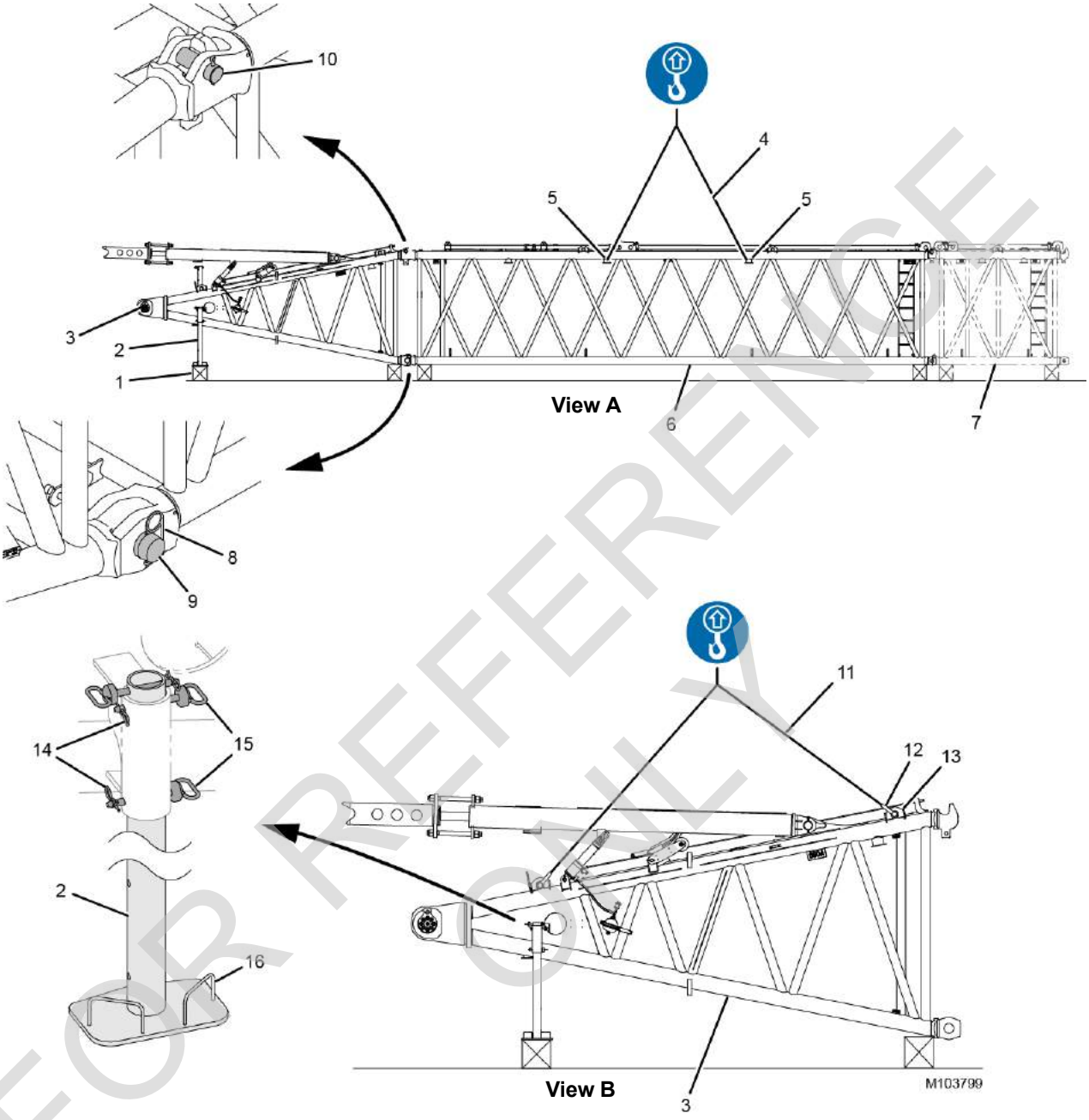
Item	Description	Item	Description
1	Jib Stop Raising Pendant (qty 2)	6	Pin Puller Cage
2	Jib Stop Raising Pendant Lug (qty 2)	7	Boom Top
3	Collar Assembly (qty 2)	8	Jib Butt Assembly
4	Hinge Pin (qty 2)	9	Hinge Pi n Lug (qty 2)
5	Hydraulic Pin Puller		

FIGURE 4-57

Removing the Jib Butt Assembly

See Figure 4-57 for the following procedure.

1. Slowly haul in the load line to raise the jib strut to 65° and the main strut to no more than 70°.
2. Attach lifting slings from an assist crane to the jib butt assembly (8) as outlined in Figure 4-22 on page 4-40 and Lifting the Jib Butt Assembly, on page 4-41.
3. Remove the jib stop raising pendant (1, View A) from the jib stop raising pendant lug (2).
4. Remove the collar assembly (3) from the hinge pin (4, View D) on both sides of the jib butt.
5. Install the hydraulic pin puller (5) to the pin puller cage (6) and activate the hydraulic pin puller to remove the hinge pin (4, View C) from the boom top (7). Repeat this step for the other side.
6. Place the hinge pin (4, View E) and collar assembly in the storage position on the jib butt (8, View E).
7. Attach the jib stop raising pendant (1, View E) to the hinge pin lug (9).
8. Remove the jib butt assembly from the boom top.



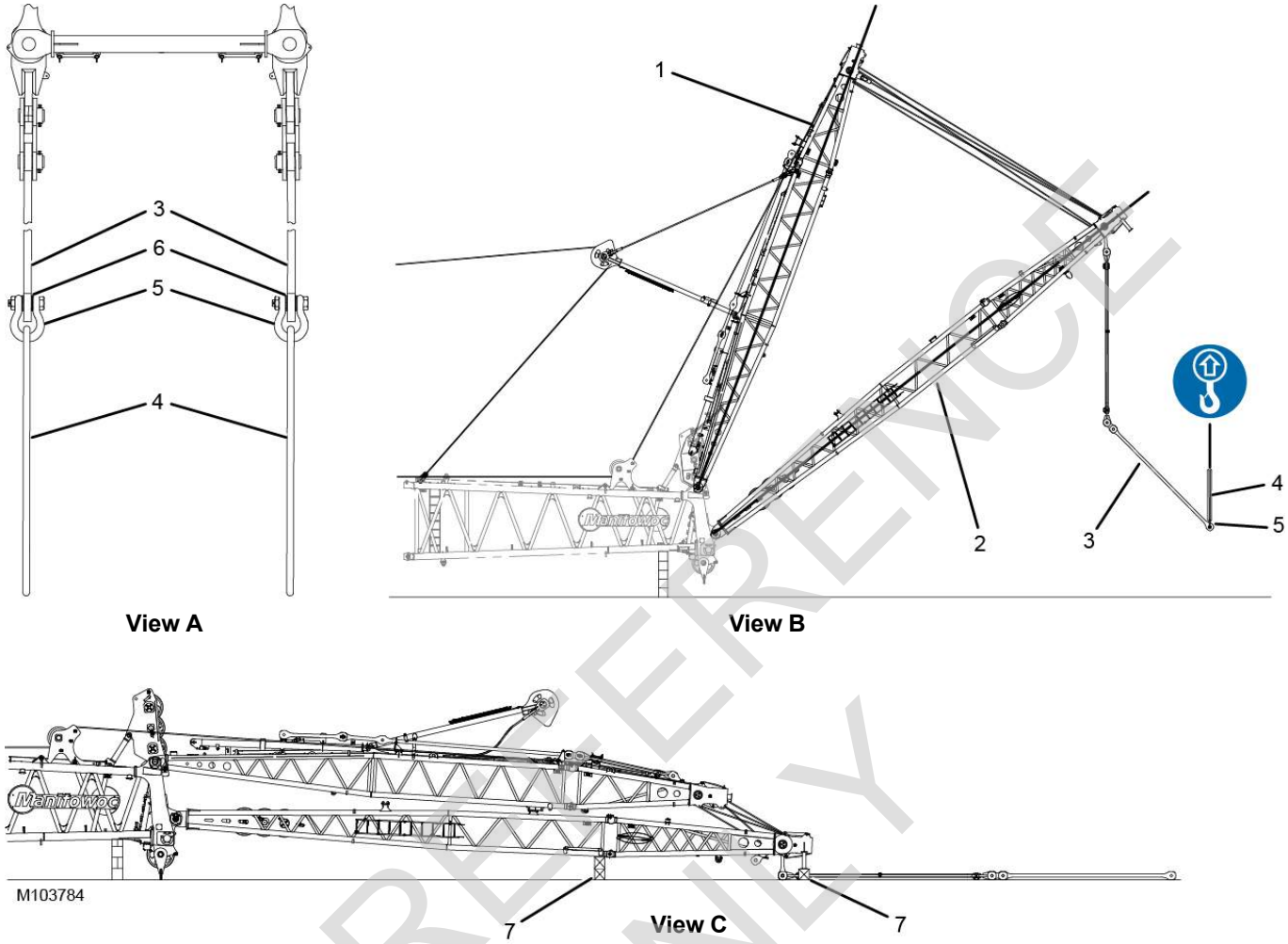
Item	Description	Item	Description
1	Blocking (qty 4)	9	Connecting Pin (qty 2)
2	Butt Support Pedestal (qty 2)	10	Pin (qty 2)
3	Jib Butt	11	**SL 4** Sling – 8 017 kg (17,675 lb) (qty 4)
4	**SL 4** Sling – 8 017 kg (17,675 lb) (qty 4)	12	**SH 2** Shackle – 17 t (18.7 USt) (qty 4)
5	Lifting Lug (qty 4)	13	Lifting Lug (qty 4)
6	12M Insert	14	Hair Pin Cotter (qty 4)
7	Insert	15	Hitch Pin (qty 4)
8	Safety Pin (qty 2)	16	Handle (qty 4)

FIGURE 4-58

Disassembling the Jib Butt Assembly

See Figure 4-58 for the following procedure.

1. Remove the insert (7, View A) in the same manner the previous inserts were removed. See Disassembling the Jib Inserts, on page 4-101.
2. Attach four **SL 4** slings (4) from an assist crane to the four lifting lugs on the 12M insert assembly (6). If the insert is a #680/681 insert, use the four lifting lugs nearest the top end of the insert. Do not use the two lifting lugs nearest the butt end of the insert.
3. Remove the bottom connecting pins (9) in the same manner they were removed for the previous inserts. See Disassembling the Jib Inserts, on page 4-101.
4. Lift the 12M insert (6) away from the jib butt (3, View A).
5. Attach four **SL 4** slings (11) and four **SH 2** shackles (12) to the lifting lugs (13) on the jib butt (3, View B). Using an assist crane, lift the jib butt from the blocking.
6. Remove the hair pin cotters (14) on both sides of the jib butt.
7. Hold the butt support pedestal (2, View B) by the handle (16). Remove the hitch pins (15) and raise the butt support pedestal to the stored position. Reinstall the hitch pins and hair pin cotters. Repeat this step for the other side of the jib butt.
8. Prepare the jib butt (3) and the 12M insert (6) for shipping.



View A View B View C

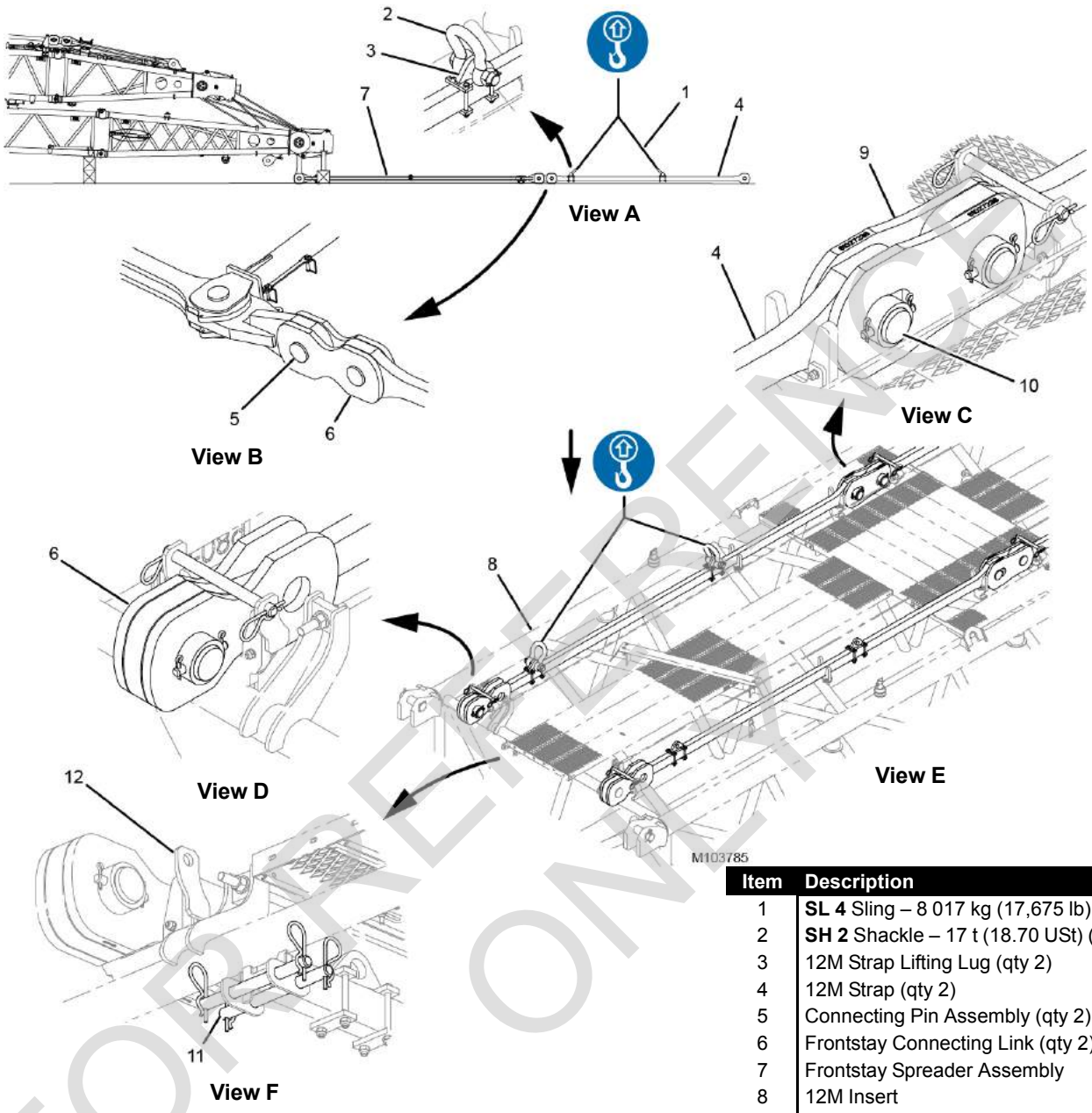
Item	Description
1	Main Strut
2	Jib Strut
3	12M Strap (qty 3)
4	**SL 4** Sling – 8 017 kg (17,675 lb) (qty 2)
5	**SH 3** Shackle – 40 t (44 USt) (qty 2)
6	Bushing (qty 2)
7	Blocking (qty varies)

FIGURE 4-59

Lowering the Strut Assemblies

See Figure 4-59 for the following procedure.

1. Pay out the load hoist line while paying in the luffing hoist to bring the main strut (1) and jib strut (2) down together.
2. Lower the strut assembly until the 12M straps (3, View B) are within handling height.
3. Attach the **SL 4** slings (4, View A) and the **SH 3** shackles (5, View A) with the bushings (6) installed to the 12M straps. Attach the slings to an assist crane.
4. Pay out the load hoist and luffing hoist lines while swinging the 12M straps out in front of the struts.
5. Place blocking (7) under the struts and rest the struts on the blocking.



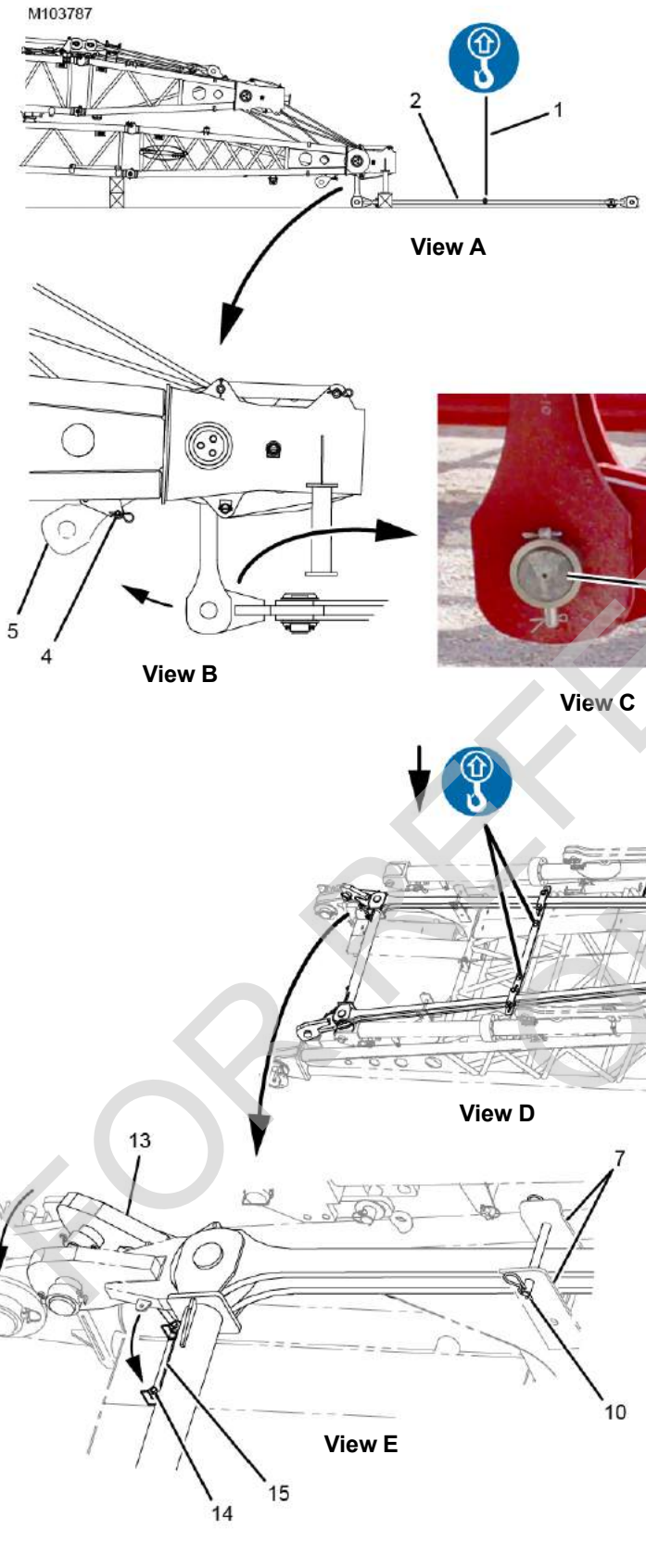
Item	Description
1	**SL 4** Sling – 8 017 kg (17,675 lb) (qty 4)
2	**SH 2** Shackle – 17 t (18.70 USt) (qty 2)
3	12M Strap Lifting Lug (qty 2)
4	12M Strap (qty 2)
5	Connecting Pin Assembly (qty 2)
6	Frontstay Connecting Link (qty 2)
7	Frontstay Spreader Assembly
8	12M Insert
9	Connecting Link (qty 2)
10	Bracket (qty 2)
11	Two-hole Pin Assembly (qty 2)
12	Bracket (qty 2)

FIGURE 4-60

Removing the 12M Straps

See Figure 4-60 for the following procedure.

1. Using an assist crane, attach two **SL 4** slings (1) and two **SH 2** shackles (2) to the 12M strap lifting lugs (3) on the 12M strap (4, View A).
2. Remove the connecting pin assembly (5) from the frontstay connecting link (6).
3. Raise the 12M strap (4, View A) from the frontstay spreader assembly (7) and place the 12M strap on the 12M insert (8), positioning the 12M strap (4, View C) between the connecting link (9).
4. Secure the strap to the frontstay connecting link using the connecting pin assembly.
5. Remove the two-hole pin assembly (11) from the storage bracket and place the assembly in the bracket (12) to secure the frontstay connecting link.
6. Repeat this procedure for the other 12M strap.



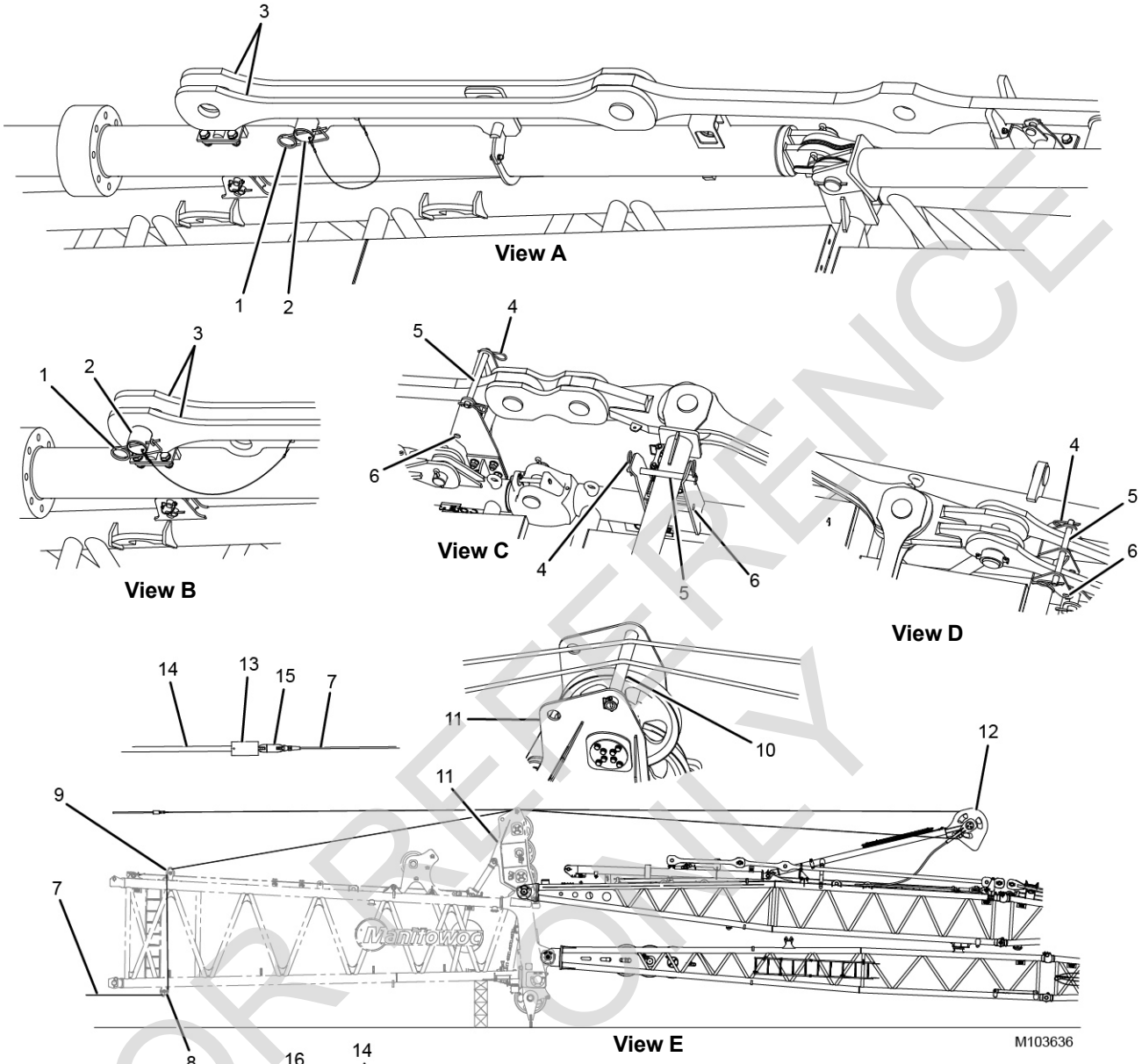
Item	Description
1	**SL 4** Sling – 22 680 kg (50,000 lb) (qty 2)
2	Frontstay Spreader Assembly
3	Connecting Pin Assembly (qty 2)
4	Two-hole Pin Assembly (qty 2)
5	Strut Shaft Link (qty 2)
6	Main Strut Butt Assembly
7	Storage Bracket (qty 2)
8	Storage Bracket (qty 2)
9	Two-hole Pin Assembly (qty 2)
10	Two-hole Pin Assembly (qty 2)
11	Locking Pin (qty 2)
12	Spreader Link (qty 2)
13	Spreader Strap (qty 2)
14	Locking Pin (qty 2)
15	Spreader Strap Link (qty 2)

FIGURE 4-61

Removing the Frontstay Spreader Assembly

See Figure 4-61 for the following procedure.

1. Attach two **SL 4** slings (1) and **SH 2** shackles to the D-rings on the frontstay spreader assembly (2, View A).
2. Remove the connecting pin assembly (3).
3. Remove the two-hole pin assembly (4). Raise the strut shaft link (5) and secure with the two-hole pin assembly. Repeat this step for the other side.
4. Lift the frontstay spreader assembly (2, View D) and position the frontstay spreader assembly between the storage brackets (7 and 8) on the main strut butt assembly (6).
5. Remove the two-hole pin assemblies (9 and 10) from the storage position and place them in the working position, securing the frontstay spreader assembly to the main strut butt assembly.
6. Remove the locking pin (11). Place the spreader link (12) in the stored position and secure it with the locking pin.
7. Remove the locking pin (14). Position the spreader strap (13) in the shipping position and swing out the spreader strap link (15). Install the locking pin to secure the spreader strap. Repeat this step for the other side.



Item	Description	Item	Description
1	Safety Pin (qty 2)	11	Boom Top Wire Rope Guide
2	Hold-down Pin (qty 2)	12	Raising Arm Sheave
3	Adjustable Link (qty 4)	13	Button End
4	Hair Pin Cotter (qty 6)	14	Load Hoist Wire Rope
5	Two-hole Pin (qty 6)	15	Swivel
6	Pin Storage Hole	16	Pin
7	Rigging Line	17	Socket Button
8	Lower Boom Top Wire Rope Guide	18	Pin
9	Upper Boom Top Wire Rope Guide	19	Cotter Pin
10	Wire Rope Keeper	20	Boom Top Bracket

FIGURE 4-62

Unreeving the Strut Raising Arm

See Figure 4-62 for the following procedure.

1. Pay out on the load hoist drum to slacken the load hoist wire rope (14, View G).
2. Remove the cotter pin (19) and the pin (18) from the socket button (17) and the boom top bracket (20). Return the socket button to the lower boom point dead end.
3. Route the rigging line (7) around the lower and upper boom top wire rope guides (8 and 9, View E).
4. Remove the socket button (17) from the button end (13) of the load hoist line and attach the rigging line to the load hoist wire rope using a swivel (15, View F).

NOTE: If the button end is below the upper boom top wire rope guide, remove the pin (16) before proceeding with the next step.

CAUTION

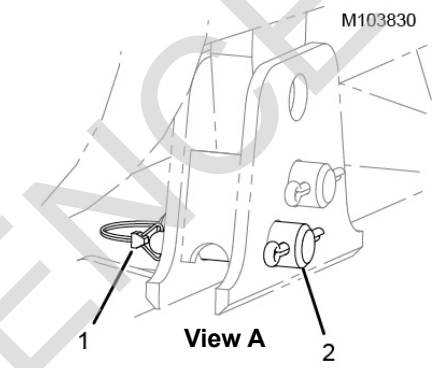
Avoid Rigging Winch or Wire Rope Damage!

The rigging winch drum will not automatically pay out if the selected load drum control handle is pulled back to the haul-in position.

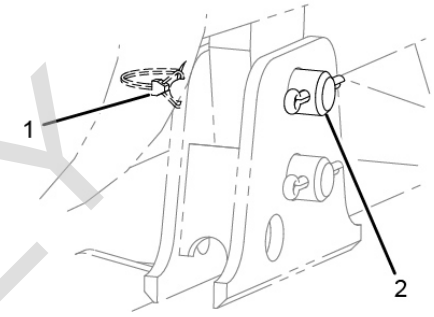
Structural damage to the winch and rigging line will occur!

If it is necessary to haul in the load line on the load drum when the load line is connected to the rigging line, pay out the rigging line with the Drum 0 control handle while hauling in the load line with the load drum control handle.

5. Slowly pay out on the rigging winch while simultaneously hauling in the load line drum to keep the load line taut while reeving the rigging line through the strut raising arm sheave.
6. After the load line has been removed from the strut raising arm, slacken the rigging line and remove it from the load line wire rope. Remove the rigging line from the strut raising arm and return it to the bottom side of the boom.
7. Remove the hair pin cotter (4, View D) and two-hole pin (5) from the stored position. Install the two-hole pin to the shipping position. Repeat this step for the other side.
8. Remove the safety pin (1, View B) and the hold-down pin (2, View B). Repeat this step for the other side.
9. Install the hold-down pin (2, View B) in the adjustable link (3, View B) and install the safety pin (1, View B) into the hold-down pin. Repeat this step for the other side.



View A



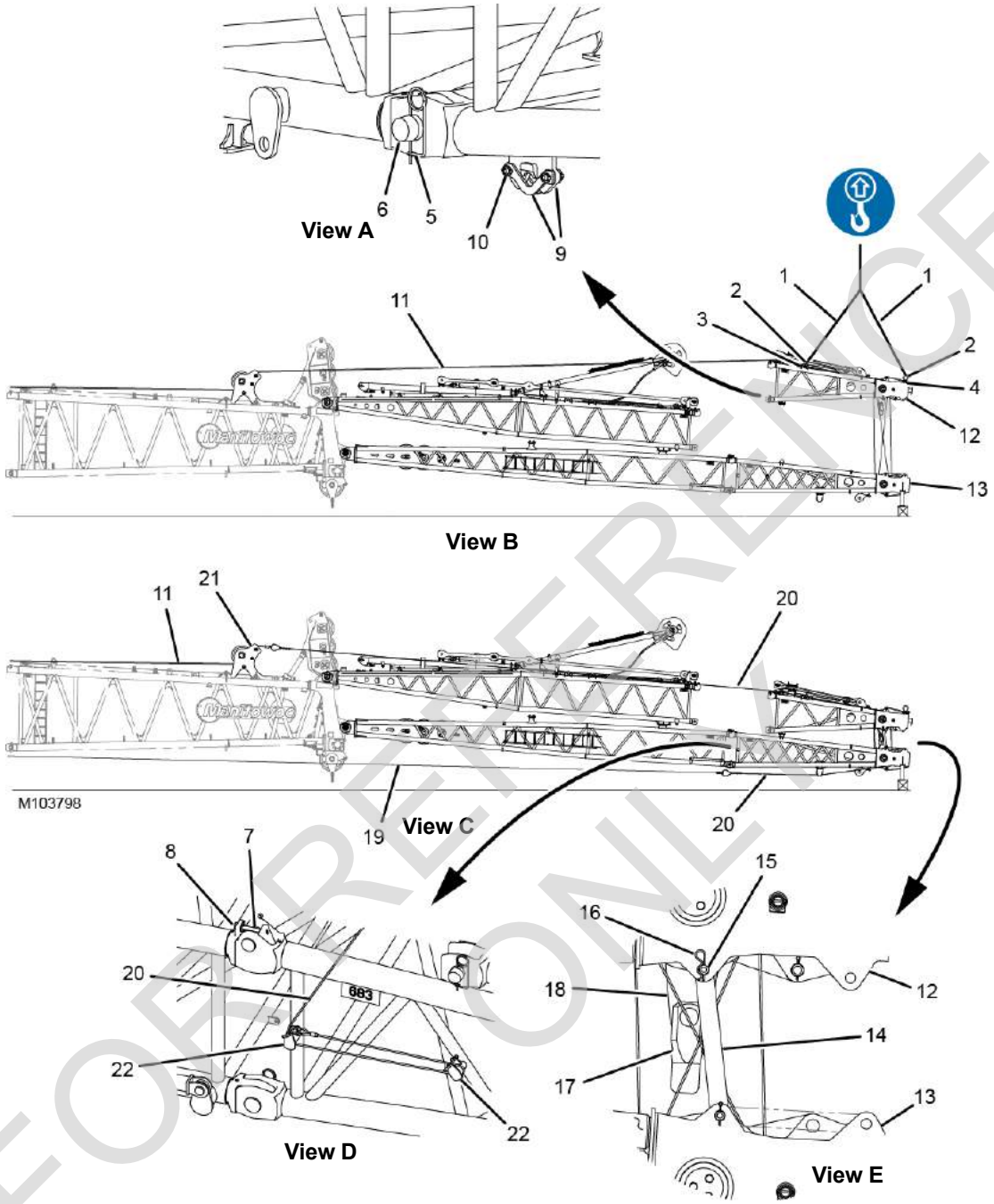
View B

Item	Description
1	Locking Pin (qty 2)
2	Strut Stop Shipping Pin (qty 2)

FIGURE 4-63

See Figure 4-63 for the remaining step:

10. Remove the locking pin (1, View A) and the strut stop shipping pin (2, View A). Install the strut stop shipping pin (2, View B) to the working position and install the locking pin (1, View B). Repeat this step for the other side.



Item	Description	Item	Description	Item	Description
1	**SL 4** Sling – 8 017 kg (17,675 lb) (qty 4)	9	Shipping Link (qty 4)	17	Button Socket
2	**SH 2** Shackle – 17 t (18.7 USt) (qty 4)	10	Pin Assembly (qty 4)	18	Dead End Bracket
3	Lifting Lug (qty 2)	11	Luffing Hoist Line	19	Rigging Line
4	D-ring (qty 2)	12	Main Strut Top	20	Sucker Line (qty 2)
5	Safety Pin (qty 2)	13	Jib Strut Top	21	Luffing Jib Wire Rope Guide
6	Connecting Pin (qty 2)	14	Shipping Strut (qty 2)	22	Sucker Line Storage Lug (qty 2)
7	Pin (qty 2)	15	Shipping Strut Pin (qty 2)		
8	Pin Connector Pocket	16	Hair Pin Cotter (qty 2)		

FIGURE 4-64

Unreeving the Strut Tops

See Figure 4-64 for the following procedure.

1. Use the ladder to gain access to the top of the struts and install four **SL 4** slings (1) and four **SH 2** shackles (2) to the main strut top lifting lugs (3) and D-rings (4).
2. Remove the safety pin (5, View B) and the connecting pin (6, View B). Repeat this step for the other side.
3. Remove the pins (7) from the pin connector pockets (8).
4. Remove the shipping links (9) and pin assemblies (10). Repeat this step for the other side.
5. Pay out on the luffing hoist line (11, View B) slightly to aid in removing the main strut top (12, View B) from the main strut. Lift the main strut top away from the main strut using an assist crane.

NOTE: Have an assistant observe the reeving while moving the main strut top to prevent damage to the luffing hoist line and the sheaves located within the strut tops.

6. Slowly move the main strut top to the jib strut top (13, View B) while an assistant observes the strut top sheaves to make sure the luffing hoist line remains seated in the sheaves of the strut tops.
7. Lower the main strut top until the shipping links can be installed on both sides to secure the butt ends of the strut tops together.
8. Rotate the shipping struts (14) located on the jib strut top from the working position to the shipping position and align the pin holes.
9. Install the shipping strut pins (15) and hair pin cotters (16, View E).
10. Release any tension from the luffing hoist line and remove the button socket (17) from the dead end bracket (18) located on the main strut top.
11. Remove the luffing hoist wire rope from the button socket on the main strut. See "Anchoring Wire Rope to Button Socket" on page 4-129.
12. Remove the sucker line (20, View D) from the sucker line storage lugs (22) and route the sucker line sections through the wire rope guides located along the boom. Connect one end to the rigging line (19) and the other end to the luffing hoist wire rope.

CAUTION

Avoid Rigging Winch or Wire Rope Damage!

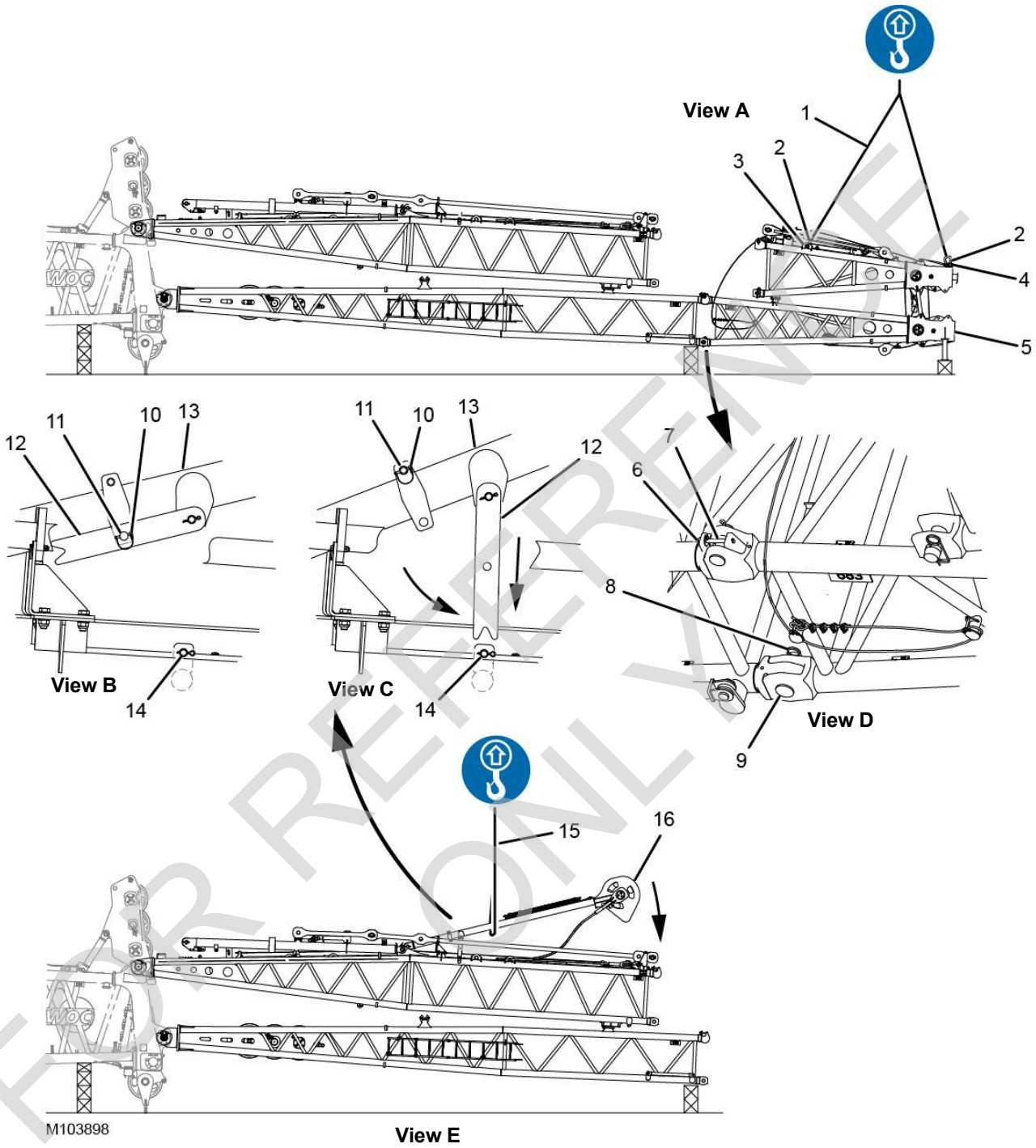
The rigging winch drum will not automatically pay out if the selected load drum control handle is pulled back to the haul-in position.

Structural damage to the winch and rigging line will occur!

If it is necessary to haul in the load line on the load drum when the load line is connected to the rigging line, pay out the rigging line with the drum 0 control handle while hauling in the load line with the load drum control handle.

NOTE: Have an assistant observe all wire rope guides during the reeving process to prevent damage to the rigging line, the luffing hoist wire rope, strut top sheaves, and wire rope guides.

13. Haul in on the luffing hoist drum while simultaneously paying out on the rigging line drum to reeve the sucker line through the strut top sheaves until the sucker line is pulled close to the luffing jib wire rope guide (21).
14. Remove any tension from the sucker line by paying out on the rigging line drum and disconnect the sucker line from the luffing hoist load line.
15. Disconnect the sucker line from the rigging line.
16. Coil the excess sucker line onto the sucker line storage lugs located on the jib strut top.



Item	Description	Item	Description
1	**SL 4** Sling – 8 017 kg (17,675 lb) (qty 4)	9	Connecting Pin (qty 2)
2	**SH 2** Shackle – 17 t (18.7 USt) (qty 4)	10	Locking Pin
3	Lifting Lug (qty 2)	11	Pin (qty 2)
4	D-ring (qty 2)	12	Kickstand (qty 2)
5	Jib Strut Top Assembly	13	Strut Raising Arm (qty 2)
6	Hair Pin Cotter (qty 2)	14	Resting Pin (qty 2)
7	Pin (qty 2)	15	**SL 4** Sling – 22 680 kg (50,000 lb)
8	Safety Pin (qty 2)	16	Strut Raising Arm (setup position)

FIGURE 4-65

Removing the Jib Strut Top Assembly

See Figure 4-65 for the following procedure.

NOTE: Manitowoc Crane Care reeves the jib strut top sheaves and the main strut top sheaves with a two-piece sucker line prior to shipping the strut package.

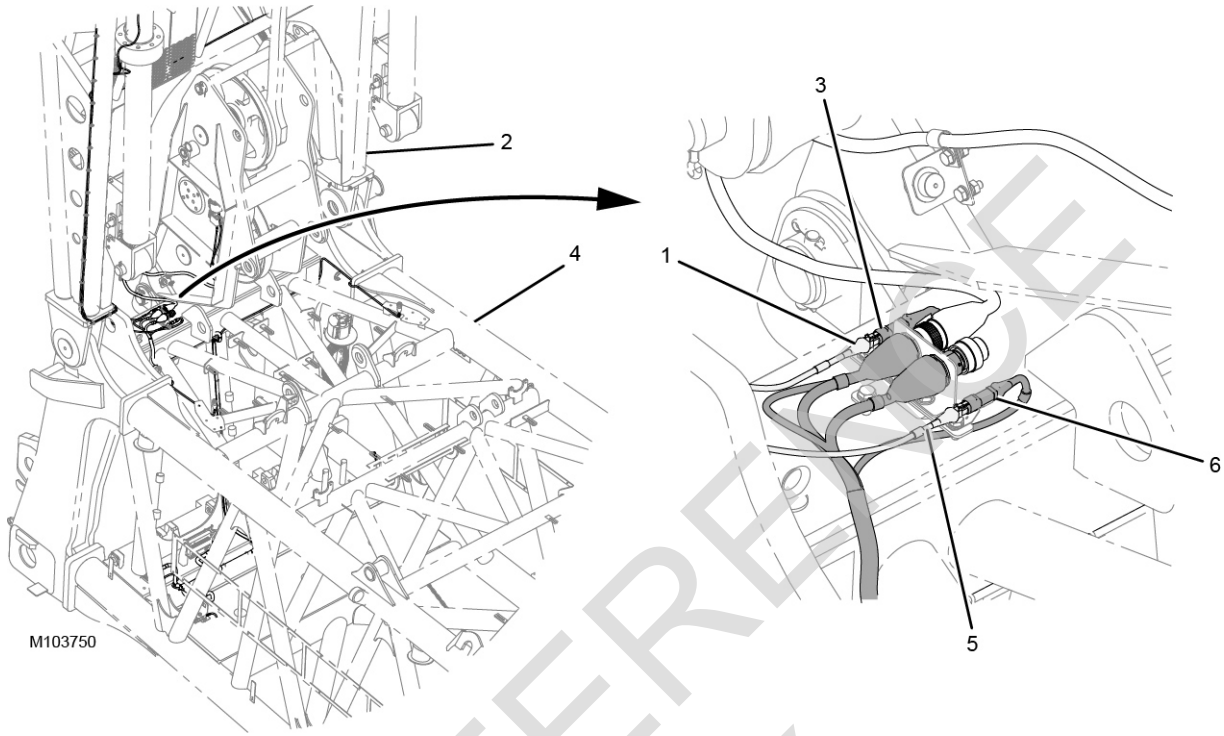
1. Attach four **SL 4** slings (1) and four **SH 2** shackles (2) to the lifting lugs (3) and D-rings (4) on the jib strut top assembly (5).
2. Hoist the assist crane until the slings are taut.
3. Remove the hair pin cotter (6) and the pin (7) from the upper pin connector. Repeat this step for the other side.
4. Remove the safety pin (8) and the lower connecting pin (9). Repeat this step for the other side.
5. Using an assist crane, lift the strut top assemblies away from the jib strut.
6. Install the lower connecting pin and the safety pin in the lower connecting pin holes. Repeat this step for the other side.
7. Install the pin and hair pin cotter in the upper pin connector. Repeat this step for the other side.
8. Prepare the jib strut top assembly for storage or shipping as necessary.
9. Remove the slings and shackles.

Lowering the Strut Raising Arm

See Figure 4-65 for the following procedure.

1. Using an assist crane and a **SL 4** sling (15), place a basket hitch under the crossbar of one of the strut raising arms (13, View C) and lift the arm so the kickstands (12, View C) disengage from the resting pins (14, View C) of the main strut butt assembly.
2. Remove the locking pin (10, View C) and the pin (11, View C) from the strut raising arm bracket.
3. Raise the kickstand (12, View B) into the shipping position and secure the kickstand with the pin (11, View B) and locking pin (10, View B).
4. Remove the sling from the strut raising arm crossbar.
5. Repeat the procedure for the other side.

THIS PAGE INTENTIONALLY LEFT BLANK



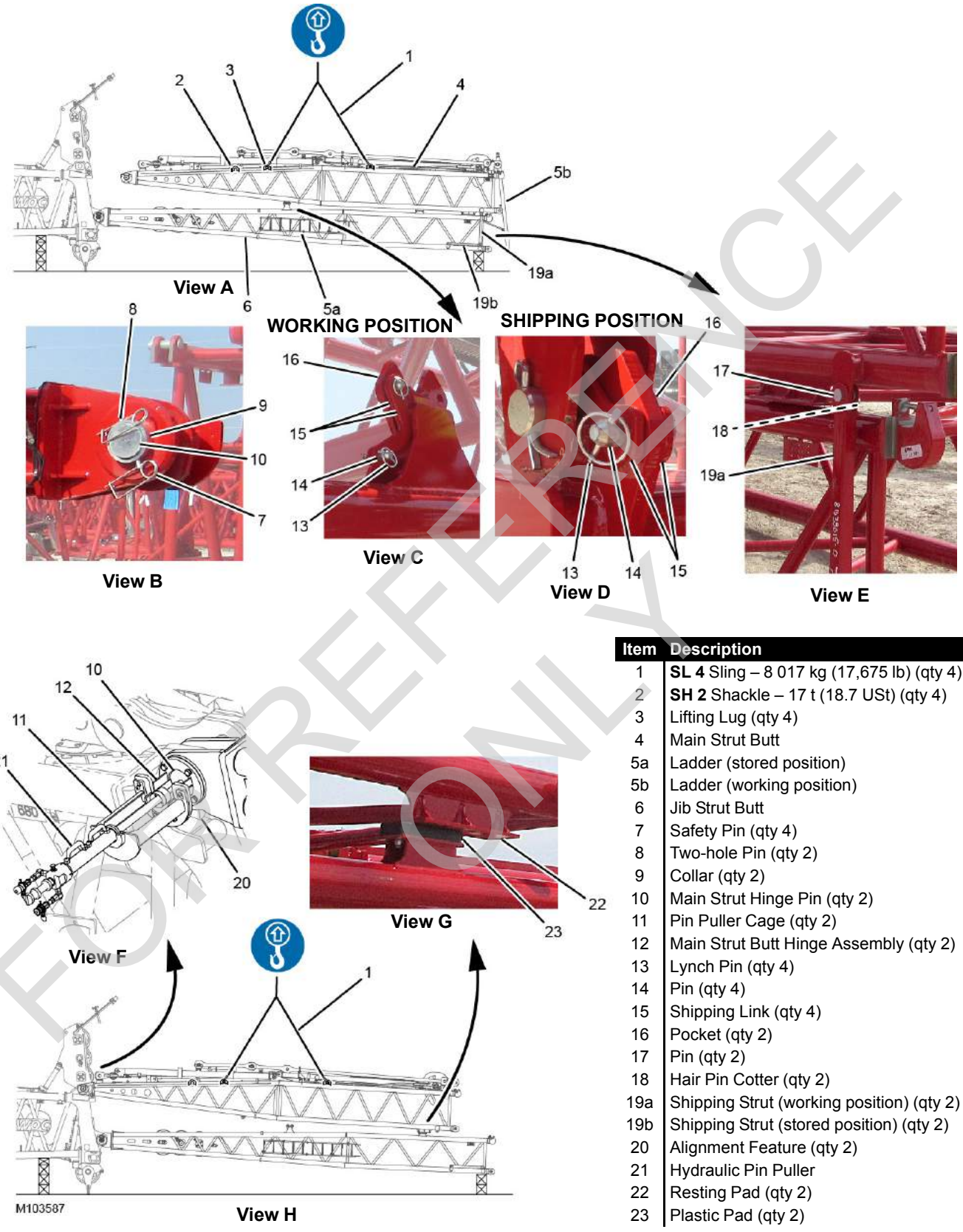
Item	Description	Item	Description
1	Electrical Plug WJS1-P1	4	Boom Top
2	Main Strut Butt	5	Electrical Plug WJS2-P1
3	Electrical Plug WBT1-J8	6	Electrical Plug WBT1-J7

FIGURE 4-66

Removing the Main Strut Butt

See Figure 4-66 for the following procedure.

1. Disconnect electrical plug WJS2-P1 (5) on the main strut butt (2) from electrical plug WBT1-J7 (6) on the boom top (4).
2. Disconnect electrical plug WJS1-P1 (1) on the main strut butt from electrical plug WBT1-J8 (3) on the boom top.

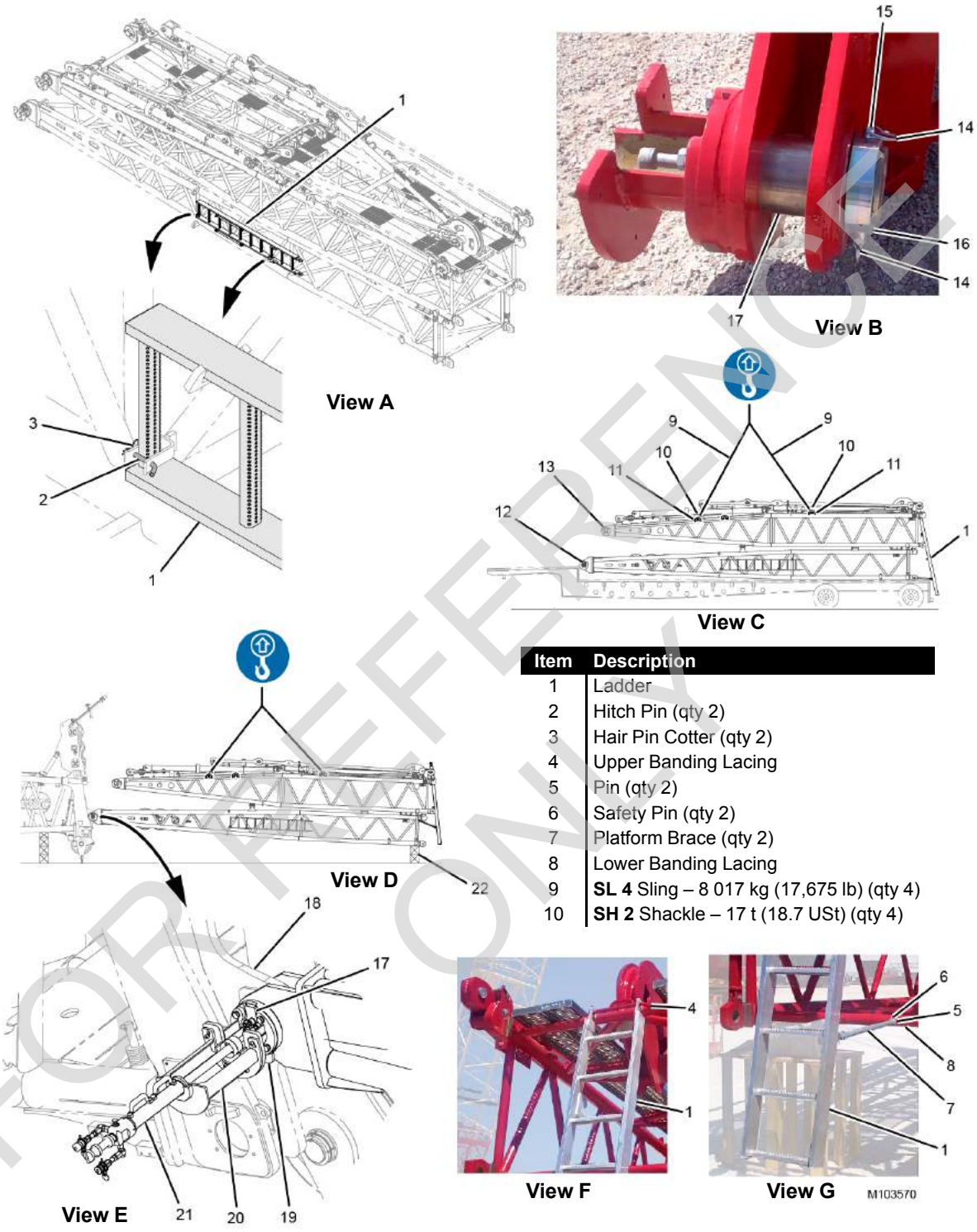


Item	Description
1	**SL 4** Sling – 8 017 kg (17,675 lb) (qty 4)
2	**SH 2** Shackle – 17 t (18.7 USt) (qty 4)
3	Lifting Lug (qty 4)
4	Main Strut Butt
5a	Ladder (stored position)
5b	Ladder (working position)
6	Jib Strut Butt
7	Safety Pin (qty 4)
8	Two-hole Pin (qty 2)
9	Collar (qty 2)
10	Main Strut Hinge Pin (qty 2)
11	Pin Puller Cage (qty 2)
12	Main Strut Butt Hinge Assembly (qty 2)
13	Lynch Pin (qty 4)
14	Pin (qty 4)
15	Shipping Link (qty 4)
16	Pocket (qty 2)
17	Pin (qty 2)
18	Hair Pin Cotter (qty 2)
19a	Shipping Strut (working position) (qty 2)
19b	Shipping Strut (stored position) (qty 2)
20	Alignment Feature (qty 2)
21	Hydraulic Pin Puller
22	Resting Pad (qty 2)
23	Plastic Pad (qty 2)

FIGURE 4-67

See Figure 4-67 for the remaining steps:

3. Using the ladder (5b) to gain access to the top of the struts, attach the **SL 4** slings (1, View A) and **SH 2** shackles (2) to the four lifting lugs (3) closest to the top end of the main strut butt (4).
4. Hoist the assist crane until the slings are taut.
5. Remove the ladder from the struts. Secure the ladder (5a) to the storage hooks on the jib strut butt (6).
6. Remove the safety pin (7), two-hole pin (8), and collar (9) from the main strut hinge pin (10, View B) in the main strut butt. Repeat this step for the other side.
7. Install the pin puller cage (11) to the main strut butt hinge assembly (12). Repeat this step for the other side.
8. Using the hydraulic pin puller (21), push the main strut hinge pins out of the holes on the boom top.
9. Remove the pin puller cages from the main strut butt.
10. Lift the main strut butt away from the boom top and place the main strut butt on top of the jib strut butt.
11. Make sure the main strut butt resting pad (22) makes contact with the plastic pad (23) on the jib strut butt.
12. Install the main strut hinge pins in the main strut hinge pin holes.
13. Install the two-hole pin, collar, and safety pin in the main strut hinge pins.
14. Remove the pin (17) and the hair pin cotter (18) from the shipping strut (19a, View E) and rotate the strut from the working position to the shipping position. Reinstall the pin and the hair pin cotter. Repeat this step for the other side.
15. Remove the lynch pins (13, View C), pins (14, View C), and shipping links (15, View C) from the pocket (16, View C). Move the shipping links to the shipping position. Reinstall the shipping links (15, View D), pins (14, View D), and lynch pins (13, View D). Repeat this step for the other side.



Item	Description
1	Ladder
2	Hitch Pin (qty 2)
3	Hair Pin Cotter (qty 2)
4	Upper Banding Lacing
5	Pin (qty 2)
6	Safety Pin (qty 2)
7	Platform Brace (qty 2)
8	Lower Banding Lacing
9	**SL 4** Sling – 8 017 kg (17,675 lb) (qty 4)
10	**SH 2** Shackle – 17 t (18.7 USt) (qty 4)

Item	Description	Item	Description
11	Lifting Lugs (qty 4)	17	Hinge Pin (qty 2)
12	Jib Strut Butt	18	Boom Top
13	Main Strut Butt	19	Alignment Plate (qty 2)
14	Locking Pin (qty 4)	20	Pin Puller Cage (qty 2)
15	Two-hole Pin (qty 2)	21	Hydraulic Pin Puller
16	Collar (qty 2)	22	Blocking

FIGURE 4-68

Removing the Jib Strut Butt

See Figure 4-68 for the following procedure.

NOTE: The main strut butt and the jib strut butt are shipped as an assembled unit.

Use the ladder to gain access to the top of the struts.

Attach the slings and shackles as follows:

1. Using four **SL 4** slings (9) and four **SH 2** shackles (10), attach the first pair of slings and shackles to the lifting lugs (11) closest to the butt end on the main strut butt (13).
2. Attach the second pair of slings and shackles to the middle pair of lifting lugs.
3. Hoist the assist crane until the slings are taut.
4. Remove the locking pin (14), two-hole pin (15), and collar (16) from the hinge pin (17, View E) on the jib strut butt. Repeat this step for the other side.
5. Install the pin puller cage (20). Repeat this step for the other side.
6. Install the hydraulic pin puller (21) to the pin puller cage and activate the pin puller to push the hinge pin out of the hinge pin hole. Repeat this step for the other side.
7. Lift the butt assembly away from the boom top.

NOTE: The struts will hang at an approximate angle of 4°.

8. Install the connecting pins in the holes. Repeat this step for the other side.
9. Install the collar, two-hole pin, and locking pin on the hinge pin. Repeat this step for the other side.
10. Remove the pin (5) and the safety pin (6) and move the platform brace (7) to the shipping position. Reinstall the safety pin. Repeat this step for the second platform brace.
11. Remove the ladder (1, View F) from the upper banding lacing (4).
12. Install the ladder (1, View A) in its shipping position on the side of the jib strut butt, and install the hitch pins (2) and hair pin cotters (3).
13. Prepare the strut butt assembly for storage or shipping as necessary.

THIS PAGE INTENTIONALLY LEFT BLANK

WIRE ROPE INSTALLATION

Wire Rope Specifications

See the Wire Rope Specifications Chart in the Capacity Chart Manual for the correct type, size, and amount of wire rope to be installed on the crane.

The Wire Rope Specifications Chart contains the following information:

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

Wire Rope Storage

Store the wire rope in coils or on reels off the ground or floor in a clean, 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 the periodic inspection given in the Service Manual at least monthly.

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 will result in overloading of some strands and under-loading of others. Bird-caging and breakage of the wire rope can occur.

Before cutting the 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 4-69 for:

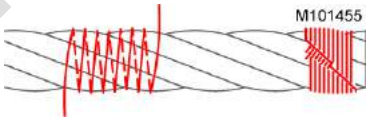
- The number of seizings to be applied to the ends of the wire rope and to both sides of the point where a cut will be made
- The proper application method: Each seizing should be one rope diameter long

Wire Rope Type	Seizings Required
Preformed	1
Non-preformed	2

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

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

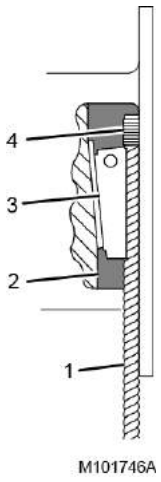
Wind the seizing wire around the wire rope as shown. Then twist the two ends of seizing wire together at the center of the seizing. Alternately twist the ends until the seizing is tight.



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

FIGURE 4-69

Don't Allow End of Wire Rope to Extend Out of Socket Opening



Item	Description
1	Wire Rope
2	Pocket in Drum Barrel
3	Straight Wedge
4	Seizing

FIGURE 4-70

Anchoring Wire Rope to Drum

See Figure 4-70 for the following procedure.

Use the correct wedge part number for the size of wire rope being used. See the parts drawing for the boom hoist drums or for the load drum shaft to obtain the correct part number.

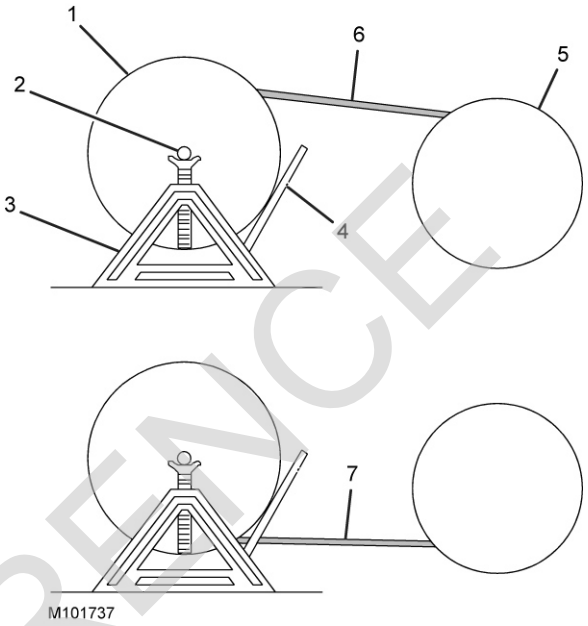
1. Assemble wire rope and wedge to drum socket.
2. Tighten wedge, rapping back of wedge with a brass drift pin and hammer.

WARNING

Falling Load Hazard!

The wire rope can be pulled out of the drum if the following steps are not taken.

- Install the straight wedge so the corrugated side is against the wire rope.
- Install the wedge so the end of the wire rope extends past the end of wedge, but not out of the drum socket.
- Make sure the seizing is not under the wedge. Remove the seizing if it interferes with assembly.



Item	Description	Item	Description
1	Shipping Reel	5	Drum
2	Shaft	6	Top to Top Winding
3	Jack Stand	7	Bottom to Bottom Winding
4	Brake		

FIGURE 4-71

Winding Rope onto Drum

CAUTION

Avoid Wire Rope Damage

The shipping reel must rotate when the wire rope is unwound.

Attempting to remove the wire rope from a stationary reel can result in a kinked wire rope, and the wire rope will be ruined.

See Figure 4-71 for the following procedure.

1. Remove the wire rope from the shipping reel:
   a. Mount the wire rope shipping reel (1) on a shaft (2) supported at both ends by jacks (3) or blocks.
   b. Provide a brake at the shipping reel so that the wire rope can be wound tightly on the drum.
   c. Avoid a reverse bend when winding the wire rope onto the drum: wind from the top of the reel to the top of drum (upper view) or from the bottom of the reel to the bottom of the drum (lower view).

d. Avoid dragging the wire rope in the dirt or around objects that can scrape, nick, cut, or crush the wire rope.

2. Carefully inspect the drums and all rope guides, rollers, and sheaves for defects that can cause the wire rope to wear or be cut. If defects cannot be fixed, replace the faulty parts.

See Figure 4-72 for the following procedure.

3. Apply tension to the wire rope as it is wound slowly onto the drum.

a. The first wrap of wire rope must be tight against the drum flange for the approximately three-fourths of the drum diameter (View A).

b. Tap the adjacent wraps against each other with a soft metal or wooden mallet as the wire rope is spooled onto the drum.

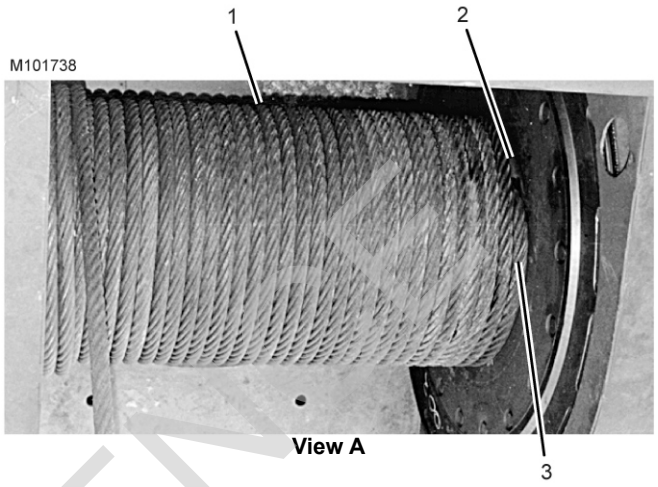
c. Use extreme care not to put twists or turns in the wire rope. Allow the rope to assume its natural lay.

CAUTION

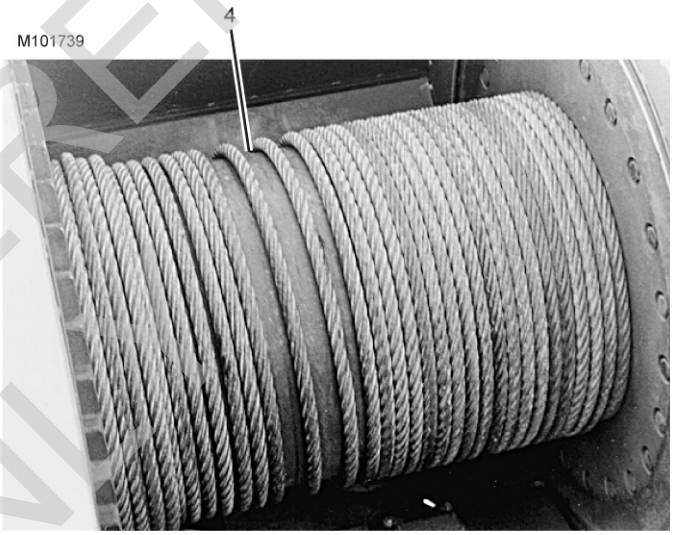
Avoid Wire Rope Damage

Voids or spaced wraps (View B) in the first layer will permit movement and a wedging action with the subsequent layers. Crushing and abrasion of the wire rope will occur.

Never allow the wire rope to “cross-wind” on the drum.



View A



View B

Item	Description
1	Wraps of first layer tight against drum flanges and each other
2	Wedge
3	Tight against drum flange for 3/4 of diameter
4	Voids and loose wraps in first layer will cause sever wear of wire rope

FIGURE 4-72

Item	Description
1	Seizing
2	Dead End
3	Live End in Straight Line with Socket
4	Socket
5	Wedge
6	Rope Clip
7	Short Piece of Wire Rope
8	Terminator Wedge
9	Shipping Holes: **Do not reinstall any shipping material (bolt, plastic strap, or wire) in shipping holes of wedge or socket after assembling.**

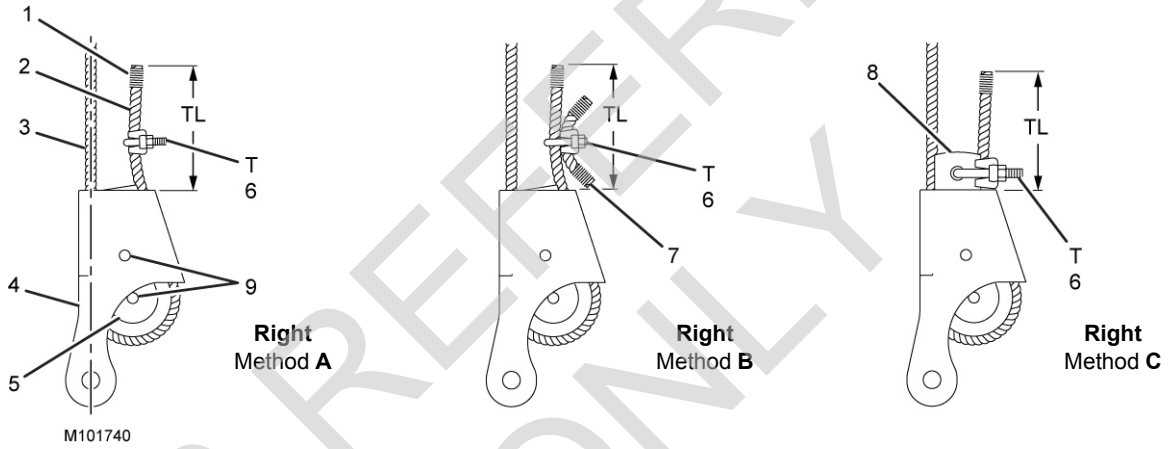
T (Rope Clip Nut Torque)

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

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

TL (Tail Length)

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

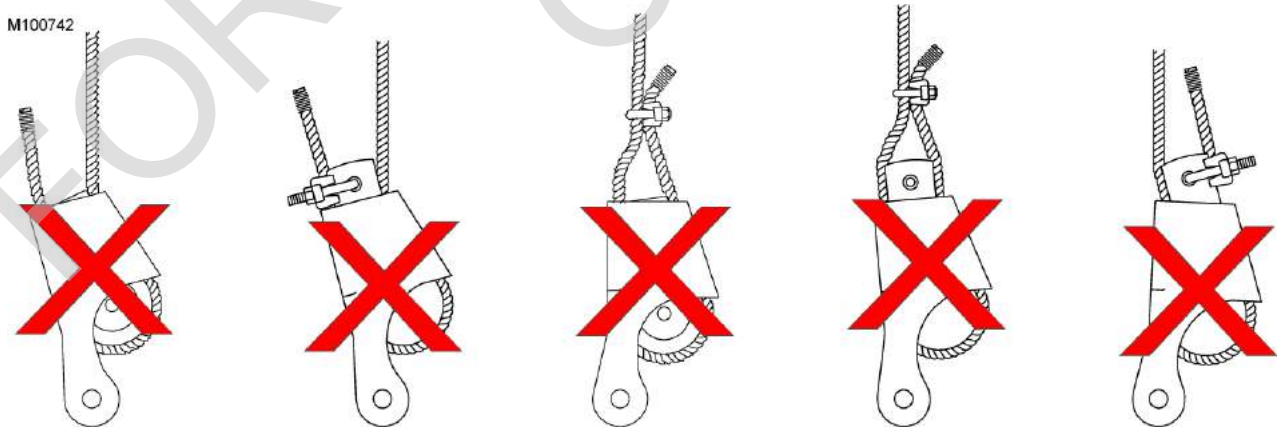


Right
Method **A**

Right
Method **B**

Right
Method **C**

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

FIGURE 4-73

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 the shipping holes (9) of the wedge or the socket after assembling them. Discard these materials because they can prevent the wedge from tightening in the socket.
- Only use a wedge and socket which are the correct size for the wire rope being used. Do not mix and match parts from one assembly with parts from another assembly.
- The Terminator™ socket and wedge has “go” and “no go” holes to check for proper rope size.
- Attach the wire rope clip to the dead end of the wire rope after assembling the wire rope to the wedge and socket.

See Figure 4-73 for the following procedure.

1. Assemble the wire rope and the wedge to the socket so the live end of the wire rope is in a straight line with the socket pin hole. Do not assemble WRONG as shown.
2. Allow the dead end of the wire rope to extend past the end of the socket the amount shown.
3. Allow the wire rope to assume its natural lay.
4. Pull against the wedge and the live end of the wire rope enough to tighten the wedge in the socket.
5. Use a brass hammer to seat the wedge and wire rope as deep into the socket as possible.
6. Attach a wire rope clip to the dead end of the wire rope using one of the RIGHT methods shown. The rope clip will aid in preventing the wire rope from being pulled out of the socket.

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

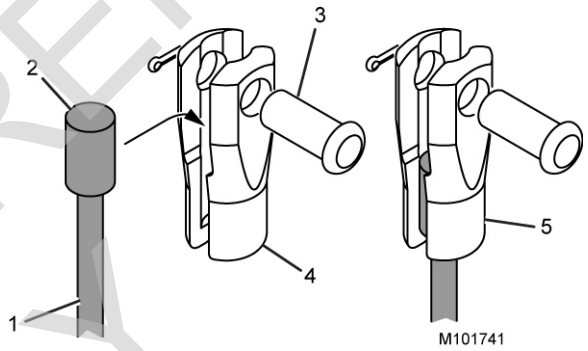
7. After the socket is pinned in place, hoist the load slowly so the wedge seats tightly. Do not shock load the socket and wedge.

WARNING

Falling Load Hazard!

The wire rope can break if the following precaution is not observed:

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



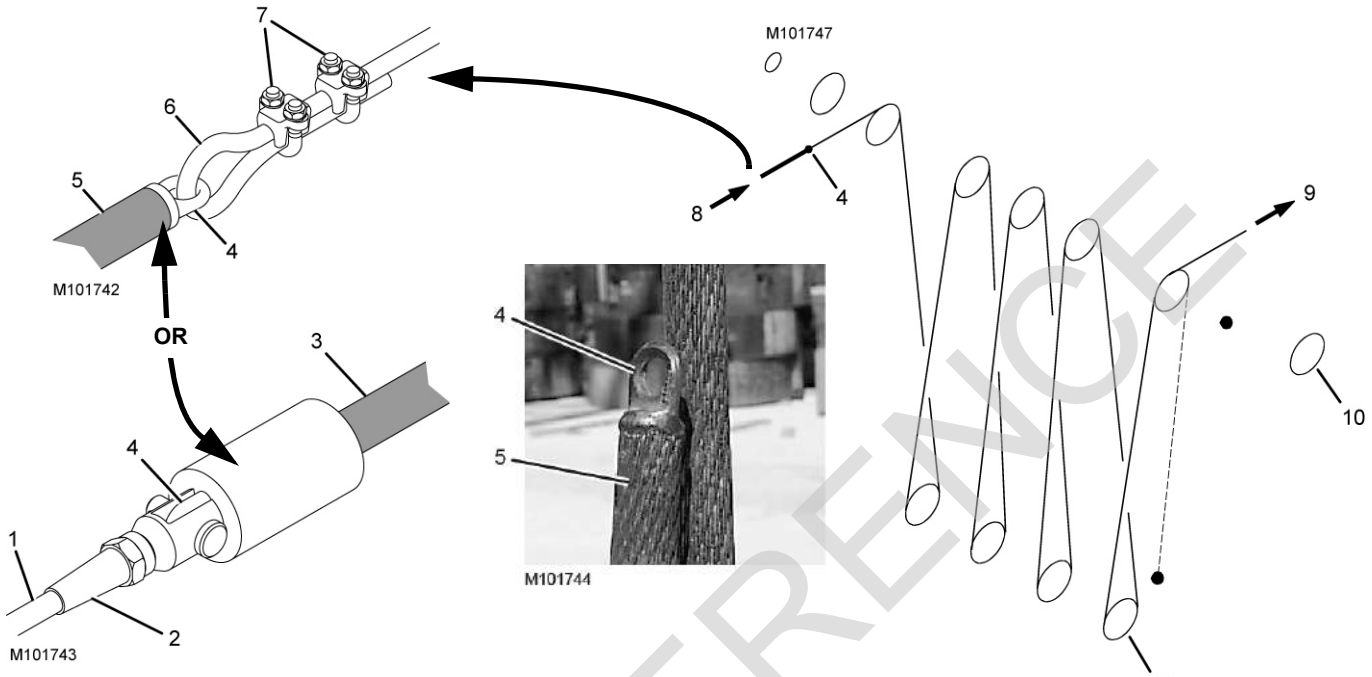
Item	Description
1	Load Line
2	Button
3	Pin
4	Button Socket
5	Locking Screw (behind if equipped)

FIGURE 4-74

Anchoring Wire Rope to Button Socket

See Figure 4-74 for the following procedure.

1. Remove the pin (3) from the socket (4).
2. Install the button (2) end of the load line (1) in the socket (4).
3. Pin the socket to the anchor point.
4. Securely tighten the locking screw (5).



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

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

No. 2 Pad Eye	Item	mm	Inch
Approximate Capacity 1 179 kg (2600 lb)	A	19,05	3/4
	B	9,65	3/8
	C	26,92	1-1/16
	D	12,70	1/2
	E	38,10	1-1/2
	F	4,83	3/16
	G	41,26	1-5/8

Item	Description
1	Rigging Line
2	Connector
3	Wire Rope with Button
4	Pad Eye
5	Wire Rope without Button
6	Rigging Line
7	Rope Clips
8	Wire Rope from Drum
9	Pull Rigging Line with Winch or Forklift
10	Boom Point Sheaves
11	Load Block Sheaves **EXAMPLE**

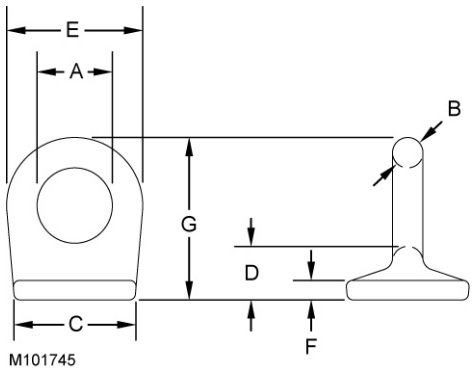


FIGURE 4-75

Pad Eye Usage for Wire Rope Reeving

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.

See Figure 4-75 for the following:

General

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

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

Safety

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

Breaking in Wire Rope

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

NOTE: The 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.

Item	Description
1	Rigging Winch in Boom Butt
2	Wire Rope Guide (2)
3	(Not Used)
4A	Lever Engaged (power)
4B	Lever Disengaged (free-spool)
5	Rigging Winch Selection Screen
6	Rigging Winch ON
7	Rigging Winch OFF

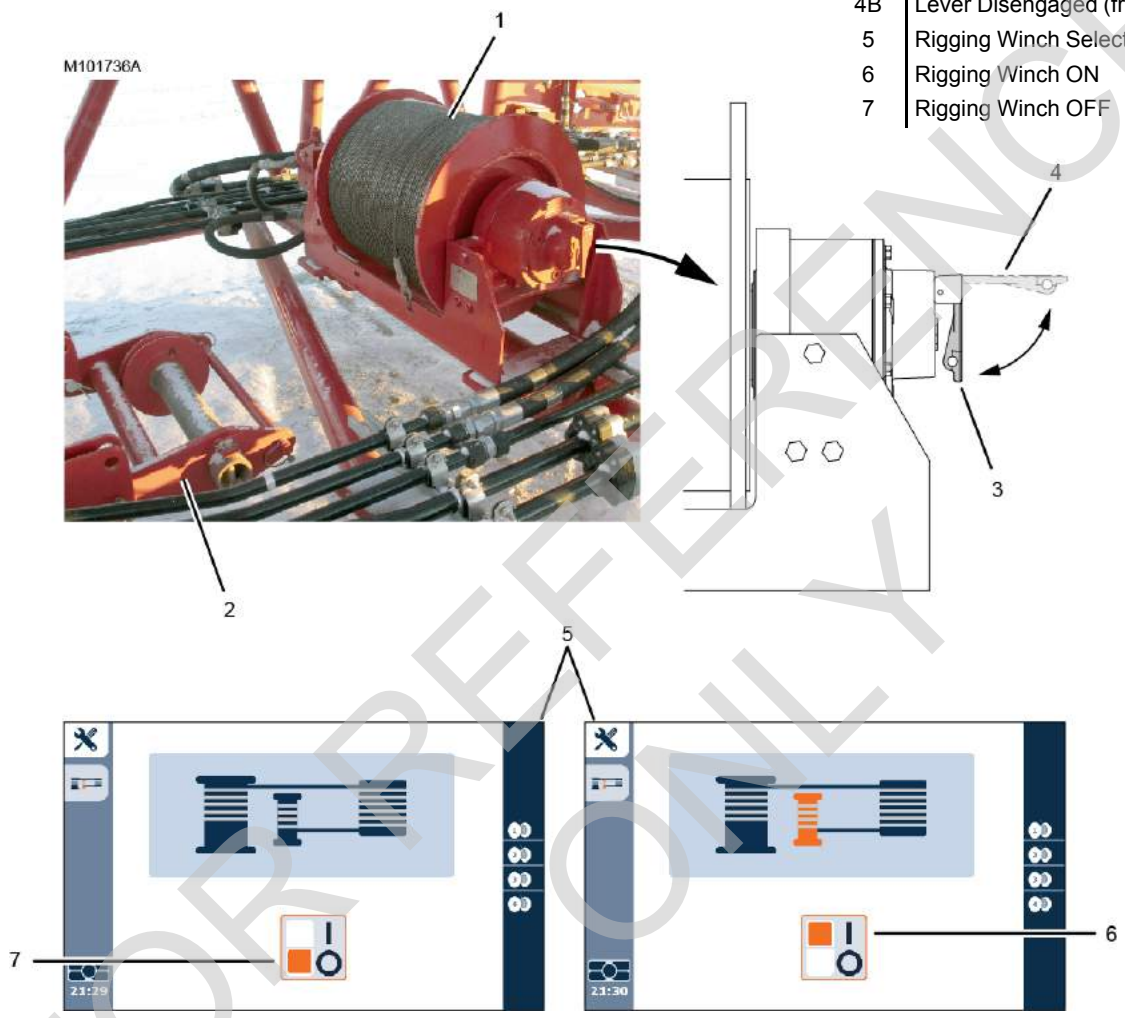


FIGURE 4-76

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 and anchoring.

See Figure 4-76 on page 4-132 for the following procedure. for the following procedures.

Selecting Rigging Winch Mode

TO TURN RIGGING WINCH ON —

1. Scroll to the rigging winch selection screen (5) in the main display. See MLC650 Main Display Operation Manual for instructions.
2. Use either the jog dial on the right console or the scroll keys on the main display to highlight the ON (I) icon (6) in the selection box.
3. Press the select button on the jog dial or on the main display to select the highlighted mode. The screen changes to reflect the change.

TO TURN RIGGING WINCH OFF —

1. Scroll to the rigging winch selection screen (5) in the main display. See MLC650 Main Display Operation Manual for instructions.
2. Use either the jog dial on the right console or the scroll keys on the main display to highlight the OFF (**O**) icon (7) in the selection box.
3. Press the select button on the jog dial or on the main display to select the highlighted mode. The screen changes to reflect the change.

Operating Rigging Winch

Free-Spool Operation

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

TO TURN FREE-SPOOL OFF engage the lever (4A).

TO TURN FREE-SPOOL ON disengage the lever (4B)

Power Operation

1. Engage the lever to turn the free-spool off.
2. Turn on the Rigging Winch mode.
3. To ensure the winch gears are properly engaged, proceed as follows:
   a. Push the Drum 0 control handle forward to slowly rotate the winch drum 90° in the pay out direction.
   b. Pull the Drum 0 control handle back to slowly rotate the winch drum 90° in the haul in direction.
4. Pay out the rigging line by moving the Drum 0 control handle forward.
5. Reeve the rigging line through the load block and the boom point and connect it to the desired load line as shown in the Rigging Winch Assembly drawing at end of this section.
6. Move the Drum 0 control handle to off and push the corresponding load drum control handle forward to pay out the load line. The rigging winch will haul in the rigging line automatically.

NOTE: Use the engine throttle to increase and decrease rigging winch line pull and to control line slack at the rigging winch.

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!

The rigging winch drum will not automatically pay out if the selected load drum control handle is pulled back to the haul in position.

Structural damage to the winch or rigging line will occur!

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

Pay out the rigging line with the Drum 0 control handle while hauling in the load line with the load drum control handle.

WARNING

Flying Object Hazard!

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

The lines could fly apart with explosive force and strike personnel.

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

LOAD LINE REEVING

WARNING

Falling Load Hazard!

Use only a load block or hook-and-weight ball with a capacity equal to or greater than load to be handled.

The load block can fail if overloaded, allowing the load to fall.

Guide Sheaves and Drums

See Figure 4-34 on page 4-62 for identification of the load drums, the guide sheaves, and the rope routing up the boom and jib.

The jib top can be reeved in various configurations. Refer to the Reeving Diagrams at the end of this section for rope routing over the boom and jib top wire rope guides.

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

Load Block Identification

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

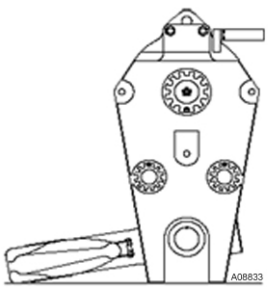
NOTE: Reference the block drawings included at the end of this section for block assembly configurations.

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.



Duplex Hook

Attach the load so it is balanced equally on the hook. The lifting slings must be within the angles given in Figure 4-77 to achieve maximum hook capacity. The duplex hook has a hole to which an optional shackle can be attached as shown in Figure 4-77.

WARNING

Falling Load Hazard!

Limit load to be handled with shackle to capacity of load block or shackle, whichever is less.

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

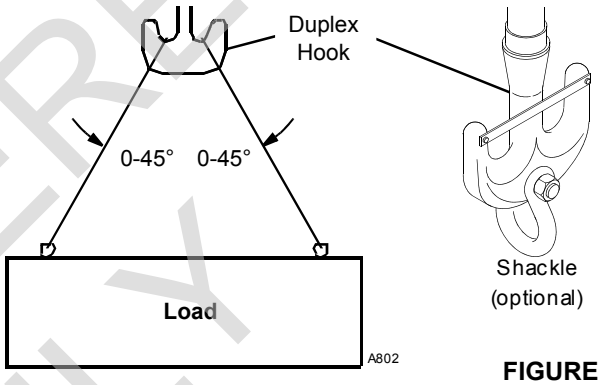


FIGURE 4-77

Wire Rope Specifications

Refer to the Wire Rope Specifications chart in the Capacity Chart Manual for:

Parts of the line required to handle desired load

Wire rope length required for various boom lengths and parts of line

Maximum spooling capacity of load drums

Load Block Reeving

For reeving of the lower jib point, see the Reeving Diagrams at the end of this section.

Reeving in any manner other than shown can result in excessive block twist.

CAUTION

Wire Rope Damage!

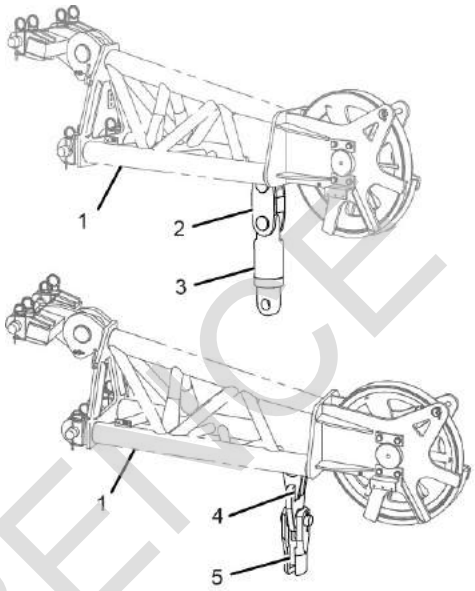
Do not hoist the load block closer to the boom point than shown in the reeving diagrams. Improper fleet angle or contact with other parts can damage the wire rope.

Dead End Locations

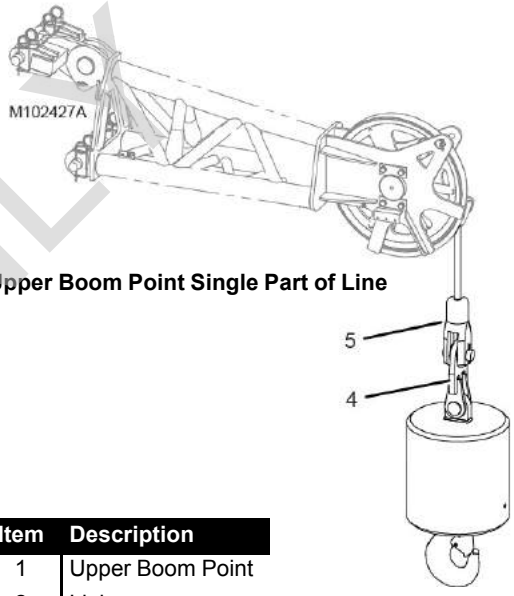
See Figure 4-78 for the upper boom point dead end locations and required hardware.

See the Boom Rigging Drawing for the lower boom point dead end locations and required hardware.

All hardware is stored in the job boxes provided with the crane.



Upper Boom Point Multiple Parts of Line



Upper Boom Point Single Part of Line

Item	Description
1	Upper Boom Point
2	Link
3	Swivel
4	Link
5	Button Socket – 28 mm or 32 mm (1.1 or 1.26 in)

FIGURE 4-78

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 5
LUBRICATION

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 5
LUBRICATION

LUBRICATION

See F2271 at the end of this section.

LUBE AND COOLANT PRODUCT GUIDE

See the publication at the end of this section.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 6
MAINTENANCE

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

Published 09-06-19, Control # 230-08

SECTION 6
MAINTENANCE

GENERAL MAINTENANCE

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

For maintenance and inspection of the following components, see the service manual supplied with your crane:

- Straps
- Fleeting sheaves
- Wire rope and pendants
- Load block and hook-and-weight ball
- Boom and jib


M102472

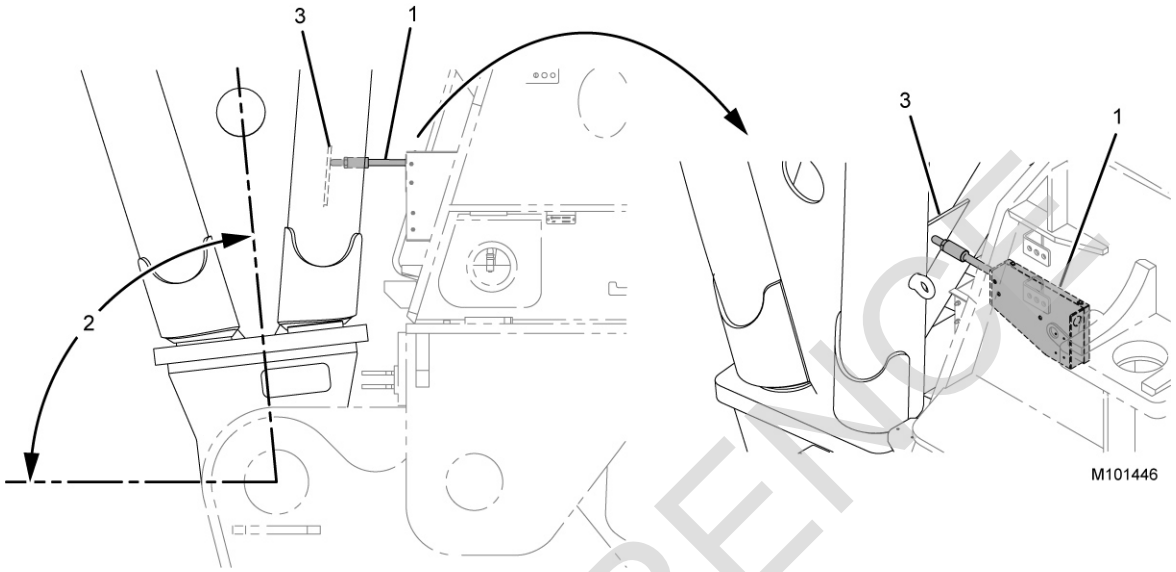
FIGURE 6-1

CALIBRATING THE BOOM AND LUFFING JIB ANGLE INDICATORS

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

The boom and luffing jib angles are calibrated automatically by the crane's programmable controller as part of the load calibration procedure for the Rated Capacity Limiter (RCL)/ Rated Capacity Indicator (RCI). Refer to the RCL/RCI Display Operation Manual for instructions.

THIS PAGE INTENTIONALLY LEFT BLANK



Item	Description
1	Automatic Boom Stop Limit Switch Assembly
2	Maximum Boom Angle:
	83° Boom Only with VPC-MAX™
	85° Boom with Luffing Jib and without VPC-MAX
	85° Boom with Luffing Jib and VPC-MAX
	85° Boom Only with VPC™
3	Boom Stop Surface

FIGURE 6-2

AUTOMATIC BOOM STOP

WARNING

Falling Attachment Hazard!

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

See Figure 6-2 for the following.

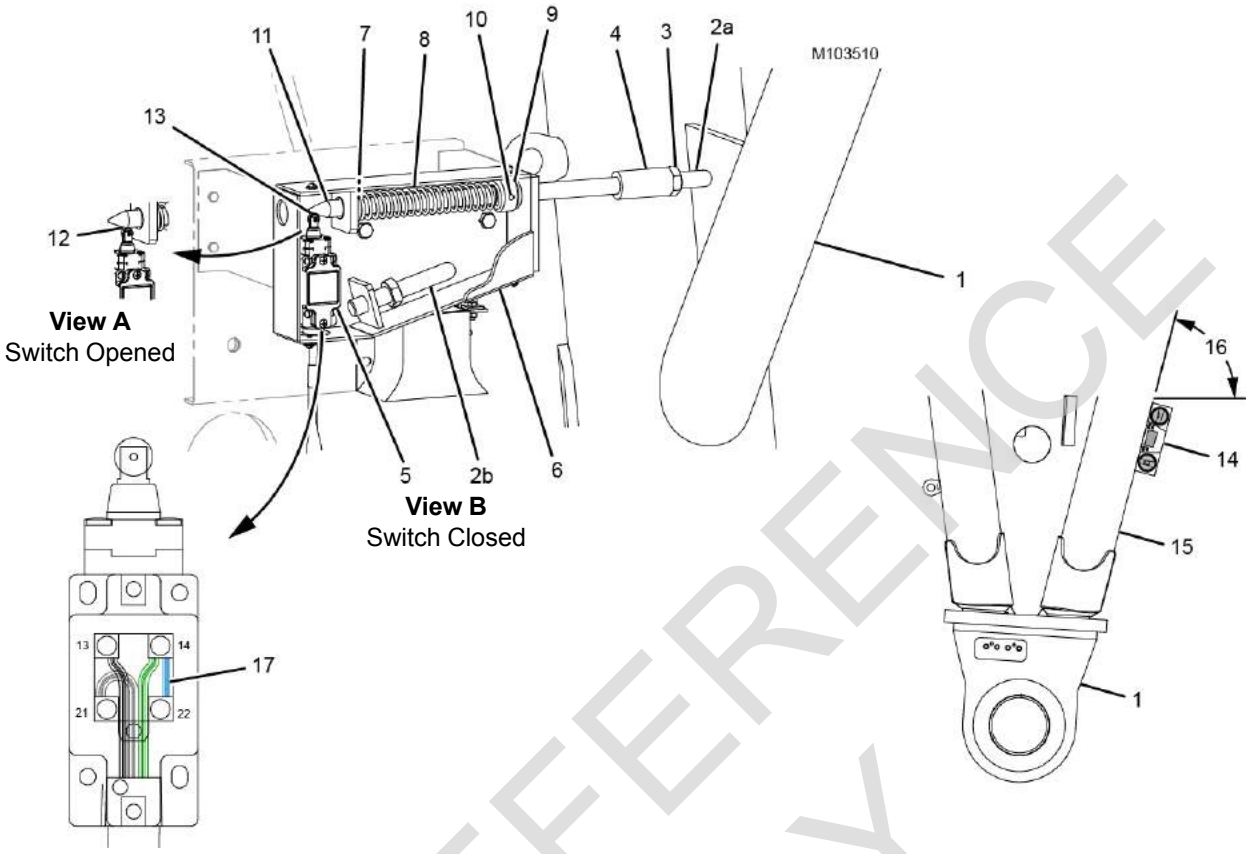
The automatic boom stop limit switch assembly (1) automatically stops the boom and applies the boom hoist brake if the boom is raised to the maximum boom angle (2).

When the maximum boom angle is reached, the fault alarm comes on and the boom maximum up icon appears in the information screen of the main display.

To correct the fault once it is activated, lower the boom. The fault cannot be bypassed.

Automatic Boom Stop Maintenance

Check the automatic boom stop weekly for proper operation. If the boom does not stop at the specified maximum angle, replace any worn or damaged parts and/or adjust the boom stop.



View A
Switch Opened

View B
Switch Closed

View C
Limit Switch Wiring

View D
Right Side of Boom Butt

Receptacle	Switch Terminals		Function
Black	13		Ground
Green	14		Maximum Angle
White	21		24 VDC Supply
Blue	14	22	Jumper

Maximum Switch Boom Angle	Digital Level Angle (16)
84.5° Boom Only with VPC-MAX	73.57°
86.4° Boom with Luffing Jib and without VPC-MAX	75.47°
86.4° Boom with Luffing Jib and VPC-MAX	75.47°
86.4° Boom Only with VPC	75.47°

Item	Description	Item	Description
1	Boom Butt	9	Spring Washer
2a	105 mm (4.125 in) Adjusting Rod for 85° Boom Angle	10	Spring Pin
2b	133 mm (5.25 in) Adjusting Rod for 83° Boom Angle	11	Actuator Rod
3	Jam Nut	12	Over-travel—Switch Opened
4	Coupling (part of actuator rod)	13	Switch Closed
5	Limit Switch Assembly	14	Digital Protractor/Level
6	Automatic Boom Stop Limit Switch	15	Boom Butt Bottom Chord
7	Spring Washer	16	Digital Level Angle
8	Spring	17	Blue Jumper Wire

FIGURE 6-3

Adjusting Automatic Boom Stop

WARNING

Falling Attachment Hazard!

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

See Figure 6-3 for the following procedure:

The automatic boom stop limit switch (6) was set at the factory and should not require periodic adjustment. Adjustment is necessary at the following times:

- When parts are replaced
- When the boom/luffing jib configuration changes

NOTE: This includes installation and removal of the boom and/or luffing jib.

This procedure assumes that the rated capacity limiter (RCL)/rated capacity indicator (RCI) is installed and properly calibrated.

During the following procedure, monitor the boom angle on the RCL/RCI working screen and on a digital protractor/level (14):

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 as follows:
   - Adjusting rod for an 85° boom angle (2a)
   - Adjusting rod for an 83° boom angle (2b)
3. Boom up slowly while monitoring the boom angle on the RCL/RCI working screen.
4. Stop booming up when the boom reaches the specified angle in the table under View D.

NOTE: The maximum switch boom angle is greater than the maximum boom angle to allow for boom deflection.

5. Verify the boom angle with an accurate digital protractor/level held on the centerline of the boom butt bottom chord (15). The corresponding digital level angle (16) should appear on the protractor/level.
   - If the boom stops at the specified angle, further adjustment is not needed.
   - If the boom stops before reaching the specified angle, go to step 6.
   - If the boom reaches the specified angle before it stops, go to step 7.
6. If the boom stops before reaching the specified angle, perform the following:
   a. Loosen the jam nut (3).
   b. Turn the adjusting rod (2a or 2b) all the way into the coupling (4).
   c. Boom up slowly until the boom reaches the specified angle.
   d. Turn the adjusting rod out against the boom butt (1) until the limit switch “clicks” open.
   e. Tighten the jam nut.
7. If the boom reaches the specified angle before it stops, perform the following:
   a. Loosen the jam nut (3).
   b. Turn the adjusting rod (2a or 2b) out against the boom butt (1) until the limit switch “clicks” open.
   c. Tighten the jam nut.
8. Make sure the actuator rod (11) over-travels (12) the limit switch as shown in View A.
9. Boom down and then back up. The boom must stop at the specified maximum boom angle.
10. If the boom fails to stop, repeat step 3 through step 9.

Replacing Automatic Boom Stop Actuator Rod

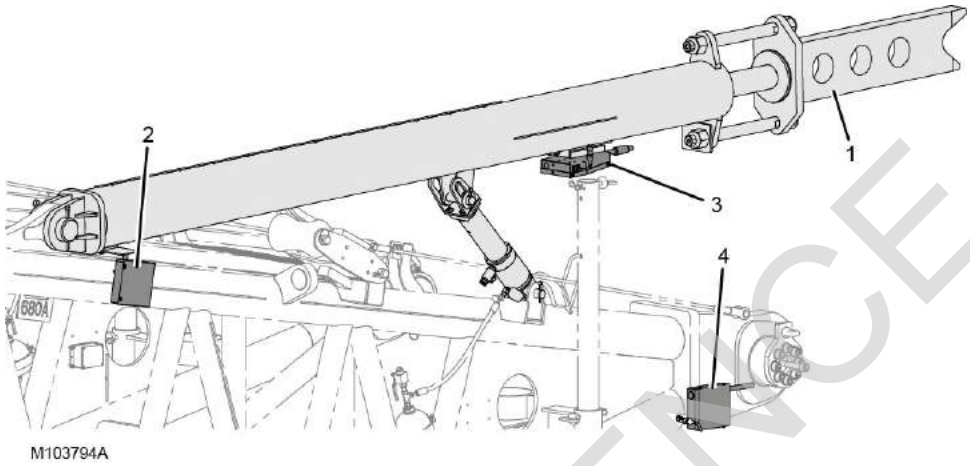
See Figure 6-3 for the following procedure:

1. Remove the spring pin (10), spring washer (9), and actuator rod (11) from the automatic boom stop limit switch.
2. Install a new actuator rod and spring washer in the automatic boom stop limit switch.
3. Position the actuator rod (11) so the tapered end just touches the automatic boom stop limit switch (6) roller as shown in View B.

NOTE: The actuator rod must not depress the limit switch shaft.

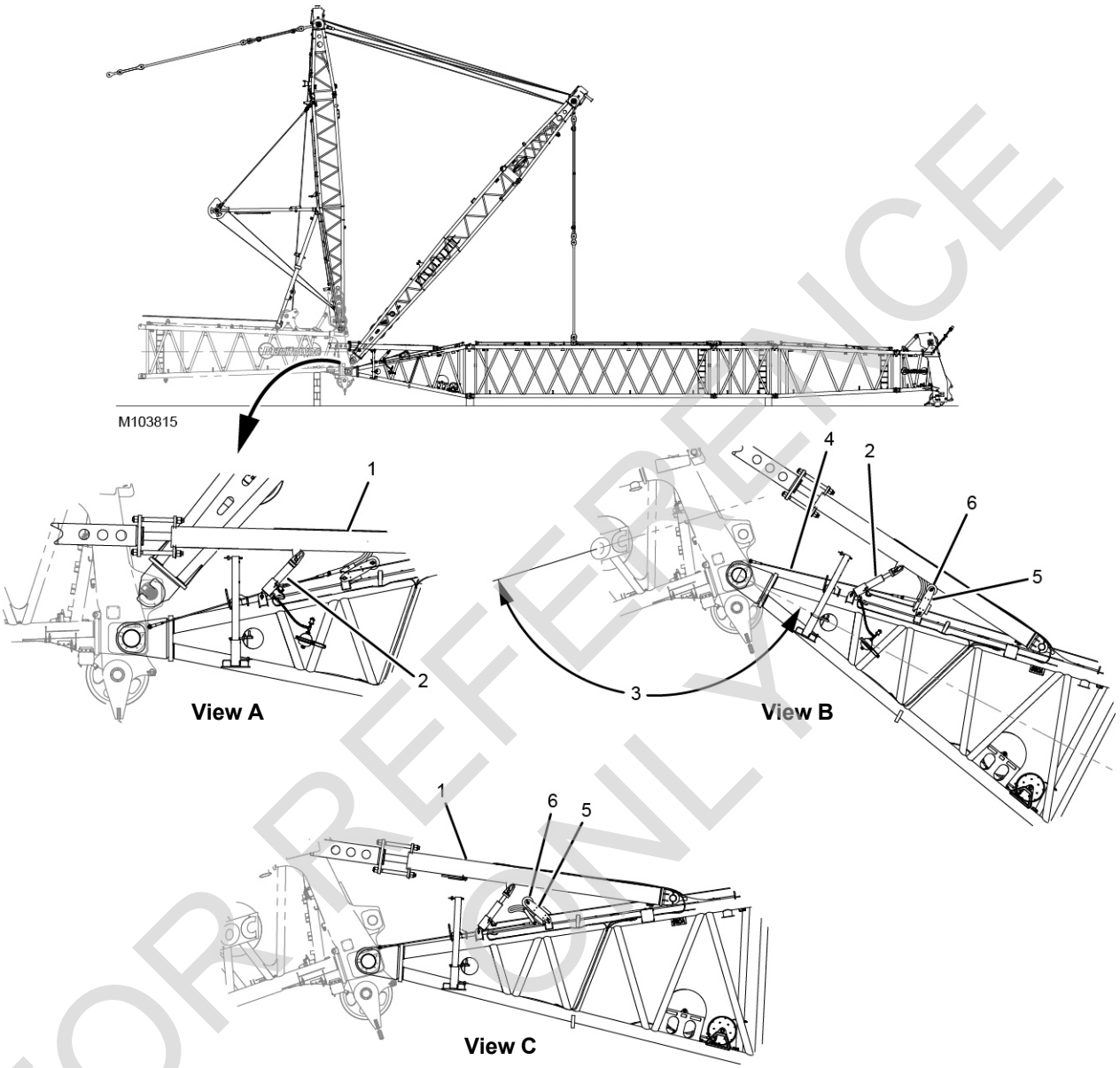
4. Drill a 6,35 mm (0.249 in) hole through the spring washer (9) and the actuator rod.
5. Install the spring pin (10).
6. Push the actuator rod in until the limit switch clicks open.
7. Check the limit switch roller to make sure there is over-travel (12).

THIS PAGE INTENTIONALLY LEFT BLANK



Item	Description	For Instructions
1	Physical Jib Stop (qty 2)	See “Physical Jib Stop Operation”, on page 6-9.
2	Physical Jib Stop Position Limit Switch (qty 2)	See “Luffing Jib Stop Position Switches — Version 1”, on page 6-11
3	Luffing Jib Max Up Limit Switch	See “Automatic Luffing Jib Stop – MAX UP”, on page 6-15
4	Luffing Jib Max Down Limit Switch	See “Automatic Luffing Jib Stop – MAX DOWN”, on page 6-19

FIGURE 6-4



Item	Description
1	Jib Stop (qty 2)
2	Jib Stop Support Cylinder (qty 2)
3	135° Included Angle
4	Jib Stop Pendant (qty 2)
5	Jib Stop Bracket (qty 2)
6	Roller (qty 2)

FIGURE 6-5

PHYSICAL JIB STOP OPERATION

Each physical jib stop has a bracket with a roller that raises the jib stop into position so that the jib stop engages the jib stop lug on the boom top.

Raising Operation

Refer to the Luffing Jib Raising (Lowering) Procedure chart in Section 4 for detailed raising instructions.

See Figure 6-5 for the following procedure:

1. At the start of the raising procedure, make sure the jib stops (1, View A) rest on fully retracted jib stop support cylinders (2, View A).
2. Raise the boom and jib to a 135° included angle (3).

   The jib stop pendants (4) become tight and pull the jib stop brackets (5, View B) with the rollers (6, View B), raising the jib stops to the operating position and extending the support cylinders.
3. Make sure the brackets (5, View C) and rollers (6, View C) flip over center with the pendants slack.

   The jib stops will now operate as follows:

   a. When the boom-to-luffing jib angle is 160°, the ends of the jib stops engage the jib stop lugs on the boom top.

   b. The jib stops fully compress to provide a physical stop if the jib is raised to a boom-to-luffing jib angle of 173°.

NOTE: The Luffing Jib Maximum Up 2 limit is activated at a boom-to-luffing jib angle of 171.5°. See "Automatic Luffing Jib Stop – MAX UP" on page 6-15 for more information.

Lowering Operation

Refer to the Luffing Jib Raising (Lowering) Procedure chart in Section 4 for detailed lowering instructions.

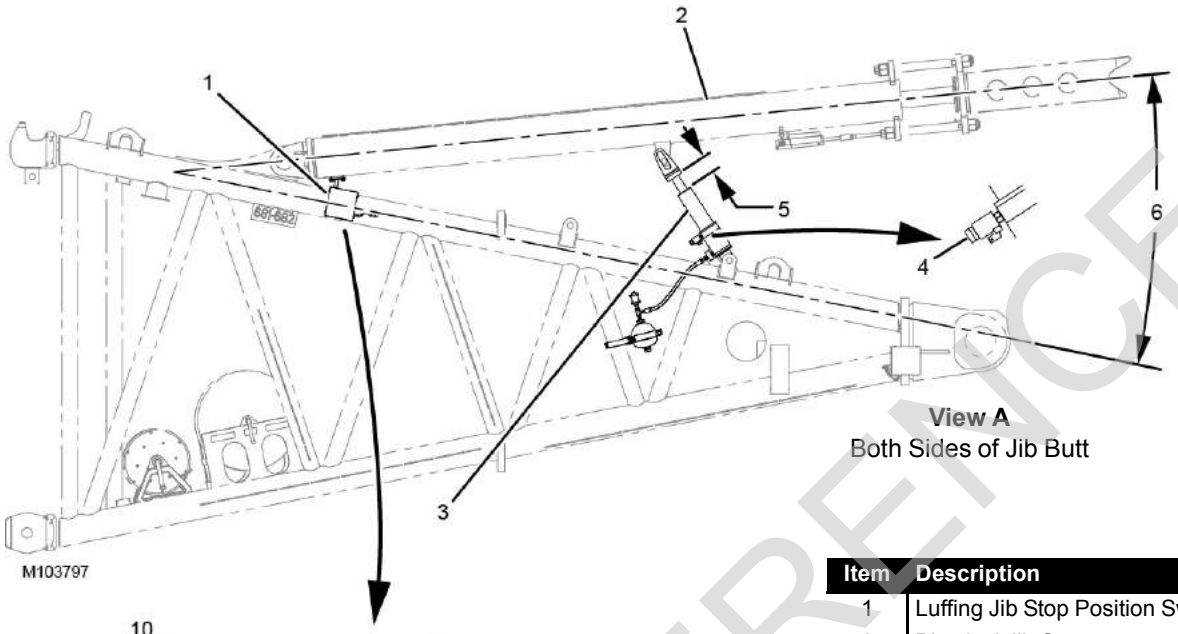
See Figure 6-5 for the following procedure:

1. Lower the boom until the upper boom point rollers contact the ground.

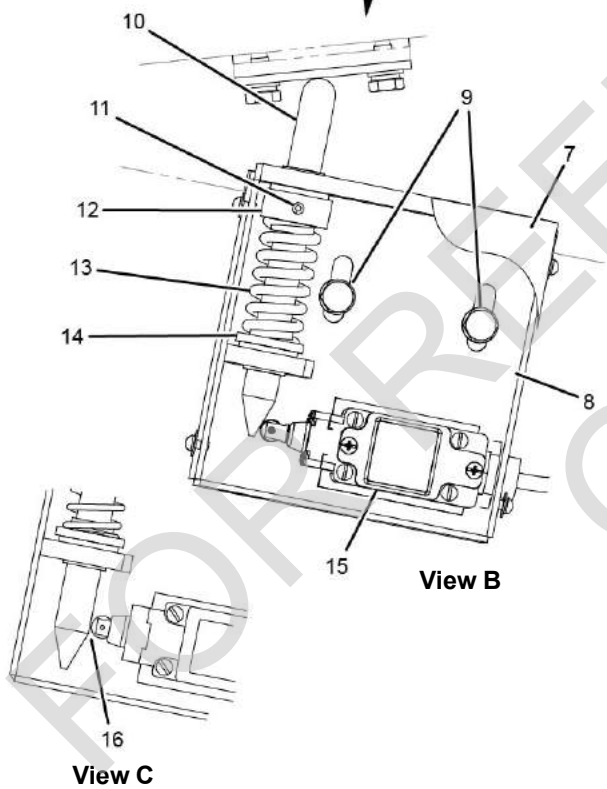
   As the jib is lowered, the jib stops (1, View C) rotate away from the jib stop lugs on the boom top.
2. Continue lowering the boom until the luffing jib reaches a maximum angle of 150°, allowing for clearance of the jib stop to lower to the storage position.
3. When the luffing jib assembly is at the specified angle, turn the jib stop mode to ON. When the jib stop solenoid valve circuit is energized, the main display indicates that the jib stop mode indicator is active. This allows the jib stop support cylinder (2, View B) to retract under the weight of the jib stop assembly.

NOTE: In case of electrical failure, the jib stop solenoid valve on the jib stop support cylinders (see Figure 6-16 on page 6-32) can be mechanically actuated to lower the jib stops. Contact the Manitowoc Crane Care Lattice Team for the manual override procedure.

4. Have an assistant watch the jib stops to make sure they pass under the boom stop lugs.



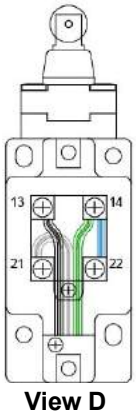
View A
Both Sides of Jib Butt



View B

View C

Item	Description
1	Luffing Jib Stop Position Switch
2	Physical Jib Stop
3	Jib Stop Support Cylinder
4	Needle Valve (inside solenoid valve)
5	100 mm (3.937 in)
6	17°
7	Cover
8	Switch Housing
9	Mounting Screws with Washers
10	Actuator Rod
11	Slotted Spring Pin
12	Spring Washer
13	Spring
14	Spring Washer
15	Limit Switch
16	Over-travel



View D

Limit Switch Wiring

Receptacle	Switch Terminals		Function
Black	13		Ground
Green	14		Maximum Angle
White	21		24 VDC Supply
Blue	14	22	Jumper

FIGURE 6-6

LUFFING JIB STOP POSITION SWITCHES — VERSION 1

See Figure 6-6 for Version 1 Luffing Jib Stop Position Switches.

The luffing jib stop position switches (1) signal the control system when the jib stops (2) have been raised to—and stay at—the required operating height.

Either limit stops the corresponding hoist and activates the operating limit fault if the following operations are attempted. The **Luffing Jib Stop Misaligned** icon appears in the fault bar of the Main Display Working Screen.

- You try to luff up when either jib stop is not fully extended (raised). The limit can be bypassed in the luffing jib setup mode only if the boom angle is less than 50°.
- You try to boom down or luff up when either jib stop is fully extended (raised) and the boom angle is less than 30°.

The luffing jib stop position switches (1) were set at the factory and should not require periodic adjustment. Adjustment is necessary at the following times:

- When parts are replaced
- Each time the attachment is erected

Jib Stop Position Switches Adjustment

Perform the following steps at each jib stop, one at a time.

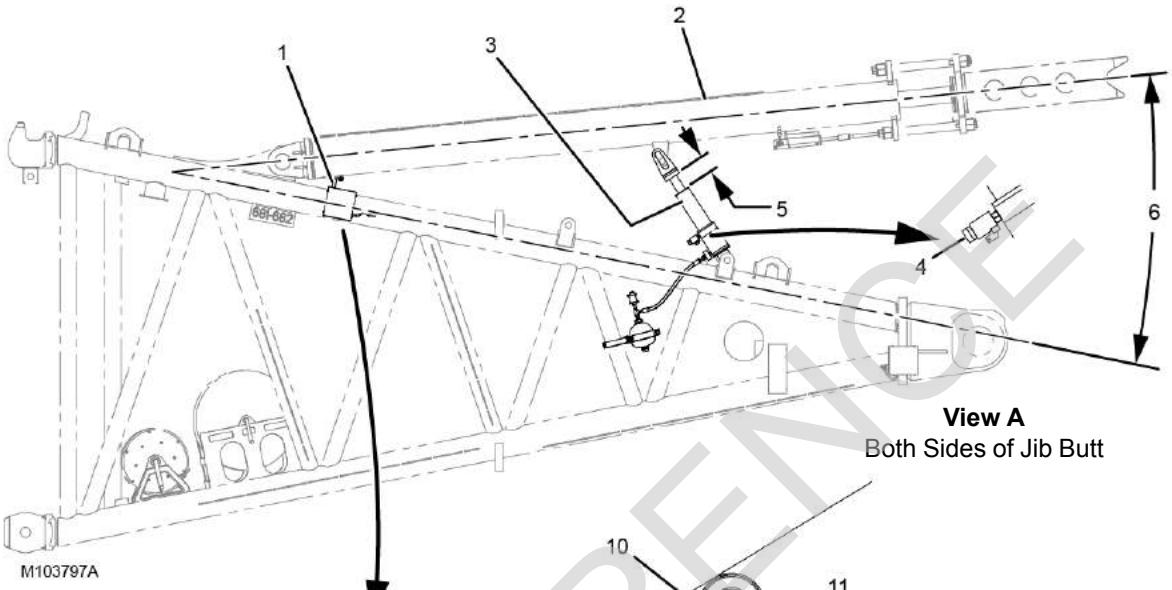
1. Loosen the mounting screws (9, View B) and lower the switch housing (8) fully in its slots.
2. If the physical jib stop (2, View A) is up in its operating position, carefully depress the needle valve (4) at the jib stop support cylinder (3), allowing the cylinder to fully retract under the weight of the jib stop.
3. Release the needle valve.
4. Using a nylon lifting sling from an assist crane, lift the physical jib stop (2) until the jib stop support cylinder (3) has extended to the distance (5). The angle (6) between the jib stop and the jib butt should be approximately 17°.
5. With the jib stop in its operating position, push up the limit switch housing (8, View B) in its slots until the limit switch (15) “clicks” open. Make sure there is over-travel (16, View C) as shown.
6. Repeat the steps for the other jib stop.

Jib Stop Position Switches Maintenance

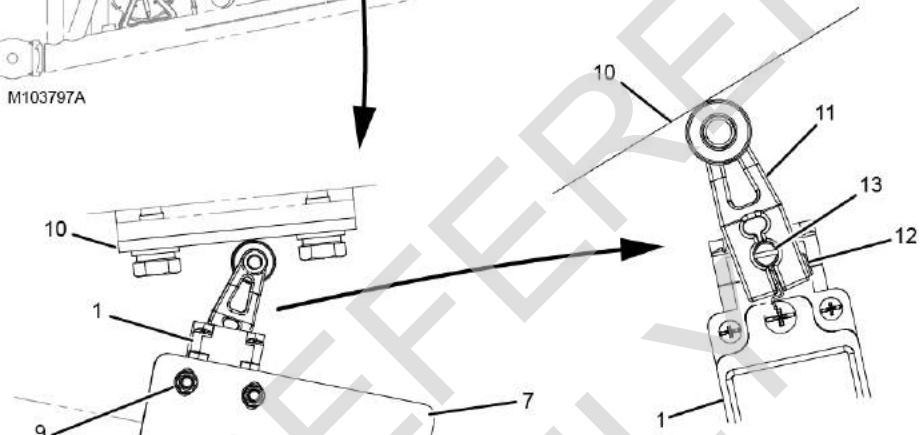
1. With the boom and luffing jib on the ground, lock out/tag out the crane.
2. Move the needle valve in and out on each jib stop to check for freedom of movement.
3. Check all cables for any cracks or wear.
4. Check the cable connections.
5. Replace components as necessary.

Actuator Rod Replacement

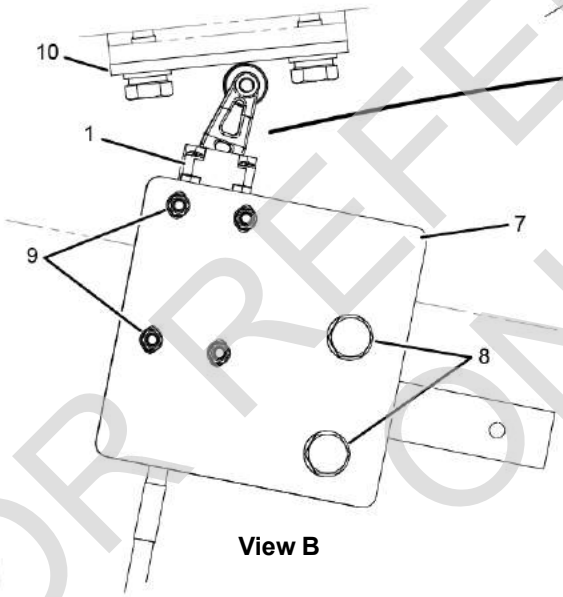
1. Disassemble the switch assembly (View B) and dispose of faulty parts.
2. Reassemble the switch assembly as shown.
3. Position the actuator rod (10, View B) so the tapered end just touches the limit switch (15) roller. The actuator rod must not depress the limit switch shaft.
4. Drill a 6,35 mm (1/4 in) hole through the spring washer (11) and the actuator rod (10).
5. Install the slotted spring pin (11).
6. Push the actuator rod (11) in until the limit switch clicks open. Check that there is over-travel (16, View C) as shown.
7. Connect the electric wires to the limit switch as shown in View D.
8. Mount the switch housing (View B) and adjust the limit switch.



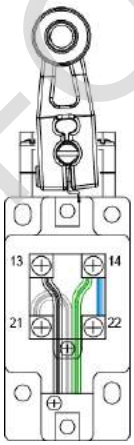
View A
Both Sides of Jib Butt



View D



View B



View C

Limit Switch Wiring

Receptacle	Switch Terminals		Function
Black	13		Ground
Green	14		Maximum Angle
White	21		24 VDC Supply
Blue	14	22	Jumper

Item	Description
1	Luffing Jib Stop Position Switch
2	Physical Jib Stop
3	Jib Stop Support Cylinder
4	Needle Valve (inside solenoid valve)
5	100 mm (3.937 in)
6	17°
7	Bracket
8	Bracket Screws with Washers
9	Limit Switch Screws with Washers and Nuts
10	Actuator Plate
11	Limit Switch Lever
12	Set Screw
13	Limit Switch Shaft

FIGURE 6-7

LUFFING JIB STOP POSITION SWITCHES — VERSION 2

See Figure 6-7 for Version 2 Luffing Jib Stop Position Switches.

The luffing jib stop position switches (1) signal the control system when the jib stops (2) have been raised to—and stay at—the required operating height.

Either limit stops the corresponding hoist and activates the operating limit fault if the following operations are attempted. The **Luffing Jib Stop Misaligned** icon appears in the fault bar of the Main Display Working Screen.

- You try to luff up when either jib stop is not fully extended (raised). The limit can be bypassed in the luffing jib setup mode only if the boom angle is less than 50°.
- You try to boom down or luff up when either jib stop is fully extended (raised) and the boom angle is less than 30°.

The luffing jib stop position switches (1) were set at the factory and should not require periodic adjustment. Adjustment is necessary at the following times:

- When parts are replaced
- Each time the attachment is erected

Jib Stop Position Switches Adjustment

Perform the following steps at each jib stop, one at a time.

1. Loosen the bracket (7) screws (8, View B) and the limit switch (1) screws (9) and lower the switch and bracket fully in their mounting slots.
2. If the physical jib stop (2, View A) is up in its operating position, carefully depress the needle valve (4) at the jib stop support cylinder (3), allowing the cylinder to fully retract under the weight of the jib stop.
3. Release the needle valve.
4. Using a nylon lifting sling from an assist crane, lift the physical jib stop (2) until the jib stop support cylinder (3) has extended to the distance (5, View A). The angle (6) between the jib stop and the jib butt should be approximately 17°.
5. With the jib stop in its operating position, push the limit switch (1) and the bracket (7, View B) up in their slots until the limit switch arm rotates rearward a few degrees.
6. Securely tighten the bracket and limit switch mounting screws (8 and 9, View B).
7. Loosen the setscrew (12, View D) so the limit switch lever (11) is free to rotate.
8. Hold the roller on the limit switch lever (12, View D) against the actuator plate (10).
9. Turn the limit switch shaft (13, View D) counterclockwise until the limit switch “clicks” open and hold.
10. Securely tighten the setscrew (12, View D).
11. Repeat the steps for the other jib stop.

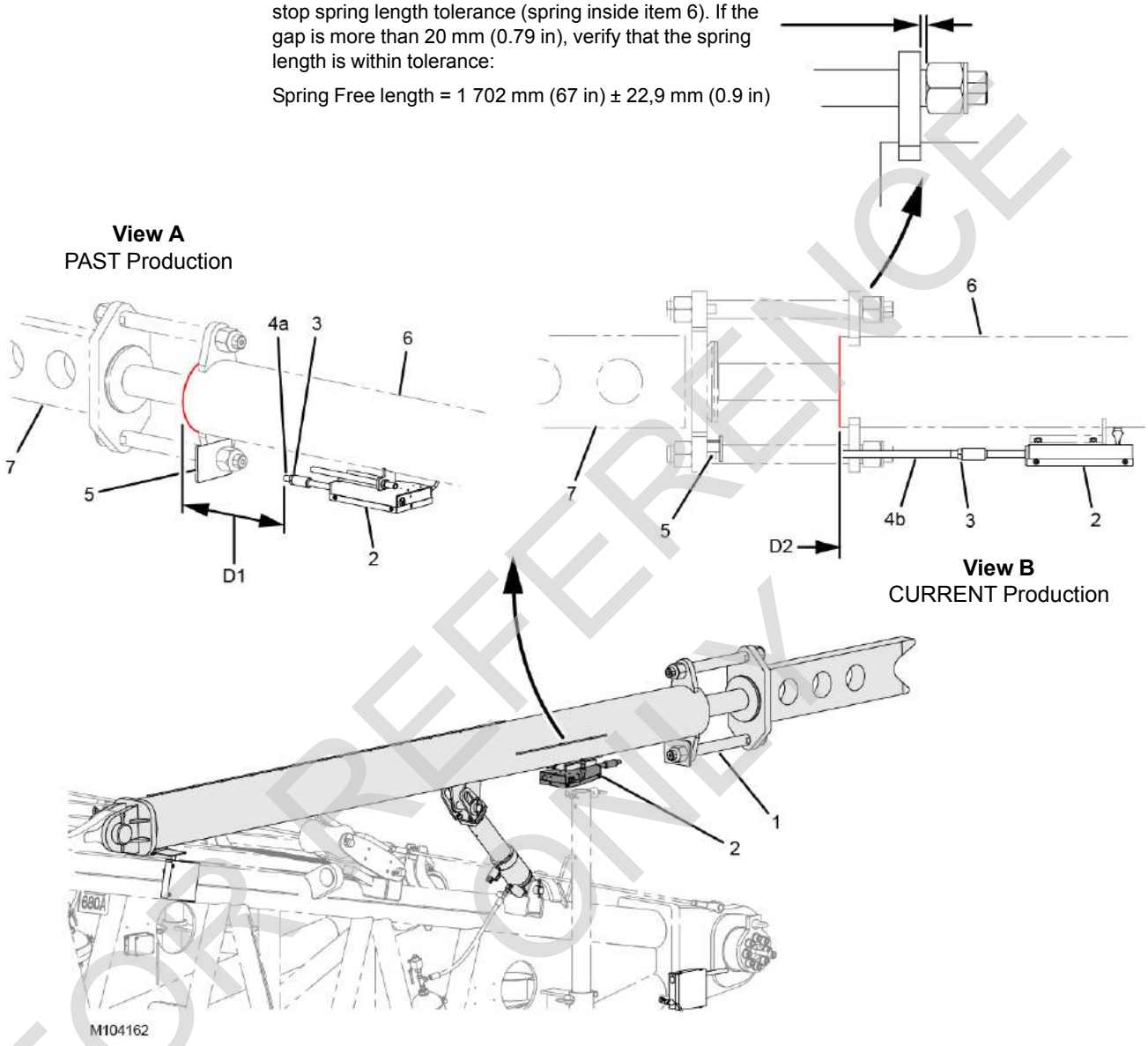
Jib Stop Position Switches Maintenance

1. With the boom and luffing jib on the ground, lock out/tag out the crane.
2. Move the needle valve in and out on each jib stop to check for freedom of movement.
3. Check all cables for any cracks or wear.
4. Check the cable connections.
5. Replace components as necessary.

Check at Overhaul/Assembly

The gap between each flange and nut will vary with the jib stop spring length tolerance (spring inside item 6). If the gap is more than 20 mm (0.79 in), verify that the spring length is within tolerance:

Spring Free length = 1 702 mm (67 in) ± 22,9 mm (0.9 in)



Item	Description
1	Physical Luffing Jib Stop (left side only)
2	Jib Maximum Up Limit Switch
3	Jam Nut
4a	Adjusting Rod: 85 mm (3.35 in) long
4b	Adjusting Rod: 370 mm (14.57 in) long
5	Actuator Plate
6	Jib Stop Outer Tube
7	Jib Stop Rod
D1	404 mm (16 in) from End of Adjusting Rod to End of Jib Stop Outer Tube
D2	End of Adjusting Rod Flush with End of Jib Stop Outer Tube

FIGURE 6-8

AUTOMATIC LUFFING JIB STOP – MAX UP

WARNING

Falling Attachment Hazard!

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

Operating the luffing jib above the Luffing Jib Maximum Up 2 limit is neither intended nor approved. The jib can be pulled over backwards.

The luffing jib attachment is equipped with two max up limits which automatically stop the luffing hoist and apply its brake when the luffing jib is raised to the following angles:

Luffing Jib Maximum Up 1 (maximum working angle)—This programmed limit automatically stops the luffing jib and activates the fault in the main display when the boom-to-luffing jib angle is 171°.

- The luffing jib can be lowered after this limit is reached.
- The limit bypass switch must be turned to the bypass position to raise the luffing jib an additional 0.5° to the Luffing Jib Maximum Up 2 limit.

Luffing Jib Maximum Up 2 (maximum angle limit)—This limit is controlled by the maximum up limit switch (2, Figure 6-10). It automatically stops the luffing jib and activates the fault in the main display when the boom-to-luffing jib angle reaches 171.5°.

- This limit cannot be bypassed.

Jib Stop Max Up Maintenance

At least once each week, and each time the attachment is erected, make sure that the luffing jib stops at the specified max up angles.

Jib Stop Max Up Pre-Erection Checks

To ensure proper operation of the luffing jib stops, observe the following:

- The jib angles must be properly calibrated in the rated capacity limiter (RCL)/rated capacity indicator (RCI). See the RCL/RCI Operation Manual for instructions.
- The jib adjusting rod must be properly adjusted before the boom and luffing jib are raised.

Jib Stop Max Up Actuator Rod Adjustment

See Figure 6-8 for the following procedure.

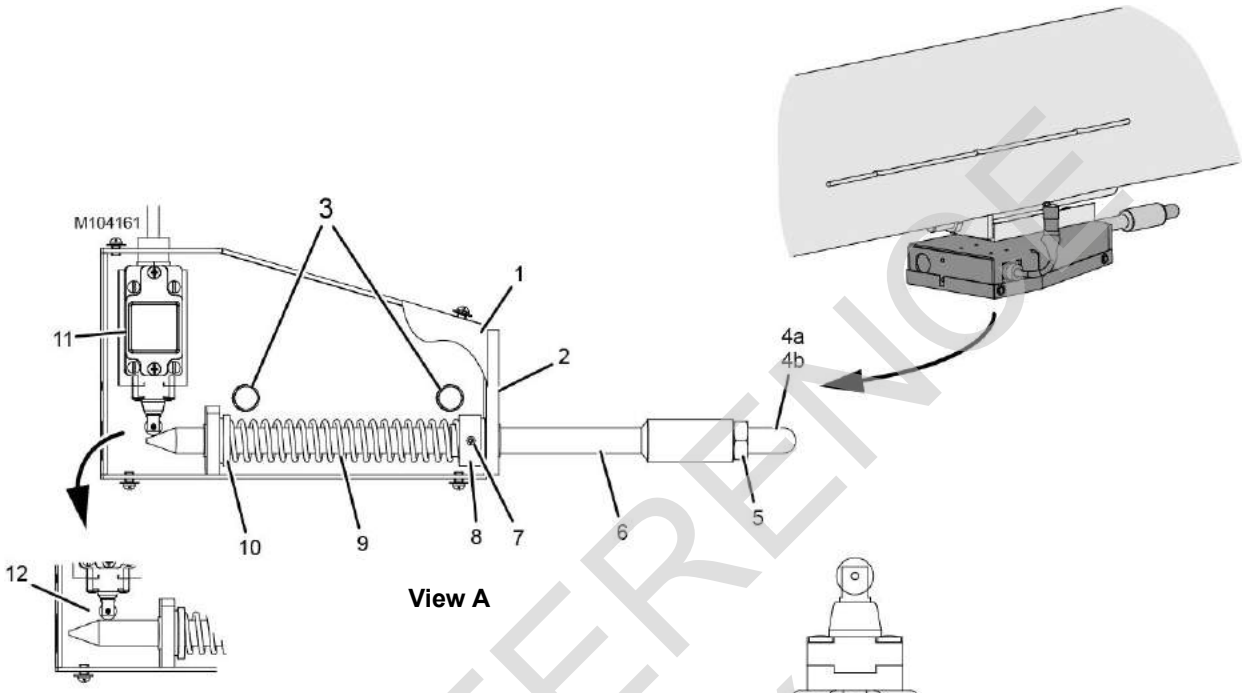
Perform the following steps with the boom and luffing jib on the ground.

1. For past production attachments (View A):
   a. Check the dimension (D1) from the end of the adjusting rod (4a) to the end of the jib stop outer tube (6).
   b. If necessary, loosen the jam nut (3) and adjust the adjusting rod (4a) to obtain the specified dimension.
   c. Securely tighten the jam nut (3).
2. For current production attachments (View B):
   a. Check the dimension (D2). The end of the adjusting rod (4b) must be **flush** with the end of the jib stop outer tube (6).
   b. If necessary, loosen the jam nut (3) and adjust the adjusting rod (4b) to obtain the specified dimension.
   c. Securely tighten the jam nut (3).

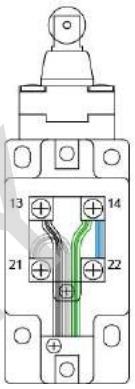
Jib Stop Max Up Operational Check

Make the following operational checks after raising the boom and luffing jib:

1. Travel the crane onto a firm, level surface or level the crane by blocking under the crawlers.
2. Raise the boom and luffing jib until the boom is at 80°.
3. Monitor the boom-to-luffing jib angle on the main display information screen while performing the remaining steps.
4. Slowly raise the luffing jib.
5. The luffing hoist must stop and not be able to turn upward when the boom-to-luffing jib angle is 171°.
6. The fault alarm should come on, indicating that the Luffing Jib Maximum Up 1 angle has been reached.
7. Turn the limit bypass key switch clockwise to bypass the Luffing Jib Maximum Up 1 angle.
8. Slowly raise the luffing jib past the Luffing Jib Maximum Up 1 limit.
9. The luffing hoist must stop and not be able to turn upward when the boom-to-luffing jib angle is 171.5°.
10. The fault alarm should come on, indicating that the Luffing Jib Maximum Up 2 limit has been reached.
11. Troubleshoot the system if the Luffing Jib Maximum Up limits do not operate properly.
12. Do not raise the luffing jib below 171.5°. ***Jib could be pulled over backwards.***



View A



View B

Item	Description
1	Cover
2	Switch Housing
3	Mounting Screws with Washers
4a	Adjusting Rod: 85 mm (3.35 in) long (PAST)
4b	Adjusting Rod: 370 mm (14.57 in) long (CURRENT)
5	Jam Nut
6	Actuator Rod
7	Slotted Spring Pin
8	Spring Washer
9	Spring
10	Spring Washer
11	Limit Switch
12	Over-travel

Limit Switch Wiring

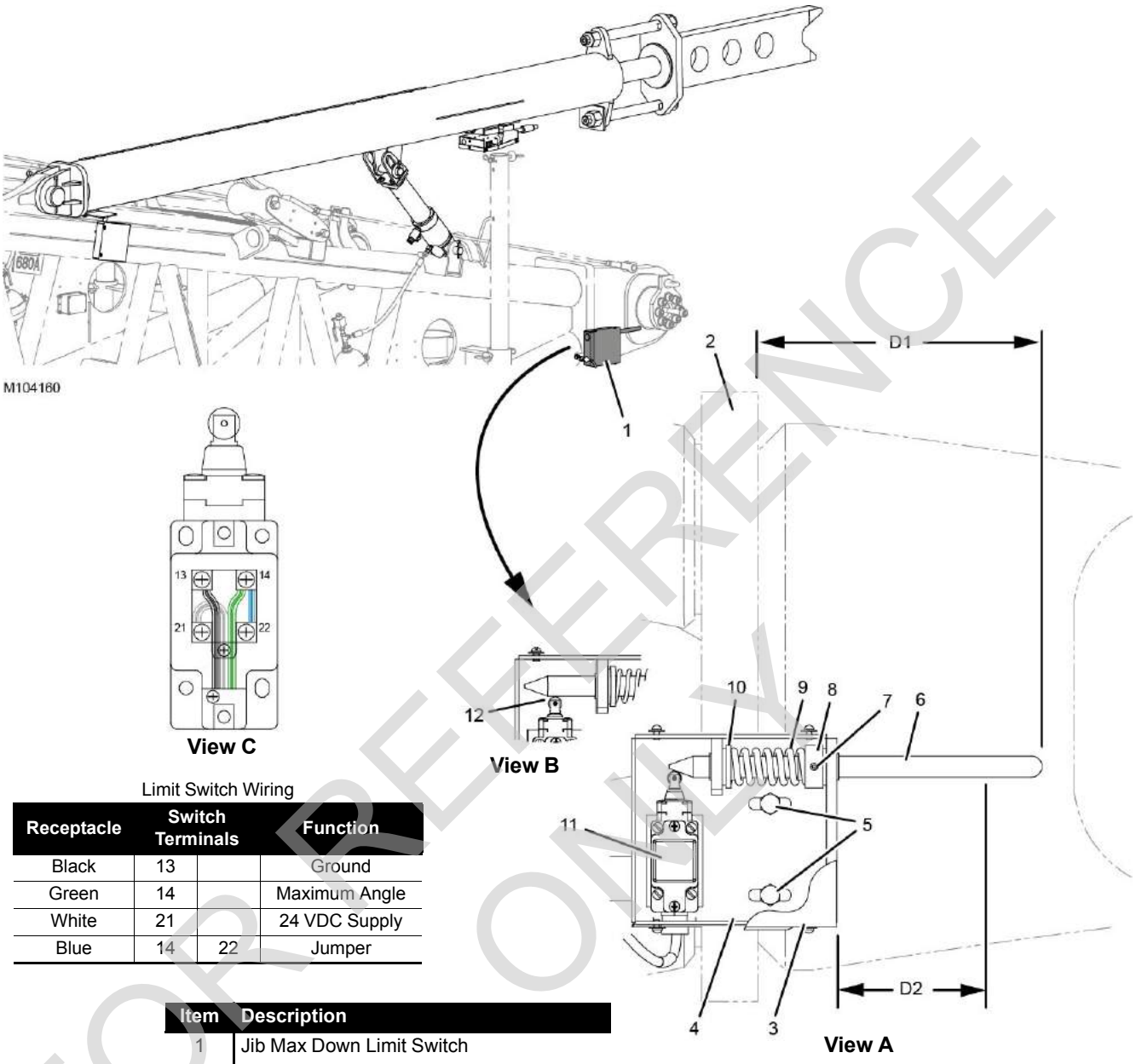
Receptacle	Switch Terminals		Function
Black	13		Ground
Green	14		Maximum Angle
White	21		24 VDC Supply
Blue	14	22	Jumper

FIGURE 6-9

Replacing Jib Max Up Actuator Rod

This procedure applies to both past and current production. See Figure 6-9.

1. Remove the adjusting rod (4a or 4b) and jam nut (5).
2. Remove the cover (1) from the switch housing (2).
3. Remove the actuator rod (4).
4. Disassemble the limit switch assembly (View A) and dispose of faulty parts.
5. Reassemble the limit switch assembly.
6. Position the actuator rod (6, View A) so the tapered end of the rod just touches the limit switch (11) roller. The actuator rod must not depress the limit switch roller.
7. Drill a 6,35 mm (1/4 in) hole through the spring washer (8) and the actuator rod (6).
8. Install the slotted spring pin (7).
9. Push the actuator rod in until the limit switch clicks open. Check the limit switch to make sure there is over-travel (12) as shown.
10. Reinstall the adjusting rod and jam nut.
11. Adjust the adjusting rod. See "Jib Stop Max Up Actuator Rod Adjustment" on page 6-15.
12. Perform "Jib Stop Max Up Operational Check" on page 6-15



Limit Switch Wiring

Receptacle	Switch Terminals		Function
Black	13		Ground
Green	14		Maximum Angle
White	21		24 VDC Supply
Blue	14	22	Jumper

Item	Description
1	Jib Max Down Limit Switch
2	Boom Butt Plate
3	Cover
4	Switch Housing
5	Mounting Screws with Nuts and Washers
6	Actuator Rod
7	Slotted Spring Pin
8	Spring Washer
9	Spring
10	Spring Washer
11	Limit Switch
12	Over-travel
D1	257,9 mm (10.15 in)
D2	180,0 mm (7.09 in)

FIGURE 6-10

AUTOMATIC LUFFING JIB STOP – MAX DOWN

See Figure 6-10 for the following procedures.

WARNING

Falling Attachment Hazard!

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

Operating the luffing jib below the Luffing Jib Maximum Down 2 limit is neither intended nor approved. The jib can collapse.

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

Luffing Jib Maximum Down 1 (minimum working angle)—This programmed limit automatically stops the luffing jib and activates the fault in the main display when the boom-to-luffing jib angle is 70°.

- The luffing jib can be raised after this limit is reached.
- The limit bypass switch must be turned to the bypass position to lower the luffing jib an additional 1.5° to the Luffing Jib Maximum Down 2 limit.

Luffing Jib Maximum Down 2 (minimum angle limit)—This limit is controlled by the jib max down limit switch (1). It automatically stops the luffing jib and activates the fault in the main display when the boom-to-luffing jib angle reaches 68.5°.

- This limit cannot be bypassed.

Jib Stop Max Down Maintenance

At least once each week and each time the attachment is erected, make sure that the luffing jib stops at the specified max down angles.

Jib Stop Max Down Pre-Erection Checks

To ensure proper operation of the luffing jib stops, observe the following:

- The jib angles must be properly calibrated in the rated capacity limiter (RCL)/rated capacity indicator (RCI). See the RCL/RCI Operation Manual for instructions.
- The jib stop max down limit switch must be mounted a the specified dimension.

Jib Stop Max Down Actuator Rod Adjustment

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

1. Check the dimension (D1) from the edge of the boom butt plate (2) to the end of the actuator rod (6).
2. If necessary, adjust the limit switch housing (4) in its mounting slots to obtain the specified dimension.
3. Securely tighten the nuts on the mounting screws (5).

NOTE: Perform the remaining steps with the engine running and the required Luffing Jib Capacity Chart selected in the RCL/RCI display.

4. Depress the actuator rod to the activated dimension (D2) from the edge of the switch housing (4) to the end of the actuator rod (6) and hold. Listen for the limit switch to click open.
5. Turn the limit bypass key clockwise and hold.
6. Push the luffing jib handle forward.

NOTE: The luffing hoist must not turn downward and the Luffing Jib Maximum Down 2 fault must come on.

Jib Stop Max Down Operational Check

Make the following operational checks after raising the boom and jib:

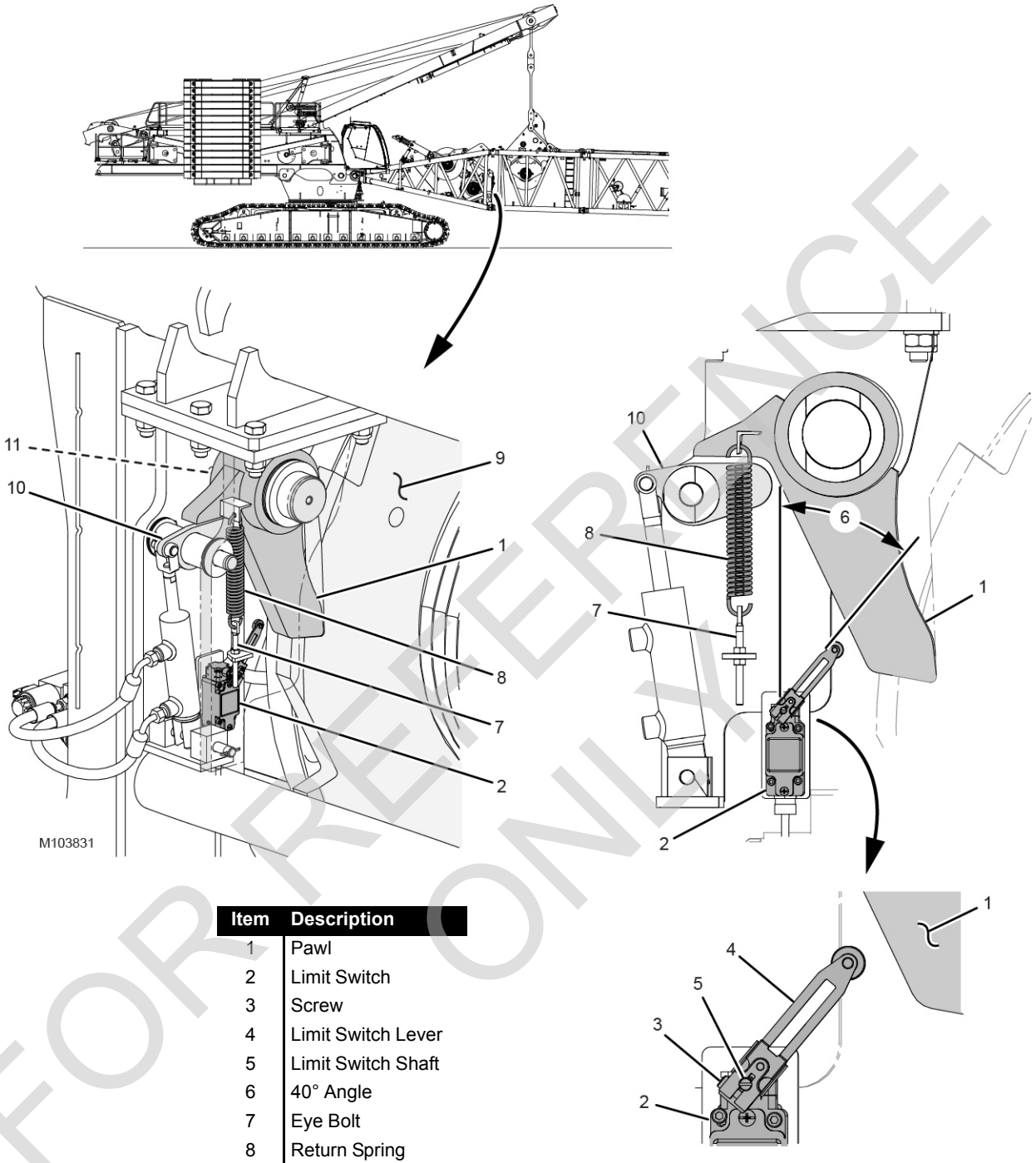
1. Travel the crane onto a firm, level surface or level the crane by blocking under the crawlers.
2. Raise the boom and luffing jib to the desired operating position.
3. Monitor the boom-to-luffing jib angle on the main display information screen while performing the remaining steps.
4. Slowly lower the luffing jib.
5. The luffing hoist must stop and be inoperable when the boom-to-luffing jib angle is 70°.
6. The fault alarm should come on, indicating that the Luffing Jib Maximum Down 1 angle has been reached.
7. Turn the limit bypass key switch clockwise to bypass the Luffing Jib Maximum Down 1 angle and continue to slowly lower the luffing jib.
8. The luffing hoist must stop and not turn downward when the boom-to-luffing jib angle is 68.5°.
9. The fault alarm should come on, indicating the Luffing Jib Maximum Down 2 angle has been reached.
10. Troubleshoot the system if the Luffing Jib Maximum Down limits do not operate properly.
11. Do not lower the luffing jib below 68.5°. ***Damage can occur.***

THIS PAGE INTENTIONALLY LEFT BLANK

Replacing Jib Stop Max Down Actuator Rod

See Figure 6-10 for the following procedure.

1. Disassemble the limit switch assembly (View A) and dispose of faulty parts.
2. Reassemble the limit switch assembly.
3. Position the actuator rod (6, View A) so the tapered end just touches the limit switch (11) roller. The actuator rod must not depress the limit switch shaft.
4. Drill a 6,35 mm (1/4 in) hole through the spring washer (8) and the actuator rod (6).
5. Install the slotted spring pin (7).
6. Push the actuator rod (6) in until the limit switch clicks open. Check that there is over-travel (12, View B) as shown.
7. Connect the electric wires to the limit switch as shown in View C.
8. Mount the switch housing (View A).
9. Adjust the adjusting rod. See "Jib Stop Max Down Actuator Rod Adjustment" on page 6-19.
10. Perform "Jib Stop Max Down Operational Check" on page 6-19.



Item	Description
1	Pawl
2	Limit Switch
3	Screw
4	Limit Switch Lever
5	Limit Switch Shaft
6	40° Angle
7	Eye Bolt
8	Return Spring
9	Ratchet
10	Cam
11	Grease Fitting

FIGURE 6-11

DRUM 6 PAWL LIMIT SWITCH

See Figure 6-11 for the following procedure:

The Drum 6 pawl limit switch must be properly adjusted to ensure proper operation of the hoist.

Operation

The pawl (1) is controlled by the park switch.

When the park switch is turned on to engage the drum pawl, the limit switch (2) opens the electric circuit to the crane's programmable controller. The cylinder rod extends, engaging the drum pawl. This action prevents the boom hoist from turning downward.

When the park switch is turned off to disengage the drum pawl, the limit switch closes the electric circuit to the programmable controller. The cylinder rod retracts, disengaging the drum pawl. This action allows the luffing hoist to turn upward.

When the control system is not powered, the drum pawl valve moves to the center position, and the pawl is engaged by spring force.

WARNING

Moving Parts Hazard!

Before performing the steps in this section, land the loads and lower the boom onto blocking at ground level. There are no positive means of holding the boom when the pawl is being serviced.

To make adjustments, the engine must be running, and the luffing hoist and the pawl must be operated.

Avoid injury from moving machinery. Stay clear of the luffing hoist drum and the pawl while either is being operated.

Maintain constant communication between the operator and the adjuster so that the drum and pawl are not operated while the adjuster is in contact with parts.

Check the luffing hoist pawl for proper adjustment each time the VPC-MAX and fixed mast are installed.

Adjustment

1. Loosen the screw (3) so that the limit switch lever (4) is free to rotate on the limit switch shaft (5).
2. Disengage the luffing hoist pawl by moving the Drum 6 park switch to the unparked position. It may be necessary to boom up slightly before the pawl disengages the ratchet.
3. Make sure the limit switch lever is at its maximum length.
4. Adjust the limit switch lever so it is 40° (6) from the centerline of the switch.
5. Securely tighten the screw.
6. Check for proper operation as follows:
   a. Engage the luffing hoist pawl by moving the Drum 6 park switch to the parked position and try to boom down. The luffing hoist should not be able to turn downward.
   b. Disengage the luffing hoist pawl by moving the Drum 6 park switch to the unparked position and try to boom down. The luffing hoist should be able to turn downward.
7. Readjust the limit switch if required.

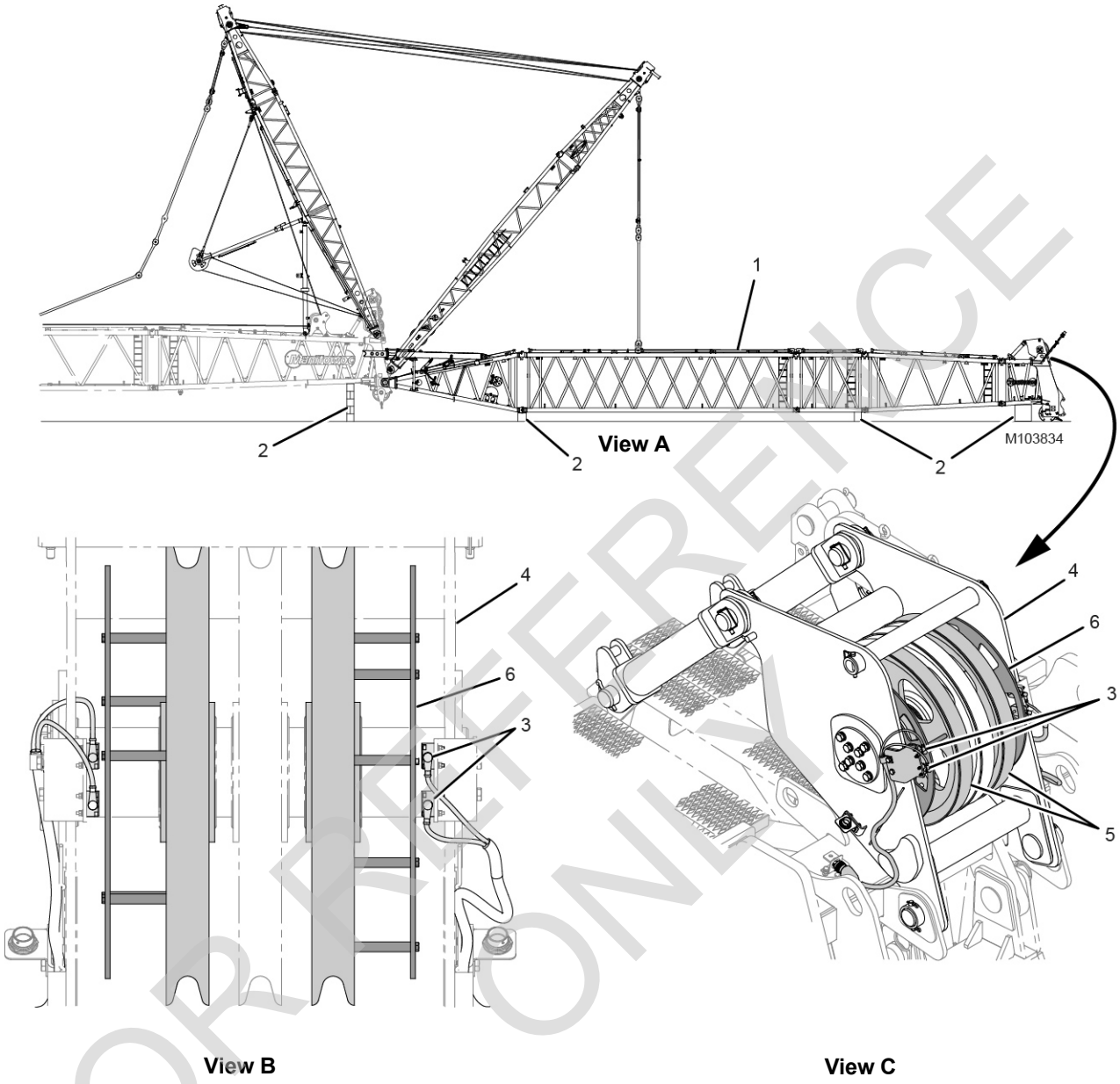
Adjusting the Return Spring

Adjust the eye bolt (7) so the return spring (8) has enough tension to fully engage and hold the pawl against the ratchet (9).

Maintenance

At the manufacturer's specified intervals, perform the following:

- Spray or brush an anti-seizing lubricant on the sliding surface between the cam (10) and the pawl.
- Grease the fitting (11) on the pawl. Use Mobilux™ EP 2 grease (MCC code number 471197) or an equivalent.



Item	Description
1	Luffing Jib
2	Blocking (qty varies)
3	Proximity Sensor (qty 4)
4	Boom Top
5	Sheave (qty 2)
6	Proximity Sensor Wheel (qty 2)

FIGURE 6-12

SHEAVE PROXIMITY SENSOR

Operation

Proximity sensors generate magnetic fields to sense metal objects. When no metal object is close to the sensor, the solid state switch within the sensor is open, and there is no output signal. When a metal object is close to the sensor, the switch within the sensor closes and outputs a signal that is 1.8 V_{DC} less than the sensor supply voltage. An illuminated yellow LED on the sensor shows that the output is energized, and an illuminated green LED shows that the sensor has power. The boom top sheave proximity sensors (3, View C) are located on both sides of the boom top (4, View C). By measuring the sheave (5) rotation during tandem drum operation, the boom top sheave proximity sensors keep the block level while raising and lowering the block.

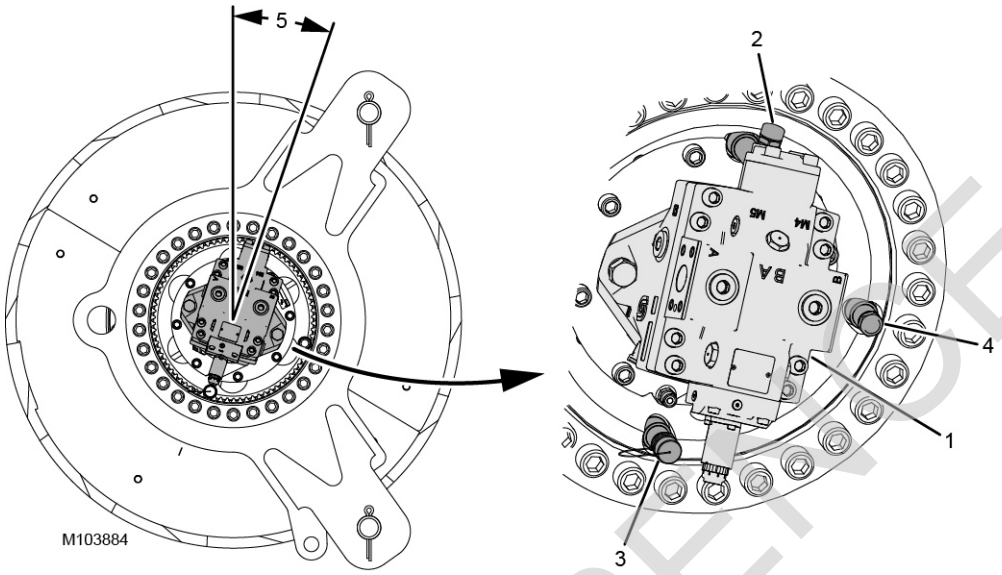
Maintenance

At least every week or every 40 hours of operation, inspect the boom top sheave proximity sensors for a loose or damaged sensor or cable.

1. Lower the boom and luffing jib (1) onto blocking (2) at ground level.
2. Lock out/tag out the crane.
3. Spin the sheave manually one complete turn. While spinning the sheave, verify that each sensors' yellow LED turns on and off the same number of times as the number of cutouts on the proximity sensor wheel (6, View C).

Adjustment

There is no adjustment for the sheave proximity sensor.



Item	Description
1	Drum 6 Gearbox
2	Fill Plug
3	Drain Plug
4	Sight Glass
5	18° Shipping Angle

FIGURE 6-13

DRUM 6 OIL CHANGE

General

The Drum 6 gearbox (1) is filled with gear oil and is not open to the inside of the drum. Only the gearbox itself contains oil.

Maintenance

Drain and refill the gearbox every 1,000 hours.

NOTE: It is better to change the oil when gearbox is warm, not hot.

See Figure 6-13 for the following procedure:

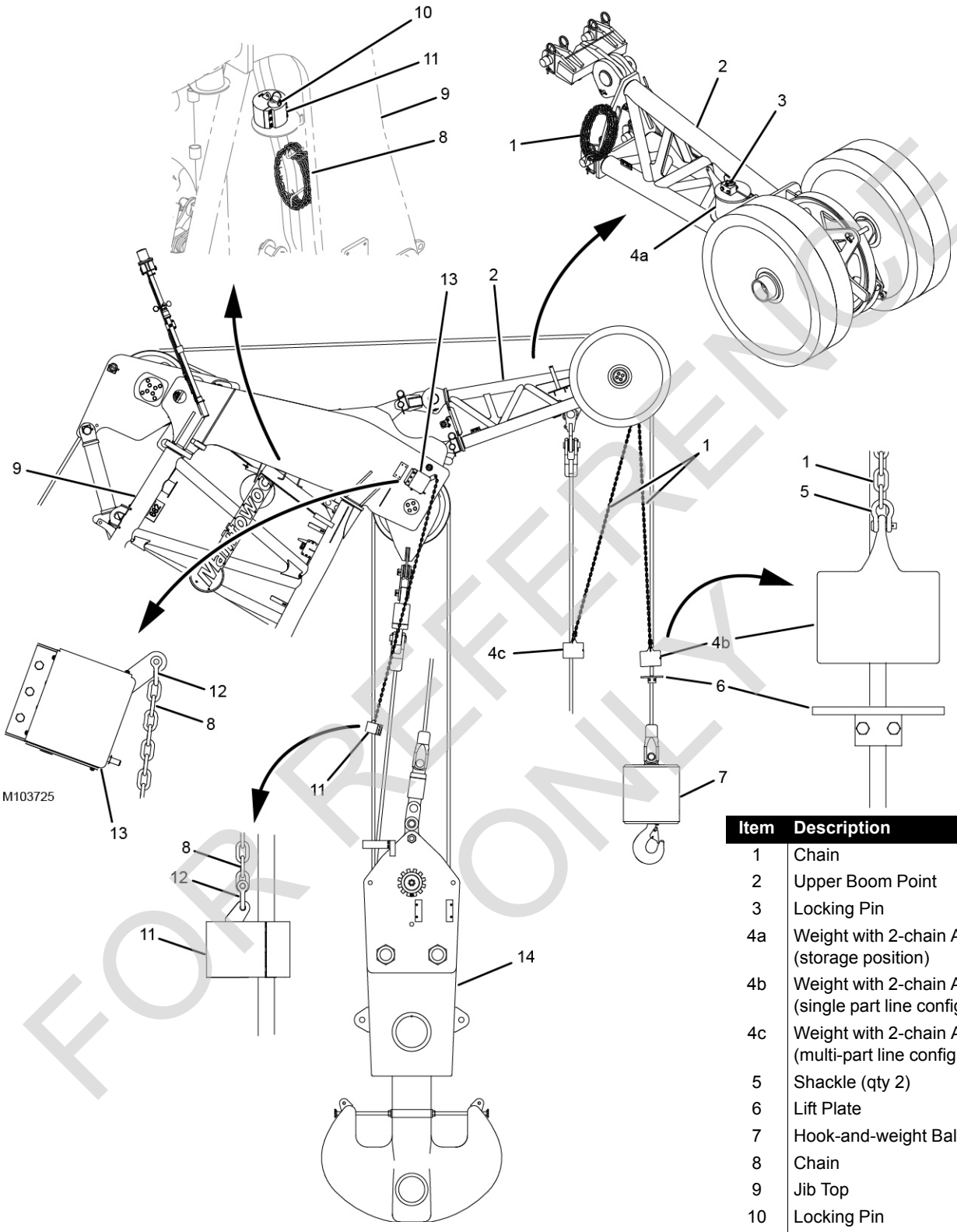
1. Position the crane in a level area.
2. Lower the boom to 0°.
3. Lock out/tag out the crane.
4. To prevent contaminants from entering the gearbox, clean the fill plug (2) and the area around the plug before removing the plug.
5. Remove the fill plug.

NOTE: With the fill plug removed, air enters the gearbox, allowing the oil to drain faster.

6. Place a suitable container under the drain plug (3).
7. Remove the drain plug and allow the oil to drain.
8. When the gearbox has finished draining, clean the drain plug and the area around the drain plug opening.
9. Reinstall the drain plug.
10. Refill the gearbox with Mobilube SHC™ 75W-90 or an equivalent until the oil level in the sight glass (4) is halfway up the glass. Do not overfill the gearbox!

NOTE: To obtain an accurate level reading, the drum needs to be in its shipping position, which is approximately equivalent to an 18° angle (5).

11. Reinstall the fill plug.
12. Recheck the level after operating the hoist.



Item	Description
1	Chain
2	Upper Boom Point
3	Locking Pin
4a	Weight with 2-chain Attachments (storage position)
4b	Weight with 2-chain Attachments (single part line configuration)
4c	Weight with 2-chain Attachments (multi-part line configuration)
5	Shackle (qty 2)
6	Lift Plate
7	Hook-and-weight Ball
8	Chain
9	Jib Top
10	Locking Pin
11	Weight with 1-chain Attachment
12	Shackle (qty 2)
13	Limit Switch
14	Load Block

FIGURE 6-14

INSTALLING AND ADJUSTING THE BLOCK-UP LIMIT

WARNING

Two-Blocking Hazard!

The block-up limit control is a protective device designed only to assist the operator in preventing a two-blocking condition. Any other use is neither intended nor approved.

The block-up limit control may not prevent two-blocking when a load is hoisted at the maximum single line speed. The operator shall determine the fastest line speed that allows block-up limit control to function properly and, thereafter, not exceed that line speed.

See Figure 6-14 for the following procedure:

General

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

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 the sheaves and/or wire rope, possibly causing the load to fall.

The block-up limit system consists of the following components:

- Jib top controller
- Normally closed limit switch assembly fastened at the locations shown
- Weight freely suspended by chain from each limit switch actuating lever (weight encircles load line as shown)
- Lift block fastened to the load line or lift plates fastened to the load block
- Cable reel in the jib butt (not shown), which allows the cable to be lengthened or shortened to meet varying jib lengths

To ensure proper operation of the components in the luffing jib point, the electrical cables must be connected properly.

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

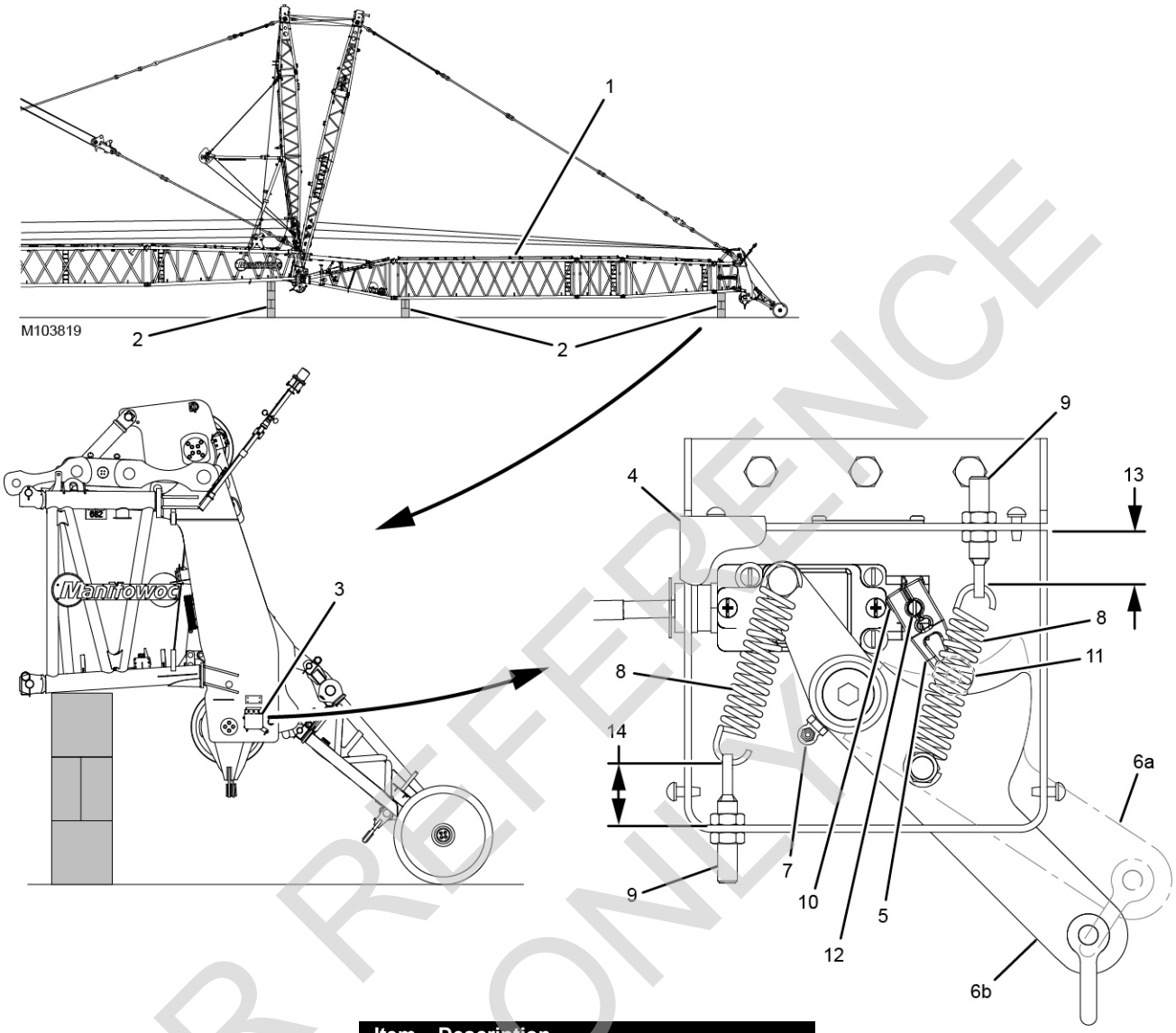
Removing the Luffing Jib

When removing the luffing jib, it is necessary to disconnect the electrical cables from the jib at the electrical cables in the boom top.

Make sure to do the following:

1. Thoroughly clean all cable connectors and dust caps.
2. Connect the dust caps to the cable connectors.
3. Connect the terminators to the cables on the boom top.

NOTE: Failing to connect the terminators will result in faulty operation. Also, the fault alarm will illuminate in the main display.



Item	Description
1	Luffing Jib
2	Blocking (qty varies)
3	Cover
4	Limit Switch Assembly
5	Limit Switch Lever
6a	Actuating Lever (closed position)
6b	Actuating Lever (open position)
7	Grease Fitting
8	Spring (qty 2)
9	Eye Bolt and Nut (qty 2)
10	Setscrew
11	Limit Switch Roller
12	Limit Switch Shaft
13	Distance—22,6 mm (0.89 in)
14	Distance—26 mm (1.023 in)

FIGURE 6-15

Block-Up Limit Switch Maintenance

CAUTION

Prevent Damage!

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

At least every week or every 40 hours of operation, inspect and test the block-up limit switches.

See Figure 6-15 for the following procedure:

1. Lower the boom and luffing jib (1) onto blocking (2) at ground level, remove the cover (3) from the limit switch assembly (4), and carefully inspect the following items:

NOTE: Lock out/tag out the crane.

   a. Inspect the limit switch lever (5) for freedom of movement.

   b. Move the actuating lever (6a) from the closed position to the actuating lever (6b) open position to check for freedom of movement. Apply one half-shot of grease to the fitting (7) on the actuating lever. Wipe away any excess grease.

   c. Inspect each weight for freedom of movement on the load lines (see Figure 6-14).

   d. Inspect each weight, chain, shackle, and connecting pin for excessive or abnormal wear (see Figure 6-14). Make sure the cotter pins for the shackles are installed and spread.

   e. Inspect the entire length of the electrical cables for damage.

   f. Make sure the electrical cables are clear of all moving parts on the boom and the luffing jib and that the cables are securely fastened to the boom and jib with clips or nylon straps.

   g. Check that all electrical cables, shorting plugs, and terminating plugs are securely fastened.

2. Test the block-up limit controls for proper operation using either of the following methods:

   a. BOOM AND LUFFING JIB LOWERED

      Manually lift each weight—one at a time—while the engine is running. The load drum should not be able to operate upward, and the boom and luffing hoists should not be able to operate downward.

CAUTION

Avoid Sheave Damage!

Use extreme care when testing the block-up limit controls when the boom and jib are raised.

If block-up limit control fails to stop the load, immediately stop the load by moving the drum control handle to OFF or by applying the drum working brake. Otherwise, two-blocking may occur.

   b. BOOM AND LUFFING JIB RAISED

      Slowly hoist each load block and weight ball — one at a time — against the corresponding weight. When the chain goes slack, the corresponding load drum should stop hoisting and the boom and luffing hoists should not be able to operate downward.

Adjusting the Block-up Limit Switch

See Figure 6-15 for the following procedure:

1. Lower the boom and luffing jib (1) onto blocking (2) at ground level.
2. Lock out/tag out the crane.

NOTE: Adjust all the limit switches.

3. Remove the cover (3) from the limit switch assembly (4).
4. Adjust the tension of both springs (8) with the eye-bolts and nuts (9) to the correct distance (13 and 14) as shown.

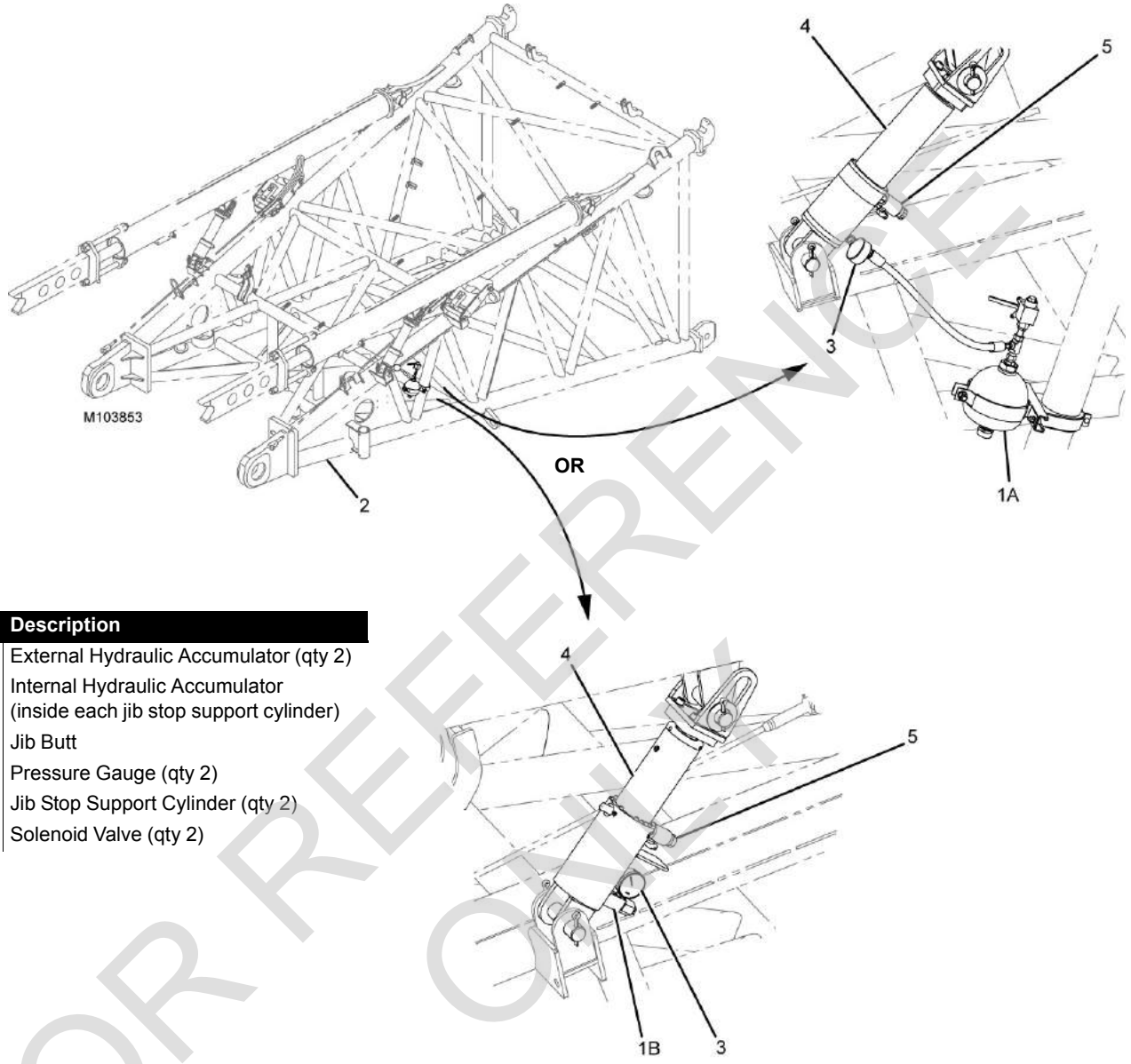
NOTE: There should be enough force to lift the chain and rotate the actuating lever (6b) from the open position to the actuating lever (6a) closed position when the weight is lifted. If the spring tension is found to be insufficient, replace the springs.

5. Loosen the setscrew (10) on the limit switch lever (5) so the limit switch lever is free to rotate.
6. Manually lift the weight to allow the actuating lever to rotate up to the closed position.
7. Move the actuating lever to the open position.
8. Hold the limit switch roller (11) against the actuating lever while performing the following.

   a. Turn the limit switch shaft (12) only enough to “click” the limit switch open. Then securely tighten the setscrew in the limit switch lever.

   b. Pull the actuating lever downward past the trip position. Then slowly raise the actuating lever while listening for the switch to trip.

   c. Repeat step 5 through step 8 until the limit switch operates properly.



Item	Description
1A	External Hydraulic Accumulator (qty 2)
1B	Internal Hydraulic Accumulator (inside each jib stop support cylinder)
2	Jib Butt
3	Pressure Gauge (qty 2)
4	Jib Stop Support Cylinder (qty 2)
5	Solenoid Valve (qty 2)

FIGURE 6-16

JIB STOP ACCUMULATOR MAINTENANCE

See Figure 6-16 for the following procedure:

Operation

The hydraulic accumulators (1A or 1B) store energy (in the form of nitrogen gas) for raising and lowering the physical jib stops.

Maintenance

WARNING

High Pressure Oil Hazard!

The accumulator and hydraulic hose are under high pressure. Use caution when working around the accumulator and hydraulic hose. If a leak is detected, use a piece of cardboard in the area to locate the leak. Do not use bare hands to check for leaks. Fluid under high pressure can penetrate the skin, requiring medical attention.

NOTE: Take corrective action if any of the following defects are found.

- ☐ Check the external accumulator hydraulic hose for cracks or wear.
- ☐ Check the accumulator (1A or 1B) for any oil leaks.
- ☐ Check the hydraulic pressure gauges (3) for any cracks or leaks.
- ☐ Check the hydraulic pressure gauges for the correct pressure. Pressures must be checked with the cylinders fully extended. See Table 6-1 or Table 6-2.

Table 6-1. External Accumulator (1A) Pressure

265 psi @ 30°F	18.3 Bar @ -1°C
271 psi @ 40°F	18.7 Bar @ 4°C
278 psi @ 50°F	19.2 Bar @ 10°C
284 psi @ 60°F	19.6 Bar @ 16°C
290 psi @ 70°F	20.0 Bar @ 21°C
297 psi @ 80°F	20.5 Bar @ 27°C
304 psi @ 90°F	21.0 Bar @ 32°C
311 psi @ 100°F	21.4 Bar @ 38°C

Table 6-2. Internal Hydraulic Accumulator (1B) Pressure

234 psi @ 30°F	16.0 Bar @ -1°C
239 psi @ 40°F	16.5 Bar @ 4°C
244 psi @ 50°F	16.8 Bar @ 10°C
250 psi @ 60°F	17.2 Bar @ 16°C
255 psi @ 70°F	17.6 Bar @ 21°C
260 psi @ 80°F	18.0 Bar @ 27°C
266 psi @ 90°F	18.3 Bar @ 32°C
271 psi @ 100°F	18.7 Bar @ 38°C

THIS PAGE INTENTIONALLY LEFT BLANK

ALPHABETICAL INDEX