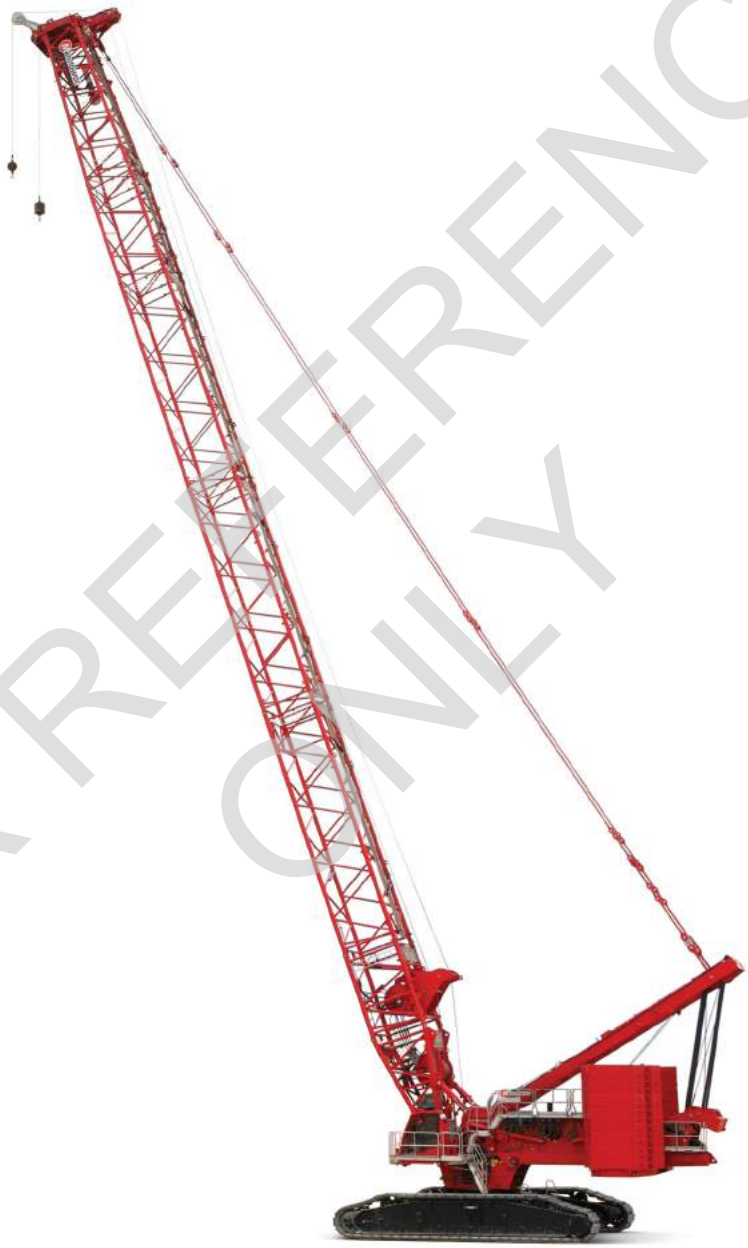
Manitowoc MLC650

VPC-MAX™

Operator Manual



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 VPC-MAX™

Crane Model Number

XXXXXREF

Crane Serial Number

This Manual is divided into the following sections:

NOTICE

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

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

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

⚠ WARNING

To prevent death or serious injury:

- Avoid unsafe operation and maintenance.

  Crane and attachments must be operated and maintained by trained and experienced personnel. Manitowoc is not responsible for qualifying these personnel.
- Do not operate or work on crane or attachments without first reading and understanding instructions contained in Operator Information Manual and Service Manual supplied with crane and applicable attachments.
- Store Operator Information Manual and Service Manual in operator's cab.

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

Published 12-16-20, Control # 231-15

THE ORIGINAL LANGUAGE OF THIS PUBLICATION IS ENGLISH

See end of this manual for Alphabetical Index

SECTION 1
INTRODUCTION

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

Published 12-16-20, Control # 231-15

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/ATTACHMENT IDENTIFICATION

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

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

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

CRANE ORIENTATION

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

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

OUTLINE DIMENSIONS

See Outline Dimension Drawing at the end of this section.

WEIGHTS OF COMPONENTS

See Crane Weights publication at the end of this section.

IDENTIFICATION OF VPC-MAX COMPONENTS

See Figure 1-2 for identification of the VPC-MAX components. See Section 1 in the MLC650 Crane Operator Manual for identification of the crane components.

FIGURE 1-1

Item	Description
1	Fixed Mast
2	Mast Straps
3	Counterweight Straps
4	Live Mast
5	Auxiliary Frame Assembly
6	Counterweight Beam
7	Counterweight Boxes
8	Counterweight Tray with Integral Drives
9	Actuator with Integral Drives
10	Boom
11	Mast Hoist (Drum 4)
12	Boom Hoist (Drum 5)
13	Whip Hoist (Drum 3)
14	Luffing Hoist (Drum 6)
15	Auxiliary (Drum 2)
16	Main Hoist (Drum 1)
17	Rigging Winch

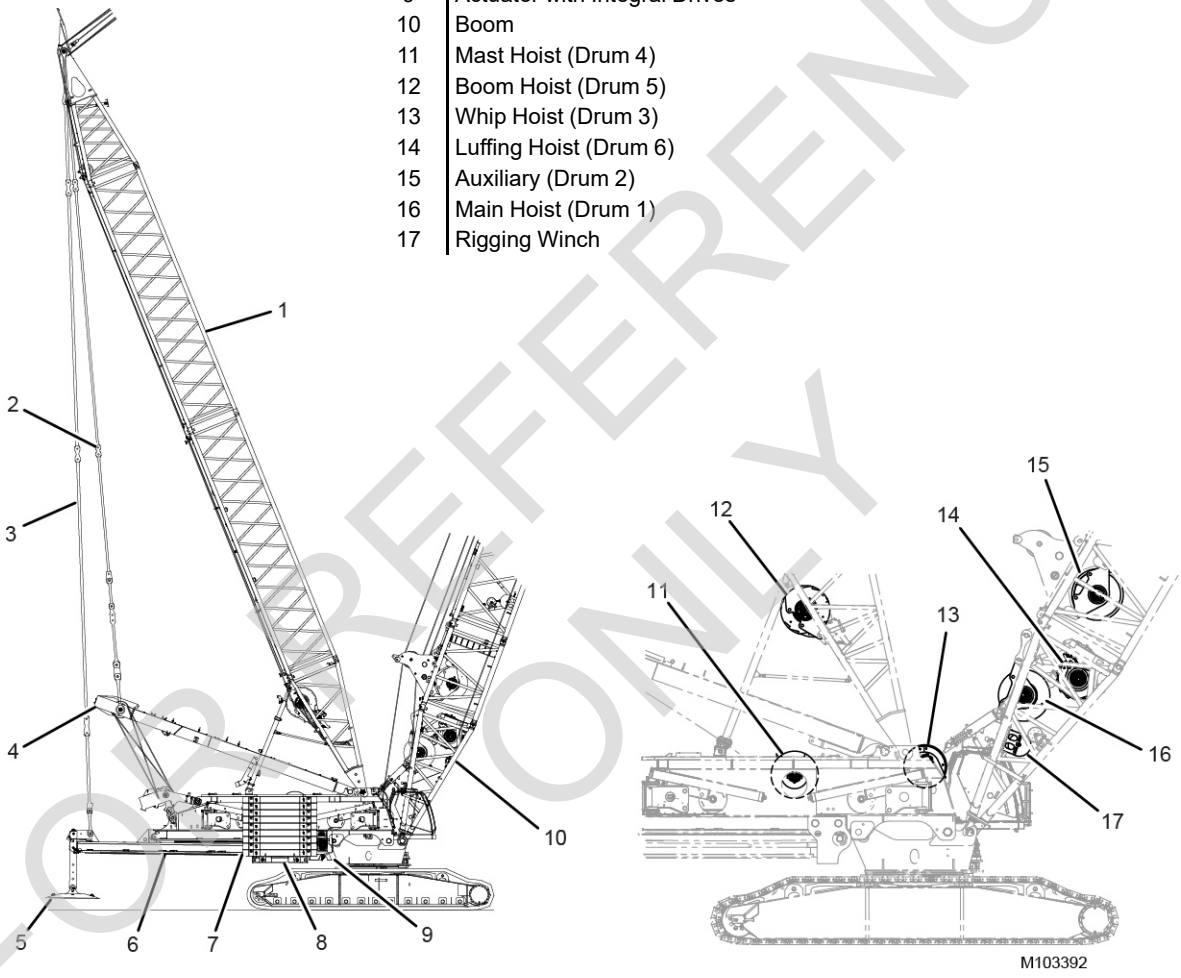


FIGURE 1-2

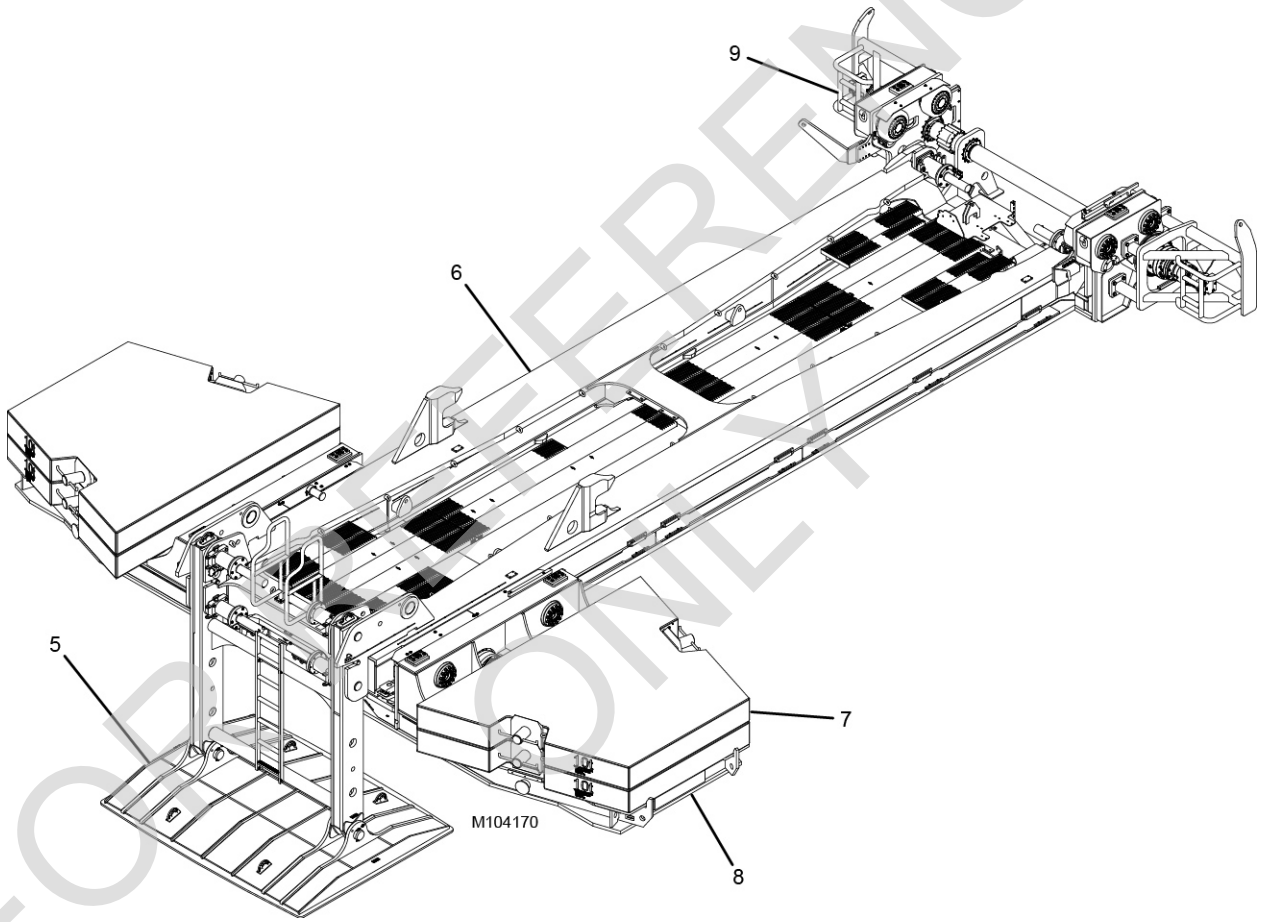


FIGURE 1-2 continued

ENGLISH AND METRIC CONVERSIONS

Direct Conversion

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

12 ft x 0.3048 = 3,6576 m

Inverse Conversion

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

3,6576 m ÷ 0.3048 = 12

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

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

CHANGE OF OWNERSHIP REGISTRATION

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.manitowoc.com***
2. Go to SUPPORT>SERVICES>CHANGE OF OWNERSHIP.
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.manitowoc.com***
2. Click on the red FIND A DEALER button.
3. Follow the on-screen prompts to locate your Manitowoc dealer.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 2
SAFETY INFORMATION

TABLE OF CONTENTS

Published 12-16-20, Control # 231-15

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

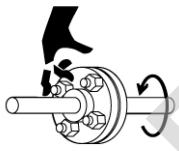
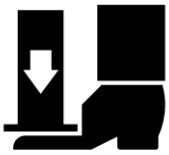
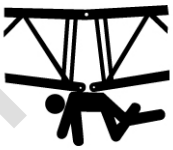
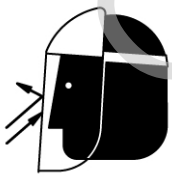
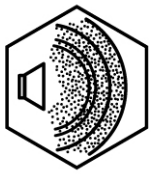
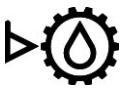
Cut or Crush Hazards					Cut Hazard
 M100090	 M100091	 M100066	 M100065	 M100069	 M100067
Crush Hazards					Fire Extinguisher
 M100070	 M100071	 M100072	 M100073	 M100074	 M100082
Fall Hazards			Falling Boom (Crush) Hazards		Explosion Hazard
 M100083	 M100084	 M100085	 M100068	 M100075	 M100080
Falling 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	Auxiliary Frame Pad (non-skid)
11	Ladder (beam access)
12	VPC-MAX Beam Catwalk
13	VPC-MAX Beam (non-skid)
14	Catwalk (each boom section)
15	Ladder (each boom section)

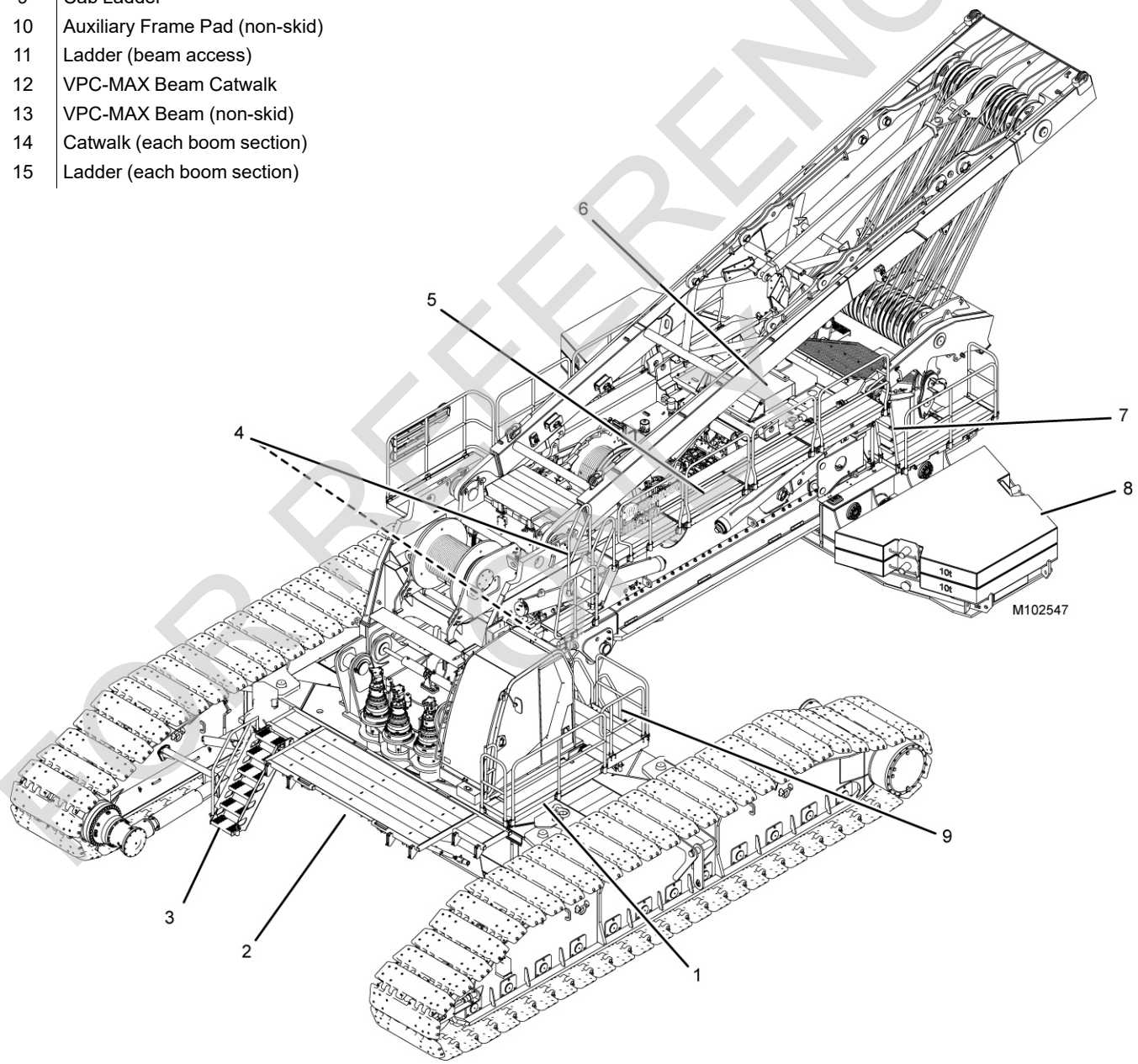


Figure 2-1. Crane Access Points

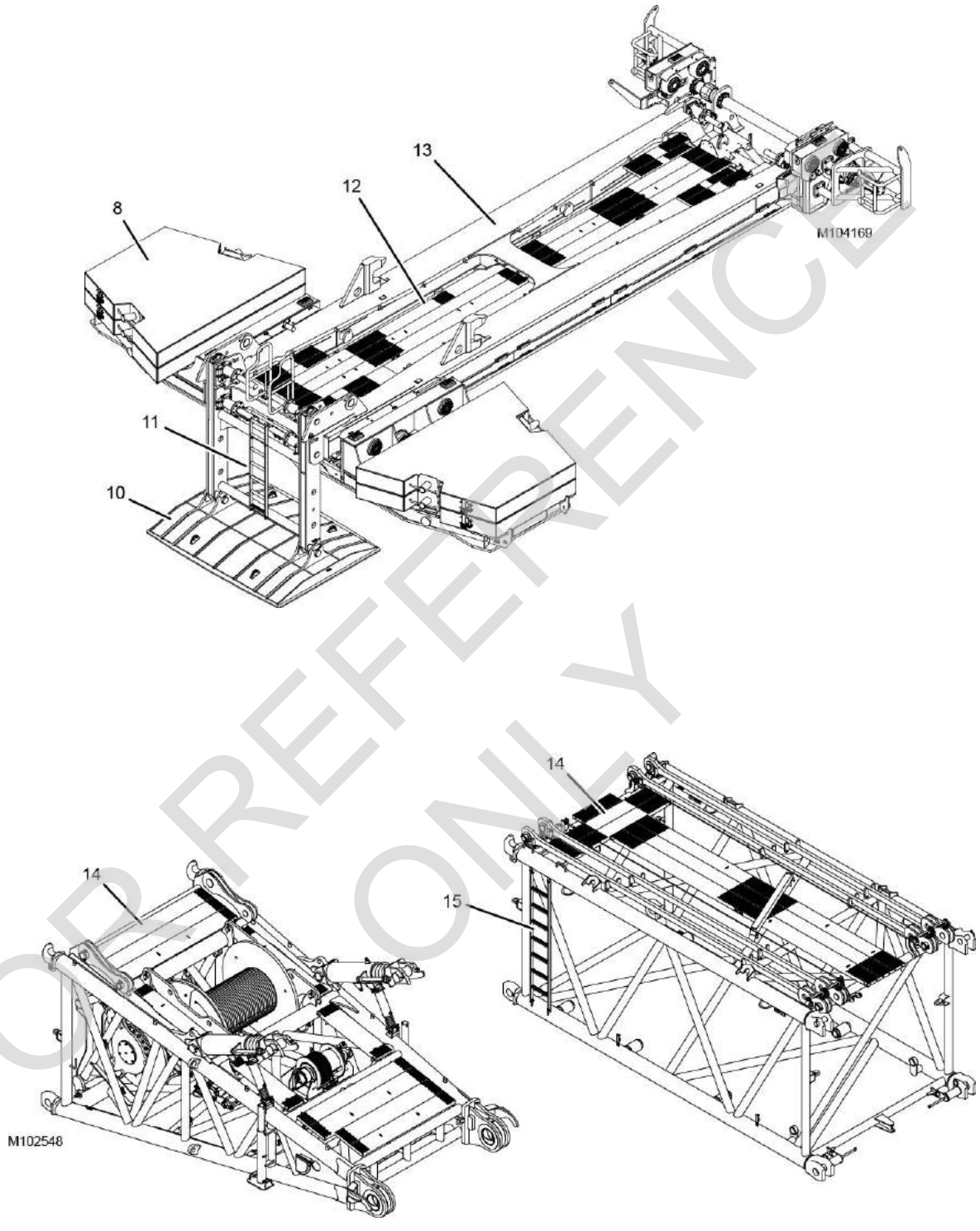


Figure 2-1 continued

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

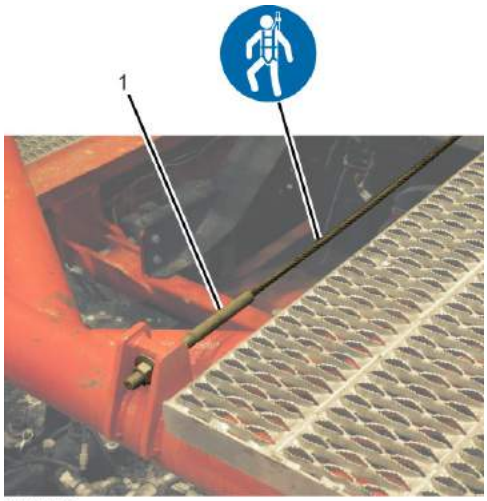
Personnel getting on and off the crane shall do so only at the ladders provided and only ***while the crane is parked***.

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.***

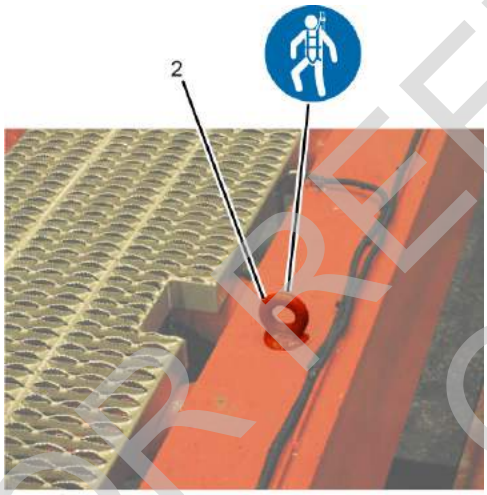
When personnel use ladders to get on or off the crane, their hands shall be free of any objects. Objects which cannot be carried in pockets or tool belts must be lifted into place with a hand line or hoist.

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



M101966



M101967

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.

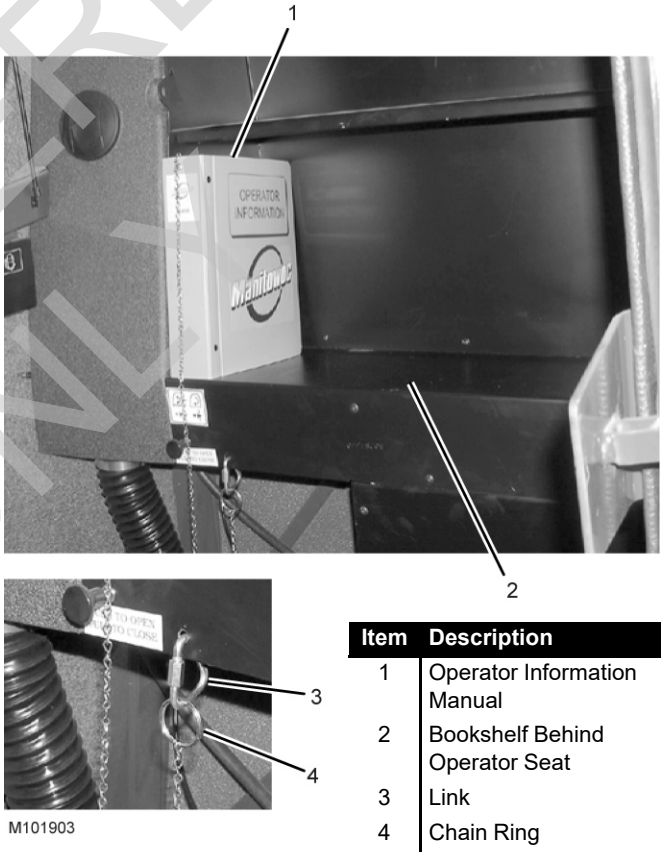
Do not operate crane or attachment if proper Capacity Chart is not in cab.

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:

1. Designated operators
2. Trainees under direct supervision of a designated operator
3. Supervisors, inspectors, and maintenance or test personnel when necessary in performance of their duties. Operation of the crane by these personnel 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 the crane Operator Manual.

7. The operator shall test all controls, limits, and communication systems at the start of each shift. Any defects found must be corrected before operation is begun.
8. The operator shall not start crane movement if the load or designated signal person is not within his/her range of vision or communication.
9. The operator shall understand and respond to signals from the person directing the lift or from the designated signal person. When a signal person or crane follower is not required, the operator is responsible for the lift. ***Operator shall obey a stop signal at all times, no matter who gives it***.
10. The operator shall verify that the Capacity Chart being used is the correct one for the cranes configuration (boom length, load line reeving, counterweight, etc.).
11. The operator shall verify that:
    a. All attachments are properly assembled and attached to the crane according to the rigging drawings called for in the Capacity Chart.
    b. The counterweight — to include applicable auxiliary counterweight — is in place and of proper weight. ***Maximum required counterweight must not be exceeded***.

WARNING

Moving Load/Tipping Crane Hazard!

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

12. The operator shall perform the following operations before leaving the operator'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:

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

SIGNALS

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

SAFETY DEVICES

WARNING

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

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

Manitowoc provides the following safety devices on its cranes.

1. Horn activated by a switch on the control console in the operator'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. Use one or more of the following methods:

   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. Use one or more of the following methods:

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

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

Set-Up and Operation

1. During crane use, assume that every line is energized ("hot" or "live") and take necessary precautions.
2. Position the crane such that the load, boom, or any part of the crane and its attachments cannot be moved to within 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 de-energized 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 to know and understand are:
   - Proximity devices are advertised to detect the existence of electricity and not its distance, quantity, or magnitude.
   - Some proximity devices may detect only alternating current (AC) and not direct current (DC).
   - Some proximity devices detect radio frequency (RF) energy and others do not.
   - Most proximity devices simply provide a signal (audible, visual, or both) for the operator and this signal must not be ignored.
   - Sometimes the sensing portion of the proximity devices becomes confused by complex or differing arrays of power lines and power sources.
8. DO NOT depend on grounding. Grounding of a crane affords little or no protection from electrical hazards. The effectiveness of grounding is limited by the size of the (wire) conductor used, the condition of the ground, the magnitude of the voltage and current present, and numerous other factors.

Electrical Contact

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

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

REFUELING

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

FIRE EXTINGUISHERS

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

ACCIDENTS

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

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

Phone: 920-684-6621

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

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

SAFE MAINTENANCE

WARNING

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

Safety information in this publication is intended only as a guide to assist qualified maintenance personnel in safe maintenance. Manitowoc cannot foresee all hazards that will arise in field, therefore ***safety remains the 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/Maintenance 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 inflator, and an extension hose which permits standing well away from the tire.

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

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

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

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

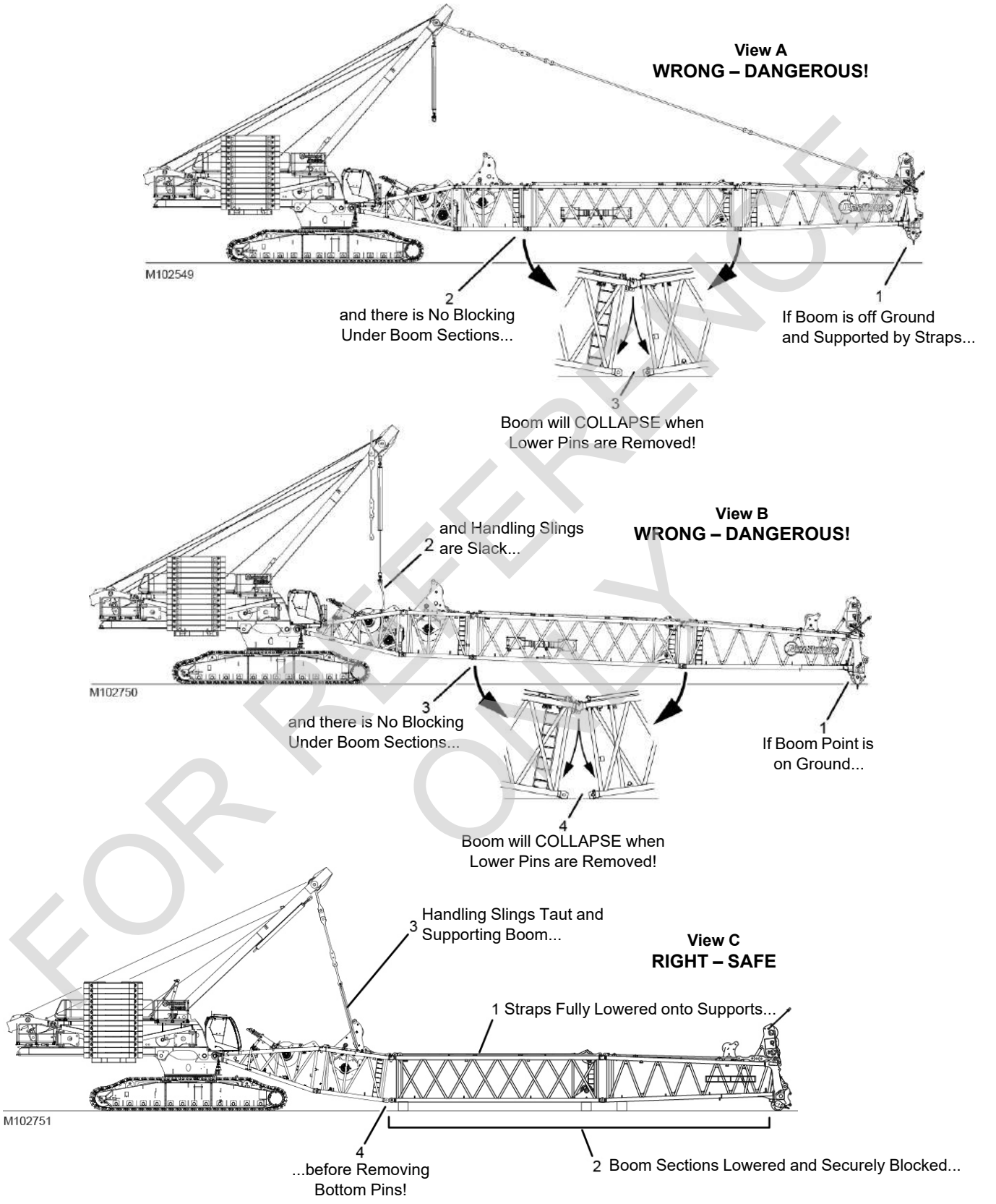


Figure 2-4. Boom Disassembly

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.

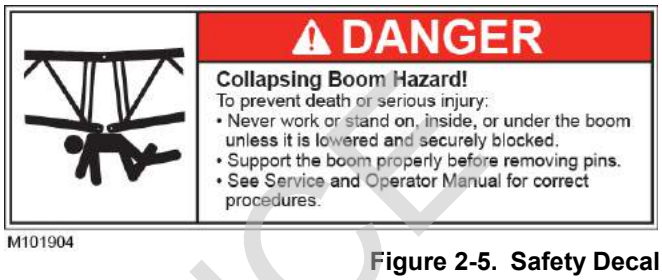


Figure 2-5. Safety Decal

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

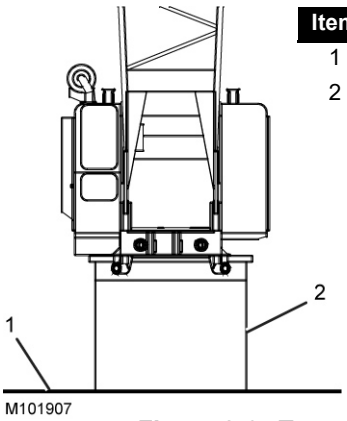
Also see ASME publication B30.8-2004, Floating Cranes and Derricks.

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).

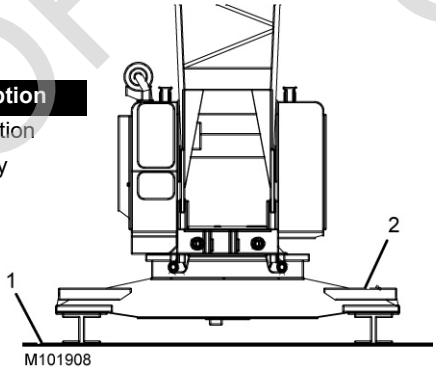


Item	Description
1	Foundation
2	Turret

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

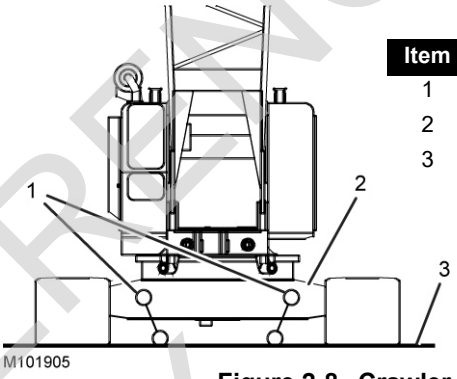
Definition

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).

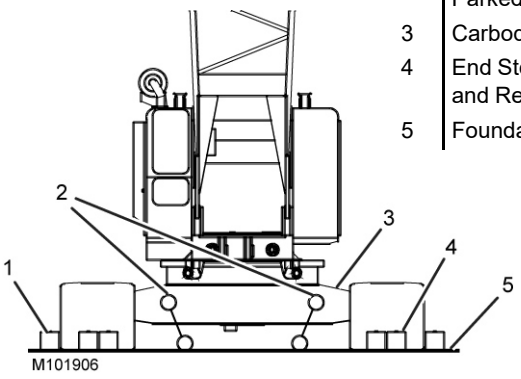


Item	Description
1	Tie-Downs
2	Carbody
3	Foundation

Figure 2-8. Crawler-Mounted Crane

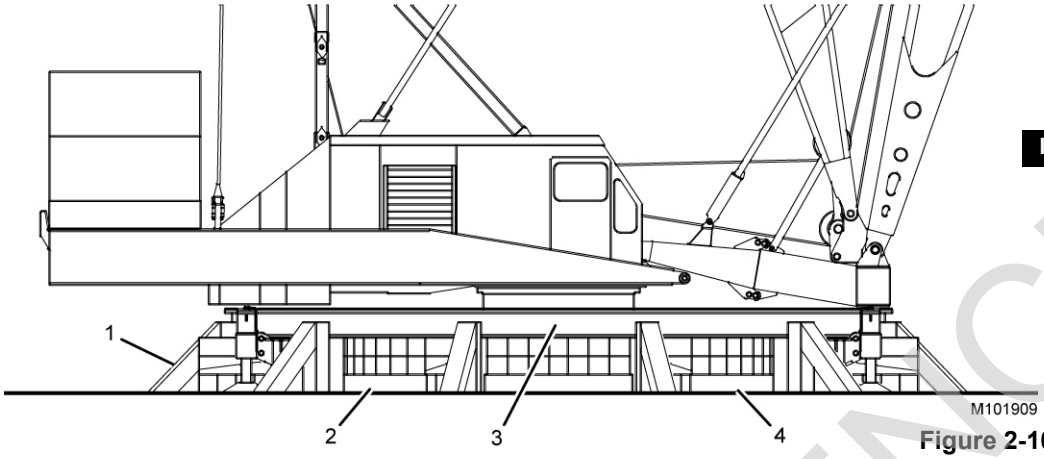
2. Crawler-mounted crane working on a timbered area of the barge, ship, or floating platform with the crawlers restrained by curbing and end stops (Figure 2-9). When not working, the crane carbody is anchored with tie-downs to the foundation. ***Traveling with load is not permitted***.

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



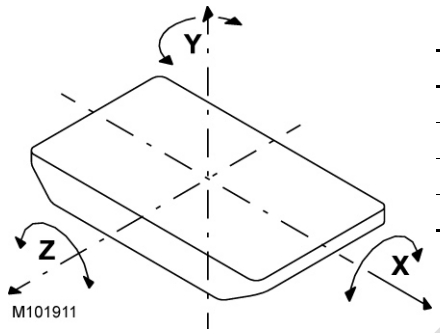
Item	Description
1	Curbing
2	Tie-Downs Required when Parked
3	Carbody
4	End Stop Front and Rear
5	Foundation

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

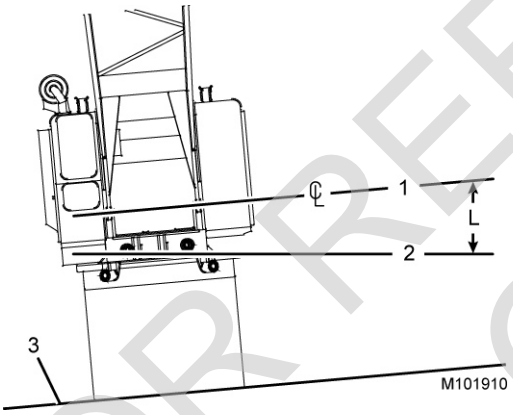
Tipping Crane Hazard!

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 the correct 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 12-16-20, Control # 231-15

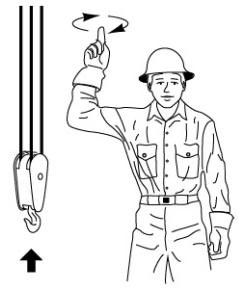
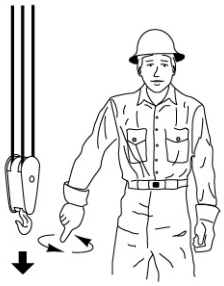
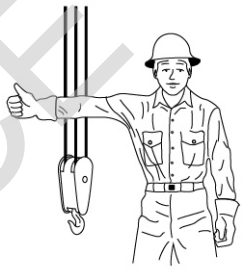
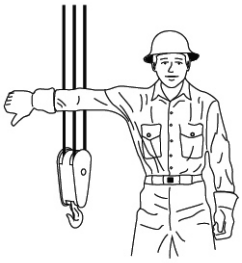
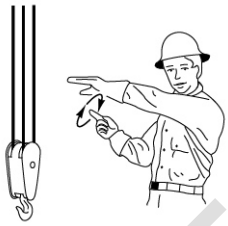
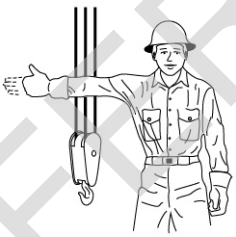
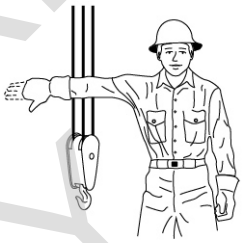
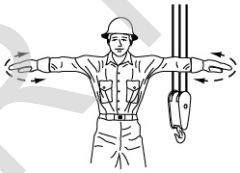
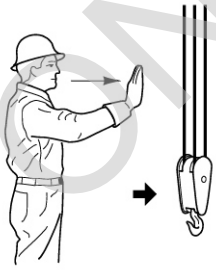
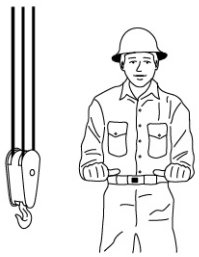
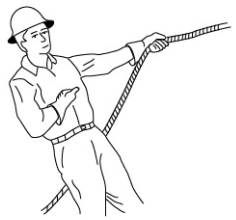
SECTION 3
OPERATING CONTROLS AND PROCEDURES

THIS SECTION STARTS ON THE NEXT PAGE

STANDARD HAND SIGNALS FOR CONTROLLING CRANE OPERATIONS

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

Table 3-1 Standard Hand Signals for Controlling Crane Operations

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

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

OPERATING CONTROLS AND PROCEDURES

See Section 3 of the MLC650 crane Operator Manual.

OPERATING PRECAUTIONS

WARNING

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

- Read and comply with the instructions in the Crane Operator Manual and in the VPC-MAX Capacity Charts before operating crane. Do not operate beyond limits given.
- If equipped with a luffing jib, also read the instructions in the Luffing Jib Operator Manual and in the Luffing Jib Capacity Charts. Do not operate beyond limits given.
- Make sure the proper counterweight is installed.
- Read and become thoroughly familiar with the instructions in the Main Display Operation Manual.
- Read and become thoroughly familiar with the instructions in the RCL/RCI Operation Manual.
- Make sure the RCL/RCI is properly configured as instructed under the topic Entering Boom Configuration in the RCL/RCI Operation Manual.
- Read and comply with the instructions in the VPC-MAX Maximum Allowable Travel Specifications Chart. The chart contains counterweight requirements for travel and swing without load.
- Make sure load sensing pins are operating properly. Otherwise, the counterweight assembly will not extend and retract automatically when required.
- Make sure the VPC-MAX limit switches are adjusted and operating properly. Otherwise, the counterweight assembly will not extend and retract automatically when required.
- Adhere to the boom raising and lowering limitations given in the Capacity Charts. Block the crawlers if specified and make sure the proper counterweight position column of the capacity chart is selected before raising or lowering the boom.
- 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.
- The counterweight assembly will remain in its last position when the engine is turned off during operation.
- Operate only with the crane on a firm surface that is uniformly supporting:
  - ***With load***, grade must not exceed 1% in any direction — 1 ft in 100 ft (0,3 m in 30 m).
  - ***Without load***, see Maximum Allowable Travel Specifications Chart.
  - During crane operation, the elevation outside of the crawlers may be up to 152 mm (6 in) above the grade of the crawlers to 610 mm (24 in) below the grade of the crawlers. Also, the grade outside of the crawlers shall not exceed 5% in any direction.

    These conditions apply to any area the auxiliary frame assembly will pass over.
- Prior to using the crane each day, verify that the active fixed mast stop manual overrides (1A, Figure 3-1) are in the WORKING position (1A).

WARNING

For the Active Fixed Mast Stops, the solenoid valve manual overrides (1A) must be in the WORKING position (1B) at all times — both when operating and when servicing the valve or cylinder.

The shifted position (1C) is for Manitowoc use only.

Before servicing either mast stop, make sure the manual override is in the working position and stop the engine. Otherwise, trapped pressure in the cylinder will cause uncontrolled movement of the cylinder.

- Prior to using the crane each day, inspect the VPC and VPC-MAX roller paths on the rotating bed and beam for obvious obstructions and/or signs of damage. Remove the obstructions. Contact the Manitowoc Crane Care Lattice Team for inspection and repair criteria.
- Do not operate the crane, to include raising the boom from ground level, if the wind exceeds the limits given in Capacity Charts. Monitor the wind speed in the working screen of the crane's RCL/RCI Display or contact your local weather station. See Wind Conditions in the Capacity Chart Manual.

- Be aware of increased tail swing with the VPC-MAX counterweight assembly. The counterweight assembly can strike objects or personnel in the area of the travel and swing paths.
- Warn all personnel to stand well clear of the crane. The VPC-MAX counterweight assembly extends and retracts automatically without warning — it can strike personnel.

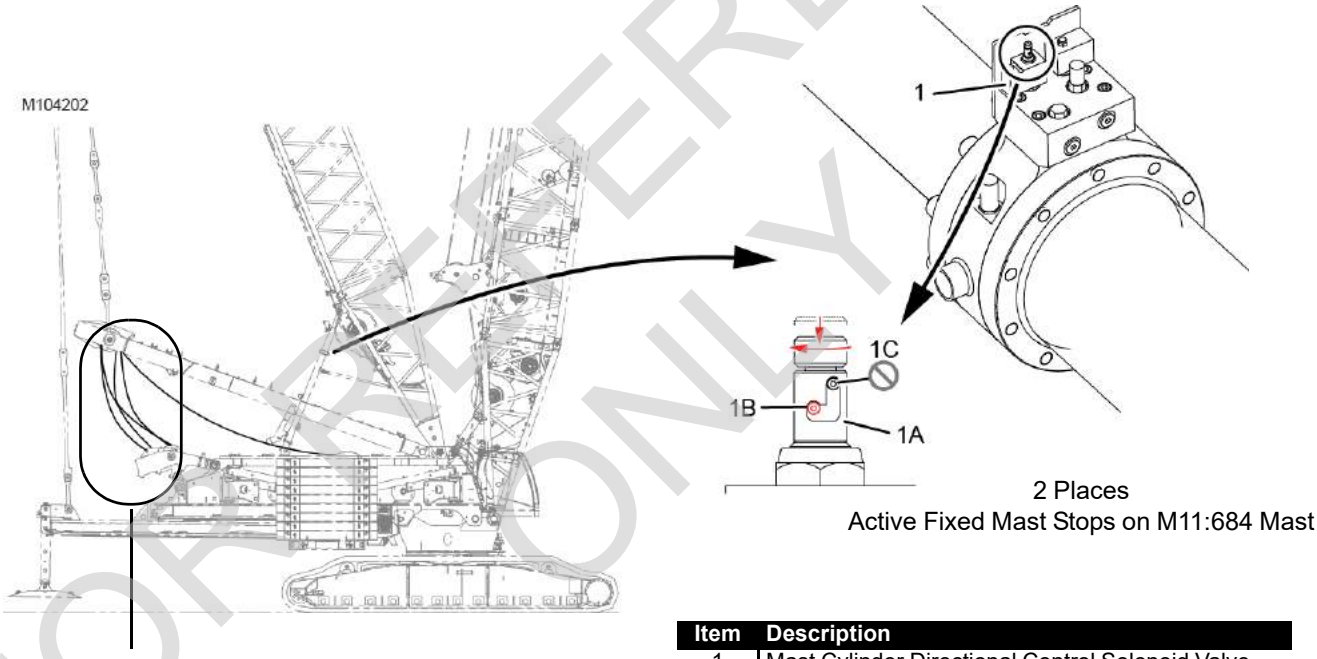
  Anytime the VPC-MAX counterweight assembly moves, an audible alarm will sound and the amber lights on the counterweight tray and beam will flash to warn personnel to stay clear.
- Provide a signal person for all crane operations.

  Have signal person watch for clearance behind and under the counterweight assembly while swinging and traveling. Do not allow the counterweight to strike obstructions or contact the foundation.

  Depending on lifted load, clearance under the auxiliary frame assembly will vary from 254 mm (10 in) to 1,5 m (5 ft).
- During operation, it is normal for the live mast wire rope reeving to become slack (Figure 3-1) when the counterweight tray is at the minimum working position. This most commonly occurs when operating at high boom angles with light loads.

  When this condition occurs, the VPC-MAX beam will be supported by the beam hooks resting on the rotating bed pins.
- When the crane is left unattended, park it as instructed in Section 3 of Crane Operator Manual. If the boom cannot be lowered to the ground, position it at the mid-point of the boom angle range given in the Capacity Chart.

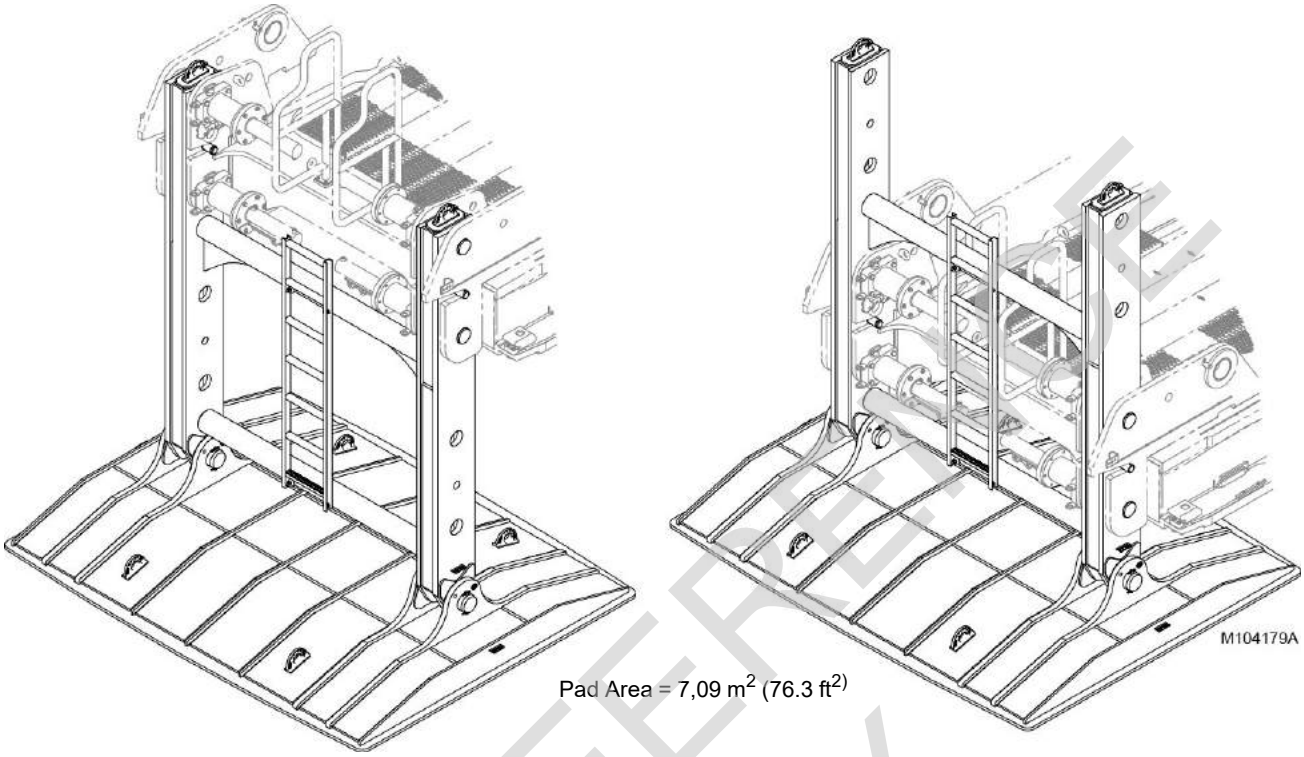
3



Item	Description
1	Mast Cylinder Directional Control Solenoid Valve
1A	Manual Override
1B	Indicator in WORKING Position
1C	Indicator in Shifted Position — DO NOT USE

FIGURE 3-1

Auxiliary Frame Assembly



Pad Area = 7,09 m^2 (76.3 $ft^{2)}$

View A
WORKING Position

View B
RAISED Position

FIGURE 3-2

AUXILIARY FRAME ASSEMBLY

WARNING

Death or Serious Injury Hazard!

A sudden release of load and/or dynamic loading (due to swinging, hoisting, or lowering and adverse weather conditions to include wind) may cause structural damage which could result in death or serious injury due to shock loading and unintended motion of the crane.

The auxiliary frame assembly is provided to limit unintended motion of the VPC-MAX beam and counterweights during a sudden release of load and/or dynamic loading (due to swinging, hoisting, or lowering and adverse weather conditions to include wind).

The auxiliary frame assembly in no way substitutes for, or lessens, the requirement that the crane must be operated properly and safely, and that it must be inspected, serviced, and maintained regularly to minimize the potential for a sudden release of load and/or dynamic loading (due to swinging, hoisting, or lowering and adverse weather conditions to include wind).

The auxiliary frame assembly (Figure 3-2) has two operating positions:

WORKING Position (View A):

This is the recommended operating position.

RAISED Position (View B):

This position can be used if additional clearance is required for swinging over job site obstacles.

Lower the auxiliary frame assembly after the obstacle is cleared. Continued operation with the auxiliary frame assembly raised is not recommended.

To change the operating position, see Auxiliary Frame Operating Positions in Section 4 of this manual.

SECTION 4
SET-UP AND INSTALLATION

TABLE OF CONTENTS

Published 12-16-20, Control # 231-15

THIS PAGE INTENTIONALLY LEFT BLANK

Published 12-16-20, Control # 231-15

SECTION 4
SET-UP AND INSTALLATION

BOOM AND JIB ASSEMBLY DRAWINGS

Boom and jib assembly drawings that apply to your crane are at the end of this section.

LIFTCRANE MAST HANDLING CAPACITIES

Lifting capacities for the live mast are located at the end of this section and in the Capacity Chart Manual for this crane.

OPTIONAL ATTACHMENTS

If applicable, instructions for optional attachments (such as luffing jib) are provided in separate serialized Operator Manuals.

GENERAL SAFETY

To prevent accidents that can result in death or injury during crane assembly and disassembly, comply with the following general safety information and with specific safety information contained in assembly and disassembly steps.

WARNING

Death or Serious Injury Hazard!

Read and understand setup and installation instructions in this section before attempting to assemble or disassemble the crane.

WARNING

Tipping/Overload Hazard!

Avoid tipping the crane over or collapsing the live mast:

- Assemble and disassemble the crane on a firm, level, uniformly supporting surface.
- Do not exceed operating limits found at the end of this section.
- Keep the crane level when operating jacks.

WARNING

Avoid Falling Off Crane and Boom!

It is necessary to climb onto the crane and boom during assembly and disassembly steps.

Use sturdy owner furnished ladders or an approved personnel hoist to gain access to areas which cannot be reached from ladders or steps provided with the crane.

WARNING

Moving Parts/Pinch Points!

Avoid death or crushing injury during crane assembly and disassembly:

- Assembly personnel — take every precaution to prevent injury when working near moving parts.
- Maintain communication between operator and assemblers to avoid accidents.
- Do not raise or lower the live mast until all personnel are off the crane.
- Keep unauthorized personnel well clear of the crane.

WARNING

Falling Load Hazard!

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

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

CRANE ORIENTATION

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

- The operator cab is on the left side of the rotating bed.
- An arrow fabricated on the left-front top of the carbody, as well as a yellow dot on the left-front face of the carbody, indicates the FRONT of the lowerworks.

ASSEMBLY AND DISASSEMBLY NOTES

The crane, boom, and jib must be assembled and disassembled by experienced personnel trained in erection and operation of construction cranes.

Read and become thoroughly familiar with the instructions in the applicable capacity charts, in this section, and in the rigging drawings at the rear of this section before attempting to assemble, operate, or disassemble the crane.

Contact your Manitowoc dealer for assistance if any procedure is not fully understood.

ASSEMBLY AND DISASSEMBLY AREA

WARNING

Moving Parts/Pinch Points!

Avoid death or crushing injury during crane assembly and disassembly:

- Assembly personnel — take every precaution to prevent injury when working near moving parts.
- Maintain communication between operator and assemblers to avoid accidents.
- Do not raise or lower the live mast until all personnel are off the crane.
- Keep unauthorized personnel well clear of the crane.

Select an assembly/disassembly area that has a firm, level, uniformly supporting surface. Make sure the area is large enough to accommodate the crane and the selected boom length, movement of trucks with trailers, and movement of an assist crane.

Set outrigger pads on a flat, firm foundation that will support the load placed on them. See Figure 4-1 for loadings.

Table 4-1 Jack and Pedestal Load Data

Maximum Load on Each Jack — 51 000 kg (112,400 lb)
Outrigger Pad Diameter — 775 mm (30.5 in)
Outrigger Pad Weight — 30 kg (65 lb)
Maximum Load on each Carbody Pedestal — 105 000 kg (231,485 lb)
Carbody Pedestal Size — 762 x 1 219 mm (30 x 48 in)
Carbody Pedestal Assembly Weight — 214 kg (470 lb)

Do not set the outrigger pads in holes, on rocky ground, or on extremely soft ground.

FIGURE 4-1

If necessary, use wood blocking or steel plates under the outrigger pads to properly distribute loading. The wood blocking or steel plates must be:

- Free of defects
- Strong enough to prevent being crushed or bent
- Of sufficient length and width to prevent settling under load

Contact your Manitowoc dealer for ground bearing information.

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, and boom that cannot be reached from the ground or from Manitowoc-provided steps, ladders, catwalks and platforms.

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

Some parts of the crane, 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.**

RETAINING CONNECTING PINS

Connecting pins are retained in various ways:

- Wire-lock pins
- Quick-release pins
- Hair-pin cotters
- Hitch pins
- Keeper plates with cap screws and lock washers

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

CRANE WEIGHTS AND SHIPPING DATA

See the Crane Weights topic at the end of Section 1 of this manual for the weights of individual crane components.

See the MLC650 Product Guide in Section 1 of this manual for outline and shipping dimensions.

PERSONAL FALL-PROTECTION

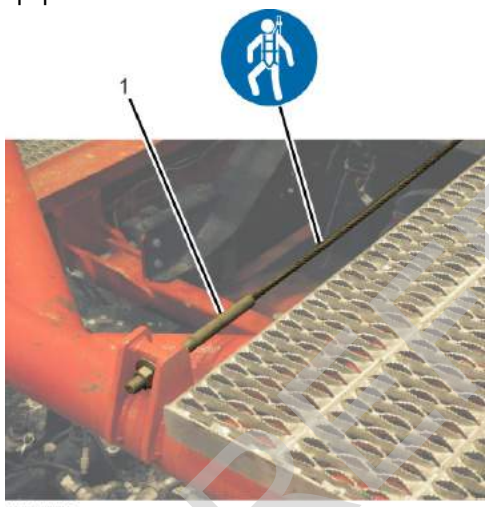
WARNING

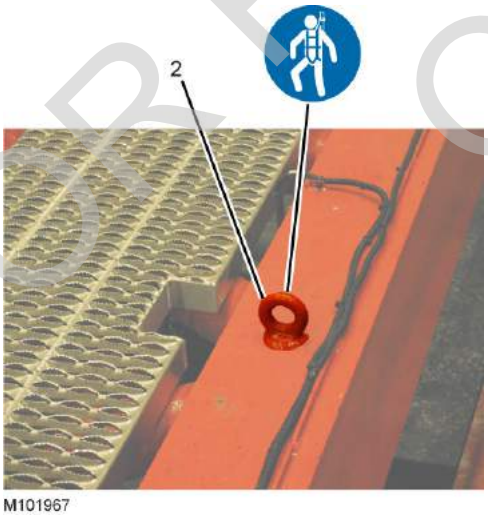
Fall Hazard!

To prevent falling from any height during crane assembly, 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.

Manitowoc has provided anchors (2) and lifelines (1) throughout the crane and attachments (see examples in Figure 4-2) to which workers can attach their personnel fall-protection equipment.





Item	Description
1	Typical Lifeline (boom, mast, and jib sections)
2	Typical Anchor

FIGURE 4-2

HANDLING COMPONENTS

The major components are equipped with lifting lugs. The lifting lugs are identified by the following symbol (see Figure 4-3) in the assembly illustrations along with a number to identify the number of lift points used for the lift.

In some cases, a forklift is required to lift components. When required, the lift points are identified by the following symbol (see Figure 4-3) in the assembly and disassembly illustrations.

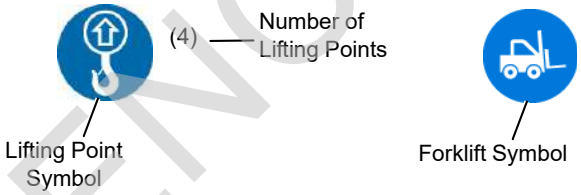


FIGURE 4-3

When lifting lugs are not provided, use nylon lifting slings. If wire rope or chain slings are used, install protective covering (such as sections of rubber tire), (see Figure 4-4) between slings and component being lifted.

FIGURE 4-4

It is the crane owner's/user's responsibility to ensure that all lifting slings, hooks, and shackles are in safe working order and capable of handling the load applied to them.

ASSIST CRANE REQUIREMENTS

An assist crane is required to handle parts during VPC-MAX assembly and disassembly.

The heaviest individual weight to be handled is the fixed mast butt, top, and equalizer package (Figure 4-44 on page 4-49) which weighs 24 857 kg (54,800 lb).

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

M102312

FIGURE 4-5

PARTS BOX

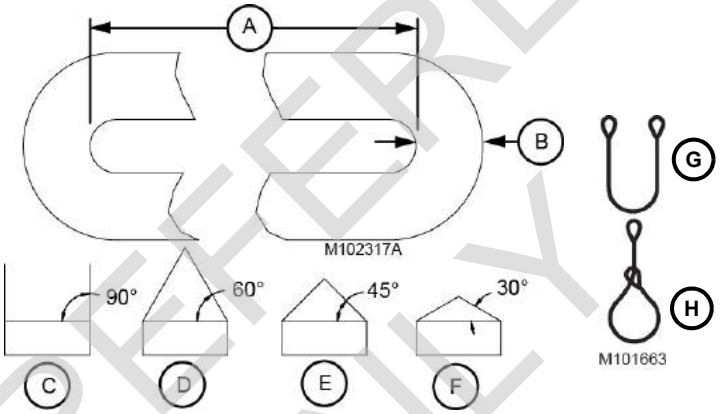
Manitowoc provides a parts box (Figure 4-5).

The following types of parts are shipped in the parts boxes:

- 1 - link assembly dead end
- 10 - Shackles (various sizes, see Figure 4-6)
- 14 - Lifting slings (various sizes, see Figure 4-6)
- 2 - hand-held pin pullers
- 2 - hydraulic hoses
- 2 - pin puller cage weldments
- 2 - pin puller boom butt cage weldments
- 1 - quick drain valve assembly
- 1 - crawler tensioning pump
- 2 each - open end wrenches (Stucchi - 16, 20, and 24)

Thoroughly inventory the parts box according to the packing diagrams under the parts box cover.

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)

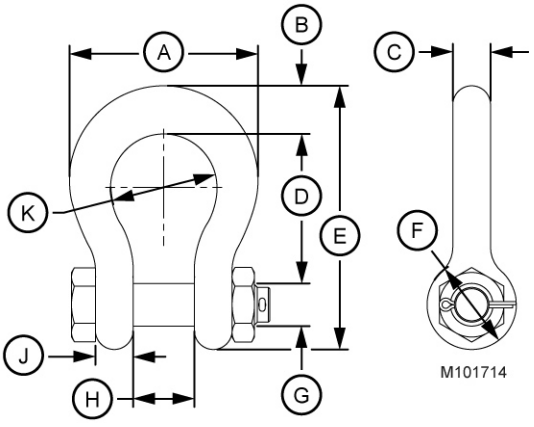
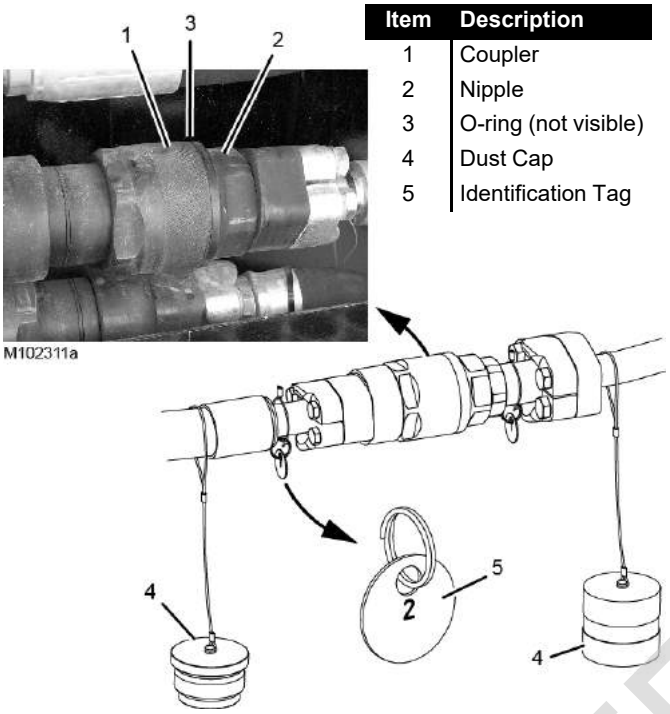


FIGURE 4-6



Item	Description
1	Coupler
2	Nipple
3	O-ring (not visible)
4	Dust Cap
5	Identification Tag

FIGURE 4-7

HYDRAULIC HOSE IDENTIFICATION

Where necessary, the hydraulic hoses and corresponding couplers have identification tags (5) as shown in Figure 4-7. Match the number on the hose with the number on the decal or the corresponding coupler to ensure proper connection.

CONNECTING/DISCONNECTING HYDRAULIC HOSES AND ELECTRIC CABLES

Always STOP ENGINE before performing the following steps during crane assembly and disassembly:

- Connecting and disconnecting hydraulic lines. It will be easier to connect and disconnect the couplers when there is no pressure in the system.
- 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.

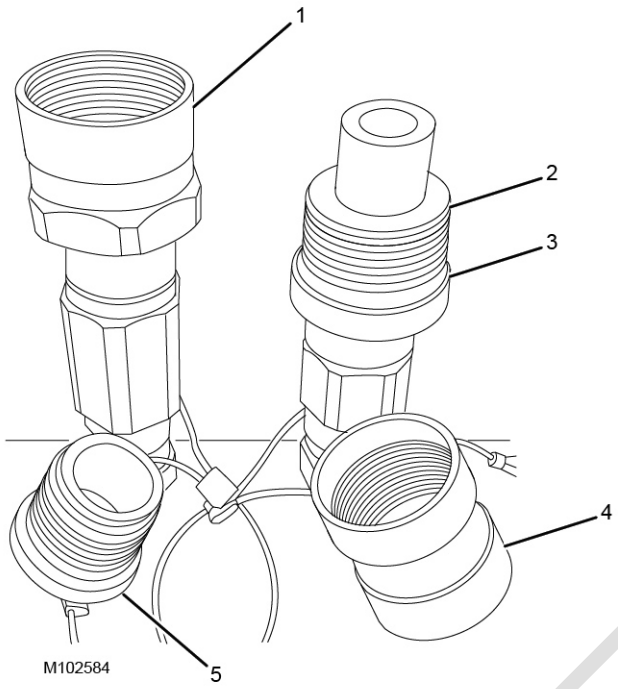
To stop the engine if it was started from the cab, use the ignition switch in the cab.

HOSE AND CABLE CLEANLINESS

To prevent dirt from entering the hydraulic systems or from damaging the electrical connectors:

- Thoroughly clean hydraulic fittings and electric connectors before connecting them.
- Thoroughly clean protective caps before attaching them to hoses, tubes, or cables.
- Do not drag hydraulic hose fittings or hoses and electrical connectors or cables on the ground.

NOTE: Apply a light coat of silicone lubricant to the threads of all protective caps, couplers, and connectors to help in preventing the threads from seizing.



Item	Description
1	Female Quick Disconnect
2	Male Quick Disconnect
3	O-ring
4	Aluminum Cap
5	Aluminum Plug

FIGURE 4-8

HYDRAULIC QUICK DISCONNECT LUBRICATION

All hydraulic quick disconnects must be protected by applying LPS-2 Aerosol Lubricant. Lubricant must be applied while connecting and disconnecting the hydraulic quick disconnects during crane assembly and disassembly.

1. All Quick Disconnects must be fully screwed together until there is metal to metal contact during crane assembly.
2. All plugs, regardless of location, must be fully screwed together into their corresponding caps until there is metal to metal contact during crane assembly.

Examples of locations of caps and plugs:

- Hanging lanyards
- Storage brackets
- Job box

3. All Quick Disconnects must be fully screwed together with their corresponding cap and plug until there is metal to metal contact during crane disassembly.

The following threaded areas of the quick disconnects, caps, and plugs must be lubricated during crane assembly and disassembly (see Figure 4-8):

- Threaded surface of male quick disconnect
- Threaded surface of female quick disconnect
- Threaded surface of aluminum caps and plugs
- O-rings

NOTE: If the crane is stored without operating for long duration, the hydraulic quick disconnects, caps, and plugs must be lubricated every 6 months.

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.

TIGHTENING HYDRAULIC COUPLERS

Connect each screw-to-connect coupler and nipple (Figure 4-8), as follows:

1. Lubricate coupler internal threads (1), nipple threads (2), and nipple O-ring (3) with LPS-2 Aerosol Lubricant.
2. Hand tighten the coupler on the nipple.
3. Using opened-end wrenches from the parts box, tighten the coupler until there is metal-to-metal contact between the coupler and the nipple. Nipple o-ring must not be visible.

   To avoid damage, do not exceed a torque of:

   - Size -06 = 2,2 Nm (1.62 lbf ft)
   - Size -08 = 1,8 Nm (1.33 lbf ft)
   - Size -12 = 5,6 Nm (4.13 lbf ft)
   - Size -20 = 8,2 Nm (6.04 lbf ft)
   - Size -24 = 26,0 Nm (19.16 lbf ft)
4. Check that the hydraulic tank shut-off valve (see Figure 4-15) is open.

Check for leaks after the crane has been operated with the hydraulic oil at operating temperature. Retighten the couplers if necessary.

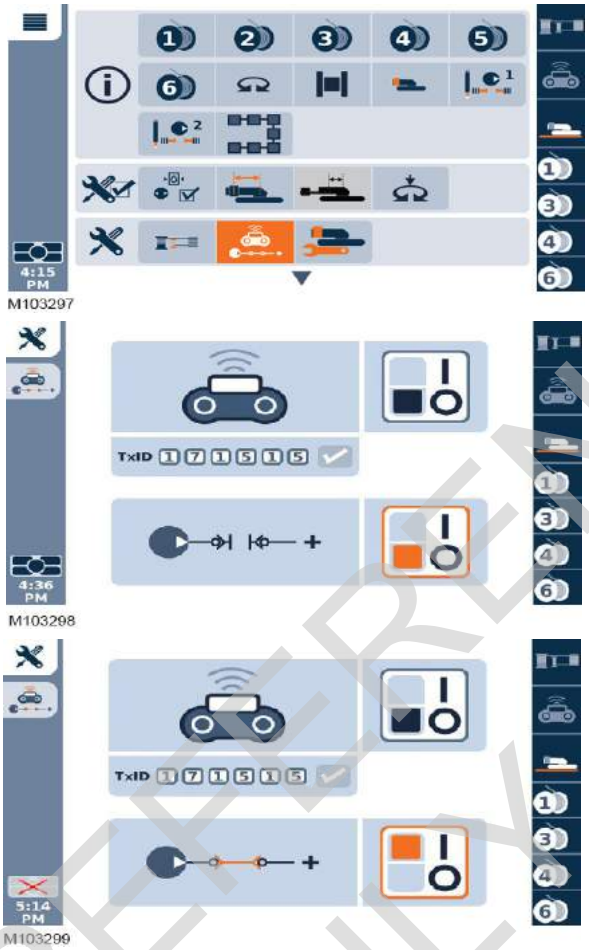


FIGURE 4-9

SETUP MODE

To operate in the setup mode during crane assembly and disassembly, the live mast must be configured in the RCL/RCI display.

See the MLC650 RCL/RCI Display Operation Manual for instructions.

This allows the boom control handle to raise and lower the live mast and the right drum control handle to extend and retract the self-erect cylinder.

AUXILIARY HYDRAULIC SYSTEM

Before using the hand-held pin puller the auxiliary hydraulic system must be activated. This function increases the accessory system pressure so the hand-held pin puller can be connected and used.

See Figure 4-9 for the following procedure.

1. Start from the first menu screen and use either the jog dial on the right console, or the scroll keys on the display to select the auxiliary hydraulics icon.
2. From the auxiliary hydraulics screen, scroll to the ON/OFF (“**I**” or “**O**”) in the selection box.
3. Touch the OK button on the jog dial or display to select the highlighted mode.

   The screen changes to reflect the new mode.

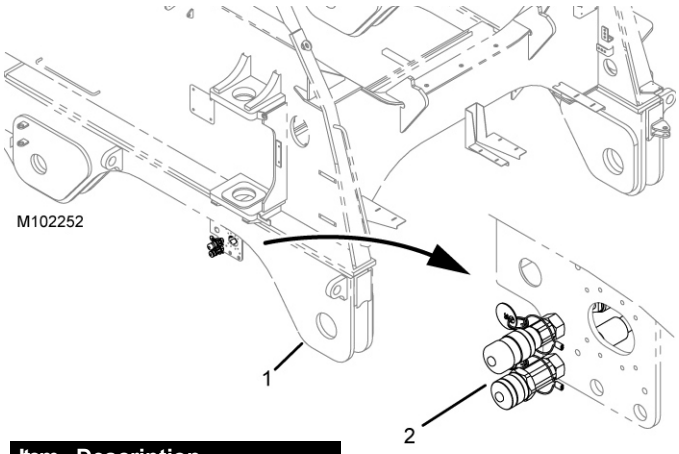
HAND-HELD PIN PULLER

Use the hand-held pin puller to assist in the installation and removal of the pins on the boom butt, live mast hoist (drum 4), gantry, backhitch, boom hinge, and the boom inserts.

See Figure 4-10 for the following procedure.

1. Locate the two hydraulic connections (2), found on the rotating bed frame (1), and connect the two hydraulic hose connections.

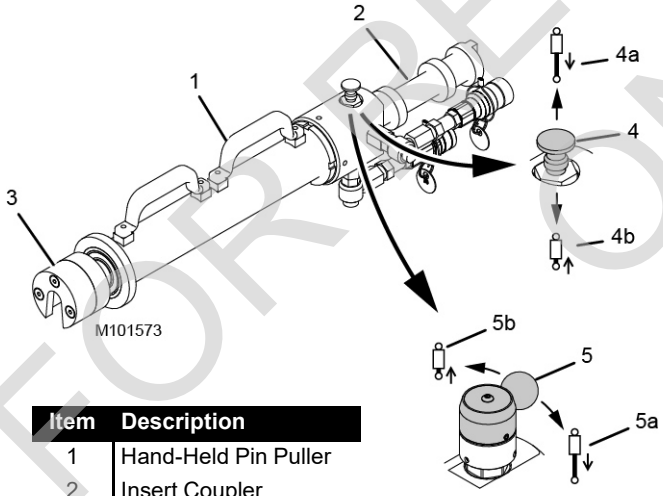
NOTE: The hydraulic connections can be found on both sides of the rotating bed.



Item	Description
1	Rotating Bed
2	Hydraulic Connections

FIGURE 4-10

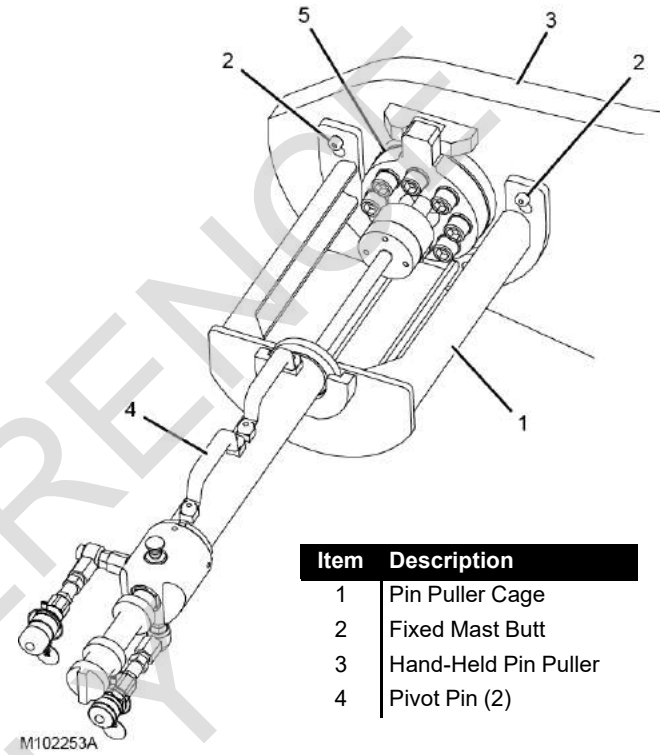
2. Connect the two hydraulic hose connections to the two connections on the hand-held pin puller (1, Figure 4-11).
   a. With the hand-held pin puller in position, pull on the control knob (4) to extend (4a) the cylinder. Push on the control knob to retract (4b) the cylinder.
   b. The cylinder rod end (3) is used to push or pull pins and the insert coupler (2) is used to align the pin puller during insert pin installation or removal.



Item	Description
1	Hand-Held Pin Puller
2	Insert Coupler
3	Cylinder Rod End
4	Control Knob
4a	Pull to Extend
4b	Push to Retract

FIGURE 4-11

3. Attach the pin puller cage (1, Figure 4-12) to the shoulder bolts (2) on the fixed mast butt.
4. Attach the pin puller (4, Figure 4-12) to the pin puller cage and to the mast pivot pin (5).



Item	Description
1	Pin Puller Cage
2	Fixed Mast Butt
3	Hand-Held Pin Puller
4	Pivot Pin (2)

FIGURE 4-12

SWING LIMITS

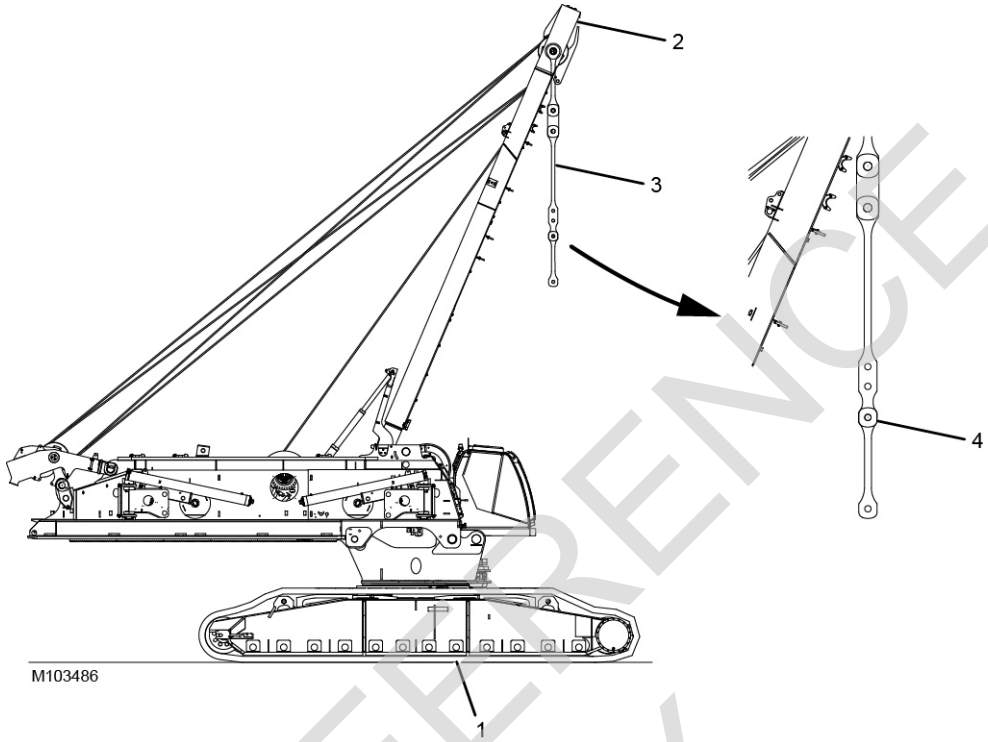
See Table 4-2 for swing limits during VPC-MAX assembly and disassembly.

Refer to the MLC650 VPC-MAX Liftcrane Mast Handling Capacities chart at the end of this section for detailed lifting capacities with the fixed mast.

Table 4-2 Swing Limitations

Crane Configuration	Swing
• VPC-MAX actuator and beam installed • Counterweight tray, auxiliary frame, and counterweight boxes (Series 1, 2, or 3) installed • ***Counterweight fully retracted***	360° Swing Permitted
• VPC-MAX actuator and beam installed • Counterweight tray, auxiliary frame, and counterweight boxes (Series 1, 2, or 3) installed • ***Counterweight fully retracted*** • Fixed mast installed and positioned at minimum radius given MLC650 VPC-MAX Liftcrane Mast Handling Capacities chart	360° Swing Permitted

ASSEMBLING THE VPC-MAX



Item	Description
1	MLC650 Upperworks and Lowerworks Assembled
2	Live Mast (111.6° minimum)
3	Live Mast Straps
4	Hole A

FIGURE 4-13

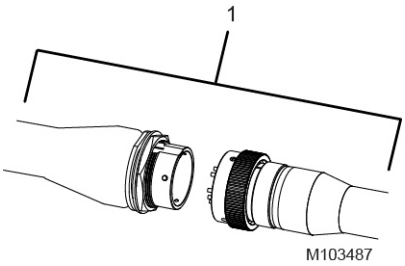
Preparing the Crane

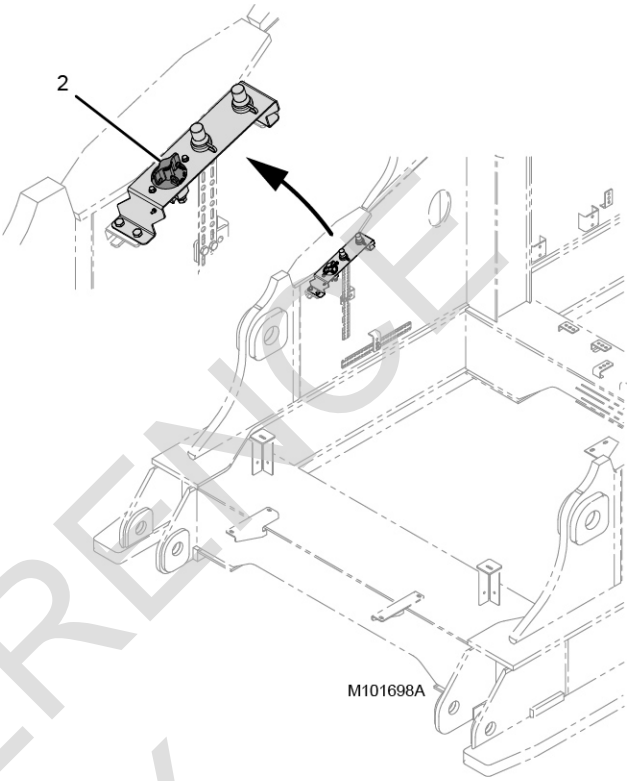
Prior to assembling the VPC-MAX, the MLC650 must be assembled to the extent shown in Figure 4-13. Refer to Section 4 of the Crane Operator Manual for crane assembly instructions.

- Makes sure the live mast arms are fully raised.
- Position the live mast at 111.6° minimum.
- Make sure the live mast straps (3) are connected via Hole A (4), which is the “longest” hole

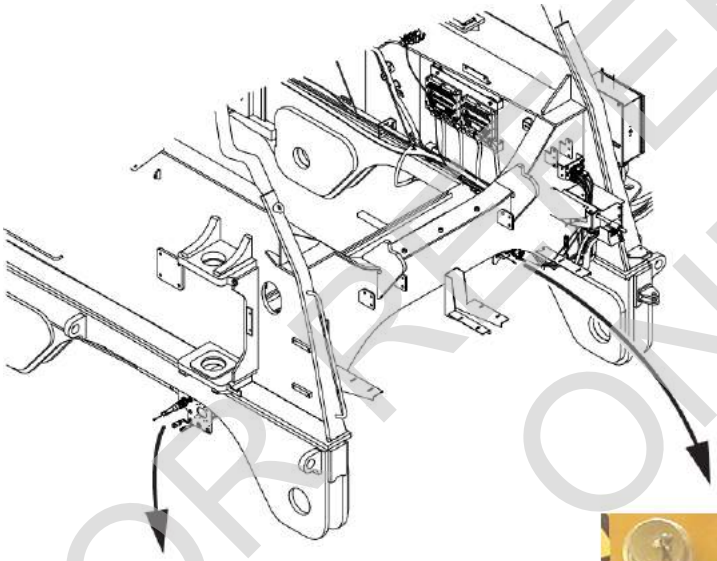
If the crane is already fully assembled and rigged with a boom or a boom and jib, proceed as follows:

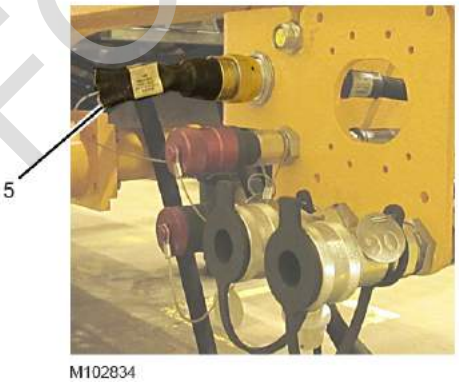
1. Lower the boom (and jib) to the ground. See Section 4 of the Crane Operator Manual or the Luffing Jib Operator Manual for lowering instructions.
2. Disconnect the boom from the boom butt. See Section 4 of the Crane Operator Manual for instructions.
3. Disconnect the boom butt from the crane. See Section 4 of the Crane Operator Manual for instructions.
4. Remove the counterweight boxes and tray from the crane. See Section 4 of the Crane Operator Manual for instructions.

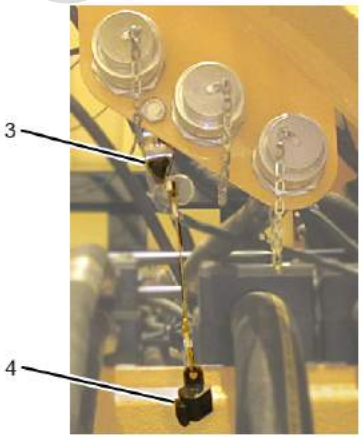




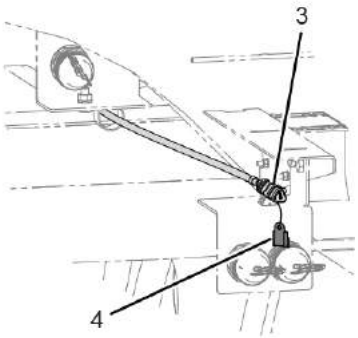
Item	Description
1	Electrical Plugs
2	Electrical Disconnect Switch (left rear on rotating bed)
3	CAN D Terminator (left front inside rotating bed)
4	Dust Cap
5	CAN Terminator (right front outside rotating bed)







PAST



CURRENT

FIGURE 4-14

Checking the Electrical System

See Figure 4-14 for the following procedure.

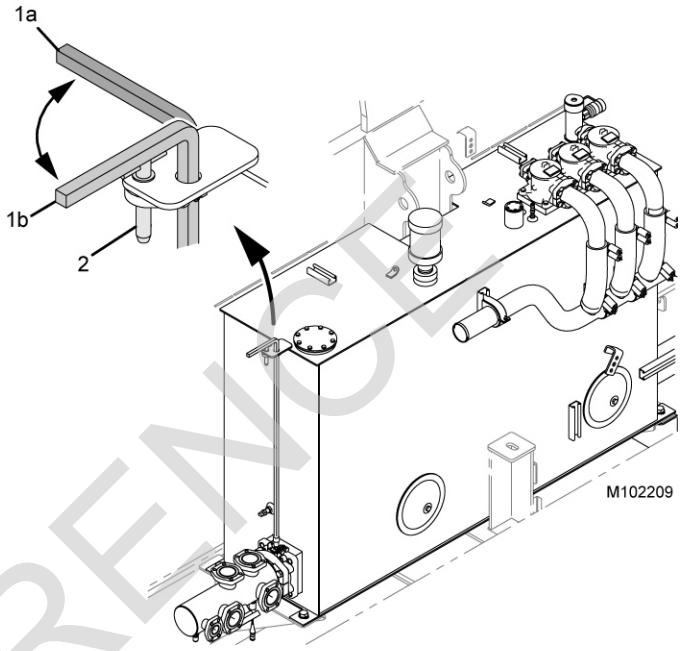
1. Check that the CAN D terminator (3) and CAN terminator (5) are connected. The engine may not start and faults will activate if the plugs are not connected.
2. Locate and turn on the electrical disconnect switch (2).

Checking the Hydraulic System

1. Check for leaks in the hydraulic system.
2. Check the hydraulic oil level.
3. Repair or refill the system as required.
4. Check that the hydraulic shut-off valve (1b, Figure 4-15) is in the open position and the locking pin (2) is installed.

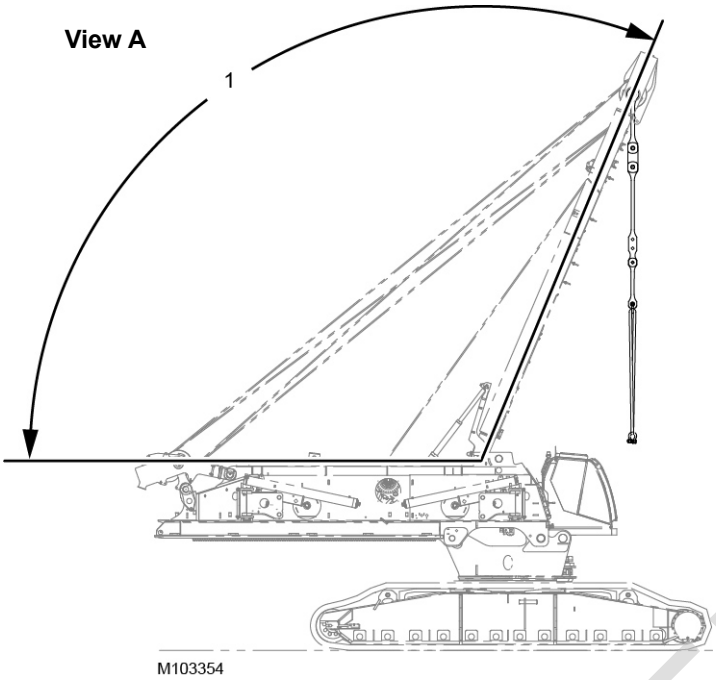
Checking the Gear Boxes

1. Perform any required lubrication services and maintenance checks. See the Lubrication Guide and Maintenance Checklist supplied with the crane.
2. Check for leaks in the gear boxes.
3. Check the gear box oil levels.
4. Repair or refill the system as required.



Item	Description
1a	Hydraulic Tank Shut-off Valve (closed)
1b	Hydraulic Tank Shut-off Valve (open)
2	Locking Pin (acceptable to replace with an owner-furnished padlock)

FIGURE 4-15



Item	Description
1	111.6° Angle (minimum)
2	Wear Plate Scraper (qty 2)
3	VPC-MAX Actuator Trolley

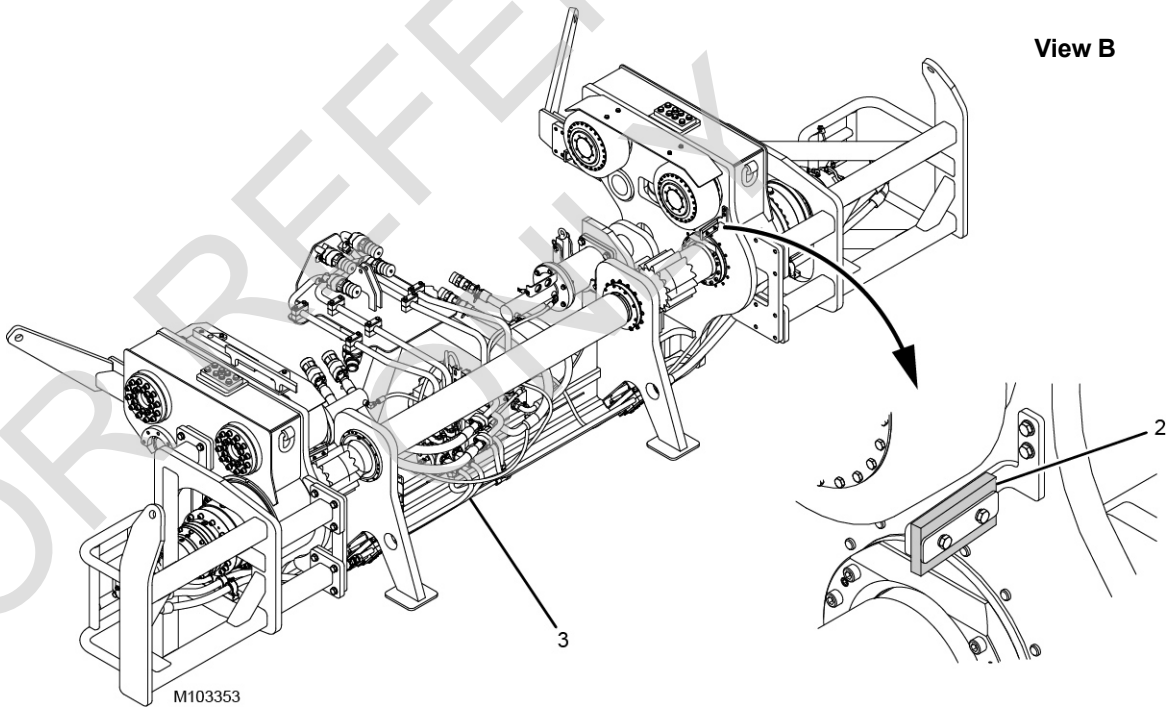


FIGURE 4-16

Preparing for Actuator Installation

See Figure 4-16 for the following procedure.

1. Rotate the live mast to 111.6° (minimum) (1, View A) from its horizontal (shipping) position.
2. Adjust the wear plate scrapers (2, View B) on the VPC-MAX actuator trolley (3, View B) to the highest position.

Item	Description
1	Safety Pin (qty 2)
2	Large Main Stop Block (qty 2)
3	Small Bolt-on Stop Block (qty 2)

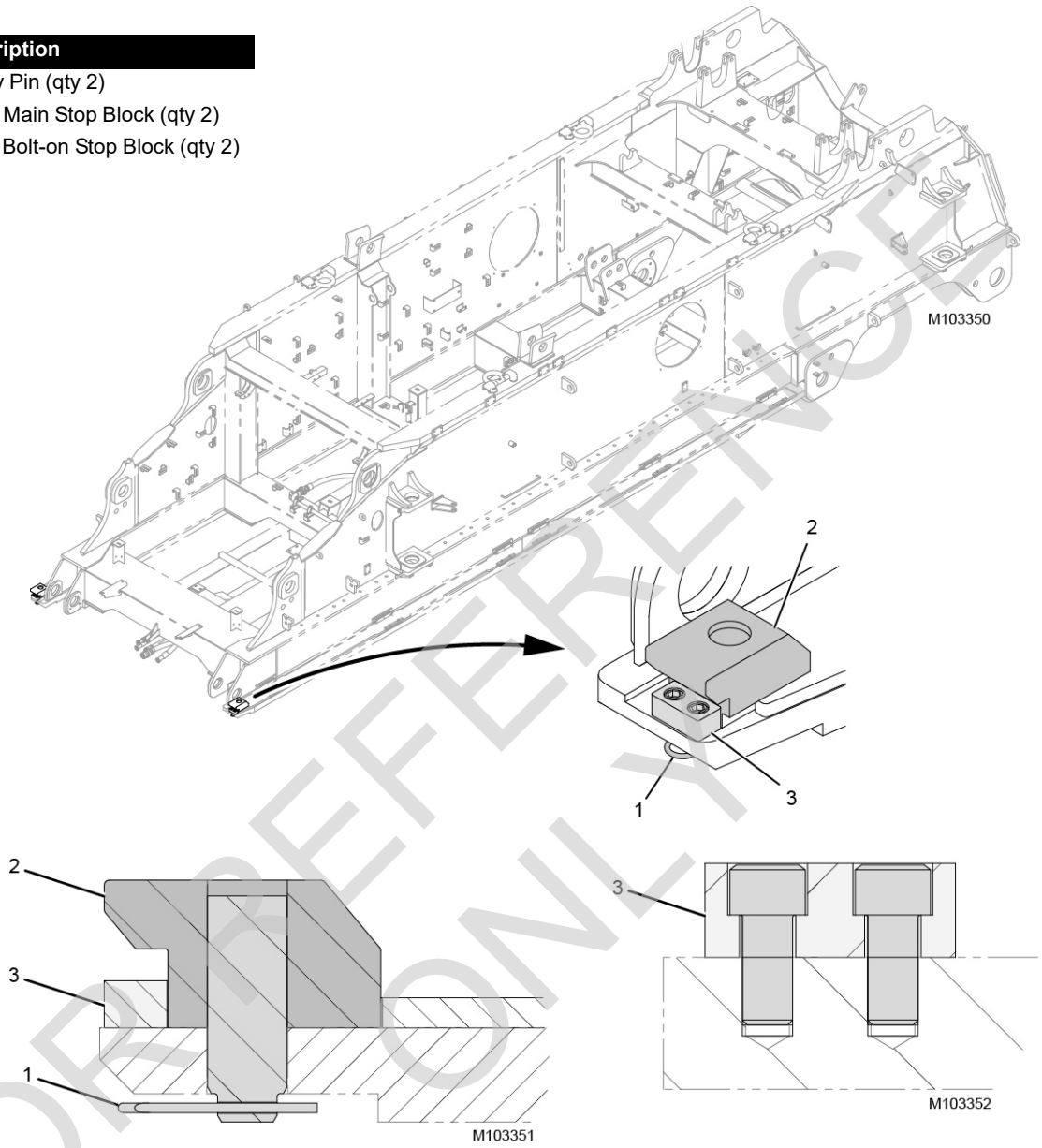


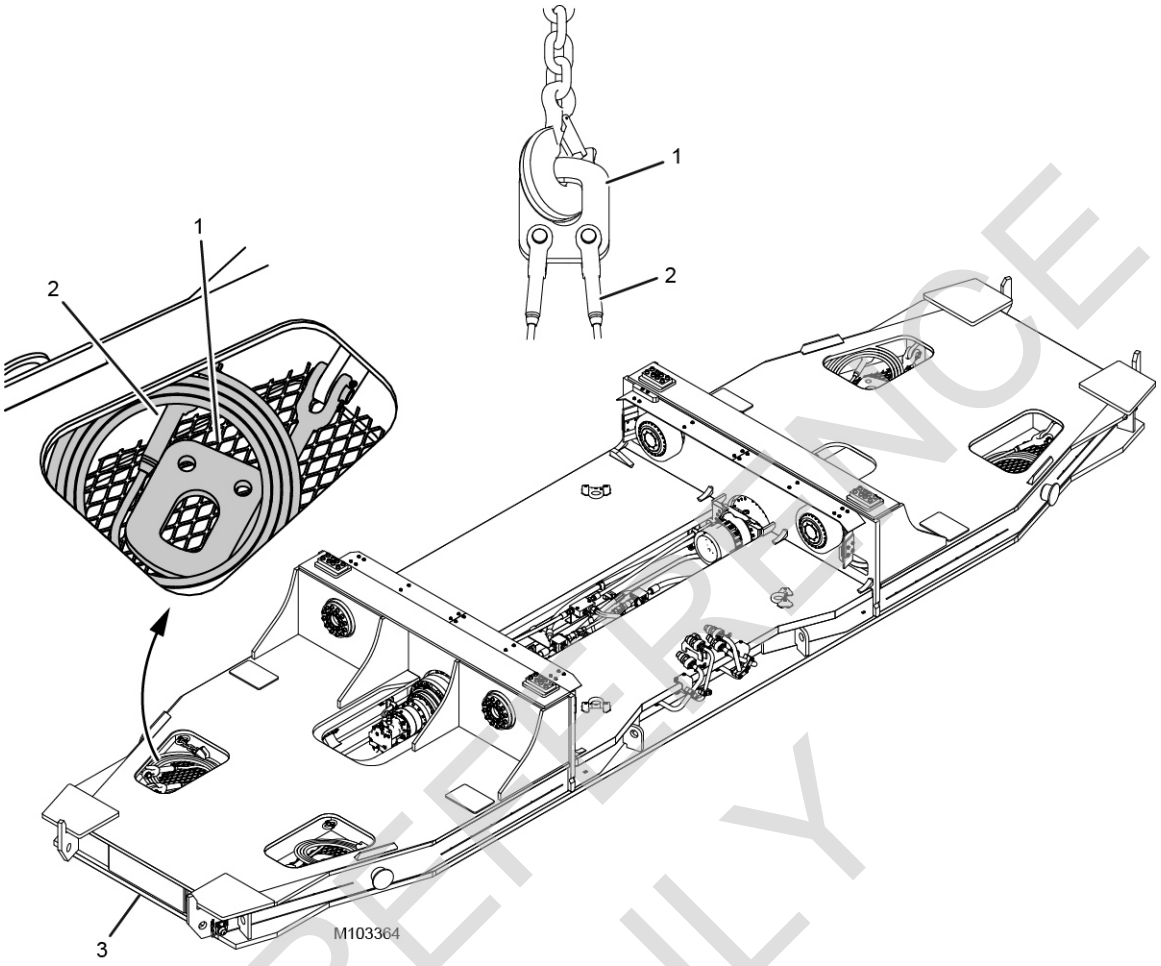
FIGURE 4-17

Removing the Large Main Stop Blocks

See Figure 4-17 for the following procedure.

1. Remove the safety pins (1) from the large main stop blocks (2) on the rear of the rotating bed.
2. Remove the large stop blocks.

NOTE: Do not remove the small bolt-on stop blocks (3).



Item	Description
1	Plate (qty 2)
2	Pendant (qty 4)
3	Counterweight Tray Assembly

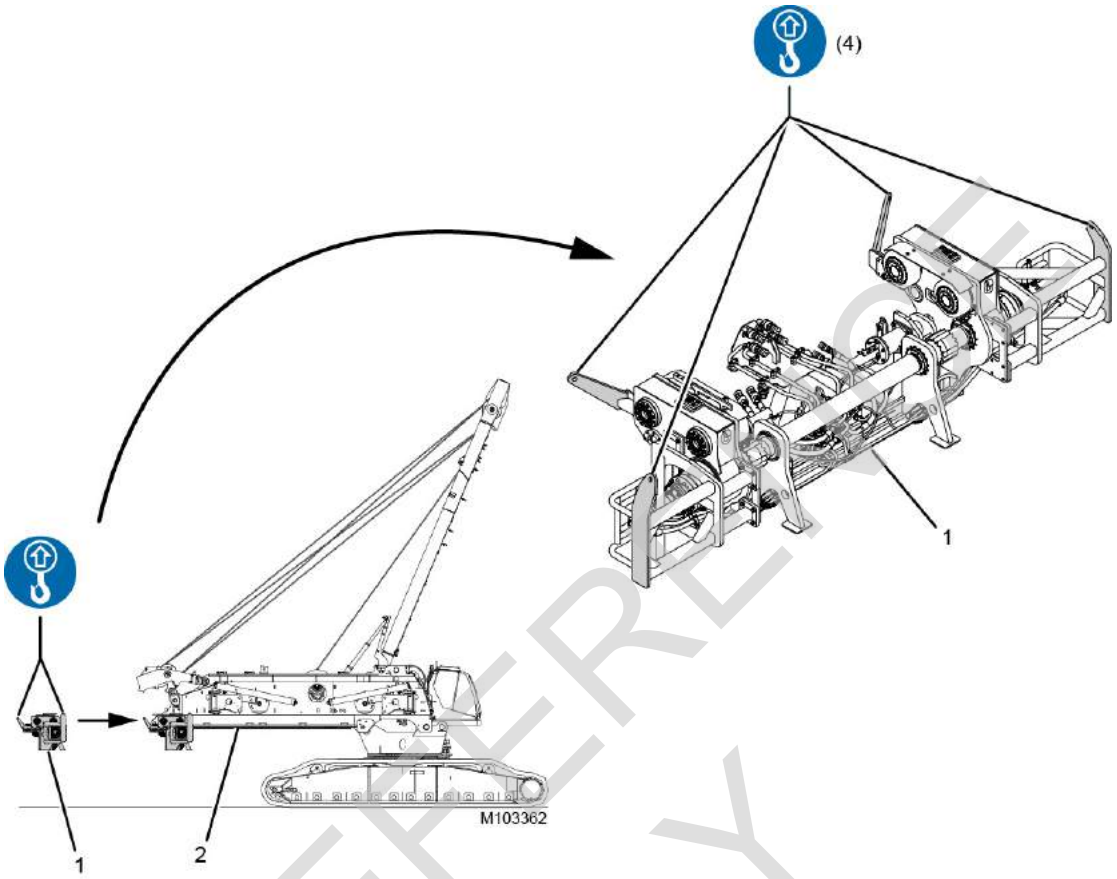
FIGURE 4-18

Installing the Actuator

See Figure 4-18 for the following procedure.

Handling the Actuator

1. Remove the two plates (1) and four pendants (2) from the counterweight tray assembly (3).



Item	Description
1	Actuator
2	Rotating Bed

FIGURE 4-19

See Figure 4-19 for the following procedure.

2. Using the plates and pendants, attach the actuator (1) to the assist crane.

NOTE: Any additional rigging used between the assist crane hook block and plates must not exceed 3,6 m (12 ft) in length. The actuator should hang at a 2° angle with the rear rollers higher than the front rollers.

3. Have assistants use the taglines to help control the movement of the actuator and to help guide it onto the rotating bed.

CAUTION

Equipment Damage!

The top of the actuator can be damaged if it is lifted too high.

Make sure the rollers on the actuator maintain contact with the roller wear plates.

4. Using the assist crane, position the actuator at the rear of the rotating bed (2) so the front (vertical) rollers contact the roller wear plates.

5. Using the assist crane, adjust the actuator to be horizontal.

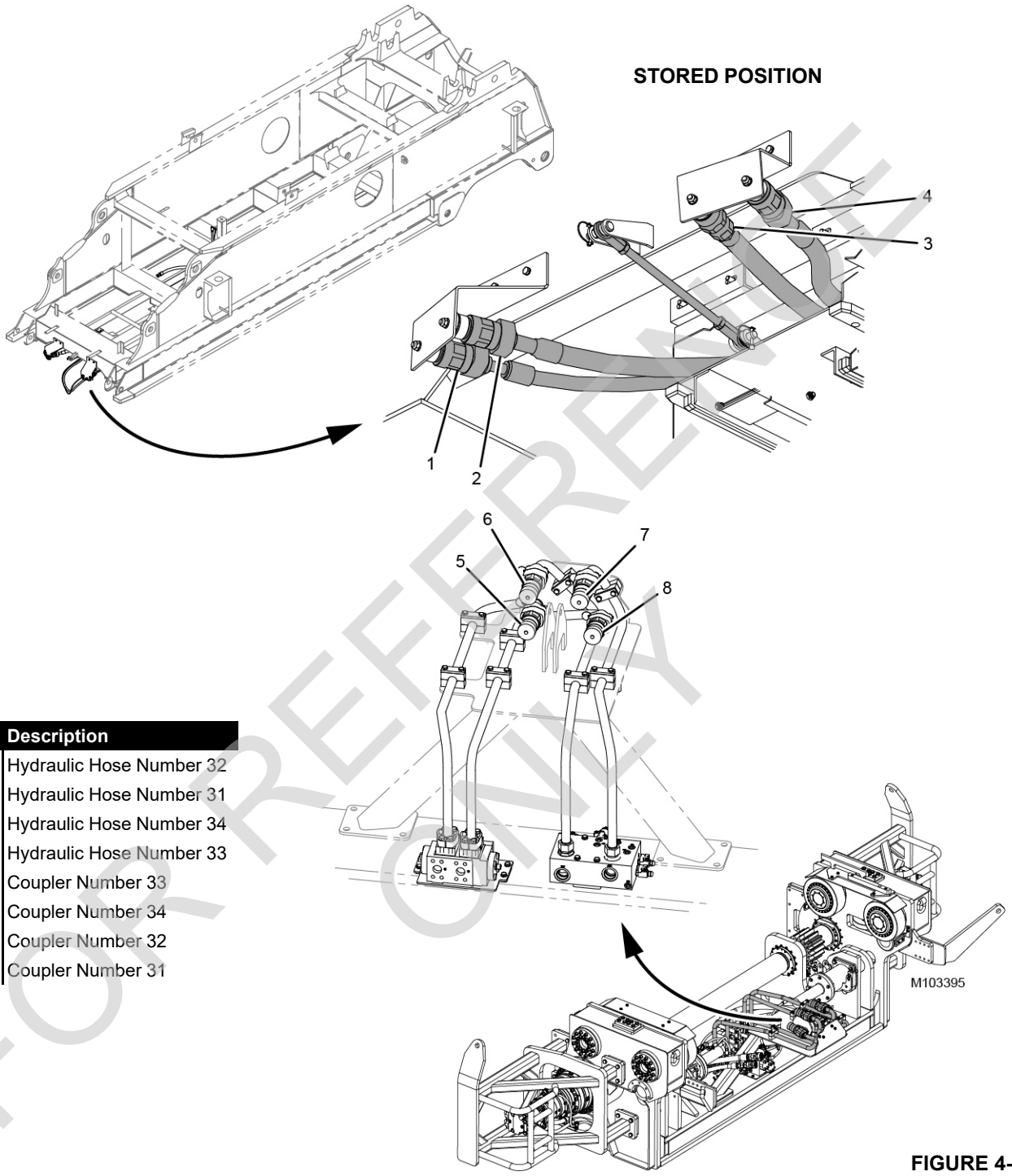
6. Using the assist crane, draw the actuator onto the rotating bed to a point where the side rollers on the actuator contacting the sides (edge) of the rotating bed.

Aligning the Actuator

Precise actuator alignment is required in order to install the actuator beyond the point where the side rollers first contact the rotating bed.

To properly align the actuator to the rotating bed, use the assist crane to slowly draw the actuator farther onto the rotating bed until the rear (vertical) rollers contact the wear plates.

During this process, the rear rollers contact and roll over the small rear bolt-on stop blocks.



Item	Description
1	Hydraulic Hose Number 32
2	Hydraulic Hose Number 31
3	Hydraulic Hose Number 34
4	Hydraulic Hose Number 33
5	Coupler Number 33
6	Coupler Number 34
7	Coupler Number 32
8	Coupler Number 31

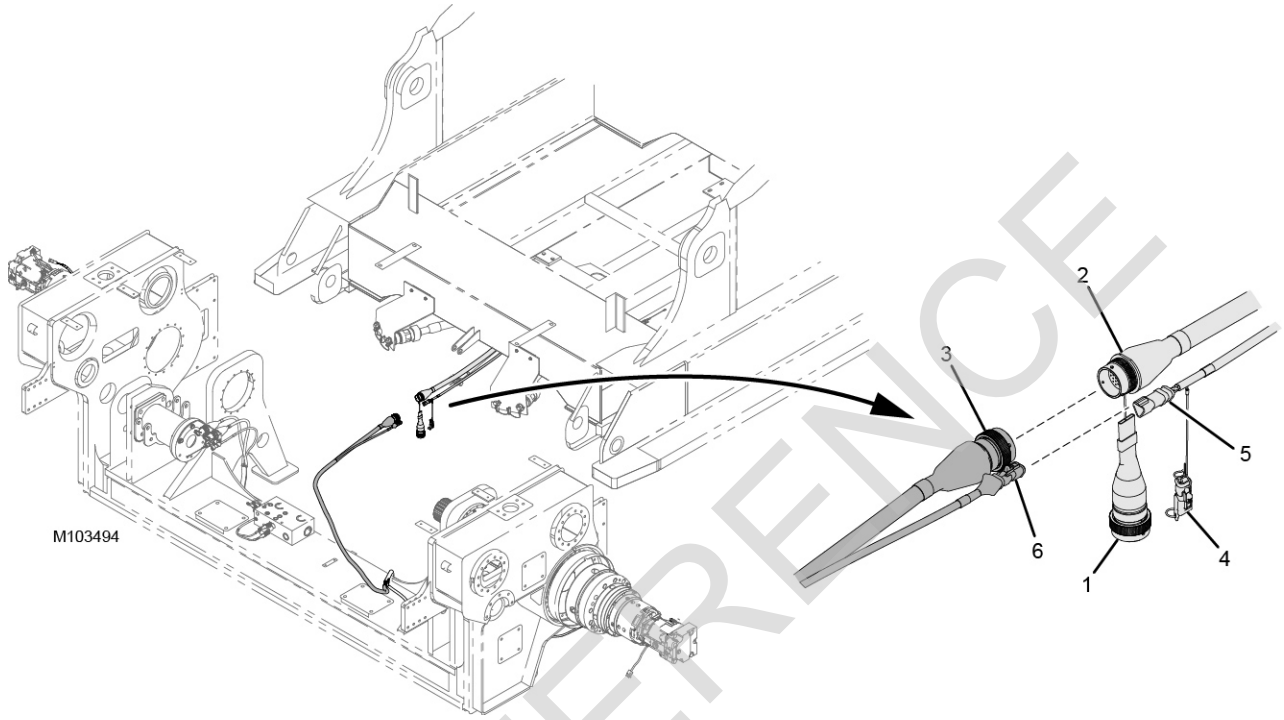
FIGURE 4-20

Connecting the Hydraulic Hoses

See Figure 4-20 for the following procedure.

1. Remove the hydraulic hoses (1–4) from the stored position.
2. Connect the hydraulic hoses to the couplers (5–8) on the actuator.

NOTE: The hoses and the corresponding couplers are tagged with numbers. Match the numbers to ensure proper hose connection.



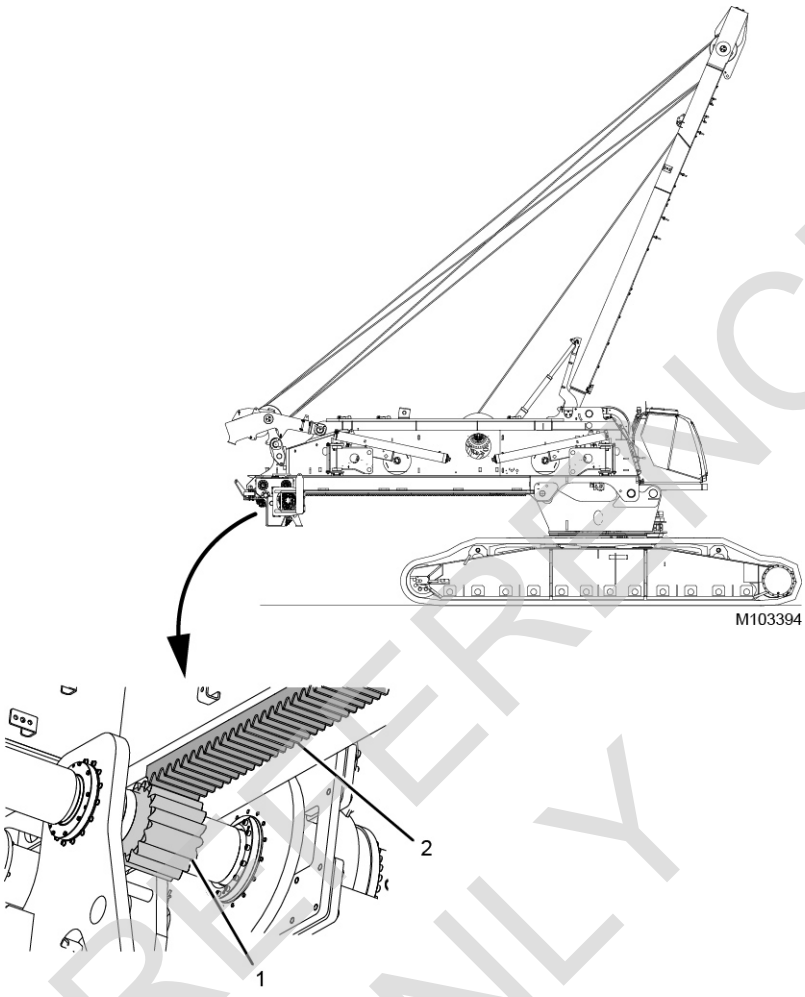
Item	Description
1	Dust Cap
2	Electrical Plug WVB1
3	Electrical Plug WVH1-P1
4	Terminating Resistor
5	Electrical Plug WVB2
6	Electrical Plug WVH1-P2

FIGURE 4-21

Connecting the Electrical Cables

See Figure 4-21 for the following procedure.

1. Remove the dust cap (1) from electrical plug WVB1 (2).
2. Connect electrical plug WVB1 to electrical plug WVH1-P1 (3) on the actuator.
3. Remove the terminating resistor (4) from electrical plug WVB2 (5) and mate the resistor to the provided dust cap.
4. Connect electrical plug WVB2 to electrical plug WVH1-P2 (6) on the actuator.



Item	Description
1	Pinion (qty 2)
2	Rack Teeth

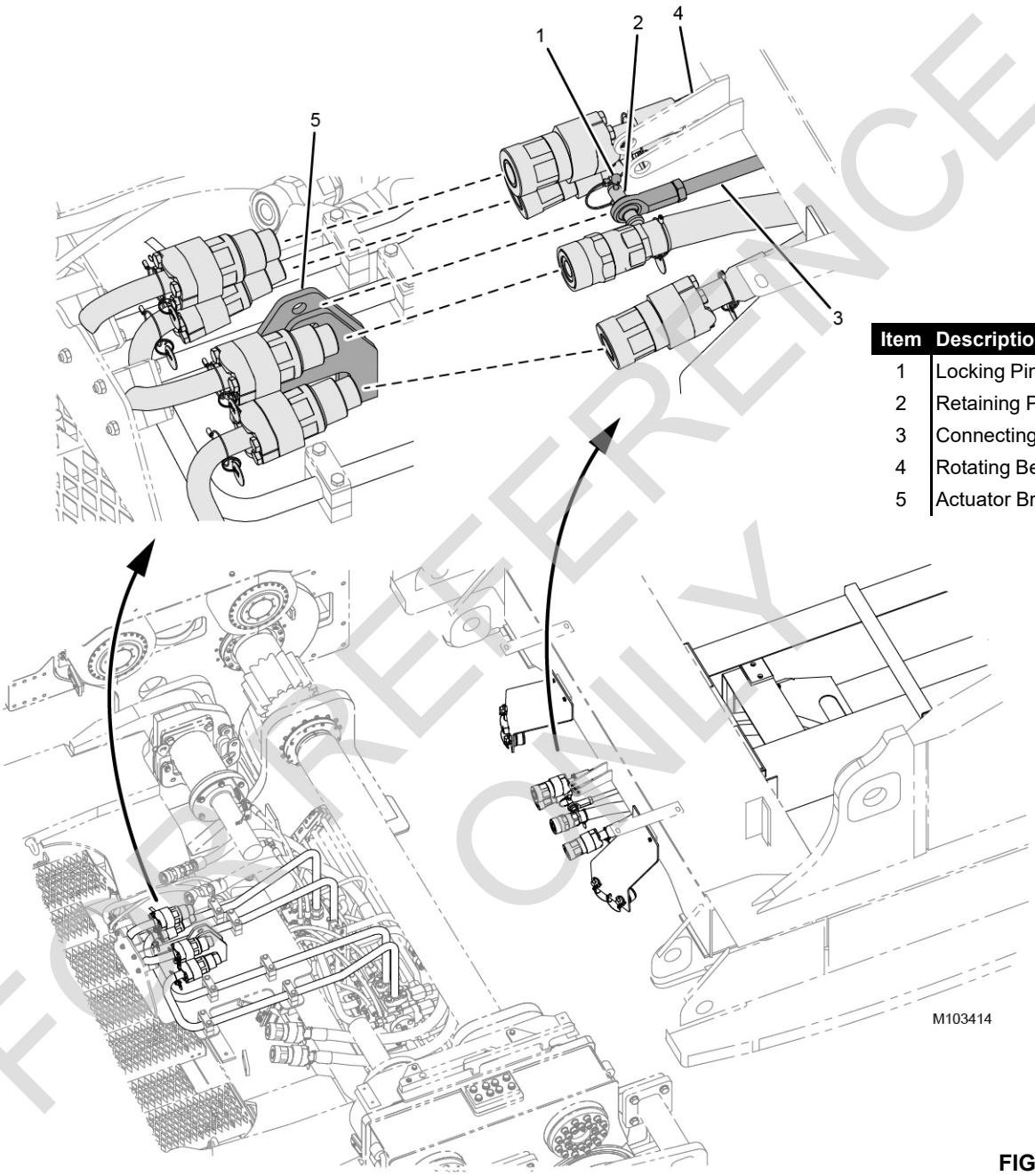
FIGURE 4-22

Testing the Actuator

See Figure 4-22 for the following procedure.

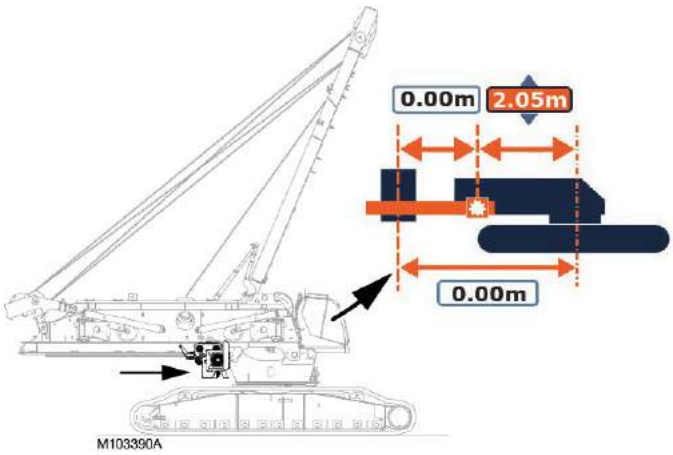
1. Using the remote control, test the pinions (1) while not in mesh with the rack teeth (2) to confirm that the pinions function properly.
2. Slowly pull the actuator forward with the assist crane until the pinions contact the rack teeth.
3. With the actuator still attached to the assist crane, relax the rigging just enough to ensure that the majority of the actuator weight is supported by the rotating bed. If the foundation is not level, the rigging may need to maintain some tension in order to hold the actuator in position.
4. With the actuator still attached to the assist crane, slowly activate the drive pinions with the remote control. Watch each side to ensure the teeth are meshing properly. Stop at the point where the first rack tooth is in full mesh with the pinion.

THIS PAGE INTENTIONALLY LEFT BLANK

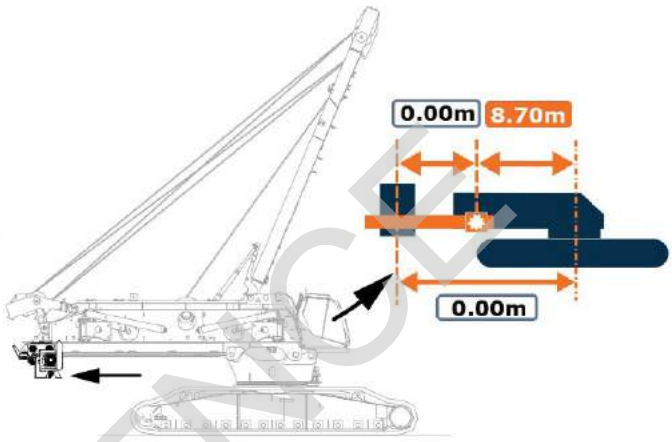


Item	Description
1	Locking Pin
2	Retaining Pin
3	Connecting Link
4	Rotating Bed Bracket
5	Actuator Bracket

FIGURE 4-23



View A
Actuator Calibration Position



View B
Beam Installation Position

FIGURE 4-24

Attaching the Connecting Link

See Figure 4-23 for the following procedure.

1. Remove the locking pin (1) and retaining pin (2) from the connecting link (3).
2. Remove the connecting link from the stored position in the rotating bed bracket (4).
3. Adjust the slide and/or tray position to align the connecting link with the actuator bracket (5).
4. Install the retaining pin and hair pin cotter to secure the connecting link in the working position in the actuator bracket.

Installing the Large Main Stop Blocks

1. Drive the actuator forward to a position to allow for large main stop block installation.
2. Install the large main stop blocks by reversing the removal procedure. See "Removing the Large Main Stop Blocks" on page 4-15.
3. Detach the actuator from the assist crane.

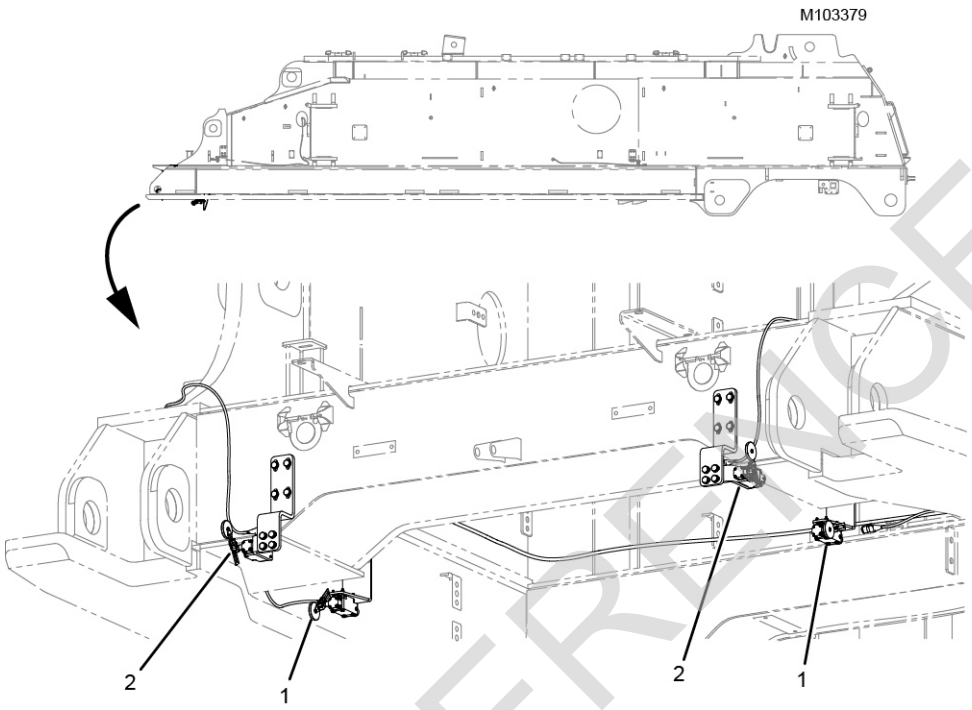
Checking Limits and Calibrating the VPC-MAX Actuator

See Figure 4-23 for the following procedure.

1. Adjust the wear plate scrapers (step 2 on page 4-14).
2. Using the remote control, drive the actuator all the way forward on the rotating bed rails (View A).
3. Verify that the actuator in and out limit switches are operating properly.

   See Section 6 of this manual for detailed instructions.
4. Calibrate the actuator in the VPC-MAX Calibration Screen of the Main Display.

   See the Main Display Operation Manual for detailed instructions under the topic VPC-MAX Calibration at Installation.
5. Once calibrated, drive the actuator rearward until it is at 8.70 m as indicted in the calibration screen (View B).



Item	Description
1	Beam Up Limit Switch (qty 2)
2	Beam-on-Hook Limit Switch (qty 2)
3	Limit Switch Tripping Bracket (qty 2)
4	VPC-MAX Beam Assembly
5	Lifting Lug (qty 4)

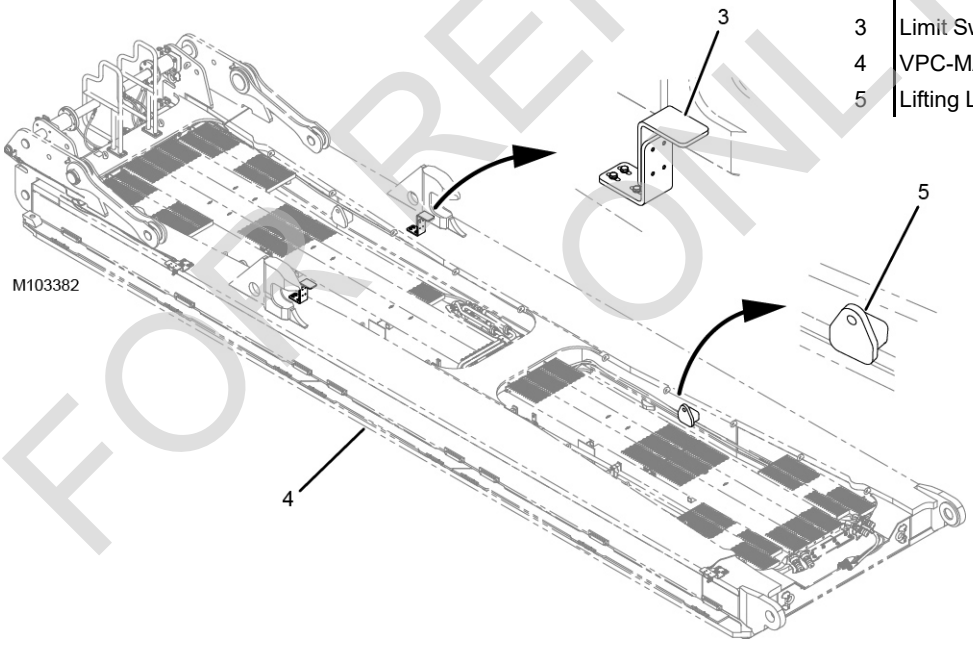


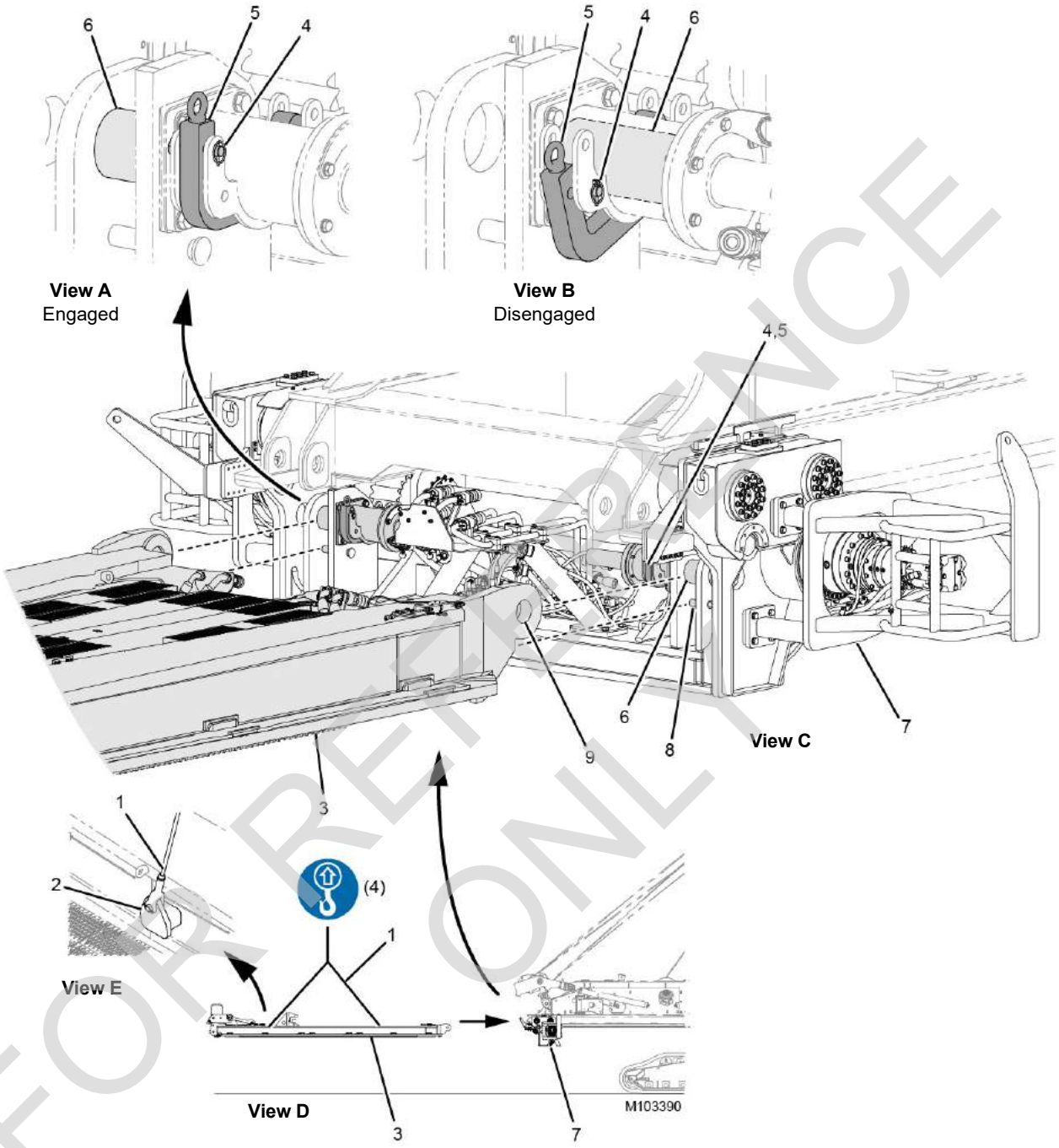
FIGURE 4-25

Installing the VPC-MAX Beam

See Figure 4-25 for the following procedure.

Perform steps 1-3 only if the beam is being installed on a different crane than it was removed from

1. Position the beam up limit switches (1) to the highest position.
2. Position the beam-on-hook limit switches (2) to the lowest position.
3. Position the limit switch tripping brackets (3) on the VPC-MAX beam assembly (4) to the rearmost position.
4. Remove the two plates and four pendants from the counterweight tray assembly. See "Handling the Actuator" on page 4-16.
5. Attach the pendants to the four lifting lugs (5) on the VPC-MAX beam assembly.



Item	Description	Item	Description
1	Pendant with Pin and Cotter Pin (qty 4)	6	Pin Puller Pin (qty 2)
2	Lifting Lug (qty 4)	7	Actuator
3	VPC-MAX Beam	8	Alignment Pin (qty 2)
4	Locking Pin with Lynch Pin (qty 2)	9	Pin Hole (VPC-MAX beam) (qty 2)
5	Pin Puller Keeper Plate (qty 2)		

FIGURE 4-26

See Figure 4-26 for the following procedure.

6. Attach the pendants (1, View E) from the assist crane to the lifting lugs (2) on the VPC-MAX beam (3).
7. Remove the locking pins (4, View A) and disengage both pin puller keeper plates (5, View B).
8. Store the locking pins (4, View B).
9. Disengage the pin puller pins (6, View B) using the remote control.
10. Lift the VPC-MAX beam (3, View C) into position at the actuator (7).
11. Using the alignment pins (8, View C), align the pin holes (9) in the VPC-MAX beam (3) with the pin holes in the actuator.
12. Engage the pin puller pins (6, View A) with the remote control.
13. Remove the locking pins (4, View B) from storage.
14. Engage the pin puller keeper plates (5, View A) and install the locking pins (4).

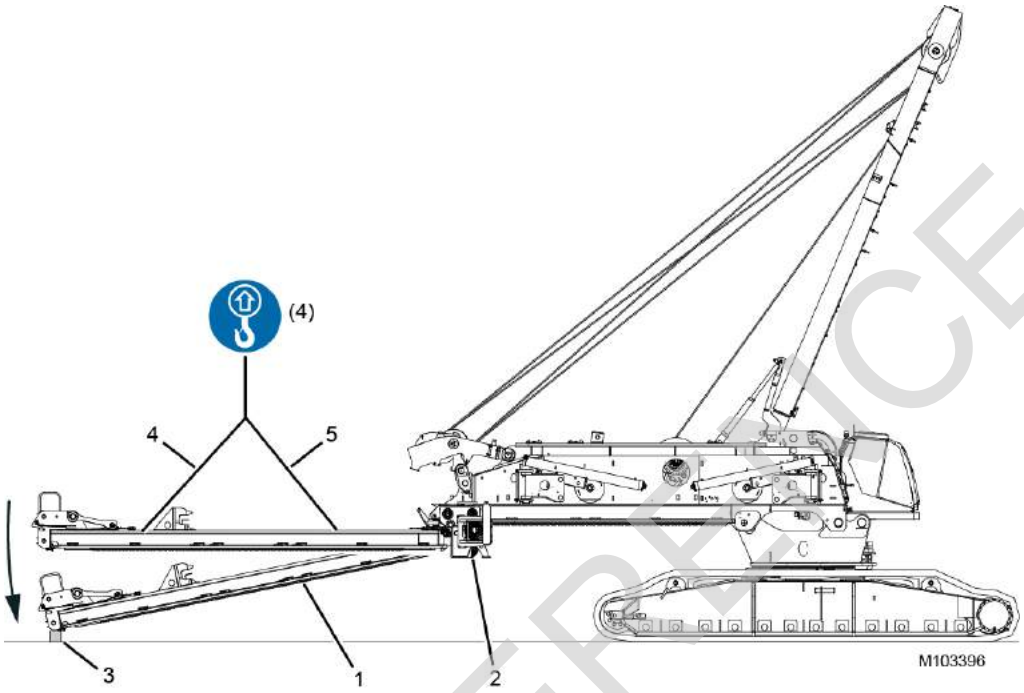
CAUTION

Equipment Damage!

The actuator can damage components if it moves unexpectedly.

Make sure to lock out the VPC-MAX actuator.

15. Turn off the cab power and the remote control key.



Item	Description
1	VPC-MAX Beam
2	Actuator
3	Blocking
4	Rear Pendant (qty 2)
5	Forward Pendant (qty 2)

FIGURE 4-27

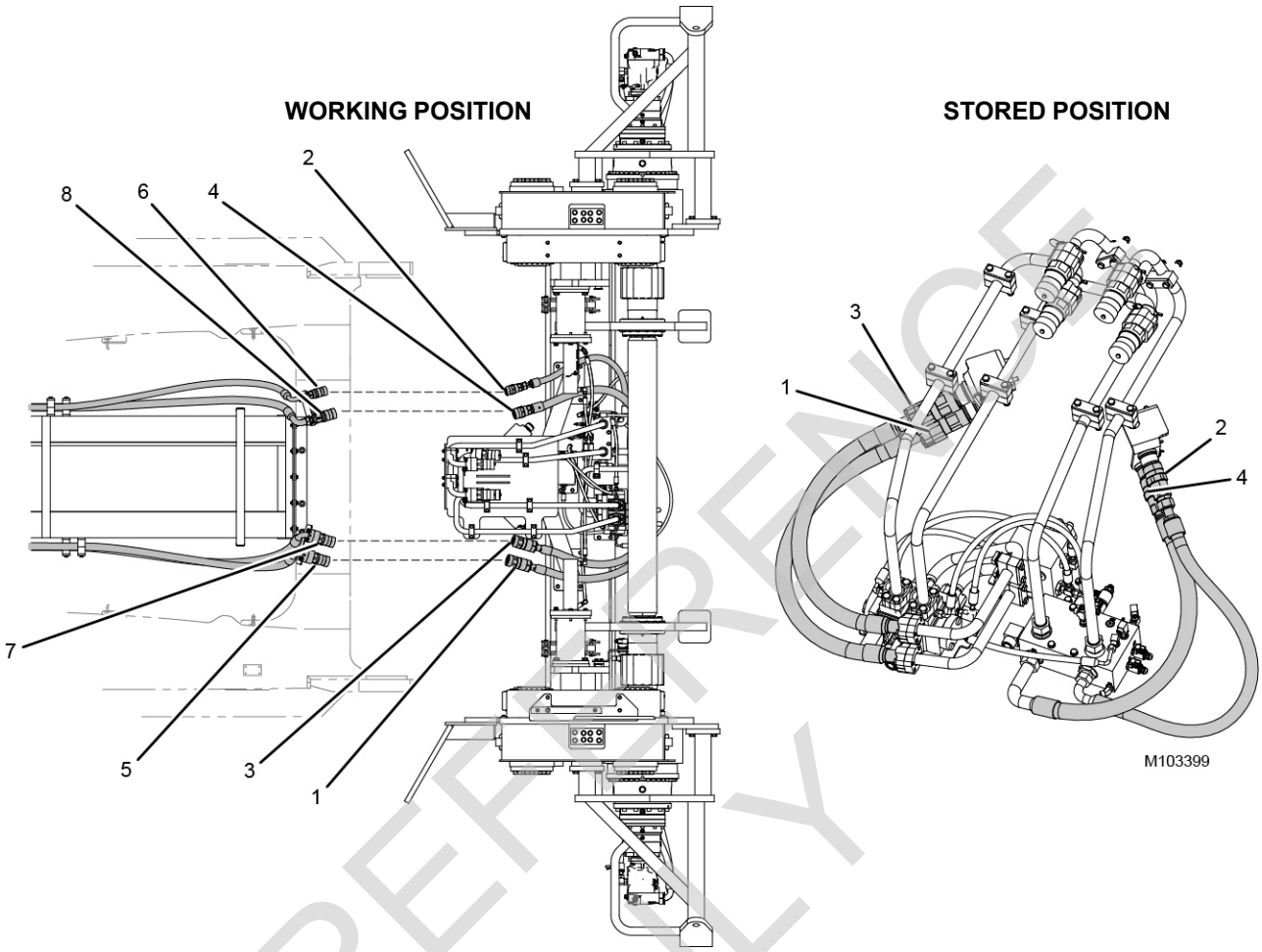
See Figure 4-27 for the following procedure.

16. With the VPC-MAX beam (1) pinned to the actuator (2) and still attached to the assist crane, lower the beam onto the blocking (3).

17. Allow the rear pendants (4) to go slack so the beam is supported only by the blocking and the actuator.

18. Detach the forward pendants (5) from the beam.

19. Secure the forward pendants to the rear pendants so the forward pendants cannot swing freely.



Item	Description
1	Hydraulic Hose Number 31
2	Hydraulic Hose Number 32
3	Hydraulic Hose Number 33
4	Hydraulic Hose Number 34
5	Coupler Number 31
6	Coupler Number 32
7	Coupler Number 33
8	Coupler Number 34

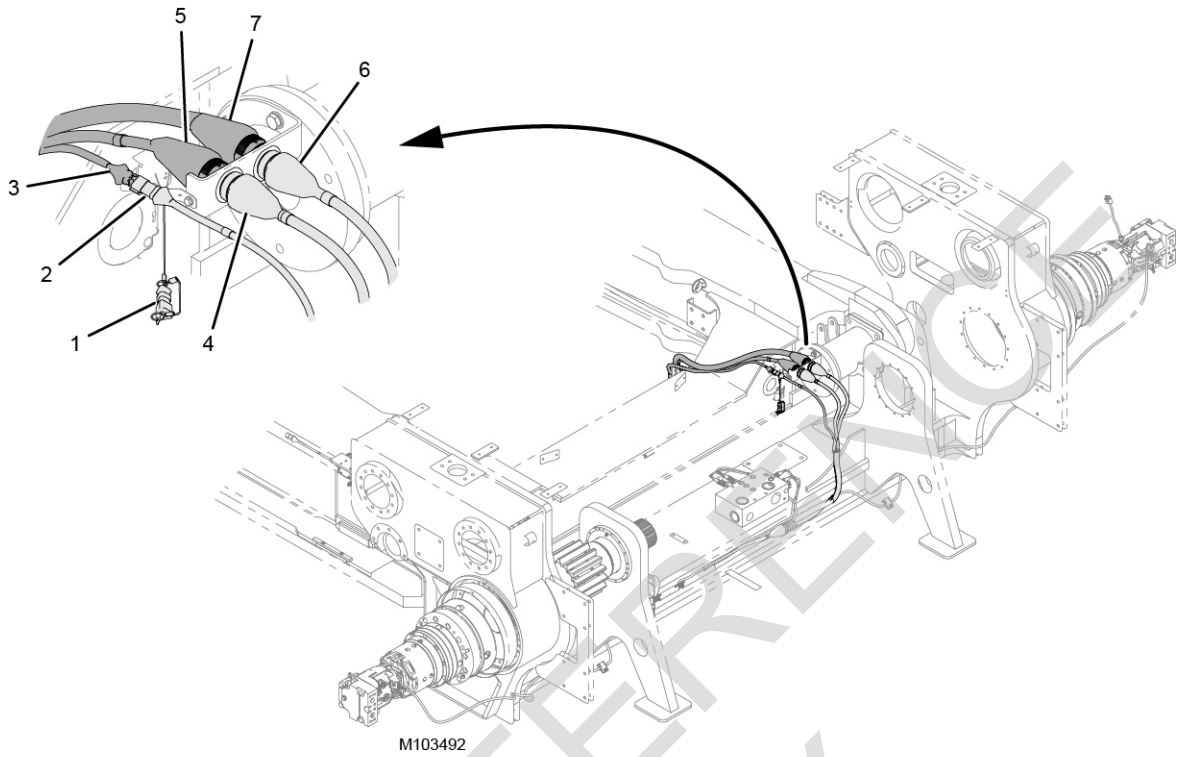
FIGURE 4-28

Connecting the Hydraulic Hoses

See Figure 4-28 for the following procedure.

1. Remove the hydraulic hoses (1–4) from the stored position.
2. Connect the hydraulic hoses on the actuator to the couplers (5–8) on the VPC-MAX beam.

NOTE: The hoses and the corresponding couplers are tagged with numbers. Match the numbers to ensure proper hose connection.



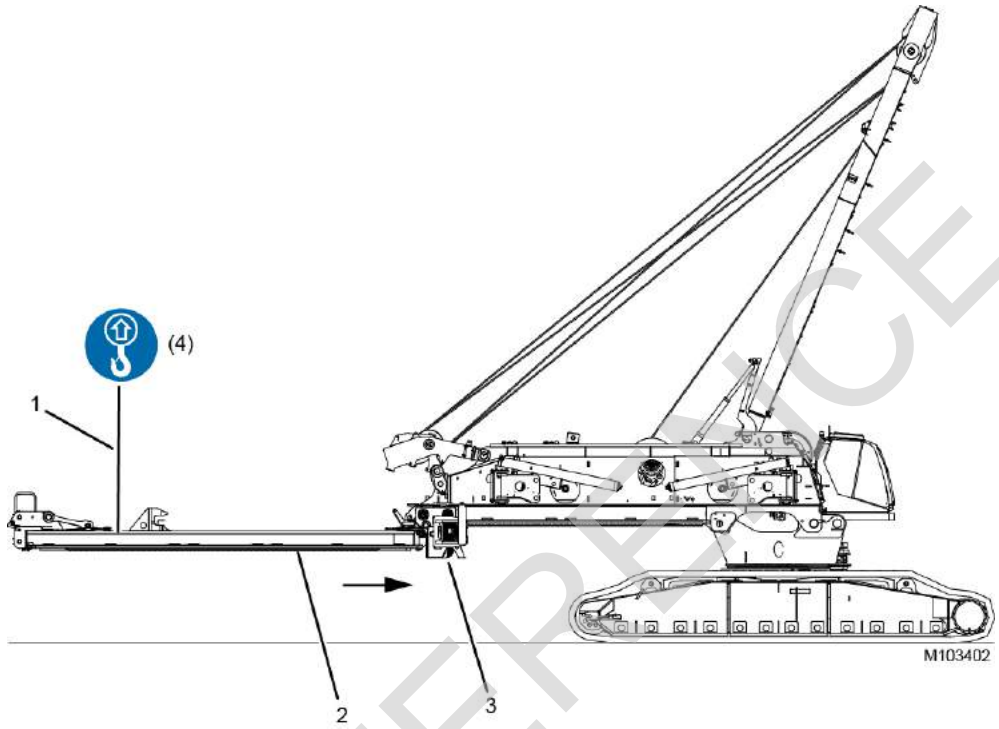
Item	Description
1	Terminating Resistor
2	CAN Plug WVH1-J2
3	CAN Plug WVB5-P1
4	Electrical Plug WVH1-J4
5	Electrical Plug WVB4-P1
6	Electrical Plug WVH1-J1
7	Electrical Plug WVB3-P1

FIGURE 4-29

Connecting the Electrical Cables

See Figure 4-29 for the following procedure.

1. Remove the dust caps from the plugs.
2. Remove the terminating resistor (1) from CAN plug WVH1-J2 (2) on the actuator and mate the resistor to the provided dust cap.
3. Connect CAN plug WVH1-J2 to CAN plug WVB5-P1 (3) on the VPC-MAX beam.
4. Connect electrical plug WVH1-J4 (4) on the actuator to electrical plug WVB4-P1 (5) on the beam.
5. Connect electrical plug WVH1-J1 (6) on the actuator to electrical plug WVB3-P1 (7) on the beam.



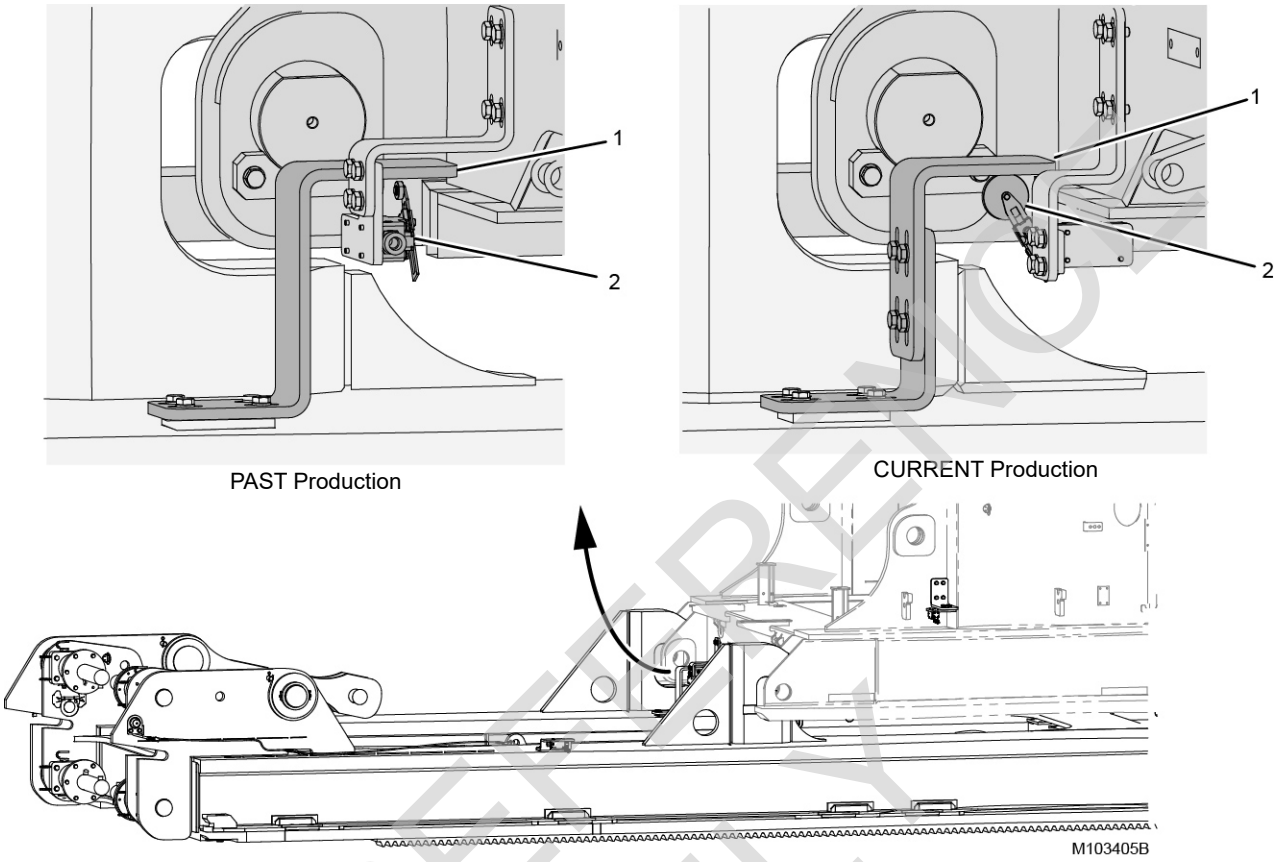
Item	Description
1	Pendant (qty 4)
2	VPC-MAX Beam
3	Actuator

FIGURE 4-30

Drawing the VPC-MAX Beam onto the Rotating Bed

See Figure 4-30 for the following procedure.

1. With the two rear pendants (1) still attached to the rear lifting lugs on the VPC-MAX beam (2), slowly lift the end of the beam off the blocking.
2. Continue to lift the beam to a horizontal position.
3. Turn on the cab power and the remote control key.
4. Using the remote control, drive the actuator (3) forward to the minimum working position while following with the assist crane.
5. While performing step 4, verify that the beam in and out switches are operating properly. See Section 6 of this manual for detailed instructions.

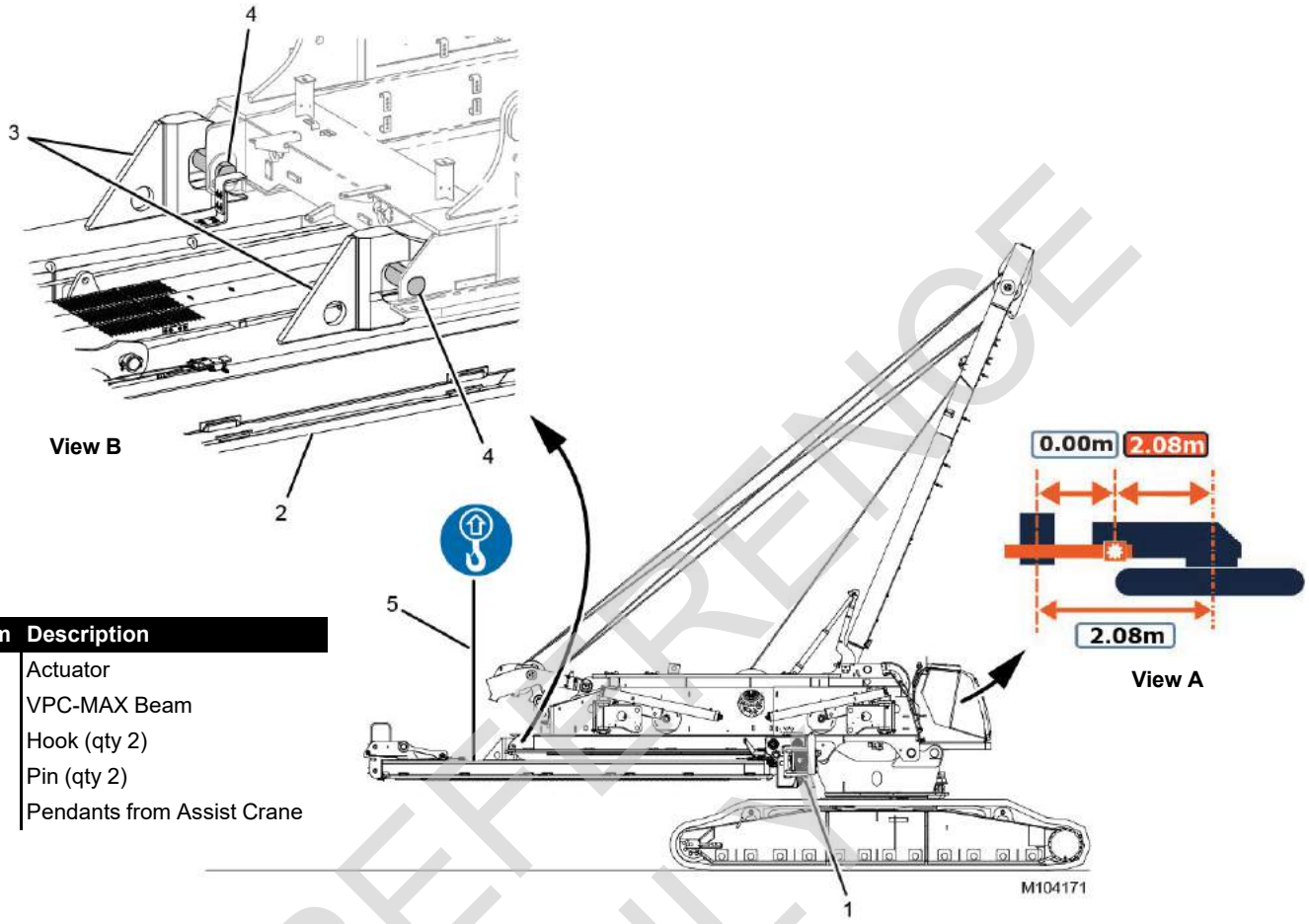


Item	Description
1	Limit Switch Tripping Bracket (qty 2)
2	Beam-on-Hook Limit Switch (qty 2)

FIGURE 4-31

See Figure 4-31 for the following procedure.

6. As the actuator reaches the minimum working position, keep the rear of the beam just high enough for the limit switch tripping brackets (1) to clear the top of the beam-on-hook limit switches (2).



Item	Description
1	Actuator
2	VPC-MAX Beam
3	Hook (qty 2)
4	Pin (qty 2)
5	Pendants from Assist Crane

FIGURE 4-32

See Figure 4-32 for the following procedure.

7. Stop moving the actuator (1) forward when it is at the **minimum working position**:

- The VPC-MAX calibration screen in the cab should read 2.08 as shown in View A.
- The VPC-MAX beam hooks (1, View B) should be positioned directly over the pins (2) at the rear of the rotating bed.

8. Adjust the beam-on-hook limit switches as instructed in Section 6 of this manual.

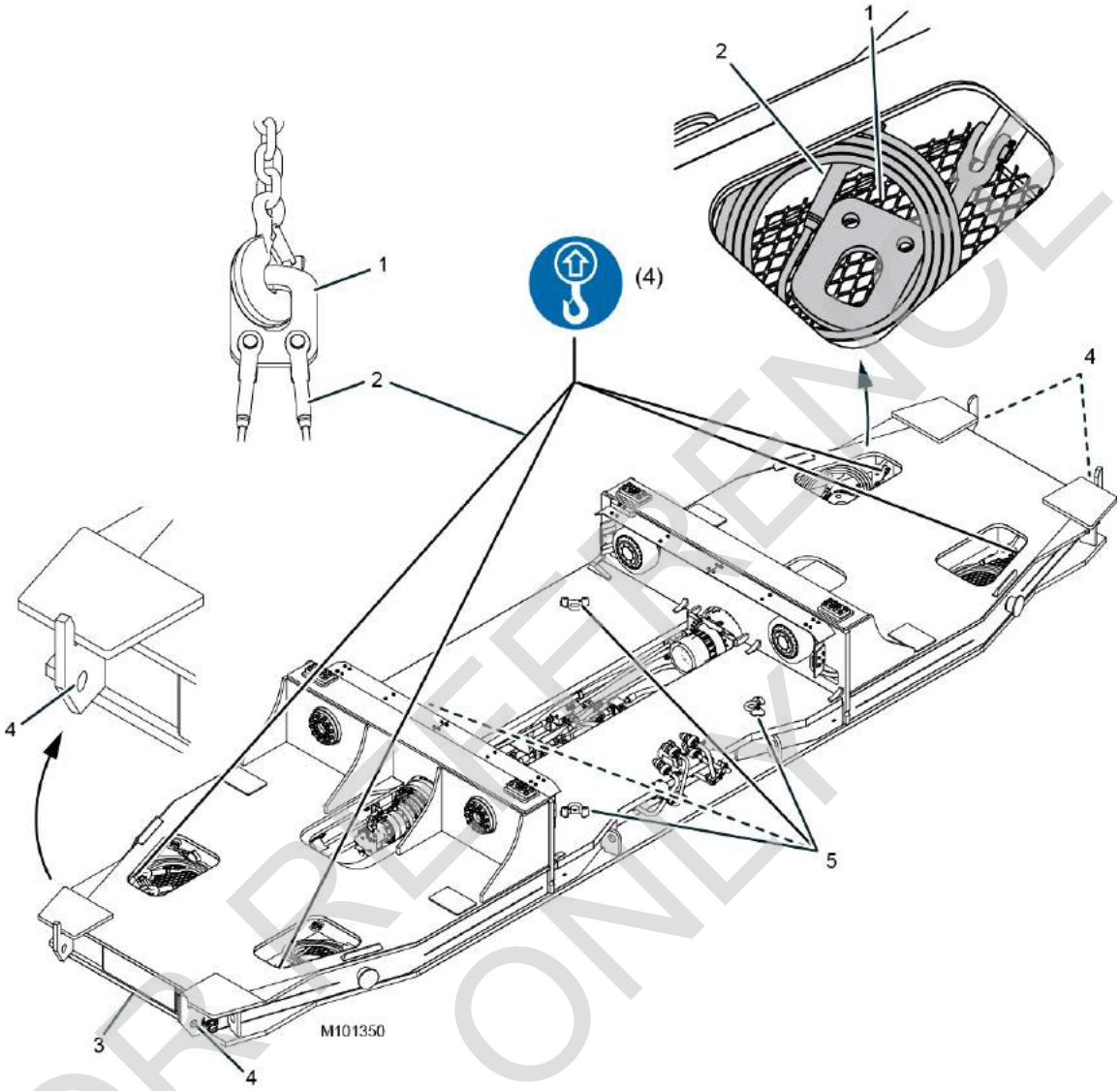
9. Adjust the beam up limit switches as instructed in Section 6 of this manual.

10. Slowly lower the beam with the assist crane until the hooks (3) are resting on the pins (4), thereby supporting the beam.

NOTE: The beam will trip the two beam-on-hook limit switches when the hooks rest on the pins. In this state, the control system does not allow the actuator to travel.

11. Slowly lower the assist crane hook to slacken pendants (5).

12. Unpin the pendants from the beam.



Item	Description
1	Plate (qty 2)
2	Pendant (qty 4)
3	Counterweight Tray
4	Lug (qty 4)
5	Alternate Lifting Ring (qty 4)

FIGURE 4-33

Installing the Counterweight Tray

See Figure 4-33 for the following procedure.

NOTE: Install the counterweight tray with an assist crane. Damage may occur if the tray is lifted too high.

WARNING

Falling Object Hazard!

The counterweight tray weighs approximately 20 000 kg (44,000 lb). Use the appropriate equipment and techniques for lifting and transporting the counterweight tray. Otherwise it could fall, possibly causing injury.

Handling the Tray

1. Using the two plates (1) and four pendants (2), attach the counterweight tray (3) to the assist crane.

NOTE: Any additional rigging used between the assist crane hook block and plates must not exceed 3,6 m (12 ft) in length.

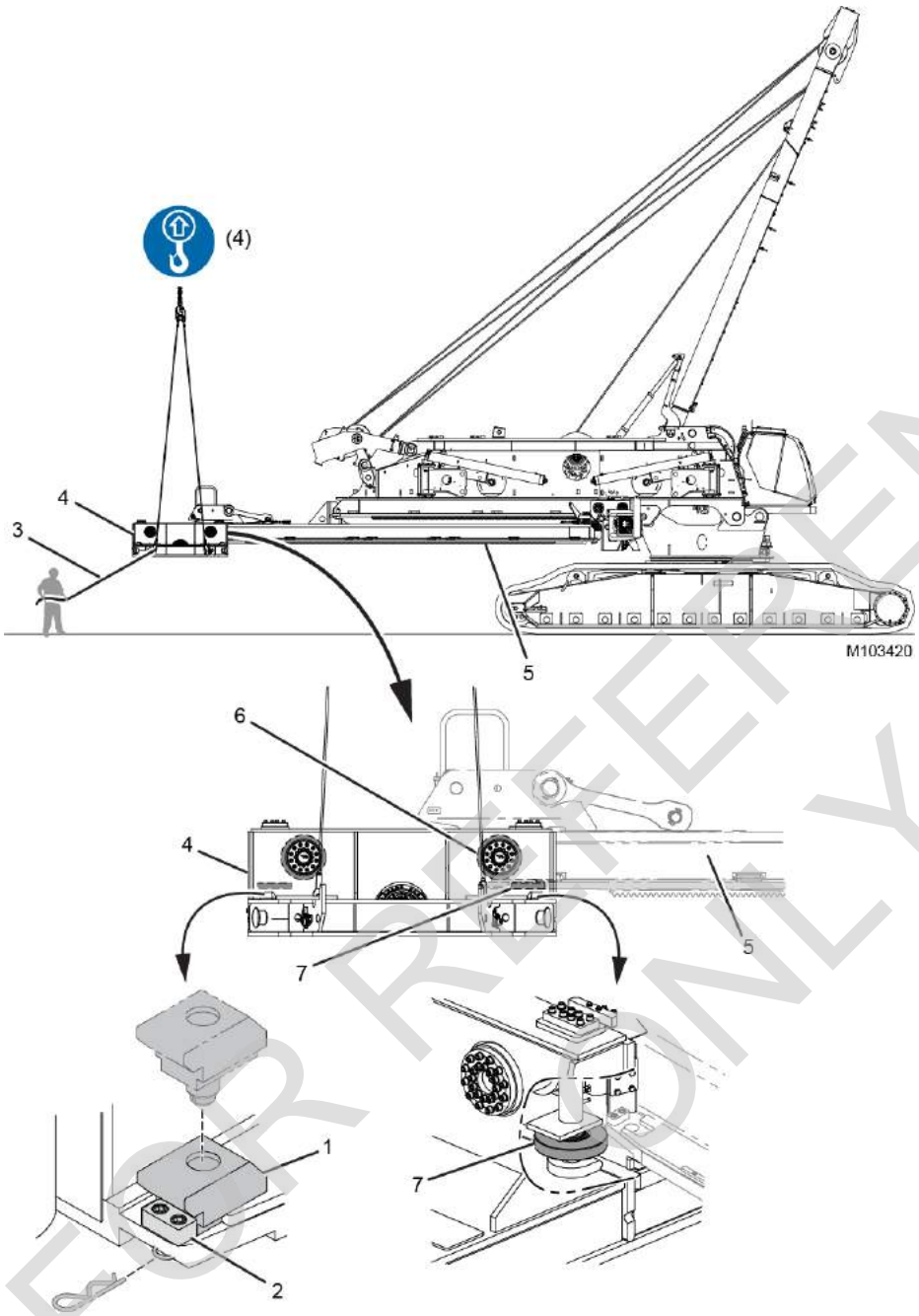
2. Attach taglines to the lugs (4) on opposite sides of the counterweight tray.

CAUTION

Equipment Damage!

The alternate lifting rings (5) must lay flat before installing the counterweight tray onto the VPC-MAX beam or damage will occur.

3. Have assistants use the taglines to help control the movement of the tray and to help guide the tray onto the VPC-MAX beam.



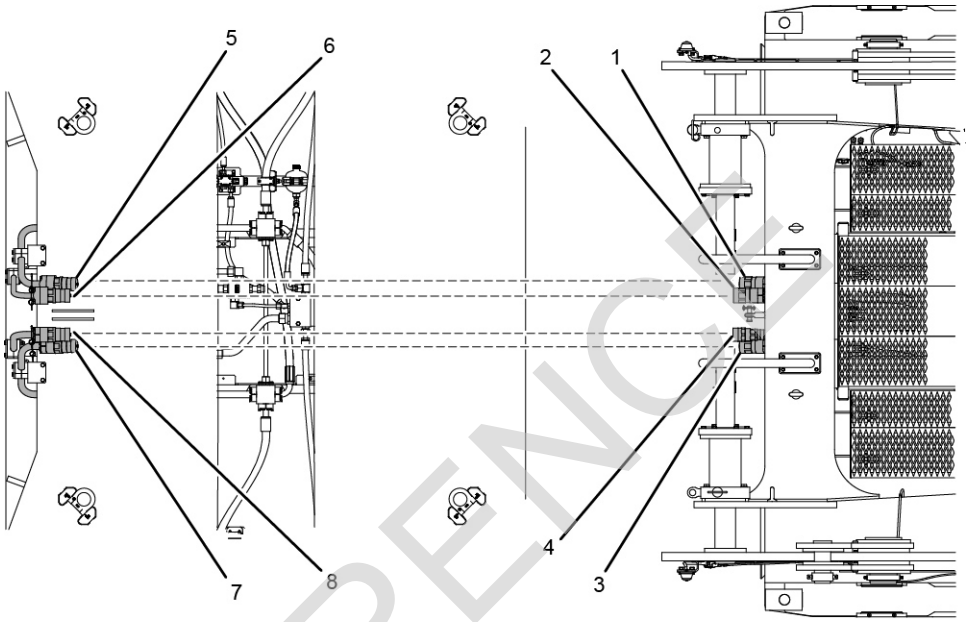
Item	Description
1	Large Main Stop Block (qty 2)
2	Small Bolt-on Stop Block (qty 2)
3	Tagline (qty 4)
4	Counterweight Tray
5	VPC-MAX Beam
6	Front (vertical) Roller (qty 2)
7	Side Roller (qty 2)

FIGURE 4-34

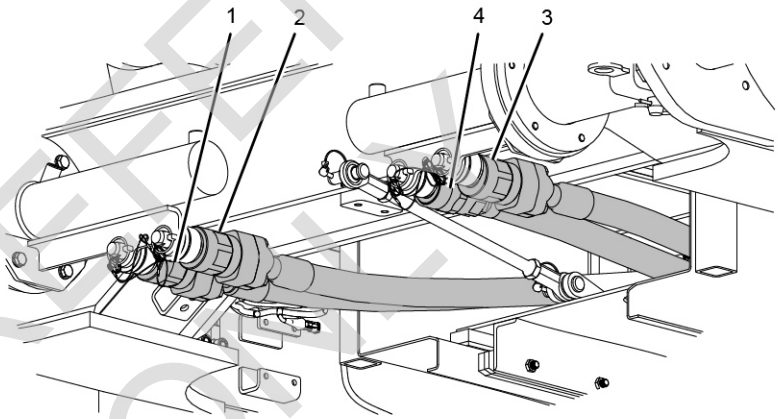
See Figure 4-34 for the following procedure.

4. Remove the large main stop blocks (1). Do not remove the small bolt-on stop blocks (2).
5. Using the assist crane and the taglines (3), position the counterweight tray (4) at the back of the VPC-MAX beam (5) so the front (vertical) rollers (6) contact the roller wear plates.
6. Adjust (lower) the tray with the assist crane so the tray is nearly horizontal.
7. Pull the tray onto the beam until the first set of side rollers (7) on the tray contact the lead-in area on the sides (edges) of the beam.
8. Using the assist crane and the taglines, slowly draw the tray farther onto the beam until the rear (vertical) rollers contact the wear plates.

   During this process, the rear rollers contact and roll over the small bolt-on stop blocks.



Item	Description
1	Hydraulic Hose Number 31
2	Hydraulic Hose Number 32
3	Hydraulic Hose Number 33
4	Hydraulic Hose Number 34
5	Coupler Number 31
6	Coupler Number 32
7	Coupler Number 33
8	Coupler Number 34



STORED POSITION

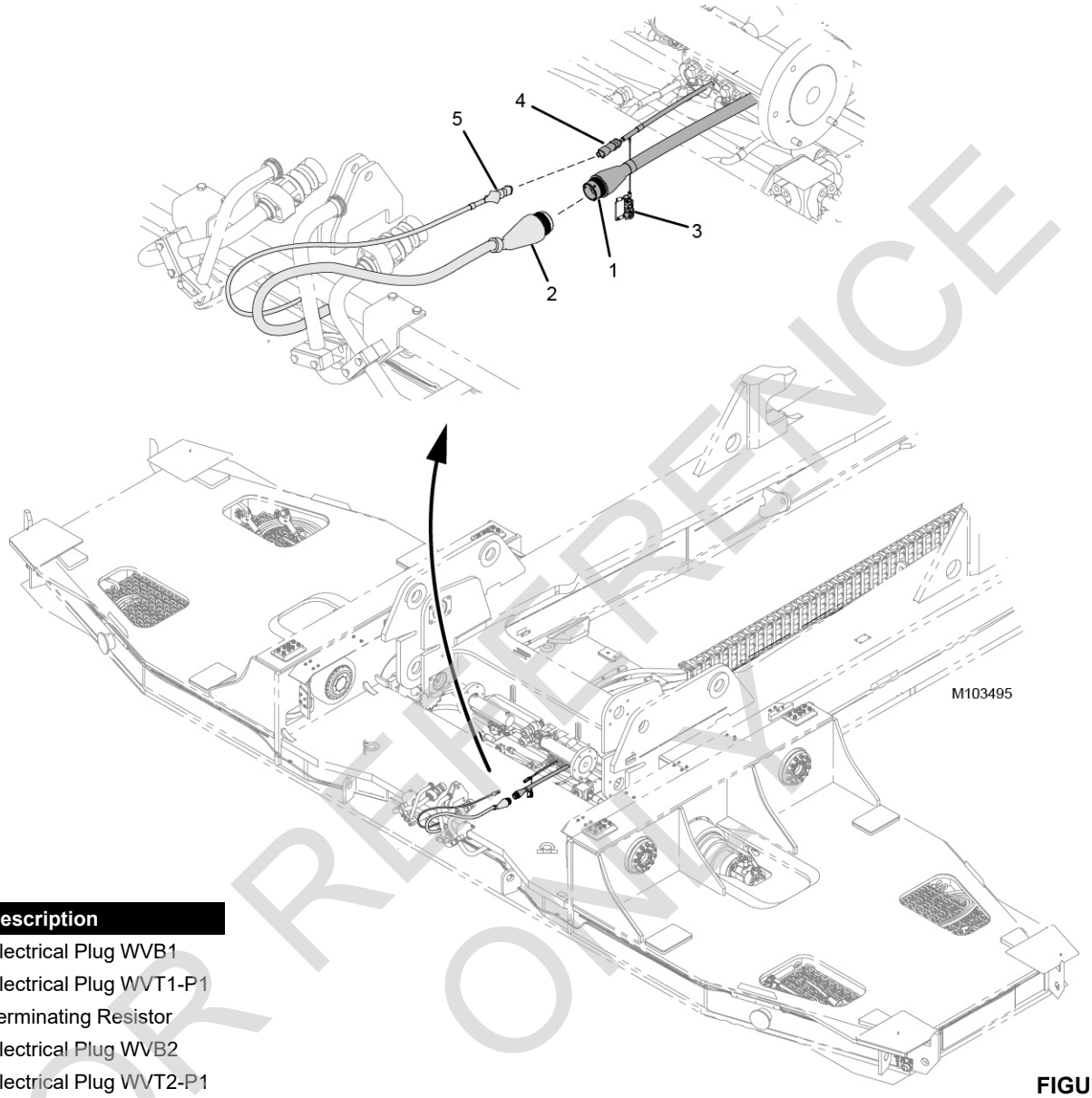
FIGURE 4-35

Connecting the Hydraulic Hoses

See Figure 4-35 for the following procedure.

1. Remove the four hydraulic hoses (1–4) from the stored position.
2. Connect the hydraulic hoses on the VPC-MAX beam to the couplers (5–8) on the counterweight tray.

NOTE: The hoses and the corresponding couplers are tagged with numbers. Match the numbers to ensure proper hose connection.



Item	Description
1	Electrical Plug WVB1
2	Electrical Plug WVT1-P1
3	Terminating Resistor
4	Electrical Plug WVB2
5	Electrical Plug WVT2-P1

FIGURE 4-36

Connecting the Electrical Cables

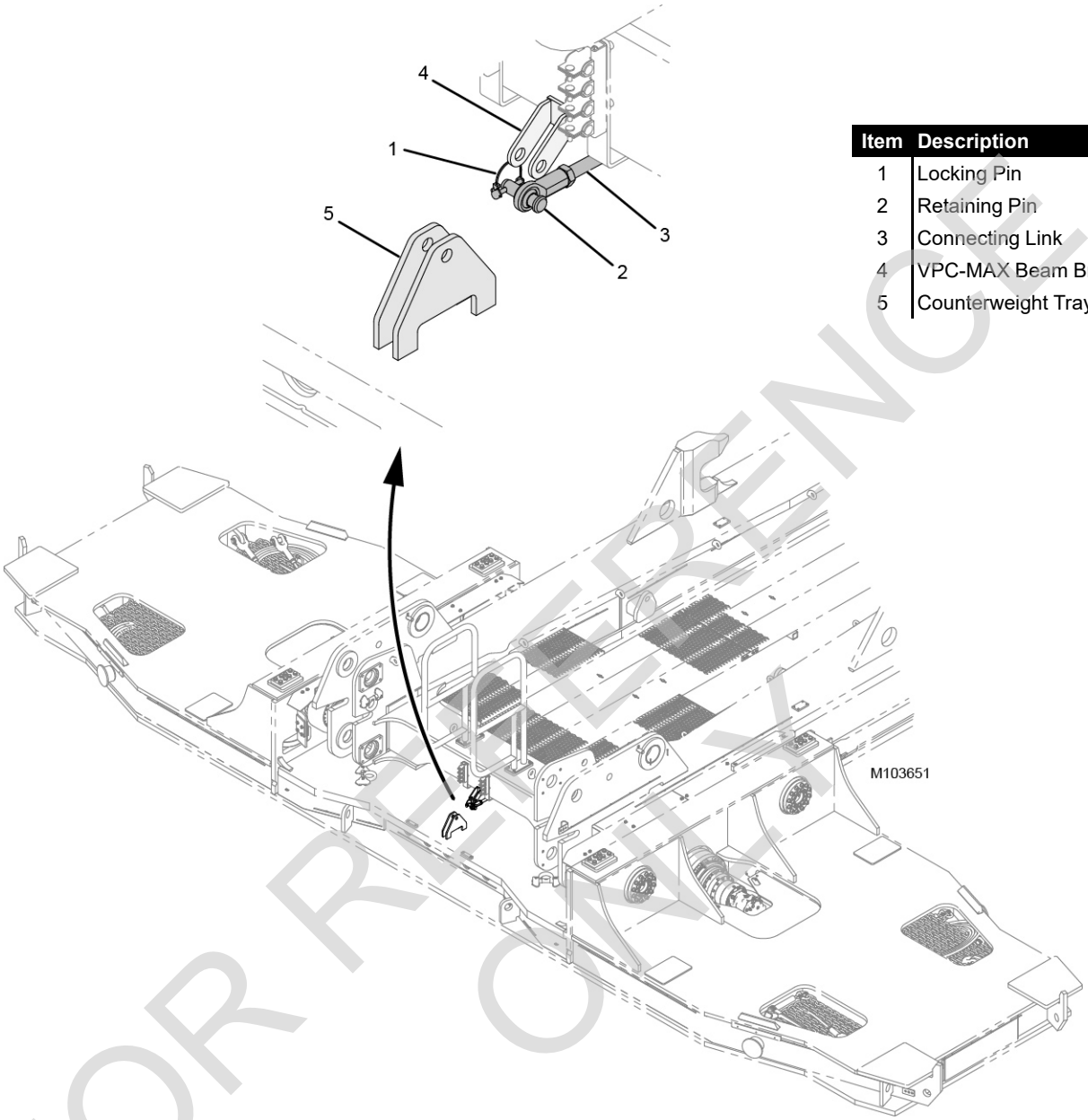
See Figure 4-36 for the following procedure.

1. Remove the dust caps from the plugs.
2. Connect electrical plug WVB1 (1) from the VPC-MAX beam to electrical plug WVT1-P1 (2) on the counterweight tray.
3. Remove the terminating resistor (3) from electrical plug WVB2 (4) on the beam and mate the resistor to the provided dust cap.
4. Connect electrical plug WVB2 on the beam to electrical plug WVT2-P1 (5) on the tray.

Positioning the Counterweight Tray

Using the remote control, slowly activate the drive pinions. Watch each side to ensure the teeth mesh properly. Stop when the first rack tooth is in full mesh with the pinion.

It is possible that only one pinion will turn prior to engaging the rack.



Item	Description
1	Locking Pin
2	Retaining Pin
3	Connecting Link
4	VPC-MAX Beam Bracket
5	Counterweight Tray Bracket

FIGURE 4-37

Attaching the Connecting Link

See Figure 4-37 for the following procedure.

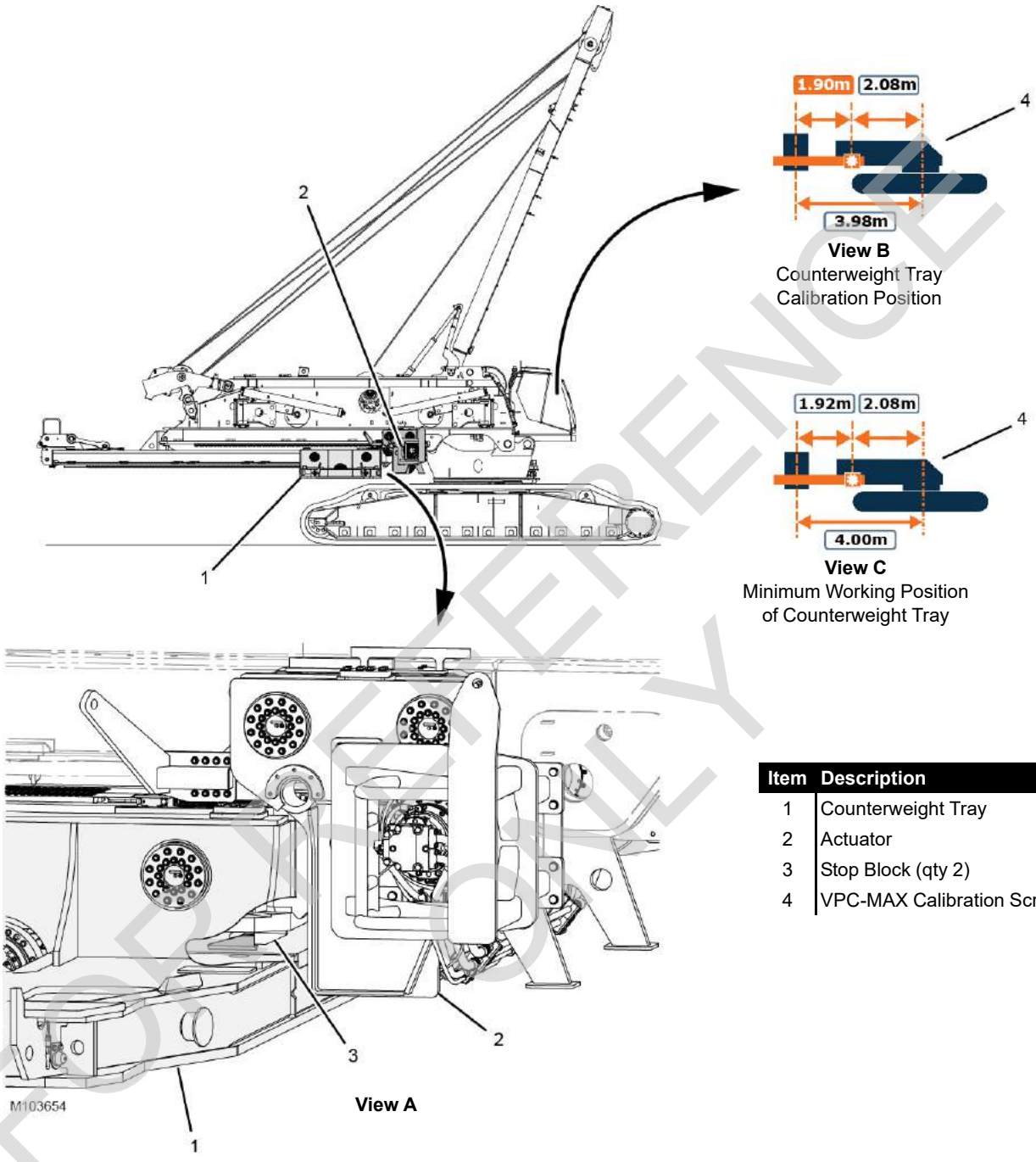
1. Remove the locking pin (1) and retaining pin (2) from the connecting link (3).
2. Remove the connecting link from the stored position in the VPC-MAX beam bracket (4).
3. Adjust the slide and/or tray position to align the connecting link with the counterweight tray bracket (5).
4. Install the retaining pin and hair pin cotter to secure the connecting link in the working position.

Installing the Large Main Stop Blocks

1. Drive the tray forward to a position to allow for large main stop block installation.
2. Install the large main stop blocks by reversing the removal procedure (see Figure 4-34 on page 4-36).

Detaching the Assist Crane

1. Detach the counterweight tray from the assist crane.
2. Store the pendants and plates in the counterweight tray as shown in Figure 4-33 on page 4-34.



Item	Description
1	Counterweight Tray
2	Actuator
3	Stop Block (qty 2)
4	VPC-MAX Calibration Screen

FIGURE 4-38

Calibrating the Counterweight Tray

See Figure 4-38 for the following procedure.

1. Using the remote control, drive the counterweight tray (1, View A) all the way forward to the stop blocks (3) on the actuator.
2. Calibrate the counterweight tray in the VPC-MAX calibration screen (View B).

   See the Main Display Operation Manual for detailed instructions under the topic VPC-MAX Calibration at Installation.
3. Once calibrated, drive the tray rearward until it is at the **minimum working position** of 4.00 m as indicted in the calibration screen (View C).

Installing the Auxiliary Frame Assembly

WARNING

Structural Damage Hazard!

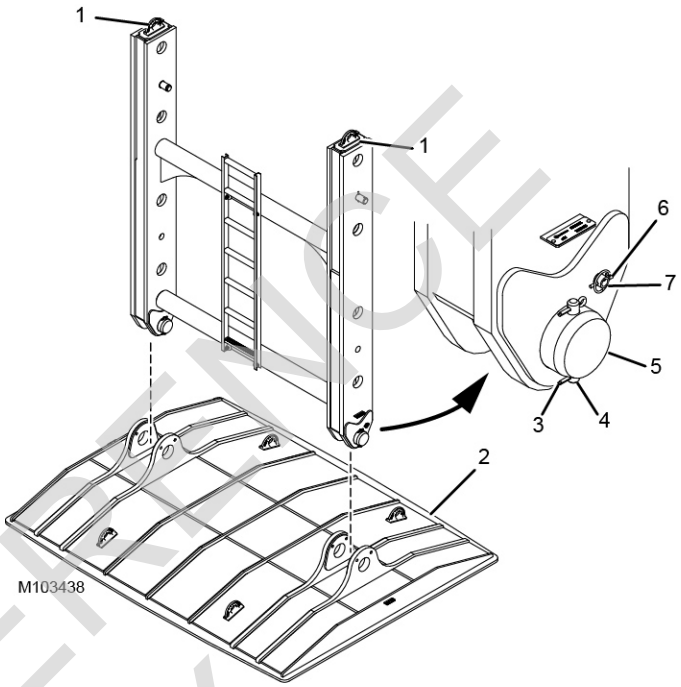
A sudden release of load and/or dynamic loading (due to swinging, hoisting, or lowering and adverse weather conditions to include wind) may cause structural damage due to shock loading and unintended motion of the crane.

The auxiliary frame assembly is provided to limit unintended motion of the VPC-MAX beam and counterweights during a sudden release of load and/or dynamic loading (due to swinging, hoisting, or lowering and adverse weather conditions to include wind).

The auxiliary frame assembly in no way substitutes for, or lessens, the requirement that the crane must be operated properly and safely, and that it must be inspected, serviced, and maintained regularly to minimize the potential for a sudden release of load and/or dynamic loading (due to swinging, hoisting, or lowering and adverse weather conditions to include wind).

See Figure 4-39 for the following procedure.

1. Using an assist crane, attach two **SL 4** slings – 3,80 m (12.50 ft), 11 340 kg (25,000 lb) – to the auxiliary frame lift points (1).
2. Hoist the auxiliary frame into position to install to the pad (2).
3. Remove the cotter pins (3) from each of the retaining pins (4).
4. Remove the retaining pins from the clevis pins (5).
5. Remove the clevis pins.
6. Remove the lynch pins (6) from each of the secondary pins (7).
7. Remove the secondary pins.
8. Install the auxiliary frame to the pad.



Item	Description
1	Auxiliary Frame Lift Point (qty 2)
2	Pad
3	Cotter Pin (qty 8)
4	Retaining Pin (qty 4)
5	Clevis Pin (qty 2)
6	Lynch Pin (qty 4)
7	Secondary Pin (qty 2)

FIGURE 4-39

Item	Description
1	Clevis Pin (qty 2)
2	Auxiliary Frame Assembly
3	Cotter Pin (qty 8)
4	Retaining Pin (qty 4)
5	Secondary Pin (qty 2)
6	Lynch Pin (qty 4)
7	Powered Retaining Pin (qty 4)
8	Hitch Pin (qty 4)
9	Hair Pin Cotter (qty 4)

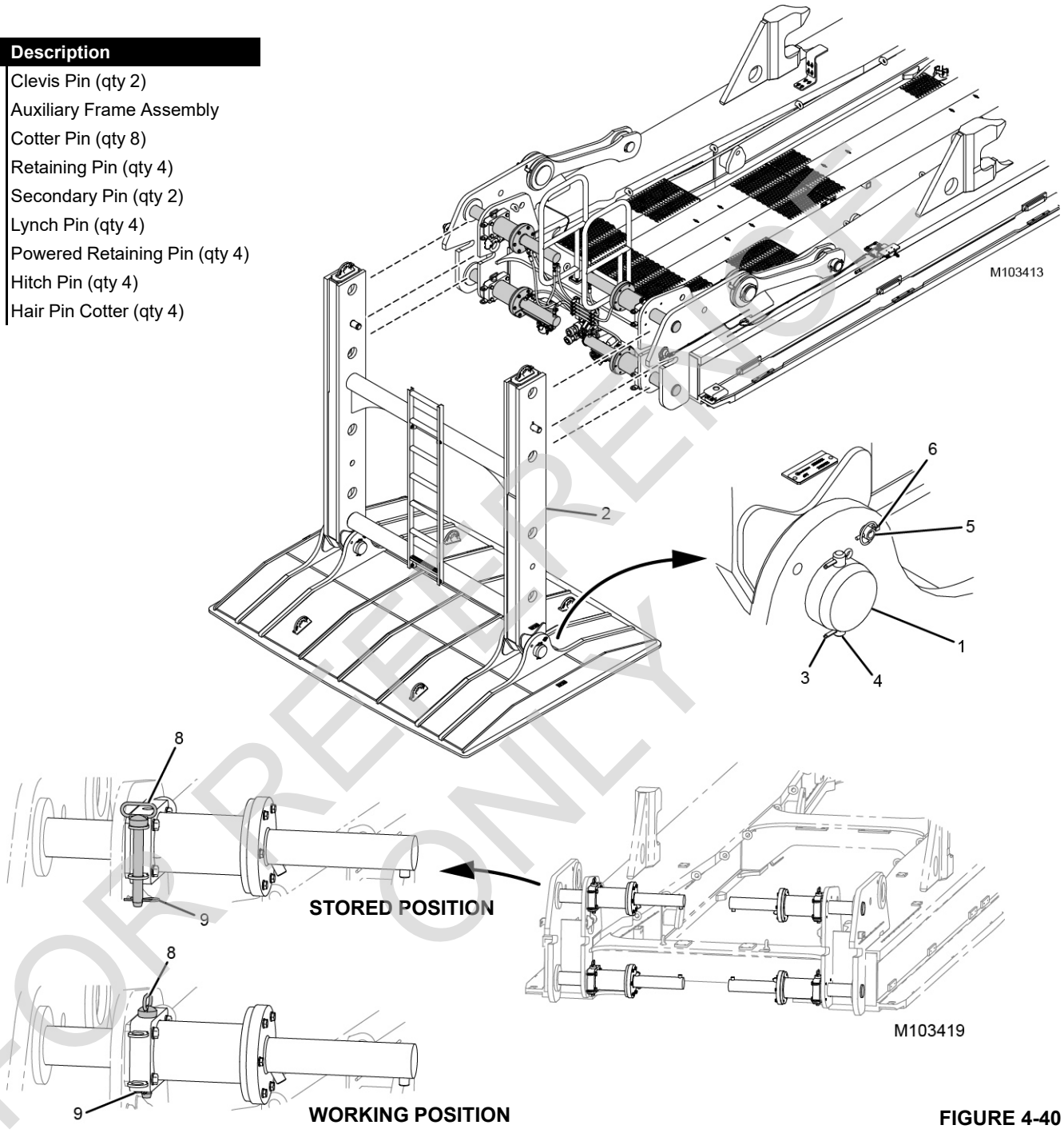


FIGURE 4-40

See Figure 4-40 for the following procedure.

9. Install the clevis pins (1) to the auxiliary frame assembly (2).

10. Install the retaining pins (4) to the clevis pins.

11. Secure the retaining pins with the cotter pins (3).

12. Install the secondary pins (5).

13. Secure the secondary pins with the lynch pins (6).

14. Using the assist crane, install the auxiliary frame assembly in its working position.

15. Using the remote control, extend the powered retaining pins (7).

16. Remove the hitch pins (8) from the stored position.

17. Install the hitch pins and the hair pin cotters (9) in the working position.

THIS PAGE INTENTIONALLY LEFT BLANK

Removing the Counterweight Boxes from the Trailer

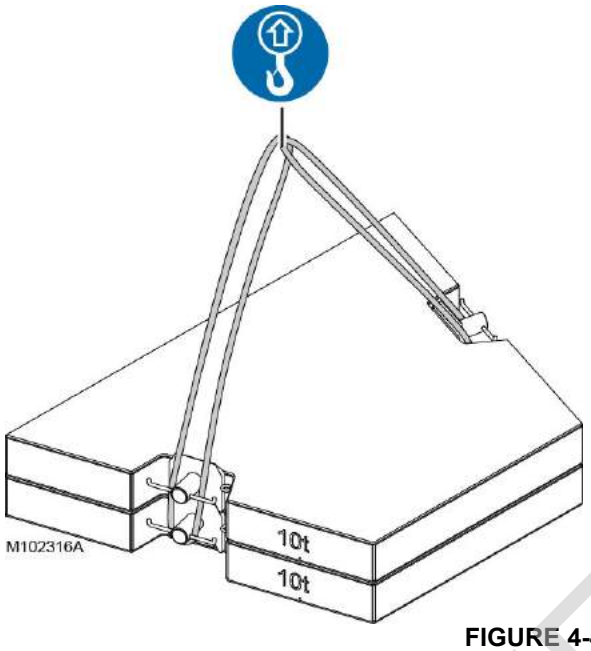


FIGURE 4-41

WARNING

Crushing Hazard!

Do not lift more than two counterweight boxes at a time. The lifting lugs may break, resulting in the boxes falling.

NOTE: One or two counterweight boxes can be lifted at a time.

1. Remove the tie downs and blocking securing the box(es) to the trailer.
2. Use two **SL 4** slings – 3,80 m (12.50 ft), 11 340 kg (25,000 lb) – to remove the counterweight box(es) from the trailer as shown in Figure 4-41.
3. Remove the trailer.
4. Place the box(es) in the assembly area for installation purposes.
5. Disconnect the slings from the box(es).
6. Repeat steps1 through 5 for all of the boxes.

Installing the Counterweight Boxes

If not already done, drive the counterweight tray to the **minimum working position** of 4.00 m as indicted in the VPC-MAX calibration screen (View C, Figure 4-38 on page 4-40).

Remove the counterweight boxes from the trailers and install them using an assist crane.

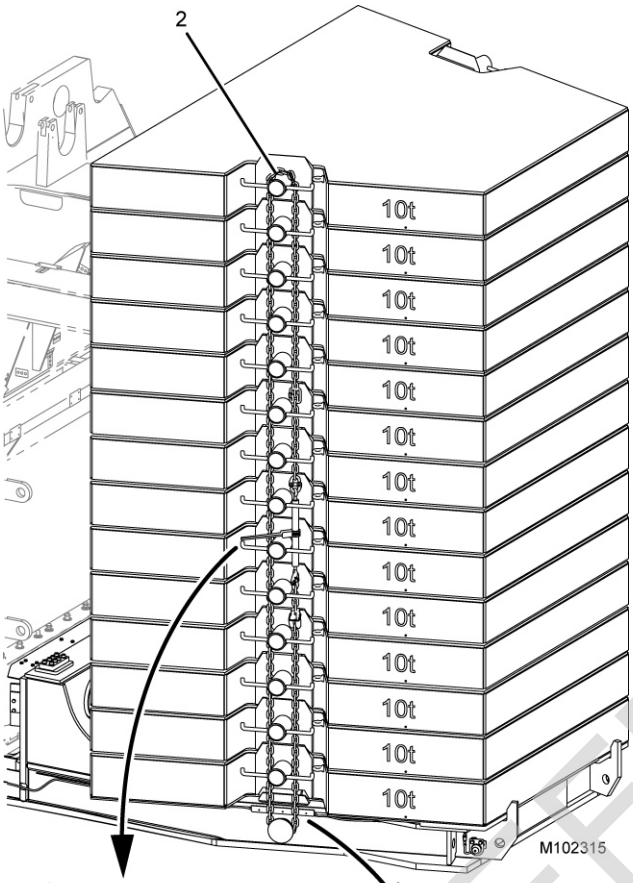
- The counterweight tray weighs 20 000 kg (44,000 lb)
- Each counterweight box weighs 10 000 kg (22,000 lb)

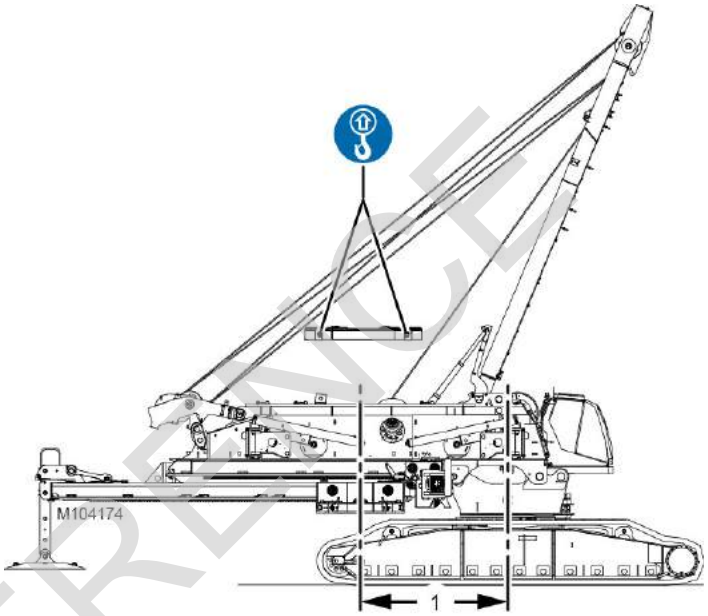
WARNING

Crushing Hazard!

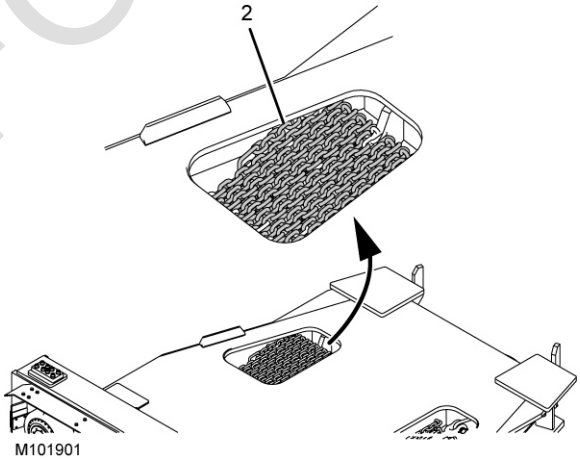
To prevent the crane from tipping and the counterweight boxes from falling off the tray during assembly/disassembly, do not install (or remove) the boxes until the counterweight tray is at the ***minimum working position***. The crane will tip.

To prevent the counterweight boxes from falling and crushing personnel, do not lift more than two boxes at a time. The lifting lugs may break, resulting in the boxes falling.





Item	Description
1	Tray at Minimum Working Position
2	Counterweight Chain Assembly (qty 4)
3	**SL** 4 Sling – 3,80 m (12.50 ft), 11 340 kg (25,000 lb) (qty 2)
4	Counterweight Box Alignment Lug (qty 2 each box)
5	Counterweight Tray Alignment Lug (qty 4)
6	Counterweight Tray Lug (qty 4)
7	Turnbuckle (qty 4)



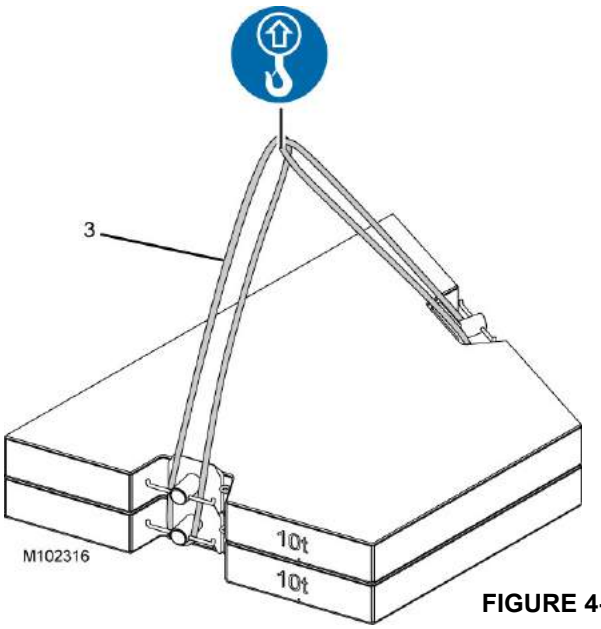


FIGURE 4-42

See Figure 4-42 for the following procedure.

NOTE: Series 1, 2, or 3 counterweight can be installed at this time.

A minimum of Series 1 counterweight is required to install the partial boom with the fixed mast.

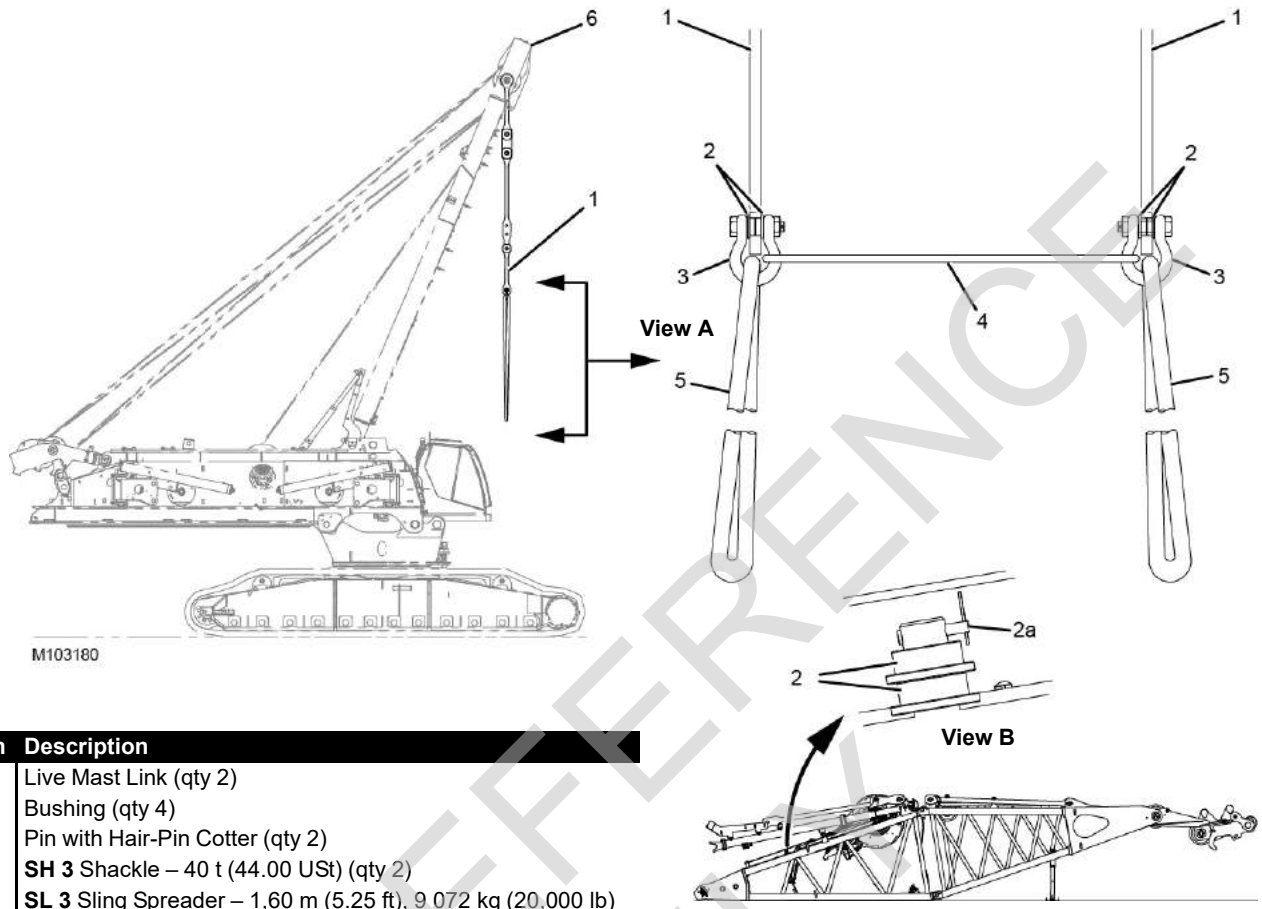
Series	Total Counterweight	Boxes each Side
1	200 000 kg (440,900 lb)	9
2	300 000 kg (661,300 lb)	14
3	400 000 kg (881,800 lb)	19

1. If not already done, drive the counterweight tray to the **minimum working position** of 4.00 m as indicted in the VPC-MAX calibration screen (View C, Figure 4-38 on page 4-40).
2. Remove the counterweight chain assemblies (2) from the stored position in the counterweight tray.
3. Attach the two **SL 4** slings (3) to the assist crane and around the lugs on one counterweight box.
4. Boom, swing, and hoist as necessary to position the box on the desired side of the counterweight tray.
5. Lower the box so the counterweight box alignment lugs (4) engage the counterweight tray alignment lugs (5).

   Each additional box must have the alignment lugs engage with the alignment lugs on the box below.
6. Remove the slings.
7. Attach the slings around the lifting lugs on two counterweight boxes.
8. Boom, swing, and hoist as necessary to position the boxes on the opposite side of the counterweight tray.
9. Lower the boxes so the lower counterweight box alignment lugs engage the counterweight tray alignment lugs.

   Lower each additional box so the alignment lugs engage with the alignment lugs on the box below.
10. Remove the slings.
11. Continue to install two boxes, alternating from side to side.
12. Install one box to level the sides.
13. Install the counterweight chain assemblies (2) by threading the chain through each counterweight lifting lug and around the counterweight tray lug (6). The counterweight chain assemblies are designed to minimize counterweight movement during travel and operation permitted by Manitowoc's operating instructions.
14. Connect the counterweight chain assemblies to the turnbuckle (7) hooks.
15. Tighten the turnbuckles until the counterweight chain assemblies around the lugs are snug.

NOTE: The ratchet on the turnbuckle must be flipped in one direction to tighten the turnbuckle and in the opposite direction to loosen the turnbuckle.



Item	Description
1	Live Mast Link (qty 2)
2	Bushing (qty 4)
2a	Pin with Hair-Pin Cotter (qty 2)
3	**SH 3** Shackle – 40 t (44.00 USt) (qty 2)
4	**SL 3** Sling Spreader – 1,60 m (5.25 ft), 9 072 kg (20,000 lb)
5	**SL 1** Sling – 3,30 m (10.83 ft), 45 360 kg (100,000 lb) (qty 2)
6	Live Mast

FIGURE 4-43

Assembling the Fixed Mast

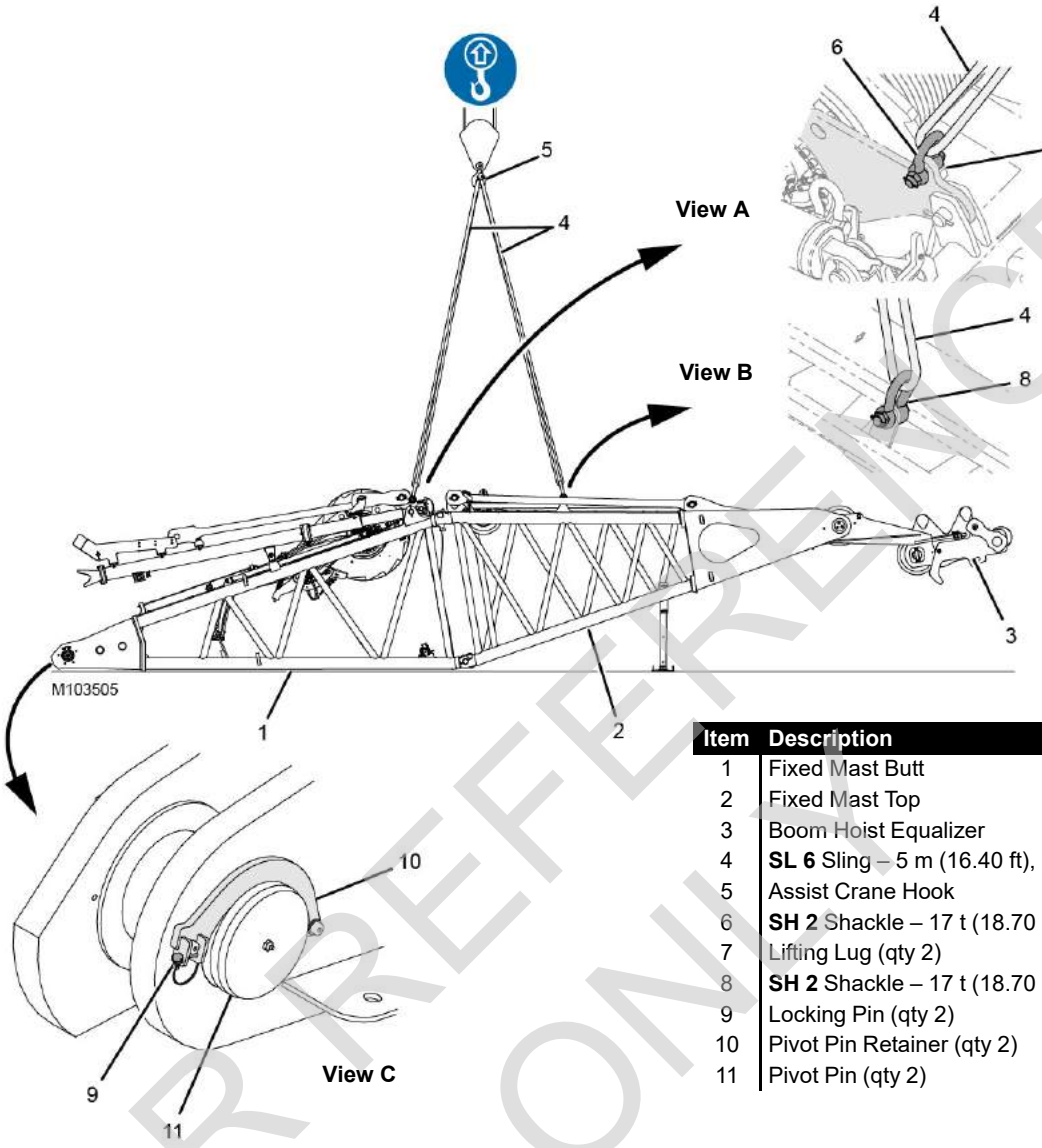
An assist crane is required to assemble and install the fixed mast.

NOTE: Disconnect the hydraulic hoses for the boom from their stored position on the front of the rotating bed. Allow the hoses to hang down at the front of the rotating bed. Raising the fixed mast will damage the hoses if this step is not performed. See Section 4 of the Crane Operator Manual for more information.

Installing the Live Mast Lifting Slings

See Figure 4-43, View A for the following procedure.

1. Remove the bushings (2, View B) from storage on each side of the mast butt.
2. Insert the bushings (2) into the live mast links (1).
3. Attach the **SL 3** sling spreader (4) to the **SH 3** shackles.
4. Attach the **SL 1** slings (5) to the **SH 3** shackles.
5. Attach the **SH 3** shackles (3) to the live mast links.



Item	Description
1	Fixed Mast Butt
2	Fixed Mast Top
3	Boom Hoist Equalizer
4	**SL 6** Sling – 5 m (16.40 ft), 31 751 kg (70,000 lb) (qty 4)
5	Assist Crane Hook
6	**SH 2** Shackle – 17 t (18.70 USt) (qty 2)
7	Lifting Lug (qty 2)
8	**SH 2** Shackle – 17 t (18.70 USt) (qty 2)
9	Locking Pin (qty 2)
10	Pivot Pin Retainer (qty 2)
11	Pivot Pin (qty 2)

FIGURE 4-44

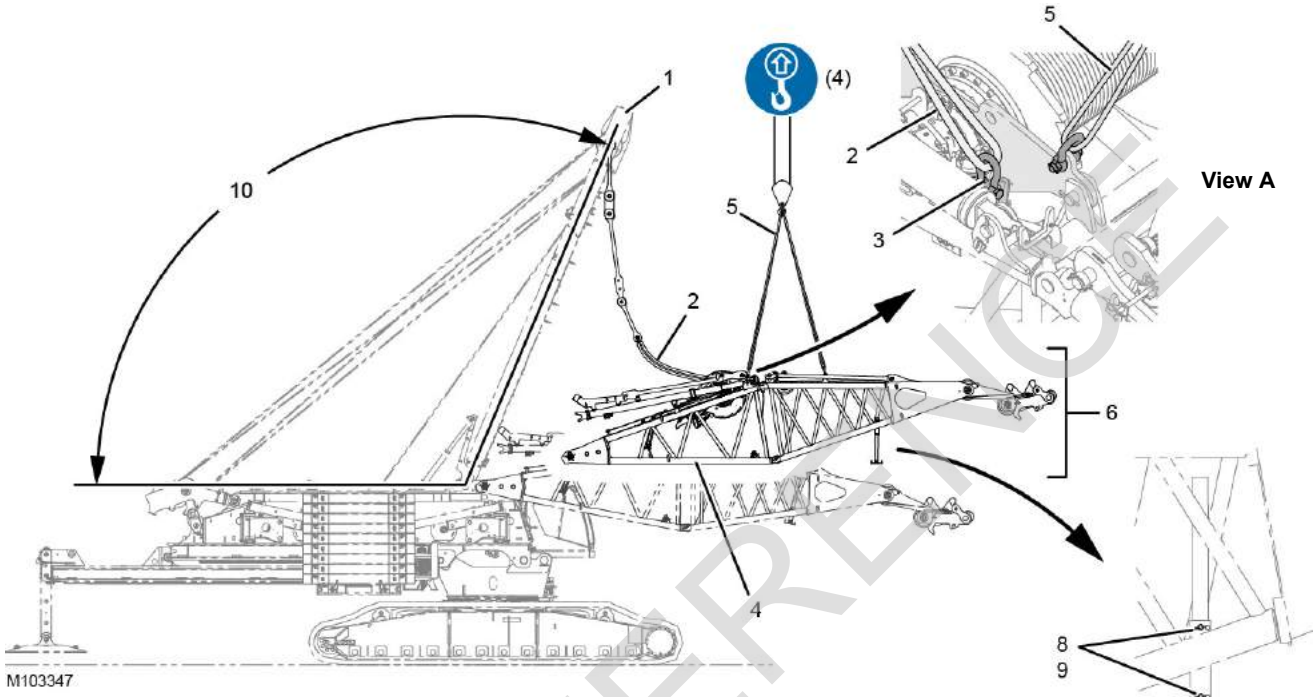
Installing the Fixed Mast Transport Package

See Figure 4-44 for the following procedure.

The fixed mast butt (1), the fixed mast top (2), and the boom hoist equalizer (3) are shipped assembled as shown.

For the weight of the transport package and individual mast components, see the Mast Rigging Drawing at the end of this section.

1. Attach four **SL 6** slings (4) to the assist crane hook (5).
2. Attach two shackles (6, View A) from the parts box to the rear slings (4) and to the lifting lugs (7) on the mast butt.
3. Attach the front slings (4, View B) to the existing shackles (8) on the mast top.
4. Lift the mast package to a convenient working height.
5. Remove the locking pin (9, View C) and flip up the pivot pin retainer (10).
6. Install the pin puller cage and the hand-held pin puller to one of the pivot pins (11).
7. Using the hand-held pin puller (see "Hand-Held Pin Puller" on page 4-8), remove the pivot pin.
8. Repeat step 1 through step 7 for the opposite pivot pin.



Item	Description
1	Live Mast
2	**SL 1** Sling – 3,30 m (10.83 ft), 45 360 kg (100,000 lb) (qty 2)
3	**SH 2** Shackle – 17 t (18.70 USt) (qty 2)
4	Fixed Mast Butt
5	**SL 6** Sling (qty 4, already attached)
6	Fixed Mast Transport Package
7	Support Pedestal (qty 2)
8	Hair Pin Cotter (qty 8)
9	Retaining Pin (qty 4)
10	107° to113° Angle

FIGURE 4-45

See Figure 4-45 for the following procedure.

9. Lower the live mast (1).
10. Attach the **SL 1** slings (2, View A) to the **SH 2** shackles (3) stored on the fixed mast butt (4).
11. Lift the fixed mast transport package (5) until the support pedestals (7, View B) are slightly above the ground.
12. Hold onto the support pedestal and remove the hair pin cotters (8) and retaining pins (9).
13. Raise the support pedestal and install the hair pin cotters and retaining pins.
14. Repeat step 12 and step 13 for the second support pedestal.
15. Making sure that the **SL 1** slings (2) remain slack and raise the live mast while lifting the fixed mast transport package into place with the assist crane.
16. Align the mast butt mounting holes with the rotating bed mounting holes.
17. Install the pin puller cage and the hand-held pin puller at one of the mounting holes.
18. Using the hand-held pin puller (see "Hand-Held Pin Puller" on page 4-8), install the pivot pin.
19. Secure the pivot pin with the pivot pin retainer and locking pin (see View C, Figure 4-44).
20. Remove the hand-held pin puller and the pin puller cage.
21. Repeat step 17 through step 20 for the opposite pivot pin.

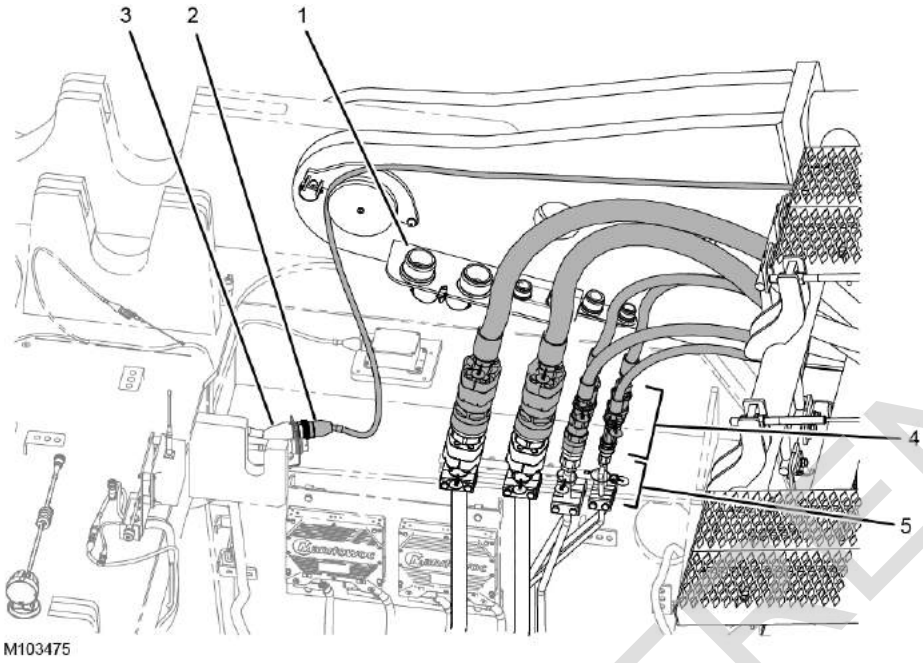
WARNING

Equipment Damage!

At this point in the assembly process, live mast angles greater than 113° will damage components.

Do not position the live mast to an angle greater than 113°.

22. Position the live mast at 107° and engage the mast hoist pawl.
23. Slowly lower the hook of the assist crane until the live mast is supporting the fixed mast transport package.



Item	Description
1	Bracket
2	Electrical Plug WMB1-P1
3	Electrical Plug WRF2-J4
4	Hydraulic Hose (4 or 6)
5	Coupler (4 or 6)

FIGURE 4-46

Connecting the Fixed Mast Hydraulic Hoses Electrical Cable

See Figure 4-46 for the following procedure.

1. On the mast butt, disconnect the hydraulic hoses (4) from their stored positions on the bracket (1).
2. Connect the hydraulic hoses to the corresponding couplers (5) on the rotating bed.

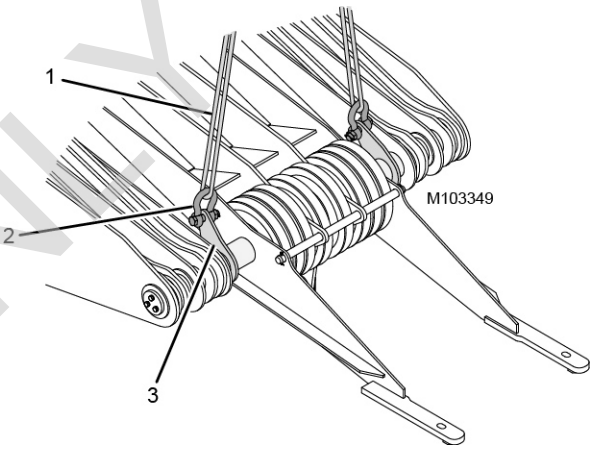
NOTE: The hoses and the corresponding couplers are tagged with numbers. Match the numbers to ensure proper hose connection.

3. Connect the electrical plug WMB1-P1 (2) from the mast butt to electrical plug WRF2-J4 (3) on the rotating bed.

Disconnecting the Fixed Mast Top from the Fixed Mast Butt

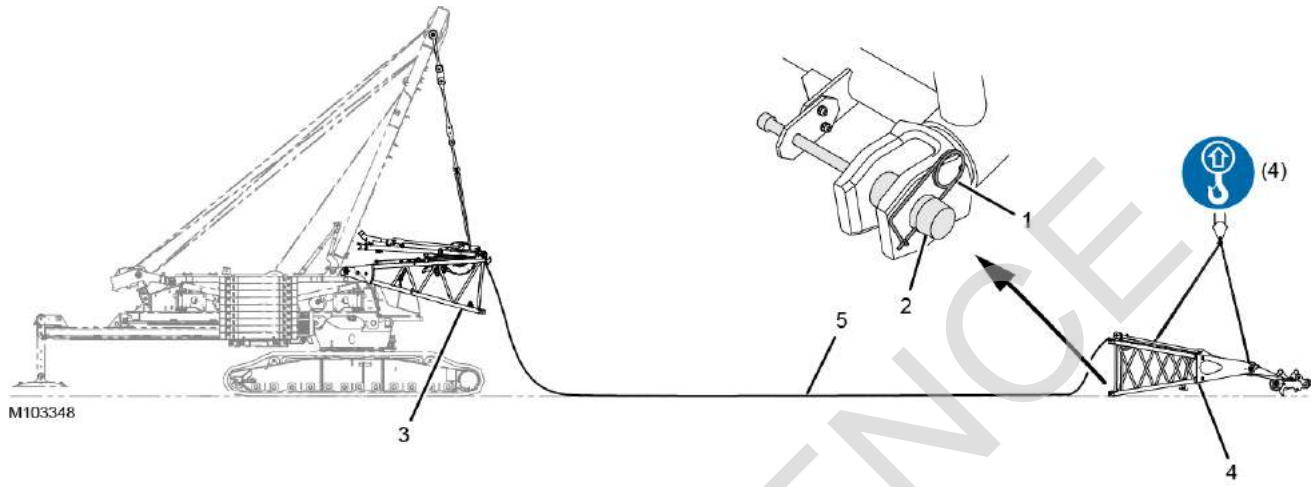
NOTE: The following steps assume the crane is in the Live Mast Configuration which allows operation of Drums 4 and 5 at the same time.

1. Disconnect two **SL 6** slings and **SH 2** shackles (View A, Figure 4-44 on page 4-49) from the lifting lugs on the mast butt and attach them to the handling links on the mast top (Figure 4-47).
2. Leave the other two lifting slings and shackles connected to the mast top as shown in View B, Figure 4-44 on page 4-49.



Item	Description
1	**SL 6** Sling – 5 m (16.40 ft), 31 751 kg (70,000 lb) (qty 2)
2	**SH 2** Shackle – 17 t (18.70 USt) (qty 2)
3	Lifting Link (qty 2)

FIGURE 4-47

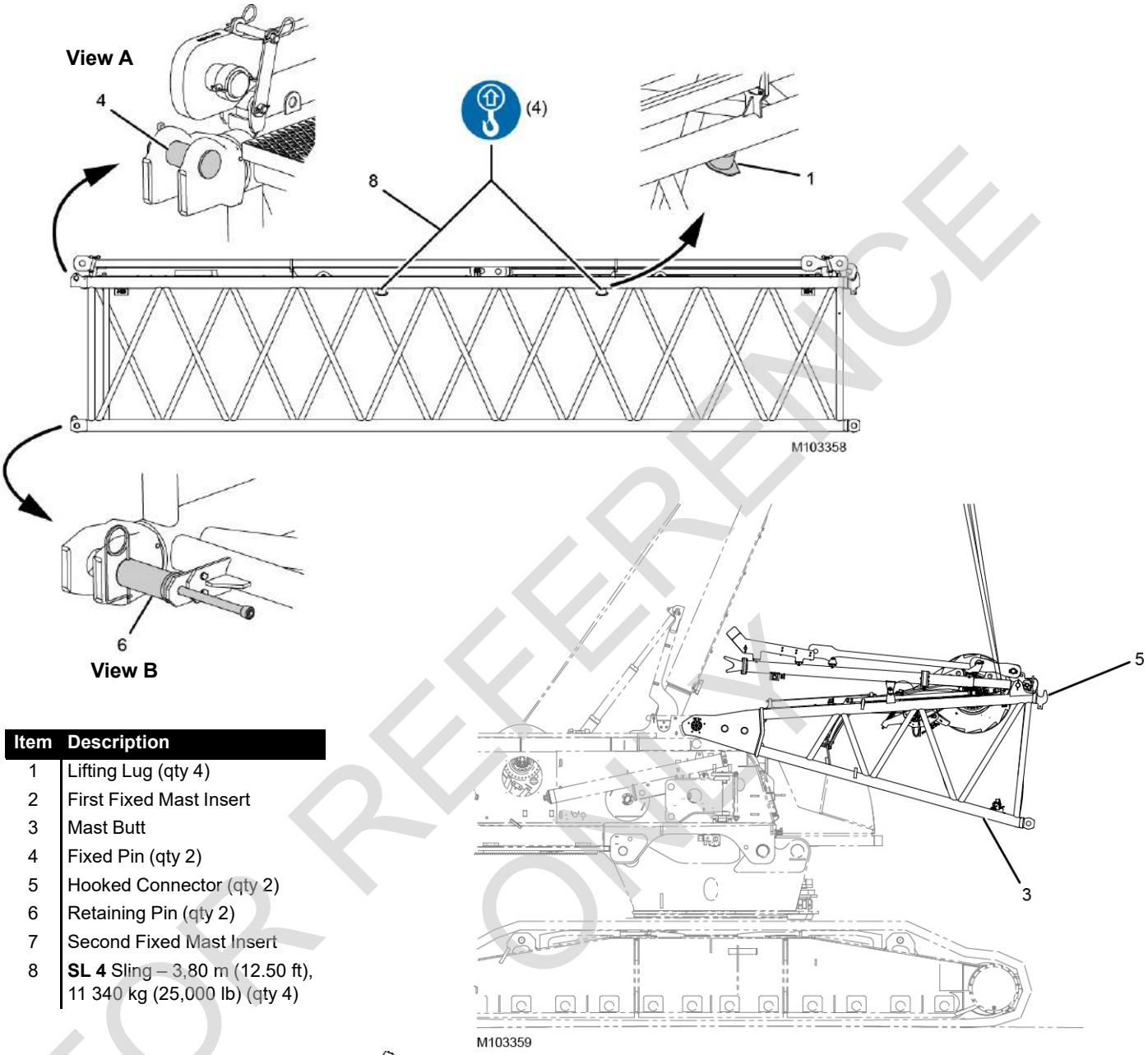


Item	Description
1	Safety Pin (qty 2)
2	Retaining Pin (qty 2)
3	Fixed Mast Butt
4	Fixed Mast Top
5	Boom Hoist Wire Rope

FIGURE 4-48

See Figure 4-48 for the following procedure.

3. Remove the safety pins (1) from the lower retaining pins (2) connecting the fixed mast butt (3) and fixed mast top (4).
4. Slide the retaining pins out.
5. Pay out wire rope from the boom hoist drum in the mast butt while performing the next step.
6. Lift the mast top away from the mast butt and place the mast top on the foundation 20 to 25 m (66 to 82 ft) in front of the mast butt as shown.
7. Lay the boom hoist wire rope (5) on the foundation alongside the mast butt and top so the wire rope does not interfere with installation of the mast inserts.
8. Slide the retaining pins back in and install the safety pins.
9. Remove the **SL 6** slings from the assist crane. Leave the slings and shackles connected to the mast top.



Item	Description
1	Lifting Lug (qty 4)
2	First Fixed Mast Insert
3	Mast Butt
4	Fixed Pin (qty 2)
5	Hooked Connector (qty 2)
6	Retaining Pin (qty 2)
7	Second Fixed Mast Insert
8	**SL 4** Sling – 3,80 m (12.50 ft), 11 340 kg (25,000 lb) (qty 4)

FIGURE 4-49

Installing the Fixed Mast Inserts

See Figure 4-49 for the following procedure.

1. Attach four **SL 4** slings (8) to the lifting lugs (1) on the first fixed mast insert (2).
2. Using the assist crane, lift the insert into position at the end of the mast butt (3) so the fixed pins (4, View A) engage the mast butt's hooked connectors (5).

NOTE: It is acceptable to cantilever both inserts from the mast butt.

3. Remove the safety pins from the retaining pins (6, View B) and slide the retaining pins out.
4. Lower the insert until the bottom connection holes align.
5. Slide the retaining pins in to attach the insert to the mast butt.
6. Install the safety pins.
7. Disconnect the slings from the first insert.
8. Attach the slings to the lifting lugs on the second fixed mast insert (7).
9. Attach the second insert to the first insert by repeating step 1 through step 6.

Item	Description
1	Minimum Block Height — 900 mm (35.43 in)
2	Mast Top
3	Lifting Shackle (qty 2)
4	Lifting Link (qty 2)
5	Safety Pin (qty 2
6	Retaining Pin (qty 2)

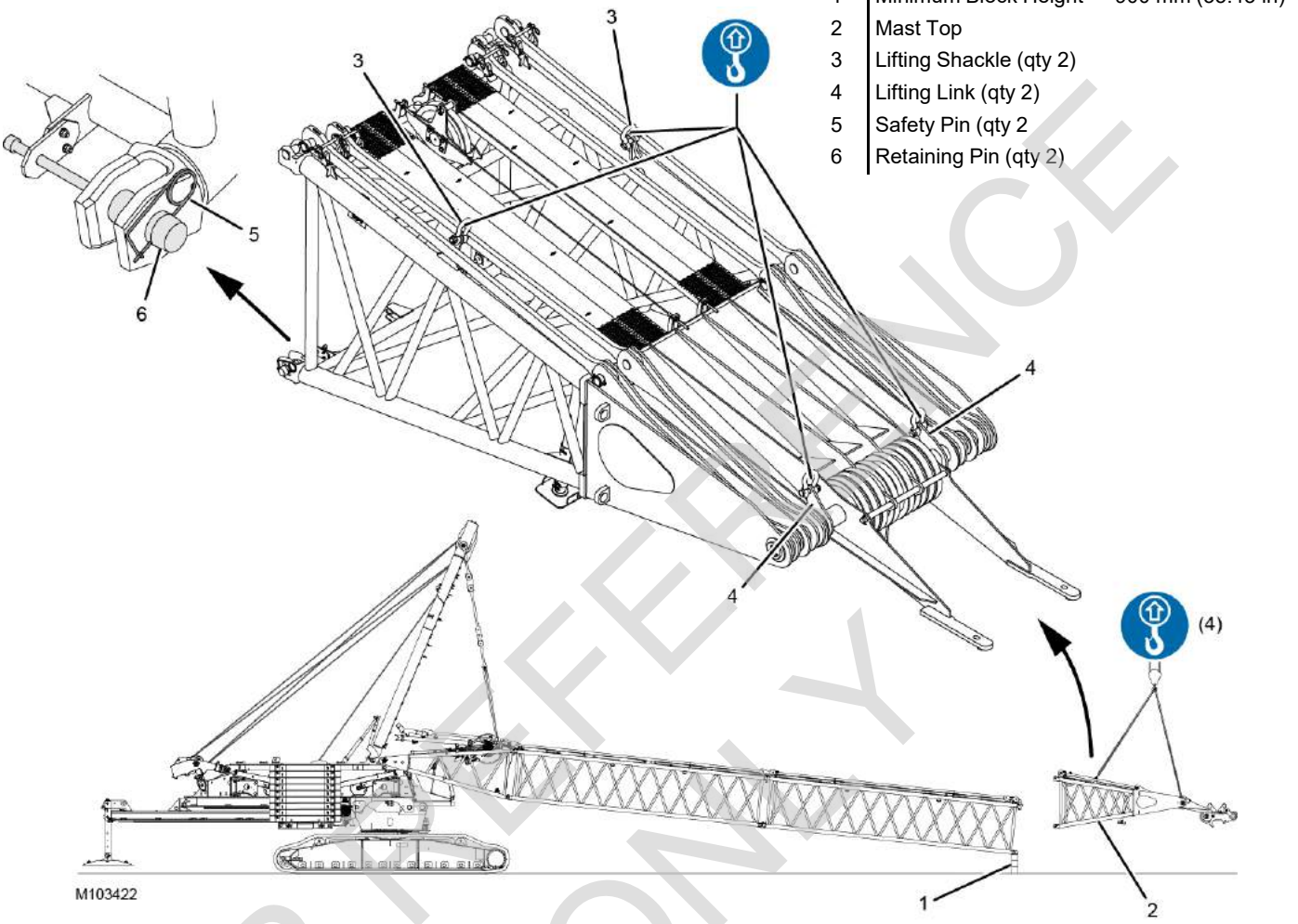


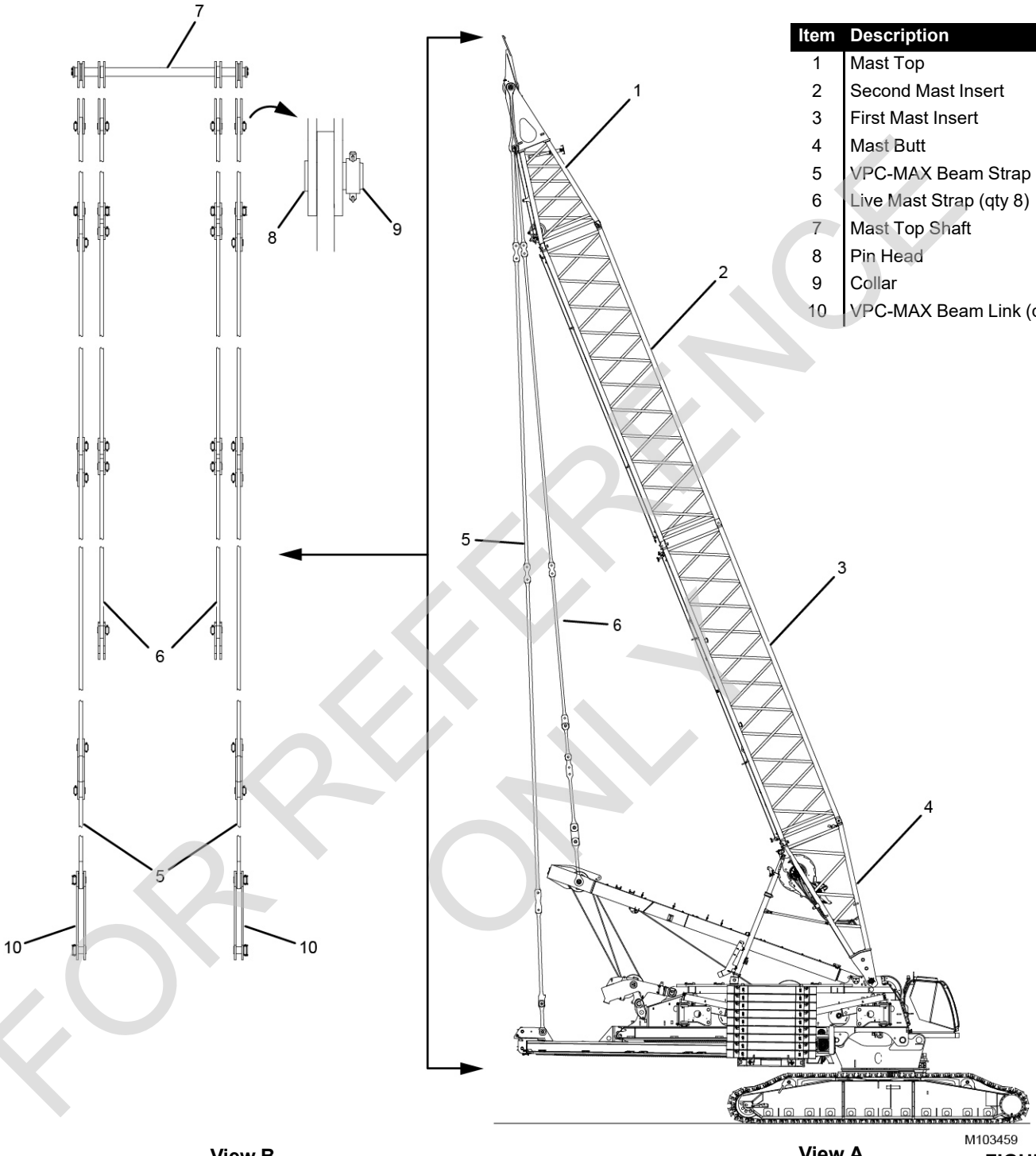
FIGURE 4-50

Installing the Fixed Mast Top

NOTE: Prior to installing the fixed mast top, the mast must be blocked. The mast butt cannot support the entire weight of the mast.

See Figure 4-50 for the following procedure.

1. Block the fixed mast. The approximate minimum block height (1) is 900 mm (35.43 in).
2. Make sure the **SL 6** slings are still attached to the mast top (2) at the permanent lifting shackles (3) and at the lifting link (4).
3. Reattach the slings to the assist crane.
4. Lift the mast top into position at the end of the second mast insert so the fixed pins on the mast top engage the hooked connectors.
5. Remove the safety pins (5) and slide the retaining pins (6) out.
6. Lower the mast top until the bottom connection holes align.
7. Slide the retaining pins in to attach the mast top to the insert.
8. Install the safety pins.
9. Disconnect the slings from the mast top and from the mast butt.



Item	Description
1	Mast Top
2	Second Mast Insert
3	First Mast Insert
4	Mast Butt
5	VPC-MAX Beam Strap (qty 8)
6	Live Mast Strap (qty 8)
7	Mast Top Shaft
8	Pin Head
9	Collar
10	VPC-MAX Beam Link (qty 2)

View B **View A**

FIGURE 4-51

Connecting the Mast Straps

See Figure 4-51 for the following:

Work from the mast top (1) down towards the mast butt (4) when connecting the mast straps. There are straps that connect the fixed mast to the live mast, and there are straps that connect the fixed mast to the VPC-MAX beam. There are two straps for the live mast and two straps for the beam. View A shows a side view of how the straps look when fully connected.

Pin head orientation is important when connecting the mast straps. View B shows pin head (8) and collar (9) orientation for each link on the straps.

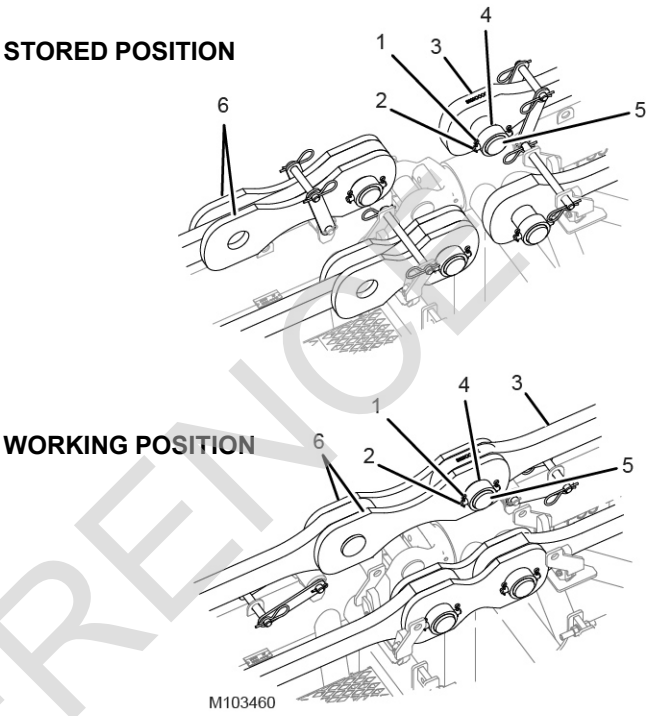
Connecting the Mast Straps and Links with Clevis Pins

See Figure 4-52 when connecting the mast straps and links using the clevis pins. Make sure the pin heads are oriented correctly. See "Connecting the Mast Straps" on page 4-57 for pin head orientation.

1. Remove the strap and link retaining pins.

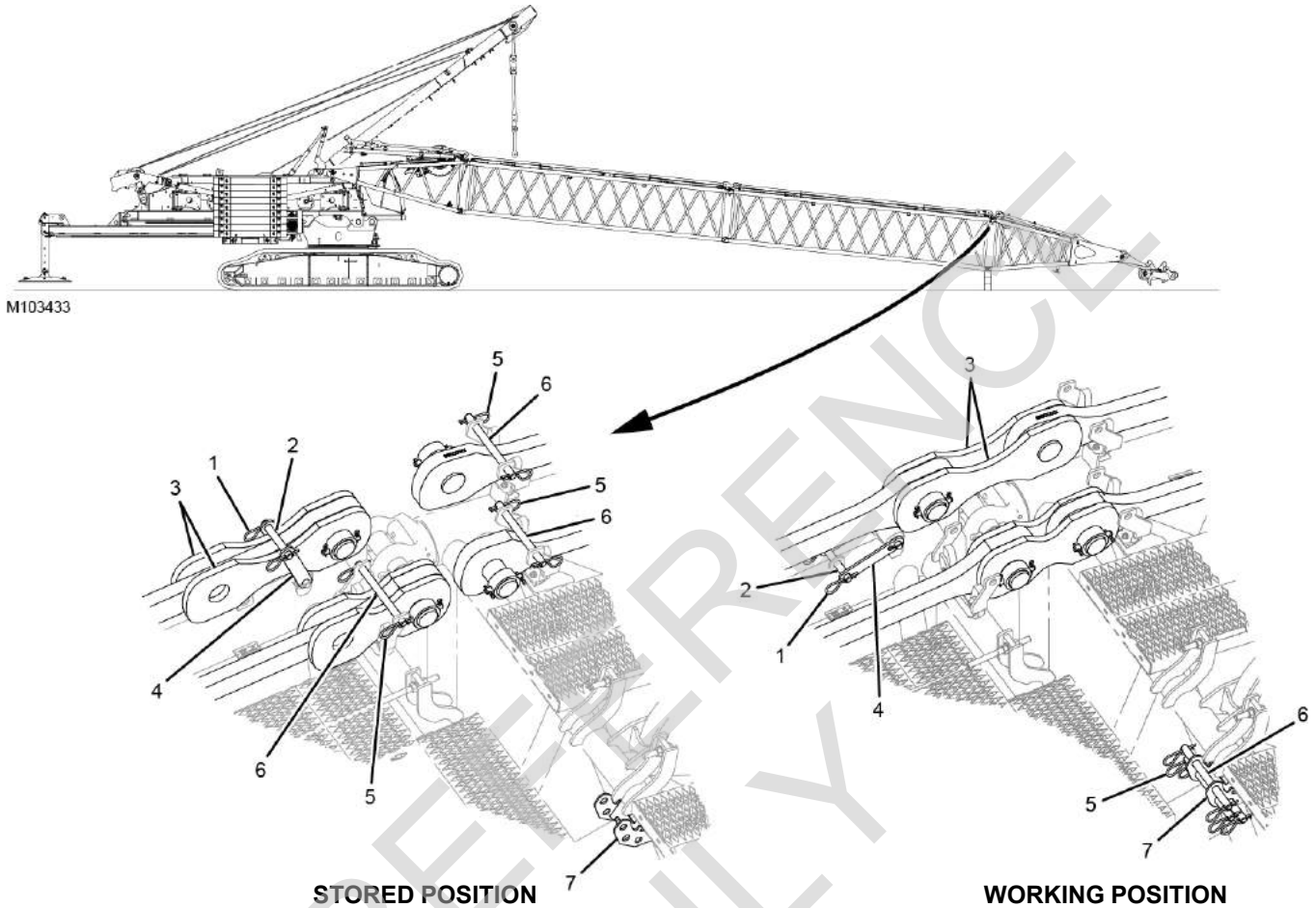
NOTE: Specific instructions for removing the strap and link retaining pins are included in the following sections.

2. Remove the cotter pins (1) from the retaining pin (2) on the desired mast strap (3).
3. Remove the retaining pin and the collar (4).
4. Remove the clevis pin (5) from the strap.
5. Rotate the links (6) to the working position.
6. Align the holes in the links with the hole in the strap.
7. Install the clevis pin to attach the links to the strap.
8. Install the collar and secure it with the retaining pin and cotter pins.



Item	Description
1	Cotter Pin (qty 2)
2	Retaining Pin
3	Mast Strap
4	Collar
5	Clevis Pin
6	Link (qty 2)

FIGURE 4-52



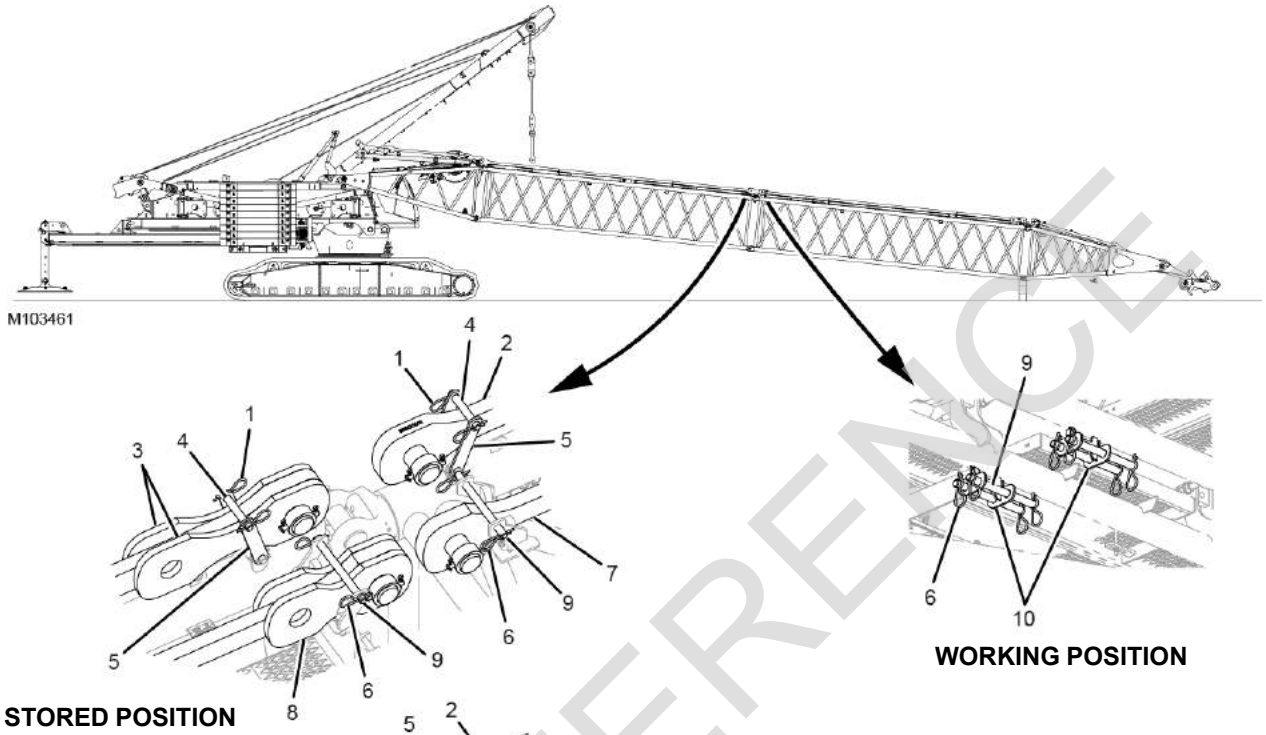
Item	Description
1	Hair Pin Cotter (qty 4)
2	Retaining Pin (qty 2)
3	VPC-MAX Beam Link (qty 4)
4	Beam Link Retaining Pin Bracket (qty 4)
5	Hair Pin Cotter (qty 12)
6	Retaining Pin (qty 6)
7	Working Position Bracket

FIGURE 4-53

Connecting the Mast Top and Second Insert Straps

See Figure 4-53 for the following procedure.

1. Remove the hair pin cotters (1) from the retaining pin (2) that secures the VPC-MAX beam links (3).
2. Remove the retaining pin and rotate the beam link retaining pin brackets (4) from the stored position to the working position.
3. Install the retaining pin and hair pin cotters to the retaining pin brackets.
4. Remove the hair pin cotters (5) and retaining pins (6) that secure the other links and straps.
5. Install the retaining pins and hair pin cotters in the working position bracket (7).
6. Connect the links to the straps. See "Connecting the Mast Straps" on page 4-57 and "Connecting the Mast Straps and Links with Clevis Pins" on page 4-58.
7. Repeat this process for the other side of the mast top and insert.



Item	Description
1	Hair Pin Cotter (qty 8)
2	VPC-MAX Beam Strap (qty 2)
3	VPC-MAX Link (qty 4)
4	Retaining Pin (qty 4)
5	Retaining Pin Bracket (qty 8)
6	Hair Pin Cotter (qty 8)
7	Live Mast Strap (qty 2)
8	Live Mast Link (qty 4)
9	Retaining Pin (qty 4)
10	Working Position Bracket (qty 2)

FIGURE 4-54

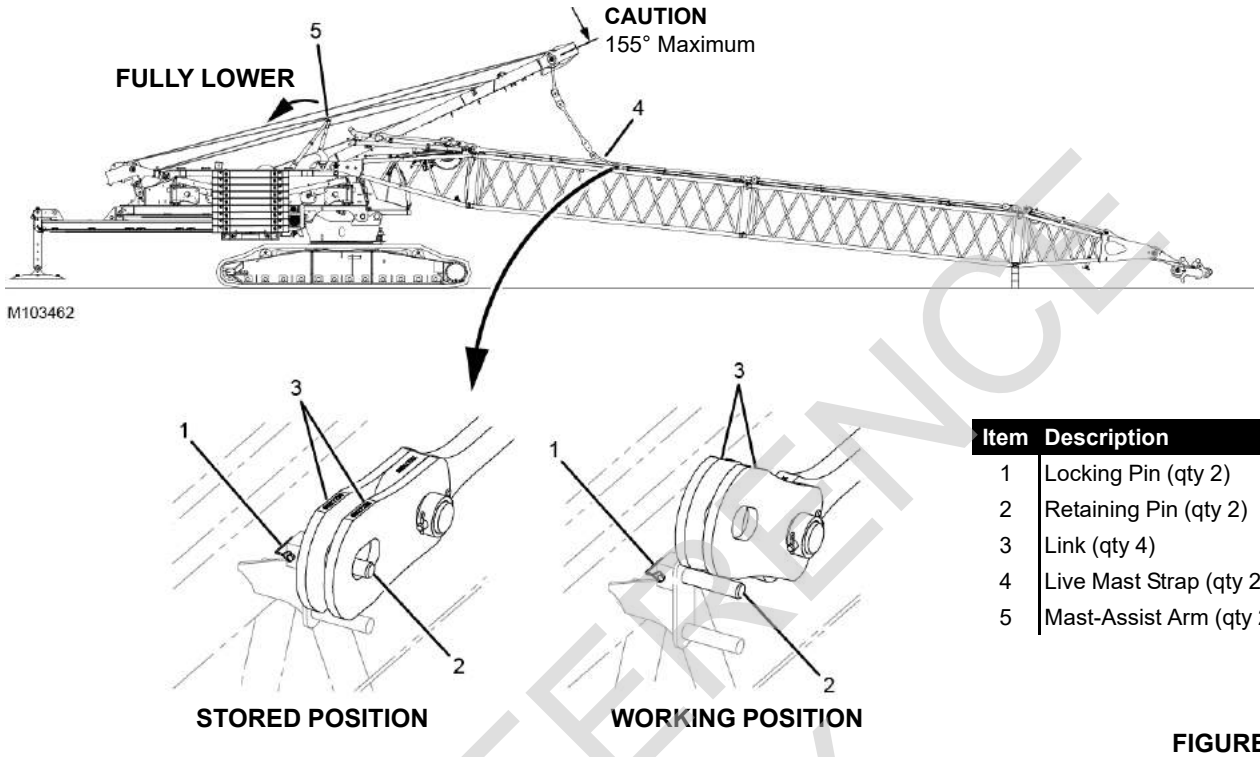
Connecting the First Insert and Second Insert Straps

See Figure 4-54 for the following procedure.

1. Remove the hair pin cotters (1) from the VPC-MAX beam strap (2) and VPC-MAX link (3) retaining pins (4).
2. Remove the retaining pins and rotate the retaining pin brackets (5) from the stored position to the working position.
3. Install the retaining pins and hair pin cotters to the brackets in the working position.
4. Remove the hair pin cotters (6) from the live mast strap (7) and live mast link (8) retaining pins (9).
5. Remove the retaining pins and install them in the working position brackets (10).

NOTE: Four pins are shown, two for each side.

6. Install the hair pin cotters to the retaining pins.
7. Connect the links to their respective straps. See "Connecting the Mast Straps" on page 4-57 and "Connecting the Mast Straps and Links with Clevis Pins" on page 4-58.
8. Repeat this process for the other side of the inserts.



Item	Description
1	Locking Pin (qty 2)
2	Retaining Pin (qty 2)
3	Link (qty 4)
4	Live Mast Strap (qty 2)
5	Mast-Assist Arm (qty 2)

FIGURE 4-55

Connecting the Live Mast Straps to the First Insert

See Figure 4-55 for the following procedure.

About halfway down the first mast insert are the end links for the live mast. Prepare the links as follows:

1. Remove the locking pin (1) from the retaining pin (2).
2. Remove the retaining pin and rotate the links (3) up.
3. Install the retaining pin and locking pin in their original positions.
4. Carefully rest the link, in its working position, on top of the retaining pin.
5. Repeat this process for the other side of the insert.
6. Remove the slings and shackles from the live mast straps (4).
7. Connect the live mast straps (4) to the links (3). See "Connecting the Mast Straps" on page 4-57 and "Connecting the Mast Straps and Links with Clevis Pins" on page 4-58.

DANGER

Falling Mast Hazard!

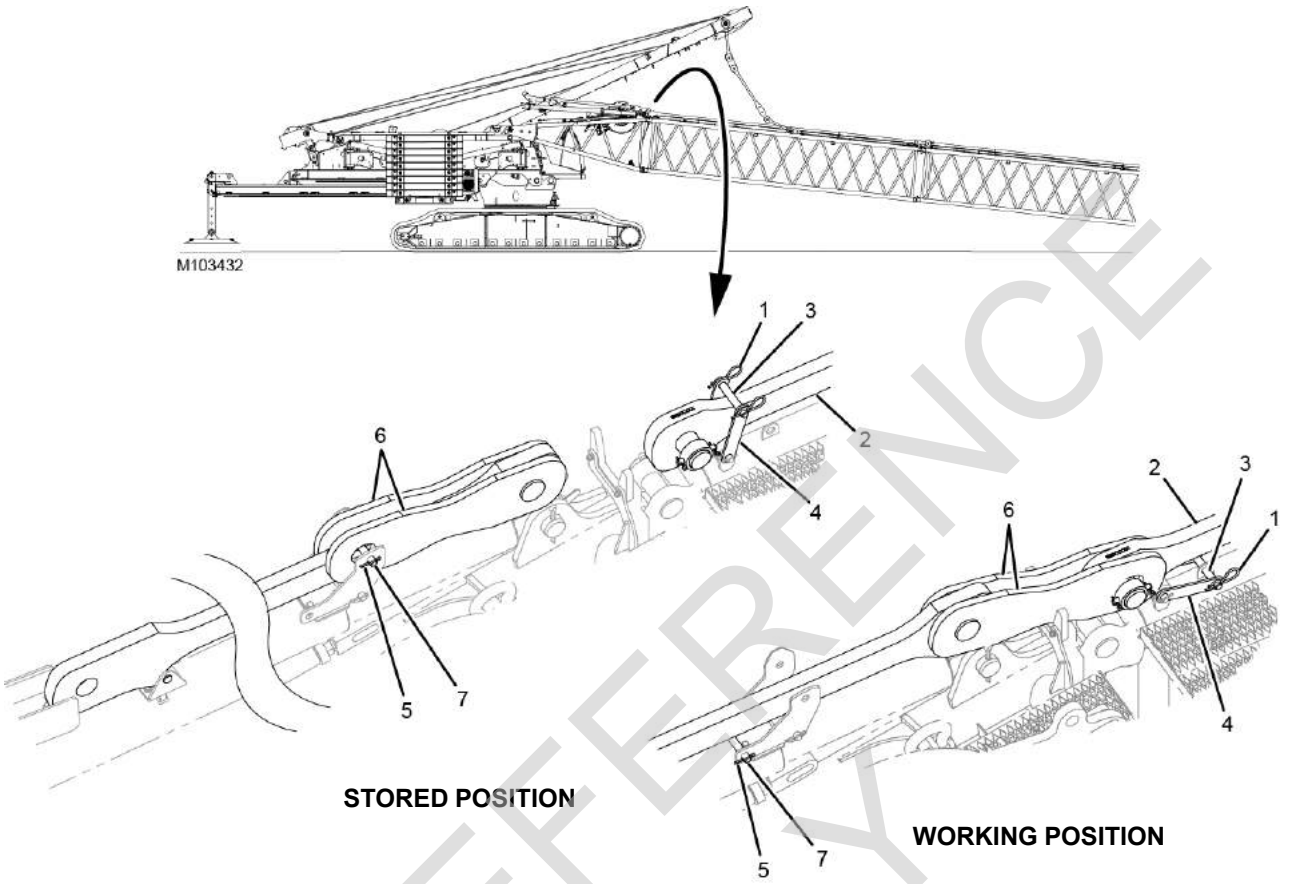
Prevent the masts from falling:

- Fully lower the mast-assist arms before raising the fixed mast with the live mast. The live mast can buckle and collapse if it contacts the mast assist-arms with a fully rigged fixed mast.

8. Fully lower the mast-assist arms (5). See Section 4 of the Crane Operator Manual for instructions.

Configuring the Fixed Mast in the RCL/RCI Display

Enter the fixed mast configuration in the RCL/RCI Display. Refer to the RCL/RCI Operation Manual for instructions.



Item	Description
1	Hair Pin Cotter (qty 4)
2	VPC-MAX Beam Strap (qty 2)
3	Retaining Pin (qty 2)
4	Retaining Pin Bracket (qty 4)
5	Cotter Pin (qty 4)
6	VPC-MAX Beam Link (qty 4)
7	Retaining Pin (qty 2)

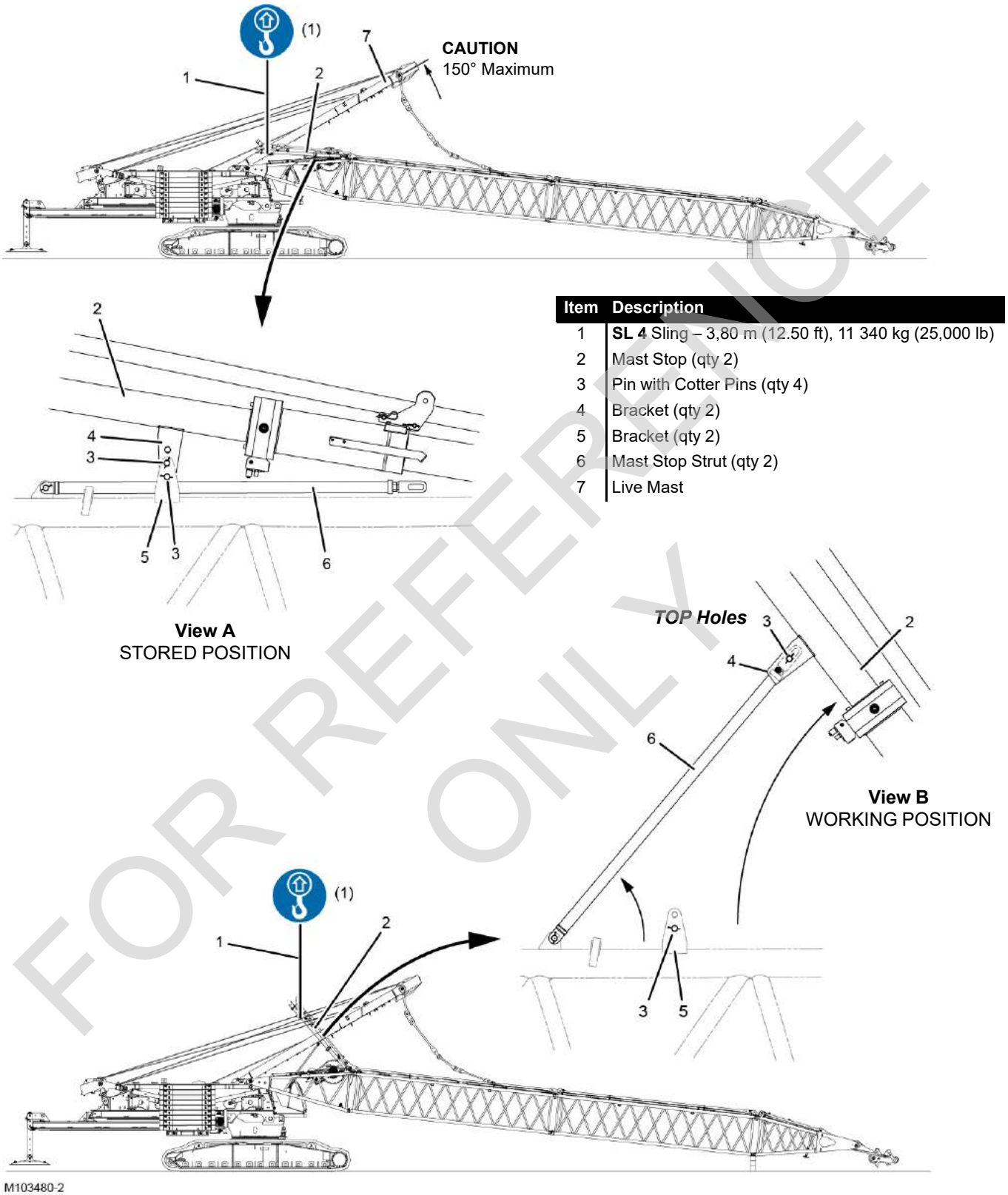
FIGURE 4-56

Connecting the First Insert and Mast Butt Straps

See Figure 4-56 for the following procedure.

1. Remove the hair pin cotters (1) from the VPC-MAX beam strap (2) retaining pin (3).
2. Rotate the retaining pin brackets (4) from the stored position to the working position.
3. Install the retaining pin and hair pin cotters to the brackets in the working position.
4. Remove the cotter pins (5) from the VPC-MAX beam link (6) retaining pin (7).
5. Remove the retaining pin from the stored position and install the pin in the working position.
6. Install the cotter pins to the retaining pin.
7. Connect the links to the strap. See "Connecting the Mast Straps" on page 4-57 and "Connecting the Mast Straps and Links with Clevis Pins" on page 4-58.
8. Repeat this process for the other side of the mast butt and insert.

THIS PAGE INTENTIONALLY LEFT BLANK



Item	Description
1	**SL 4** Sling – 3,80 m (12.50 ft), 11 340 kg (25,000 lb)
2	Mast Stop (qty 2)
3	Pin with Cotter Pins (qty 4)
4	Bracket (qty 2)
5	Bracket (qty 2)
6	Mast Stop Strut (qty 2)
7	Live Mast

FIGURE 4-57

Raising the Mast Stops

See Figure 4-57 for the following procedure.

1. Raise the live mast (7) to a maximum angle of 150°.

CAUTION

Avoid Mast Stop Damage

Do not raise the mast stops until the live mast has been raised to 150° maximum. Otherwise, the mast stops will hit the live mast possibly resulting in damage.

2. Attach one **SL 4** sling (1) to one of the mast stops (2) and to the assist crane.
3. Hoist with the assist crane just enough to support the weight of the mast stop (2).
4. Remove the top pin (3, View A) securing the bracket (4) to the bracket (5).
5. Lift the mast stop to the working position (View B).
6. Remove the bottom pin (3, View A) from the bracket (5).
7. Raise the mast stop strut (6, View B) to the working position.
8. Using pin (3, View B), pin the slotted end of the mast stop strut (6) to the ***TOP holes*** in the bracket (4).

CAUTION

Avoid Mast Stop Damage

Do not pin the mast stop strut to the lower holes in the bracket (4). Otherwise, the mast stops will not properly engage the mast stop pins (View D, Figure 4-64 on page 4-74). Structural damage will occur.

9. Store the other pin (3, View B) in the bracket (5).
10. Disconnect the sling and repeat the procedure for the other mast stop.

Preparing the Equalizer

See Figure 4-58 for the following procedure.

CAUTION

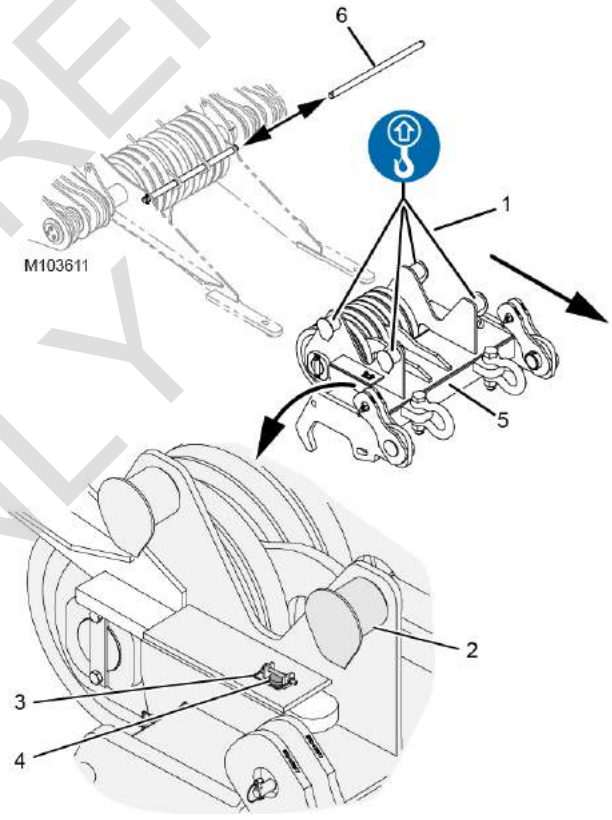
Avoid Wire Rope Damage

Remove the rope guard (6) before removing the equalizer (5) from the mast top.

Do not reinstall the rope guard until after the mast top has been raised approximately 3 m (10 ft) off the ground later in this procedure.

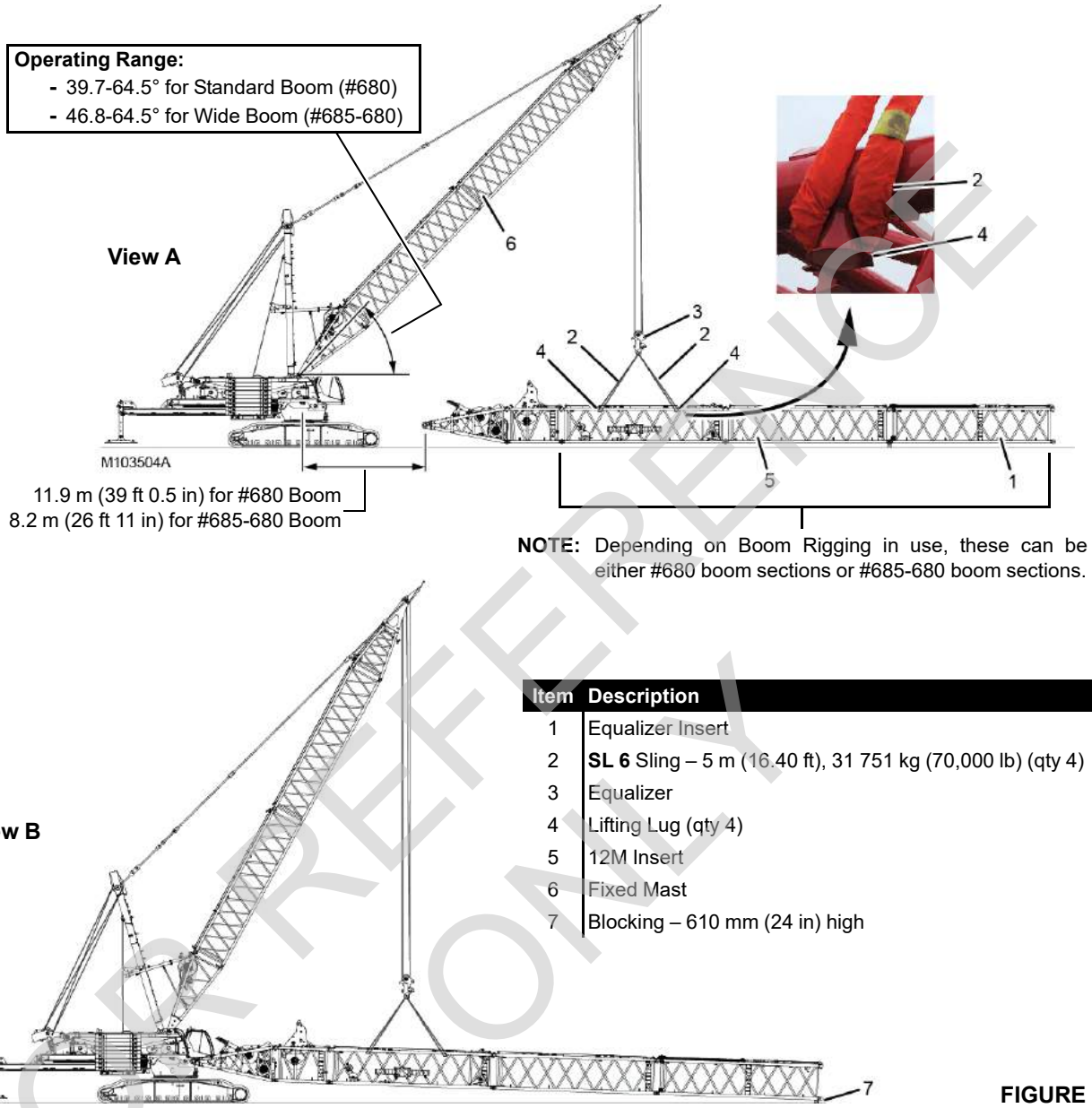
The wire rope can be damaged if these steps are not taken.

1. Remove the rope guard (6).
2. Attach four **SL 4** slings (1) to four lifting lugs (2) on the equalizer (5) and to the assist crane.
3. Remove the locking pins (3).
4. Remove the clevis pins (4).
5. Pay out wire rope from the boom hoist drum in the mast butt while performing the next step.
6. Using the assist crane, remove the equalizer (4) from the fixed mast top.
7. Set the equalizer on the foundation.
8. Reinstall the clevis pins and locking pins in the equalizer holes.



Item	Description
1	**SL 4** Sling (qty 4) – 3,80 m (12.50 ft), 11 340 kg (25,000 lb)
2	Lifting Lug (qty 4)
3	Locking Pin (qty 2)
4	Clevis Pin (qty 2)
5	Equalizer
6	Rope Guard with Cotter Pins

FIGURE 4-58



Item	Description
1	Equalizer Insert
2	**SL 6** Sling – 5 m (16.40 ft), 31 751 kg (70,000 lb) (qty 4)
3	Equalizer
4	Lifting Lug (qty 4)
5	12M Insert
6	Fixed Mast
7	Blocking – 610 mm (24 in) high

FIGURE 4-59

Installing the Boom Assembly

See Figure 4-59 for the following procedure.

NOTE: A minimum of Series 1 counterweight is required to install the partial boom with the fixed mast.

1. Make sure the live mast arms are in the stored position. See Section 4 of the Crane Operator Manual for instructions.
2. Reconfigure the rated capacity limiter (RCL)/rated capacity indicator (RCI) to the fixed mast handling configuration. See the RCL/RCI Operator Manual for instructions.
3. While lifting the equalizer off the ground, raise the fixed mast until the top is approximately 3 m (10 ft) off the ground and reinstall the rope guard (6, Figure 4-58 on page 4-65.
4. Raise the fixed mast to the operating range specified in Figure 4-59.
5. Assemble the partial boom up to the equalizer insert (1, View A).
   - See Section 4 of the Crane Operator Manual for boom assembly instructions.
   - Either an assist crane or the fixed mast can be used to assemble the partial boom.

Item	Description
1	Partial Boom (#680 or #685-680)
2	Remaining Boom Sections (inserts and top)
3	Fixed Horizontal Pin (qty 2)
4	Hooked Connector (qty 2)

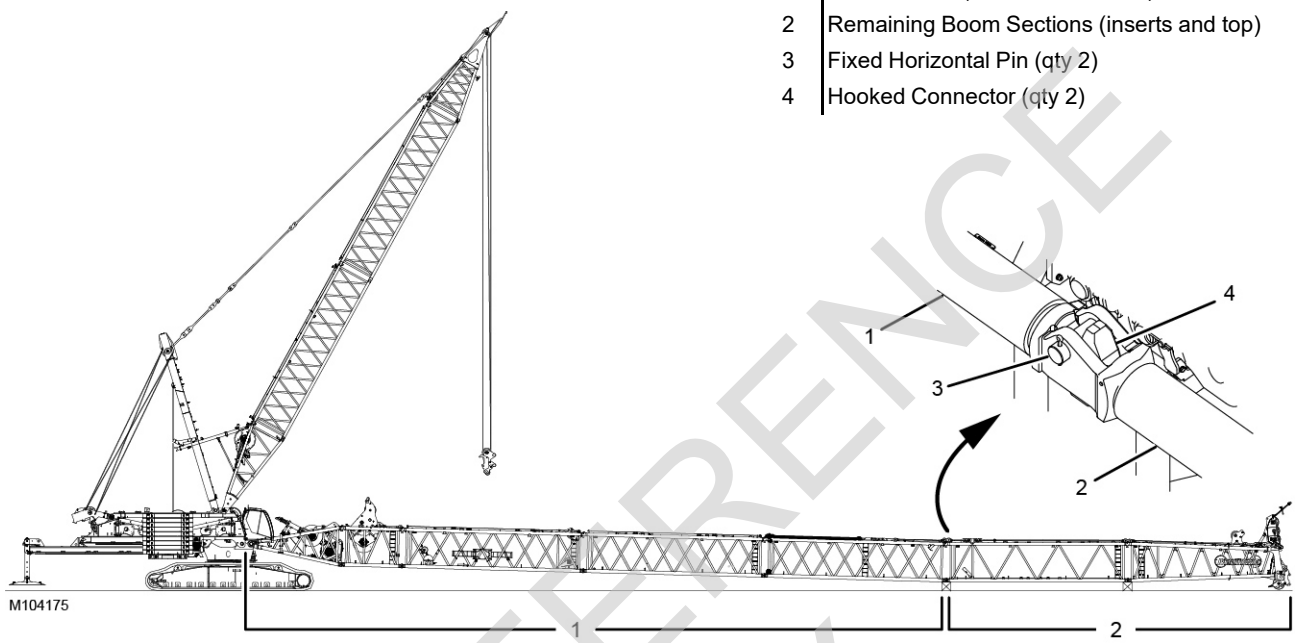


FIGURE 4-60

6. Attach the **SL 6** slings (2, View A) to the shackles on the equalizer (3, View A) and to the lifting lugs (4, View A) on the 12M insert (5, View A).
7. Assemble the partial boom to the crane using the fixed mast (6, View A).
   - See Section 4 of the Crane Operator Manual for boom butt to crane pinning instructions.
8. Lower the partial boom onto the blocking (7, View B) that is at least 610 mm (24 in) high and disconnect the slings from the insert.

Assembling the Remaining Boom Sections

See Figure 4-60 for the following procedure.

Using an assist crane, assemble the remaining boom sections (2) to the end of the partial boom (1).

- Block the boom sections at least 610 mm (24 in) high to allow for installing the boom top.
- To prevent damage to the boom sections caused by excessive sag, space the blocking at the intervals specified under “Intermediate Blocking” requirement in the Boom Rigging Drawing at the end of this section.
- See the Assemble Boom Inserts and Top topic in Section 4 of the Crane Operator Manual for instructions.
- The inserts must be assembled in the sequence shown in the Boom Rigging Drawing at the end of this section.

Connecting the Boom Straps

Starting at the boom top, connect the boom straps between all of the boom sections to include the 12 m (39.4 m) straps on the inserts with equalizer rails.

- See the Connect Boom Straps topic in Section 4 of the Crane Operator Manual for instructions.

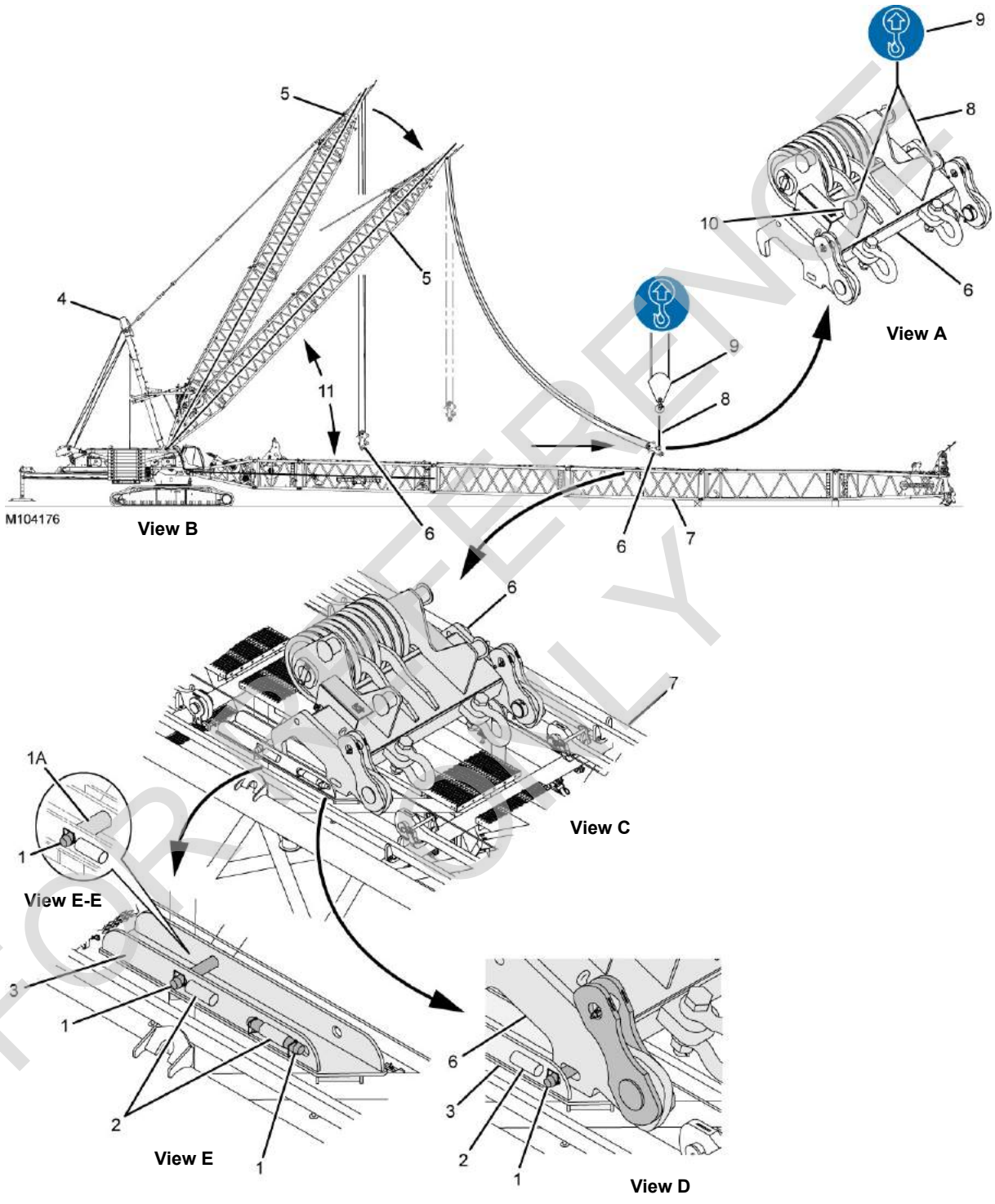


FIGURE 4-61

Legend for Figure 4-61

Item	Description
1	Stop Pin with Safety Pins (4)
1A	Roller (2) (if equipped)
2	Storage Tube (4)
3	Rails (2 sets)
4	Live Mast
5	Fixed Mast
6	Equalizer
7	12 m Insert Equalizer Insert
8	**SL 6** Sling – 5 m (16.40 ft), 31 751 kg (70,000 lb) (qty 2)
9	Assist Crane Hook
10	Lifting Lug (front 2)
11	39.7° Minimum Mast Angle

Moving the Equalizer to the Equalizer Rails

See Figure 4-61 for the following procedure.

1. If stored, remove the rear stop pins (1, View E) from the rear storage tubes (2) and install the pins in the rear holes of the rails (3).

   If equipped with rollers (1A, View E-E) install the rollers over the rear stop pins as the pins are installed. The rollers are stored in the parts box.

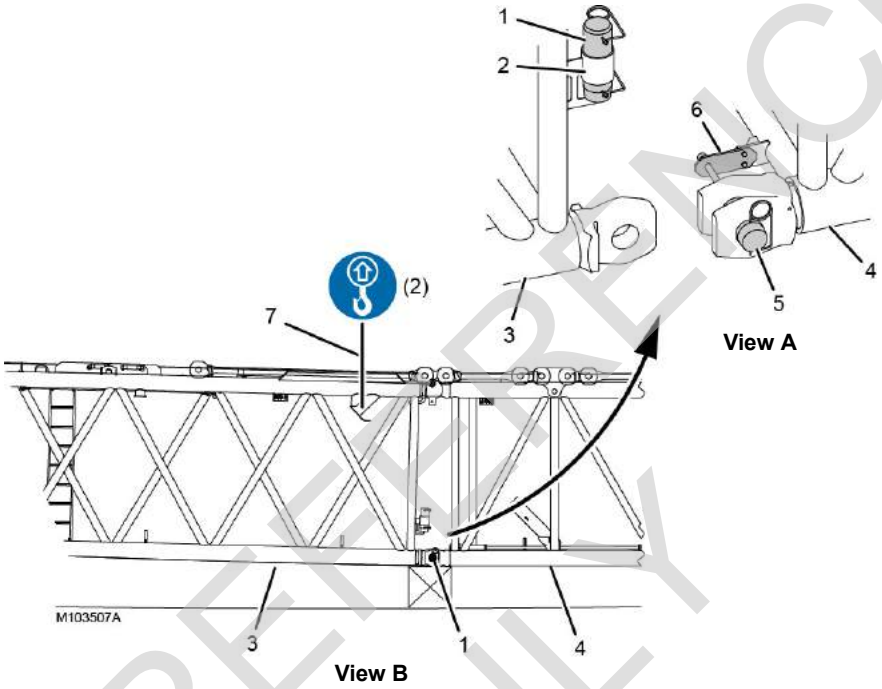
2. Leave the front stop pins (1, View D) stored in the front storage lugs (2).

CAUTION

Mast Damage!

Do not lower the fixed mast below 39.7° during the following steps. Structural damage could result.

3. Pay out the mast hoist wire rope to lower the masts (4 and 5, View B).
4. At the same time, haul in the boom hoist wire rope to raise the equalizer (6).
5. Stop lowering the masts when the fixed mast (5, View B) is at 39.7°.
6. Connect two **SL 6** slings (8, View A) from the hook of the assist crane (9) and to the front two lifting lugs (10) on the equalizer (6).
7. Slowly lift the equalizer with the assist crane until the equalizer is horizontal as shown in View A.
8. Slowly pay out the boom hoist wire rope from the MLC650 and lower the equalizer (6) with the assist crane until the equalizer is resting on the rails (3, View C).
9. Make sure the equalizer is on the forward side of the rear stop pins (1, View D).
10. Slacken the boom hoist wire rope and the **SL 6** slings so the equalizer cannot slide rearward.
11. Remove the front stop pins (1, View E) from the front storage tubes (2) and install the pins in the front holes of the rails (3, View D) and the equalizer (6).
12. Disconnect the **SL 6** slings (8, View A) from the equalizer (6).



Item	Description
1	Tapered Connecting Pin (qty 2)
2	Bracket (qty 2)
3	Equalizer Insert
4	Adjacent Insert
5	Standard Connecting Pin (qty 2)
6	Bracket with Hardware (qty 2)
7	**SL 1** Sling – 5 m (16.40 ft), 31 751 kg (70,000 lb) (qty 2)

FIGURE 4-62

Closing the Boom Sections Using an Assist Crane

The assist crane must have a capacity of 74 843 kg (165,000 lb).

See Figure 4-62 for the following procedure.

1. Tapered connecting pins (1, View A) are stored in brackets (2) on the equalizer insert (3).
2. To pin the adjacent insert (4) to the equalizer insert (3), remove the standard connecting pins (5, View A) and the brackets with hardware (6) from the adjacent insert.
3. Store the removed parts in the parts box.

WARNING

Falling Object Hazard!

If the standard connecting pins (5, View A) and brackets with hardware (6) are not removed from the adjacent insert (4) before raising the boom, they may fall, potentially resulting in death or serious injury.

4. Attach two **SL 1** slings (7, View B) to the assist crane and to the forward most lifting lugs on the equalizer insert (3).

CAUTION

Boom Damage!

Do not attempt to lift the entire boom during the following step. Damage to the boom sections could result,

5. Remove the tapered connecting pins (1, View A) from the brackets (2).
6. Lift the equalizer insert (3) with the assist crane only enough to align the bottom connecting holes between the inserts.

WARNING

Crushing Injury Hazard!

Prevent serious crushing injury:

- Do not stand inside the boom sections while installing the tapered connecting pins — STAND OUTSIDE BOOM.

7. Manually install the tapered connecting pins (1, View B) in the bottom connecting holes.
8. Detach the **SL 1** slings (7) from the equalizer insert (3).

Item	Description
1	**SL 1** Sling – 5 m (16.40 ft), 31 751 kg (70,000 lb) (qty 2)
2	Shackle (2, on equalizer)
3	Equalizer
4	Equalizer Insert
5	Stop Pin with Safety Pins (4)
5A	Roller (2) (if equipped)
6	Rails (2 sets)
7	Storage Tube (4)
8	Adjacent Insert
9	Tapered Connecting Pin
10	Bracket (qty 2)
11	Standard Connecting Pin (qty 2)
12	Bracket with Hardware (qty 2)

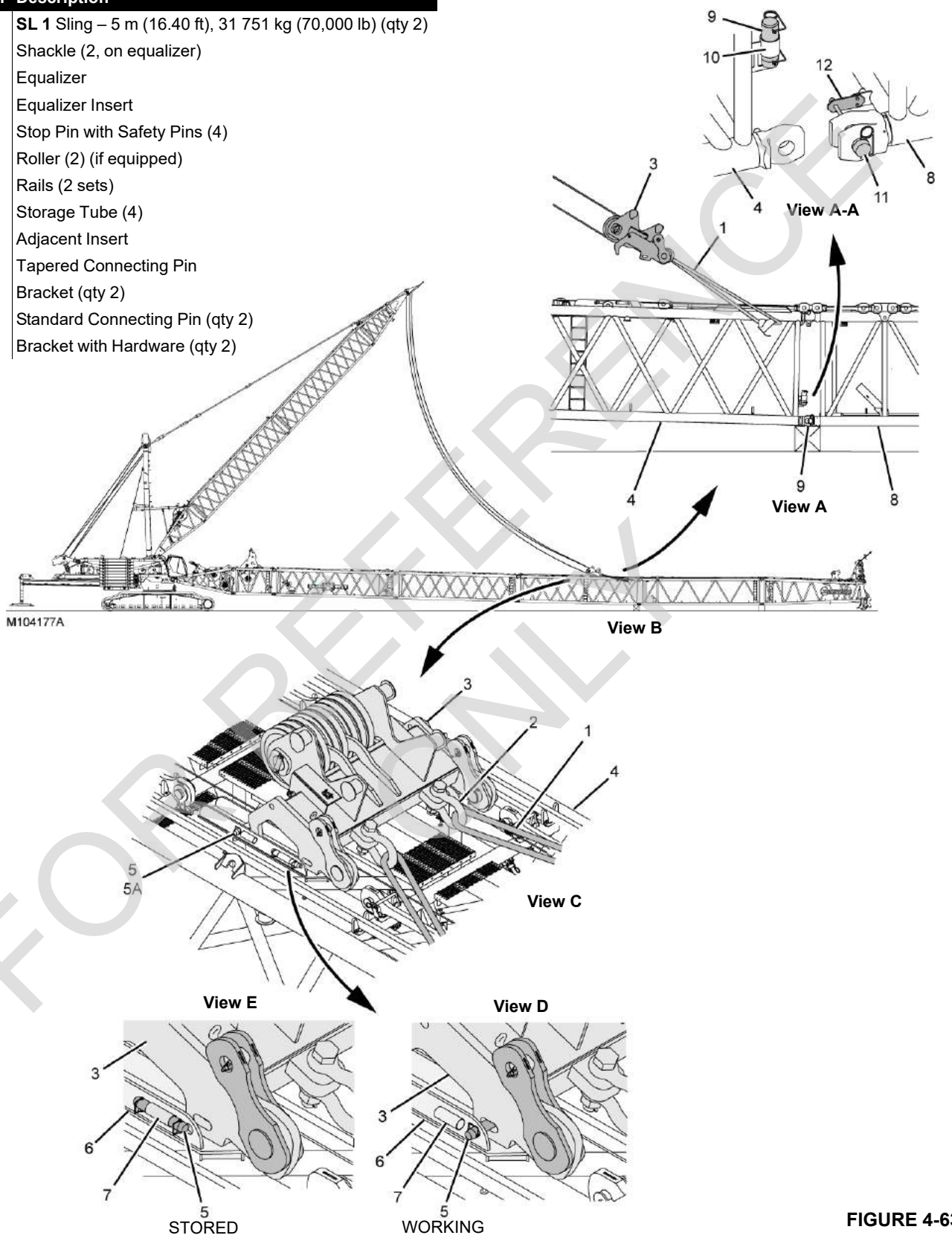


FIGURE 4-63

Closing the Boom Sections Using the Fixed Mast

See Figure 4-63 for the following procedure.

WARNING

Tipping Hazard!

Do not exceed the boom closing (opening) limitations given in the Boom Rigging Drawing at the end of this section. Make sure the crane is equipped with the specified counterweight. Otherwise, tipping could occur.

CAUTION

Mast Damage!

Do not lower the fixed mast below 39.7° during the following steps. Structural damage could result.

1. Tapered connecting pins (9, View A-A) are stored in brackets (10) on the equalizer insert (4).
2. To pin the adjacent insert (8) to the equalizer insert (4), remove the standard connecting pins (11, View A-A) and the brackets with hardware (12) from the adjacent insert.
3. Store the removed parts in the parts box.

WARNING

Falling Object Hazard!

If the standard connecting pins (11, View A-A) and brackets with hardware (12) are not removed from the adjacent insert (8) before raising the boom, they may fall, potentially resulting in death or serious injury.

4. Attach two **SL 1** slings (1, View C) to the shackles (2) on the equalizer (3) and to the forward most lifting lugs on the equalizer insert (4, View A).

CAUTION

Boom or Mast Damage!

Do not attempt to close the boom with the fixed mast until the equalizer is unpinned from the rails in step 5. Damage will result,

5. Remove the front stop pins (5, View D) from the holes in the rails (6) and the equalizer (3) and store the pins in the storage tubes (7, View E).
6. Do not remove the rear stop pins (5, View C) and rollers (5A, if equipped).
7. Slowly haul in the boom hoist wire rope on the MLC650 until the boom hoist equalizer (3, View A) is out of the rails and the **SL 1** slings (1) are tight.

CAUTION

Boom or Mast Damage!

Do not attempt to lift the entire boom during the following step. Damage to the fixed mast and/or boom could result.

Do not exceed a mast strap tension of 160,6 t (354,000 lb). Mast strap tension can be monitored in the Crane Status Bar of the Main Display (View C, Figure 4-64 on page 4-74).

8. Remove the tapered connecting pins (9, View A-A) from the brackets (10).
9. Slowly continue to haul in the boom hoist wire rope to raise the boom sections until the bottom connecting holes are aligned between the equalizer (4, View A) and the adjacent insert (8).

WARNING

Crushing Injury Hazard!

Prevent serious crushing injury:

- Do not stand inside the boom sections while installing the tapered connecting pins — STAND OUTSIDE BOOM.

10. Manually install the tapered connecting pins (9, View A) in the bottom connecting holes.
11. Slowly pay out the boom hoist wire rope until the equalizer (3, View C) is resting on the rails and the **SL 1** slings (1) are slack.
12. Remove the front stop pins (5, View E) from the front storage tubes (7) and install the stop pins (5, View D) in the holes of the rails (6) and the equalizer (3).
13. Disconnect the **SL 1** slings (1, View C) from between the shackles (2) on the equalizer (3) and the lifting lugs on the equalizer insert.
14. The shackles can remain attached to the equalizer.

Finishing Boom Assembly

Make sure all of the steps are performed under the topic Boom #680 Assembly in Section 4 of the Crane Operator Manual.

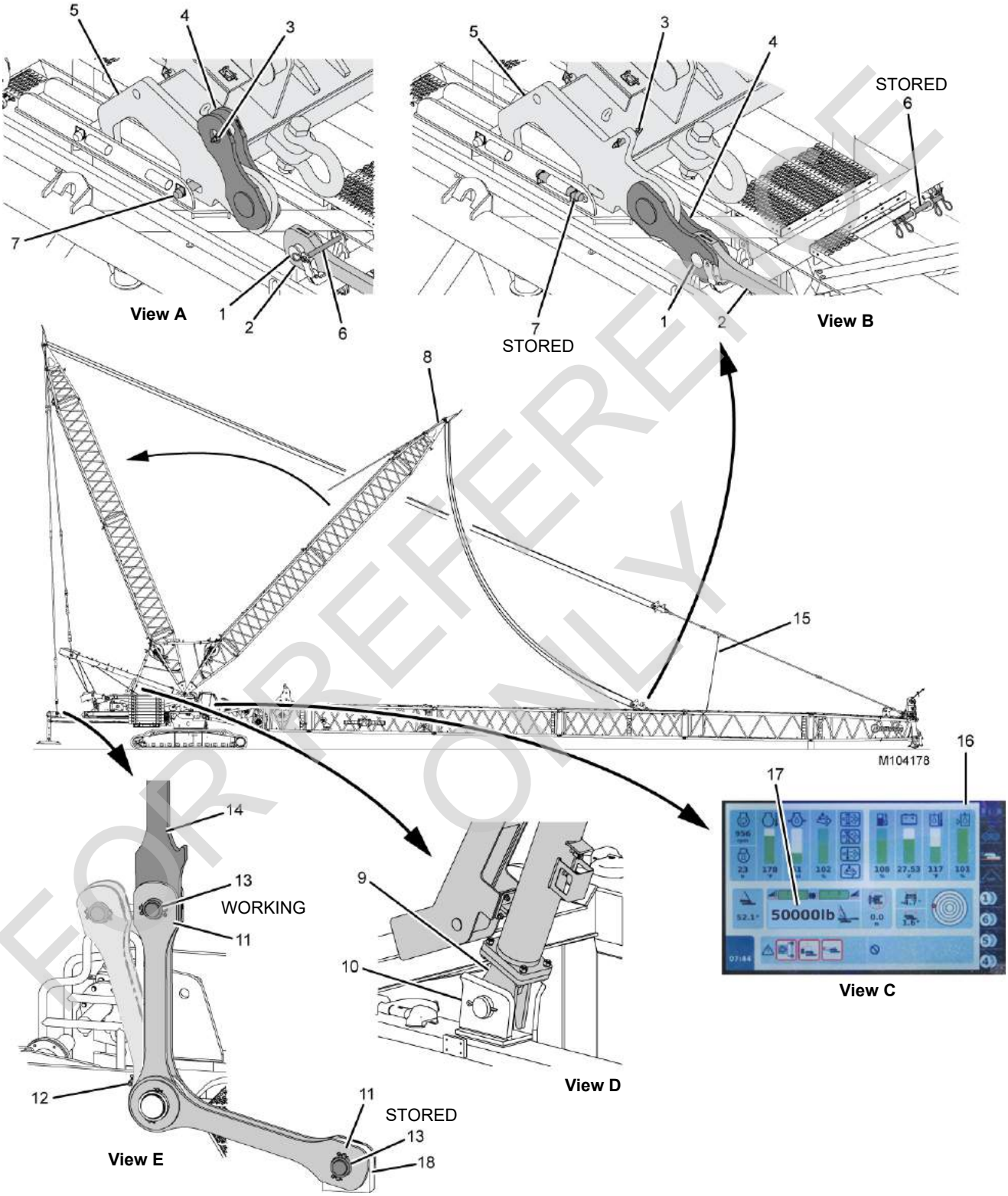


FIGURE 4-64

Legend for Figure 4-64

Item	Description
1	Pin with Collar, Retaining Pin, and Cotter Pins (2)
2	Boom Strap (2)
3	Pin with Safety Pins (2)
4	Equalizer Links (4)
5	Equalizer
6	Pins with Hair-Pin Cotters (2)
7	Front Stop Pin with Safety Pins (2)
8	Fixed Mast
9	Mast Stop (2)
10	Mast Stop Pin (2)
11	Counterweight Link (4)
12	Stop Pin
13	Pin with Collar, Retaining Pin, and Cotter Pins (2)
14	Counterweight Strap (2)
15	Intermediate Suspension Pendant (qty 2)
16	Main Display in Cab
17	Mast Tension
18	Storage Lug (if equipped)

See Figure 4-64 for the following procedures.

Connecting Equalizer Links to Boom Straps

1. Remove the pins (1, View A) from the boom straps (2).
2. Remove the pins (3, View A) and rotate the equalizer links (4) forward.
3. Pin the equalizer links (4, View B) to the boom straps (2) with the pins (1)
4. Reinstall the pins (3, View B) in the equalizer (5) holes.
5. Remove the pins (6, View A) and store them (View B).

Raising Fixed Mast to Operating Position

1. Perform the following checks before starting:
   - All boom straps unpinned from strap supports.
   - Equalizer links pinned to straps on equalizer insert.
   - Boom straps unpinned from equalizer insert.
   - Boom hoist equalizer unpinned from rails.
   - Wind within allowable limits for operation.

CAUTION

Structural Damage!

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

2. Remove the front stop pins (7, View A) and store them (View B).
3. Attach a hand-held tagline approximately 9 m (30 ft) long to each counterweight strap (14).
4. Slowly raise the fixed mast (8) while paying out the boom hoist wire rope.
   - The operator must match the rate of speed at which the mast hoist wire rope is hauled in with the rate of speed at which the boom hoist wire rope is payed out.
   - ***The boom hoist wire rope must remain slack until the fixed mast nears vertical.***
   - Use care not to allow the equalizer and straps to bounce up and down against the boom sections.
5. If equipped with intermediate suspension, have an assistant watch the intermediate suspension pendants (15) as the mast rises.

   Signal the operator to STOP raising the mast if the intermediate suspension pendants get caught on the insert. Correct the problem before continuing.
6. As the fixed mast nears vertical, tighten the boom hoist wire rope as required so the fixed mast moves smoothly past vertical to the rear.
7. Guide the counterweight straps around the live mast with the hand-held taglines.
8. Continue to slowly haul in the mast hoist wire rope and pay out boom hoist wire rope to lower the fixed mast to the rear.

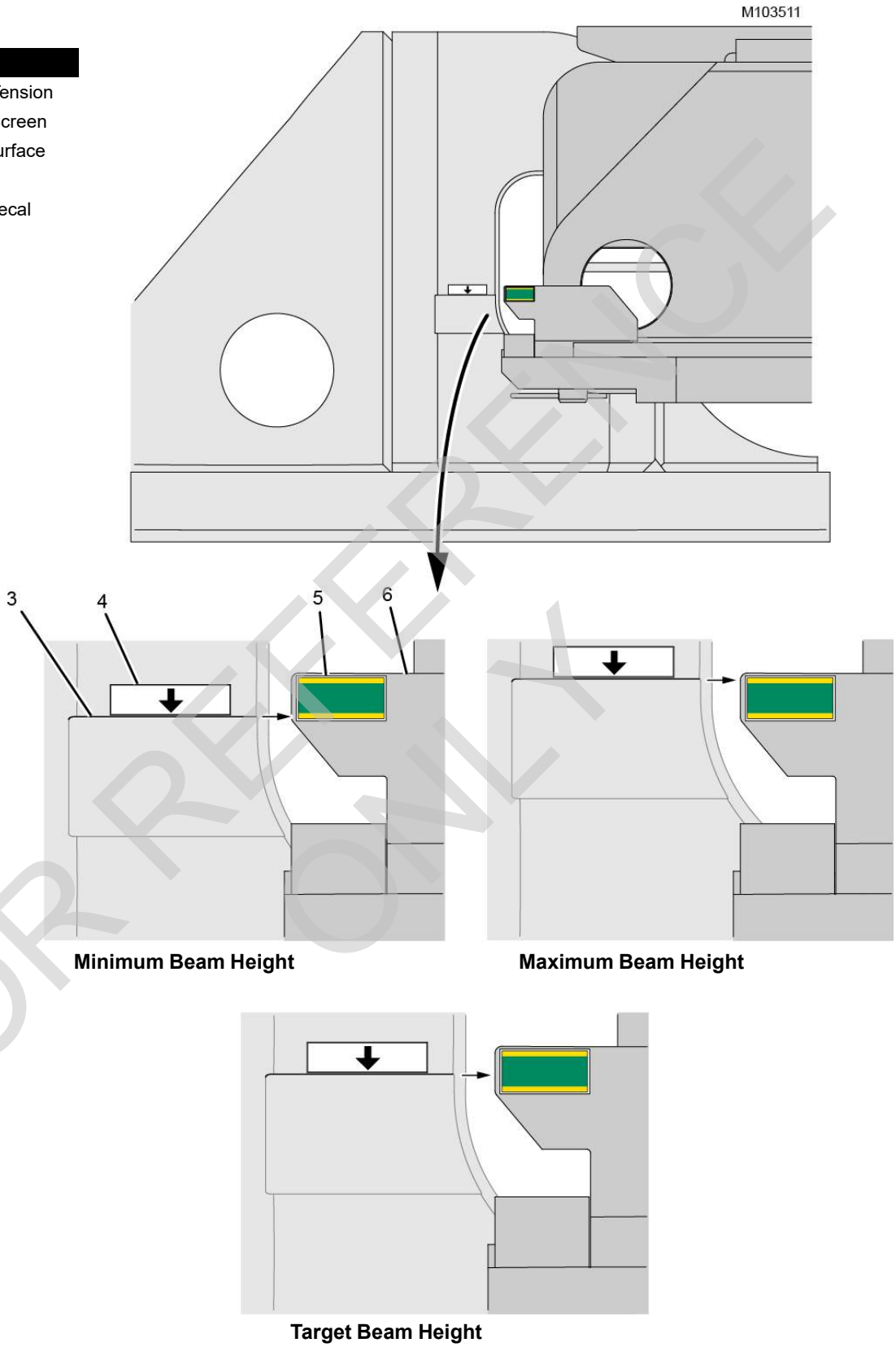
NOTE: As the fixed mast lowers, the crane control system monitors mast strap tension (left side only) and automatically slows down either Drum 4 or Drum 5 to maintain the constant target tension specified in Table 4-3 on page 77.

The left side mast strap tension (17, View C, Figure 4-64) can be monitored in the Crane Status Bar of the Main Display (16).

9. Just prior to engagement, make sure the mast stops (9, View D) are aligned with the mast stop lugs (10).
10. Continue to lower the fixed mast. Stop lowering when the fixed mast stops (9, View D) come to rest in the mast stop lugs (10) on the rotating bed.
11. Continue to slowly haul in mast hoist wire rope and pay out boom hoist wire rope so the counterweight straps can be connected to the counterweight links (at approximately 113°).
12. Connect the counterweight straps to the counterweight links, as follows (see View E):
    a. Remove the pins (13) from the counterweight links (11) and the storage lugs (18, if equipped).
    b. Rotate the counterweight links (11) against the stop pins (12).
    c. Pull the counterweight straps (14) forward with the hand-held taglines.
    d. Align the connecting holes and install the pins (13) to connect the counterweight links (11) to the counterweight straps (14).

    Repeat step 11 if necessary to align the holes.

Item	Description
1	Mast Strap Tension
2	Operator's Screen
3	Machined Surface
4	Arrow Decal
5	Alignment Decal
6	Stop Block



Minimum Beam Height

Maximum Beam Height

Target Beam Height

FIGURE 4-65

Adjusting the Fixed Mast and Beam Position

See Figure 4-65 for the following procedure.

1. For this procedure, the counterweight tray must be in the minimum working position Figure 4-38 on page 4-40 and fixed mast configuration must be selected in the RCL/RCI Display.

NOTE: During boom assembly, the mast straps should be in tension, and the counterweight straps should be slack. This condition remains from attaching the counterweight straps.

The beam should still be supported by the beam hooks at this point. The counterweight tray should be at the minimum working position. However, for some boom lengths, partial counterweight may be required to accomplish this procedure.

2. Once the boom is fully assembled and ready to be raised, pay out on drum 4 and haul in on drum 5 to raise the beam into position.

NOTE Paying out wire rope from Drum 4 decreases the boom suspension tension. Hauling in wire rope on Drum 5 increases the boom suspension tension.

During fixed mast raising and lowering, the crane control system may slow down either Drum 4 or Drum 5 to maintain the constant target tension specified in Table 4-3.

The left side mast strap tension (1, Figure 4-66) can be monitored in the Crane Status Bar of the Main Display (2).

Table 4-3 Target Mast Tension

Type of Fixed Mast Stops	Target Tension
Passive (no hydraulic lines to fixed mast stop cylinders)	22,7 ± 2,0 t (50,000 ± 4,400 lb)
Active (two hydraulic lines to each fixed mast stop cylinder)	29,1 ± 2,0 t (64,200 ± 4,400 lb)

FIGURE 4-66

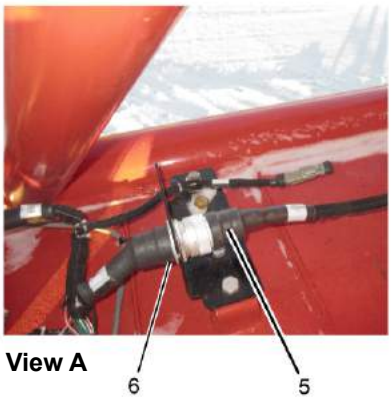
3. Make sure the counterweight straps are in tension and the beam hooks are just off the rotating bed pins.

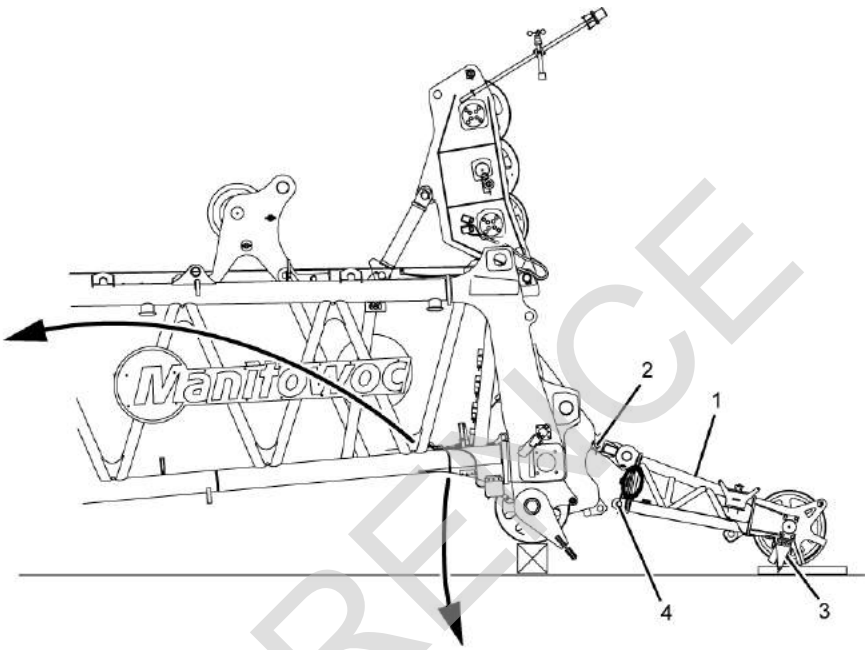
NOTE: As the counterweight strap tension increases, the backhitch load changes rapidly.

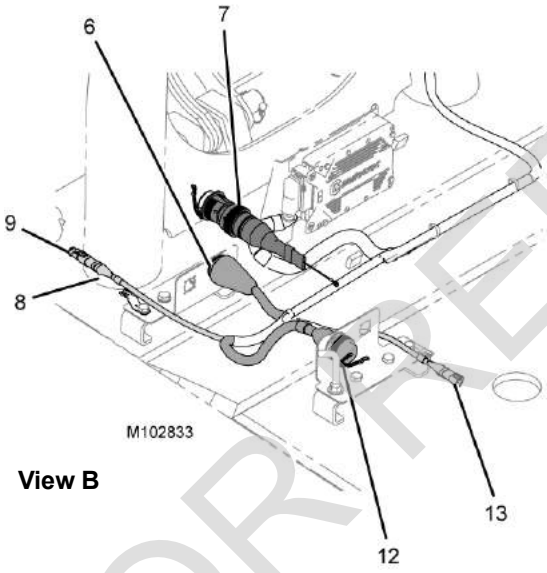
4. Continue raising the beam until the top of the machined surface (3), indicated by the arrow decal (4) on the beam hook, is aligned with the center of the green area of the alignment decal (5), located on the stop block (6) mounted to the rotating bed.

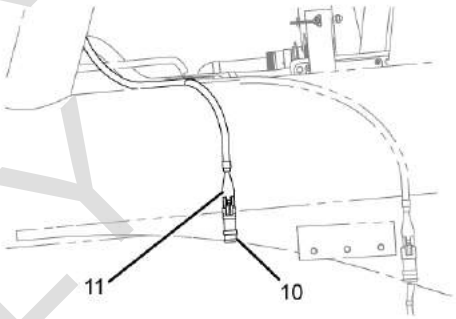
5. Prepare to raise the boom:

- Enter the desired boom and jib configuration and select the proper capacity chart in RCL/RCI display.
- Perform the pre-raising checks. See "Performing Pre-Raising Boom Checks", on page 4-79.









Item	Description
1	Upper Boom Point
2	Pin with Safety Pins (qty 2)
3	Anti-two Block Lug
4	Pin with Safety Pins (qty 2)
5	Electrical Cable (WBU1-P1 connects to WBT1-J2)
6	Receptacle (WBT1-J2 ATTACHMENTS)
7	Shorting Plug
8	Electrical Cable (WBT1-J6 — CAN NET OUT)
9	Terminator Plug
10	Shorting Plug
11	Electrical Cable - SLOW DOWN (optional)
12	Electrical Cable (WBT1-J1 — POWER from boom cable reel)
13	Electrical Cable (WBT1-J5 — CAN NET IN from boom cable reel)

FIGURE 4-67

Performing Pre-Raising Boom Checks

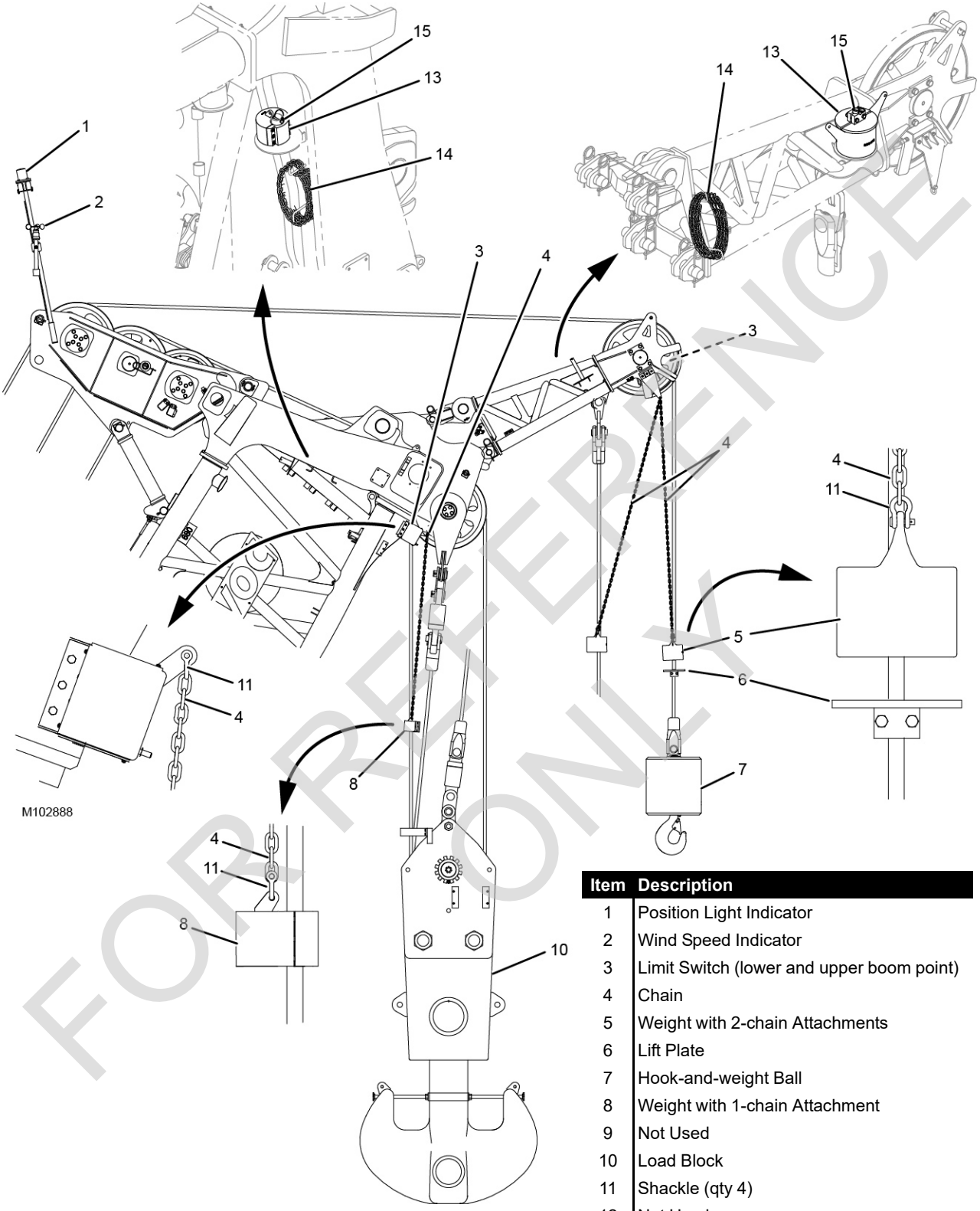
NOTE: Refer to the MLC650 Luffing Jib Operator Manual for the pre-raising checks and raising procedure when equipped with a luffing jib.

Perform the following checks before raising the boom and jib:

- ☐ Maintenance and lubrication checks have been performed according to Maintenance Checklist and Lubrication Guide.
- ☐ Crane is on a firm, level, uniformly supporting surface.
- ☐ Crawlers are blocked if required per capacity chart in use.
- ☐ Boom hinge pins are fully engaged and secured.
- ☐ Crawler connecting pins are engaged and locking pins installed.
- ☐ Carbody jack pads are removed and secured in storage position.
- ☐ Carbody jacks are fully retracted and stored.
- ☐ Boom and jib inserts are installed in proper sequence per boom and jib assembly drawings.
- ☐ Intermediate suspension insert is installed in proper position, if required.
- ☐ Intermediate suspension pendants are secured in proper operating position.
- ☐ All straps are unpinned from storage lugs unless they are allowed to remain in the shipping position during operation.
- ☐ All straps are properly pinned together. Cotter pins are installed and spread.
- ☐ Live mast straps are properly connected to boom straps.
- ☐ Mast-assist arms are fully lowered.
- ☐ Boom hoist wire rope is spooled tightly onto boom hoist and engaged with the proper sheaves.
- ☐ Load lines are spooled tightly onto drums and engaged with proper sheaves.
- ☐ Load lines are securely anchored at boom and jib points or at load block and weight ball.
- ☐ Left rear rotating bed ladder is folded in stored position or removed.
- ☐ All tools and other items are removed from boom and jib.
- ☐ Electrical boom stop is properly installed, operational, and adjusted to proper angle.
- ☐ Electrical cables from crane control system are connected to cable reel in boom butt.
- ☐ Electrical cables in boom and jib are connected to proper receptacles.
- ☐ Block-up limit control is properly installed, operational, and adjusted.
- ☐ RCL/RCI is properly configured and operational.
- ☐ Proper capacity chart is selected on configuration screen of RCL/RCI display.
- ☐ Operator has read and is thoroughly familiar with selected capacity chart. Be sure to comply with the boom raising limitations in the Maximum Boom Lengths Lifted Unassisted table of the capacity chart.
- ☐ Wind is within allowable limits for operation as shown under Wind Conditions in Section 3.

Raising the Boom

1. Verify that the pre-raising checks have been performed.
2. SLOWLY start to boom up.
3. If equipped with an upper boom point (see Figure 4-67), stop when the bottom holes in the upper boom point are aligned with the holes in the boom top. Install the connecting pins.
4. Continue to raise the boom until the lower and upper boom points are at a convenient height for installing the load block(s) and hook-and-weight ball.
5. Install the load block(s) and hook-and-weight ball at the lower and upper boom points.



Item	Description
1	Position Light Indicator
2	Wind Speed Indicator
3	Limit Switch (lower and upper boom point)
4	Chain
5	Weight with 2-chain Attachments
6	Lift Plate
7	Hook-and-weight Ball
8	Weight with 1-chain Attachment
9	Not Used
10	Load Block
11	Shackle (qty 4)
12	Not Used
13	Weight Storage
14	Chain Storage
15	Safety Pin

FIGURE 4-68

See Figure 4-68 for the following procedure.

6. Install the block-up limit components at the boom points.
7. If equipped with a jib, continue to raise the boom until the jib point is at a convenient height to install the load block or the hook-and-weight ball.
   a. Signal the operator to STOP raising the boom if the jib pendants get caught on the brackets, pins, or timber guards. Correct the problem before continuing.
   b. Make sure the jib stop pins are properly installed.
8. Install the load block or hook-and-weight ball at the jib point.
9. Install the block-up limit components at the jib point.
10. Continue to boom up until the boom is at an angle that safely allows the load block(s) and hook-and-weight ball to be lifted.
11. Once the boom is raised, perform the following checks:
    a. Check all crane functions for proper operation.
    b. Check all safety devices for proper operation (see Section 3 of the MLC650 Operator Manual).
    c. Make sure the boom stop is adjusted for the proper maximum boom angle.
    d. Make sure the RCL/RCI is properly calibrated.

WIRE ROPE INSTALLATION

NOTE: The wire rope manufacturer's recommendations take precedence over the following information.

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

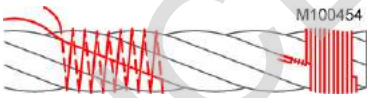
Store the wire rope in coils or on reels off the ground or floor in a clean, dry, indoor location. If outdoor storage is necessary, the wire rope must be covered with a protective wrapper.

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 the Service Manual at least monthly.

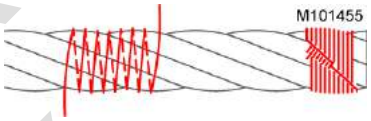
Wire Rope Type	Seizings Required
Preformed	1
Non-preformed	2

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

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.

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

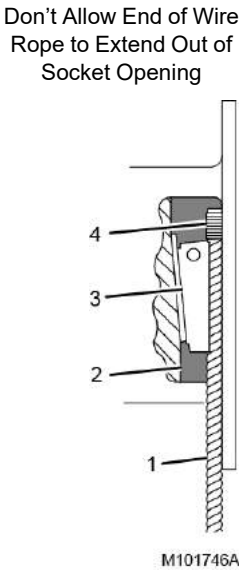
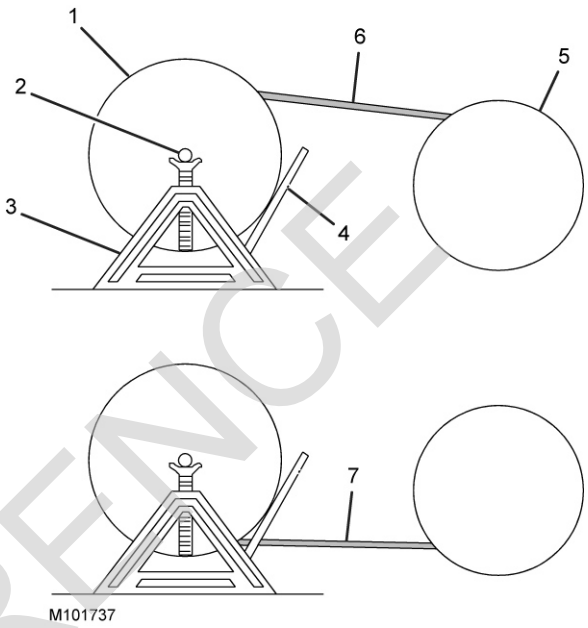


FIGURE 4-70



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

Anchoring Wire Rope to Drum

See Figure 4-70

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

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

WARNING

Falling Load Hazard!

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.

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.

1. Remove the wire rope from the shipping reel:
   a. Mount the wire rope shipping reel (1, Figure 4-71) 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.

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, Figure 4-72).

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

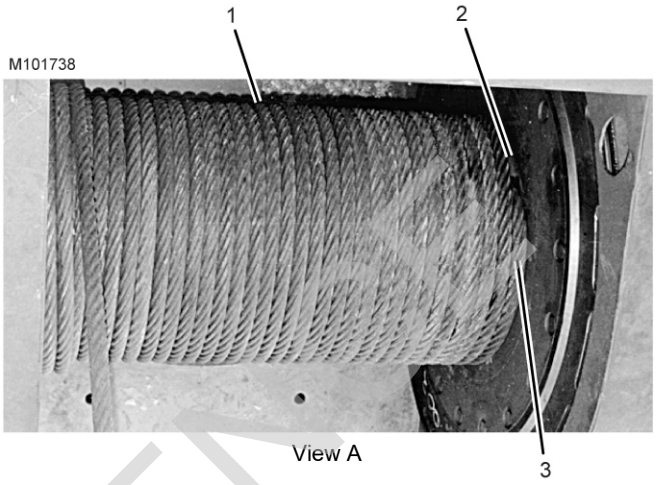
c. Use extreme care not to put twists or turns in the wire rope. Allow the rope to assume its natural lay.

CAUTION

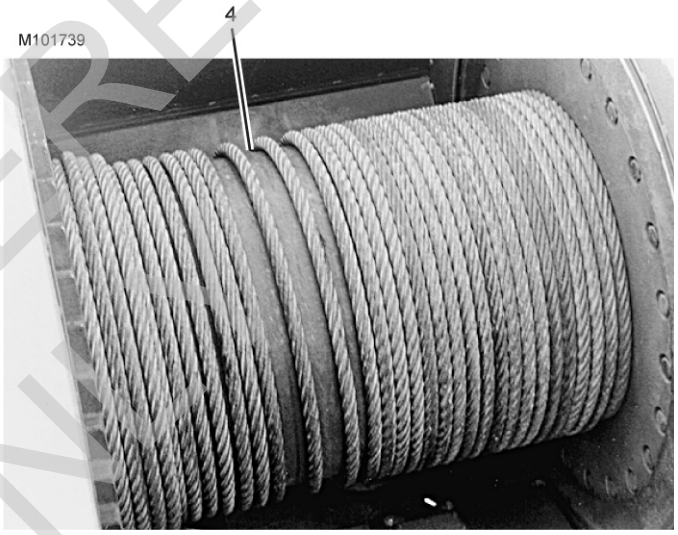
Avoid Wire Rope Damage

Voids or spaced wraps (View B, Figure 4-72) 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

THIS PAGE INTENTIONALLY LEFT BLANK

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.

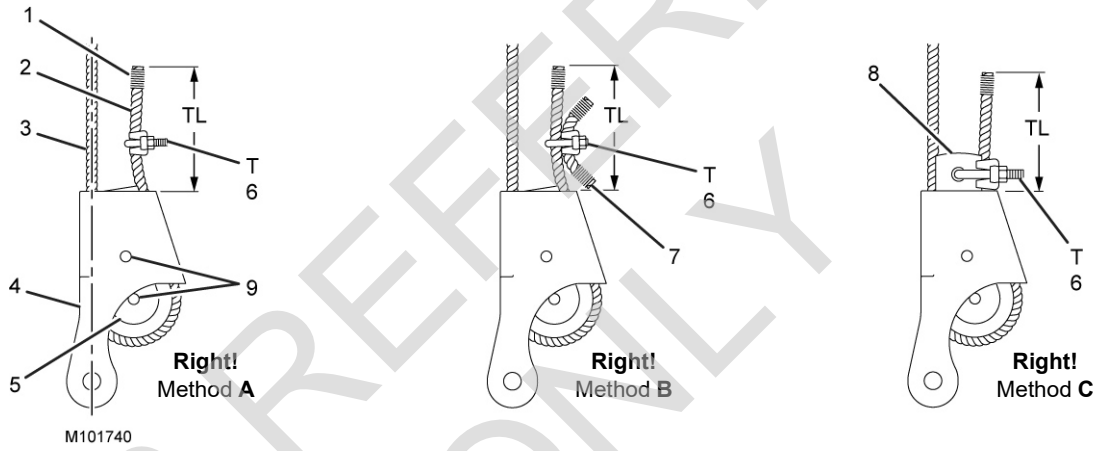
T (Rope Clip Nut Torque)

	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)

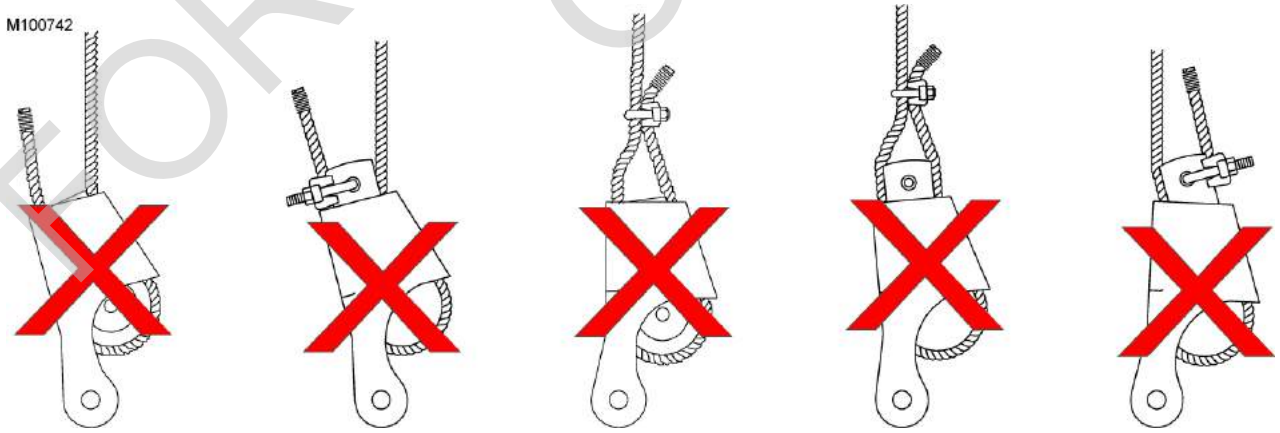
*Tightening torque values shown are based on threads being clean, dry, and lubrication free.

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).



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.

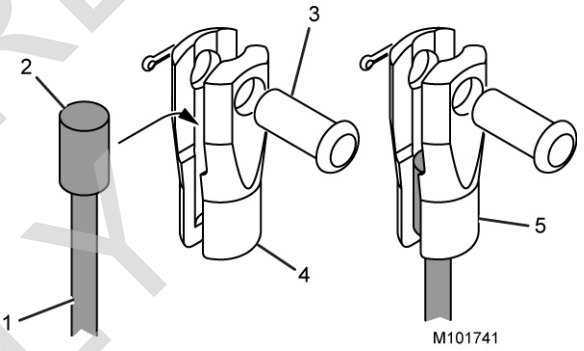
7. After the socket is pinned in place, hoist the load slowly so the wedge seats tightly. Do not shock load the socket and wedge.

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.



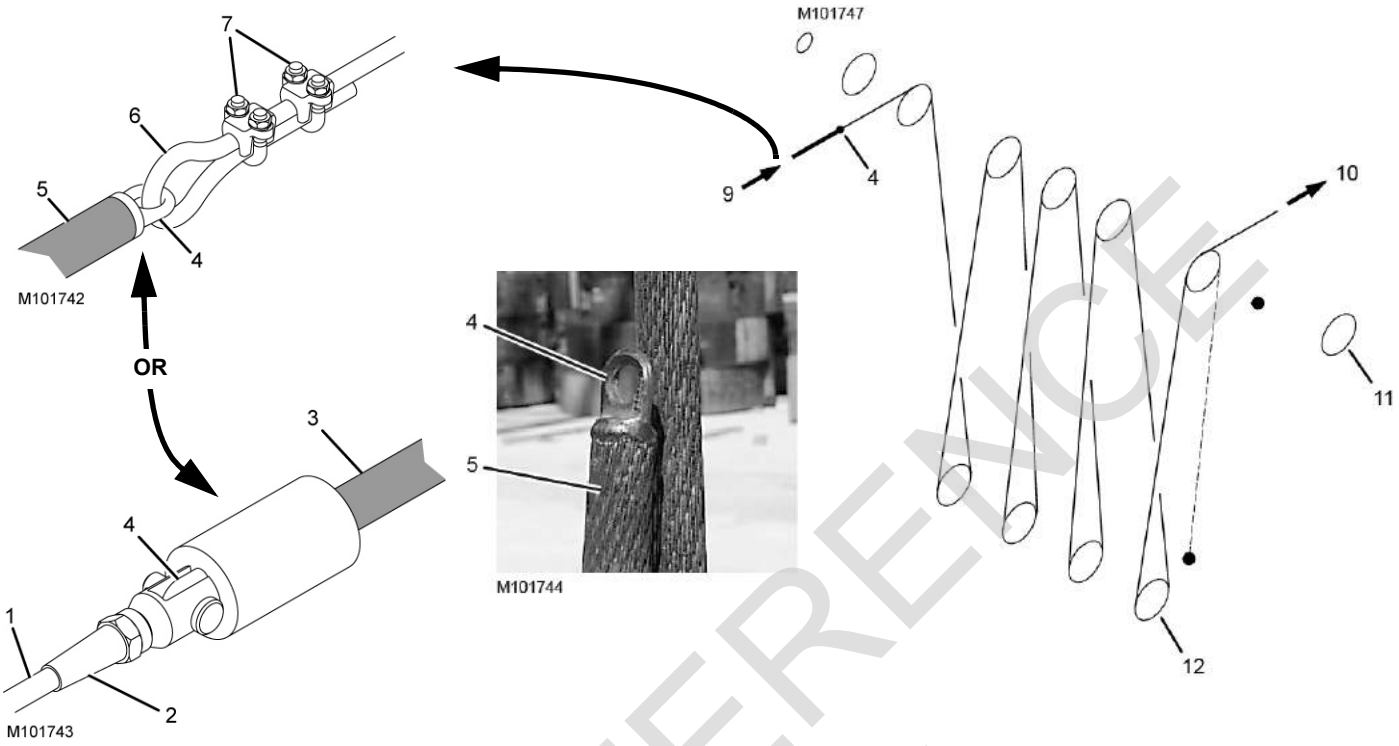
Item	Description
1	Load Line
2	Button
3	Pin
4	Button Socket
5	Locking Screw (behind if equipped)

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**

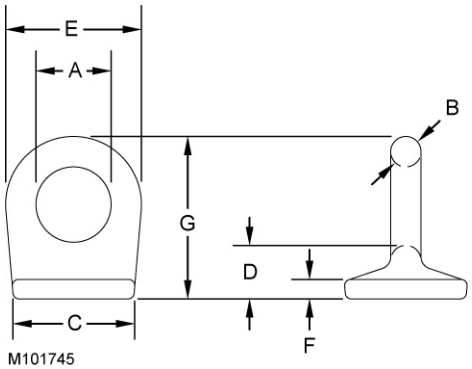


FIGURE 4-75

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

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 listed in Figure 4-75.
2. Make sure the rigging line and the attaching hardware (clips and rope connectors) are rated for the approximate capacities shown in Figure 4-75.
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

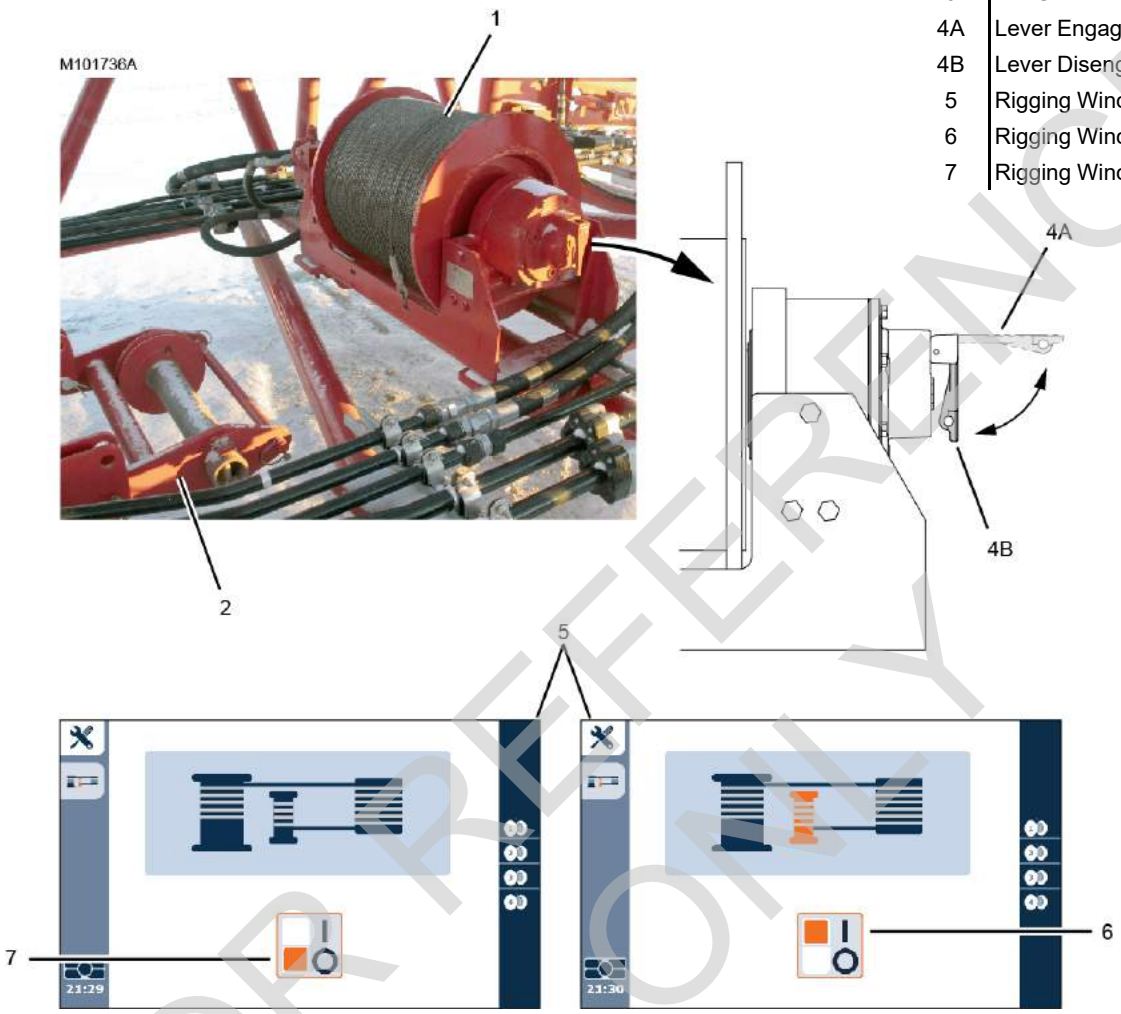


FIGURE 4-76

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 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 turn 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 will not automatically pay out line if the selected load drum control handle is pulled back to the hoist 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

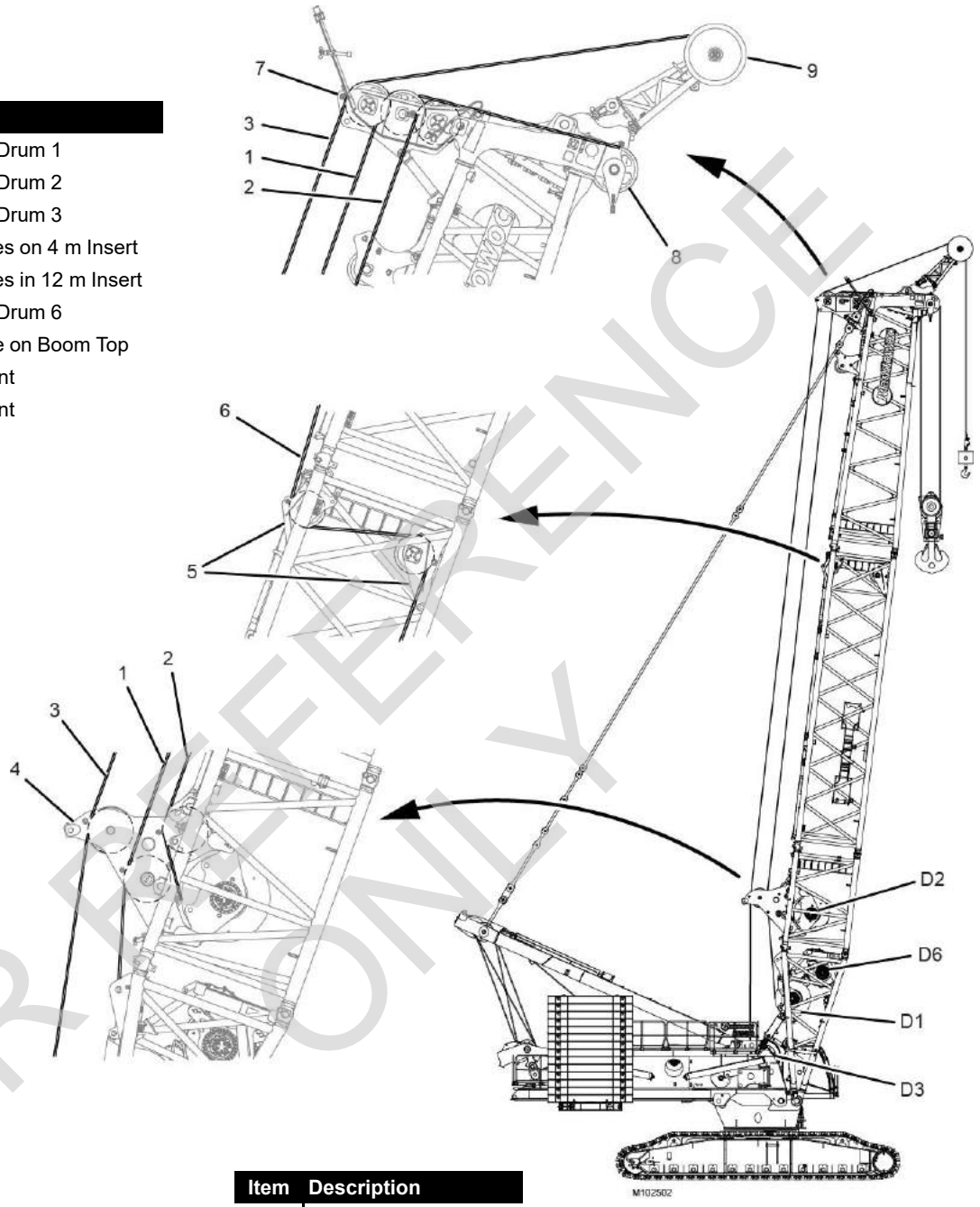
Flying Object Hazard!

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.

Item	Description
1	Wire Rope from Drum 1
2	Wire Rope from Drum 2
3	Wire Rope from Drum 3
4	Wire Rope Guides on 4 m Insert
5	Wire Rope Guides in 12 m Insert
6	Wire Rope from Drum 6
7	Wire Rope Guide on Boom Top
8	Lower Boom Point
9	Upper Boom Point



Item	Description
D0	Rigging Winch
D1	Main Hoist
D2	Main Hoist Option
D3	Whip Hoist
D6	Luffing Hoist

FIGURE 4-77

LOAD LINE REEVING

NOTE: The boom top can be reeved in various configurations. See the reeving diagrams included at the end of this section for each reeving option.

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 4-78 for identification of the load drums and the guide sheaves.

Refer to the Reeving Diagrams at the end of this section for rope routing over the boom top wire rope guide (7).

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.

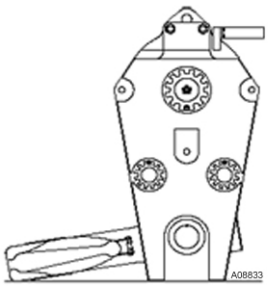
NOTE: Reference the block drawings included at the end of this section for block assembly configurations.

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 4-78 to achieve maximum hook capacity. The duplex hook has a hole to which an optional shackle can be attached as shown in Figure 4-78.

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.

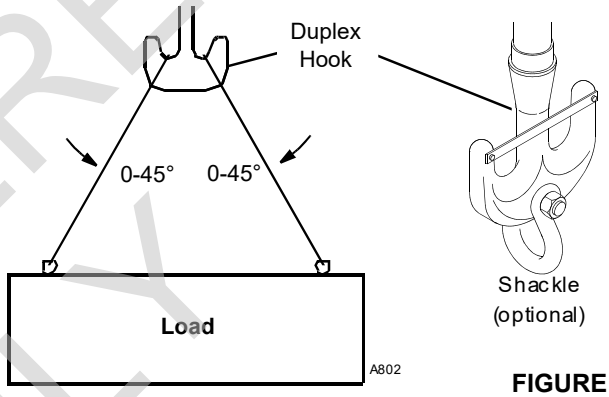


FIGURE 4-78

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 boom 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 4-79 for the upper boom point dead end locations and required hardware.

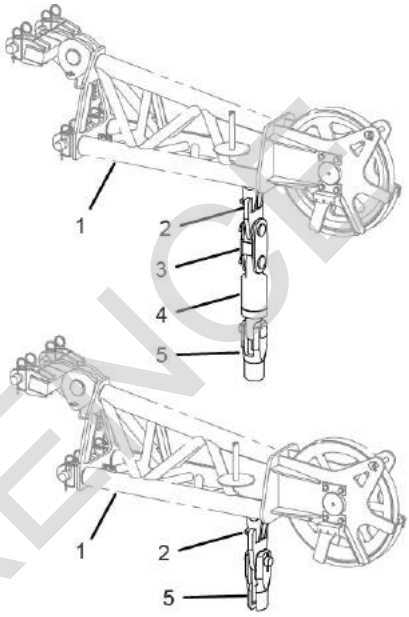
See the Boom Rigging Drawing for the lower boom point dead end locations and required hardware.

All hardware is stored in the job boxes provided with the crane.

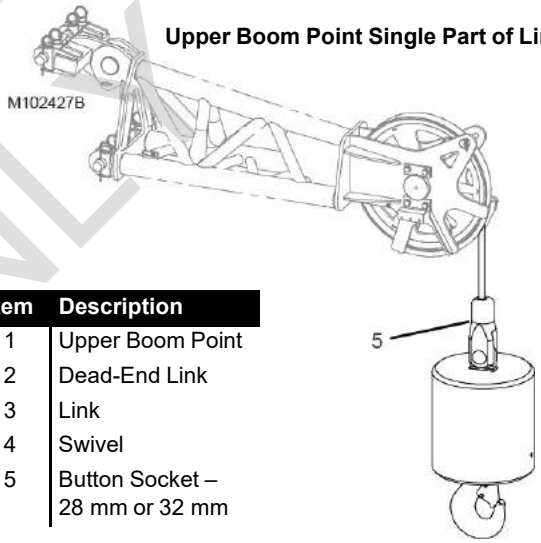
INSPECTING THE VPC AND VPC-MAX ROLLER PATHS

Prior to using the crane each day, inspect the VPC and VPC-MAX roller paths on the rotating bed and beam for obvious obstructions and/or signs of damage. Remove the obstructions. Contact the Manitowoc Crane Care Lattice Team for inspection and repair criteria.

Upper Boom Point Multiple Parts of Line



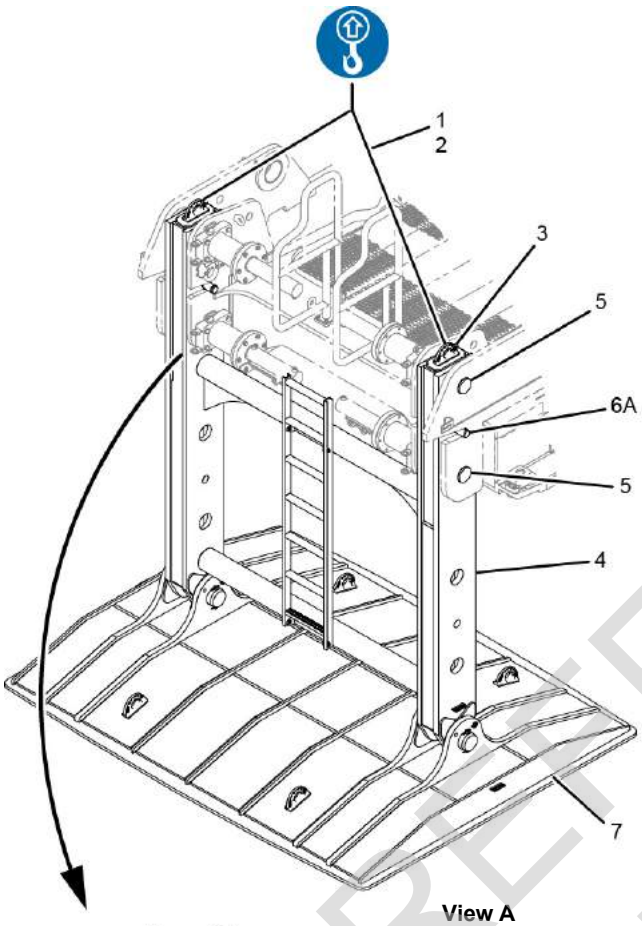
Upper Boom Point Single Part of Line



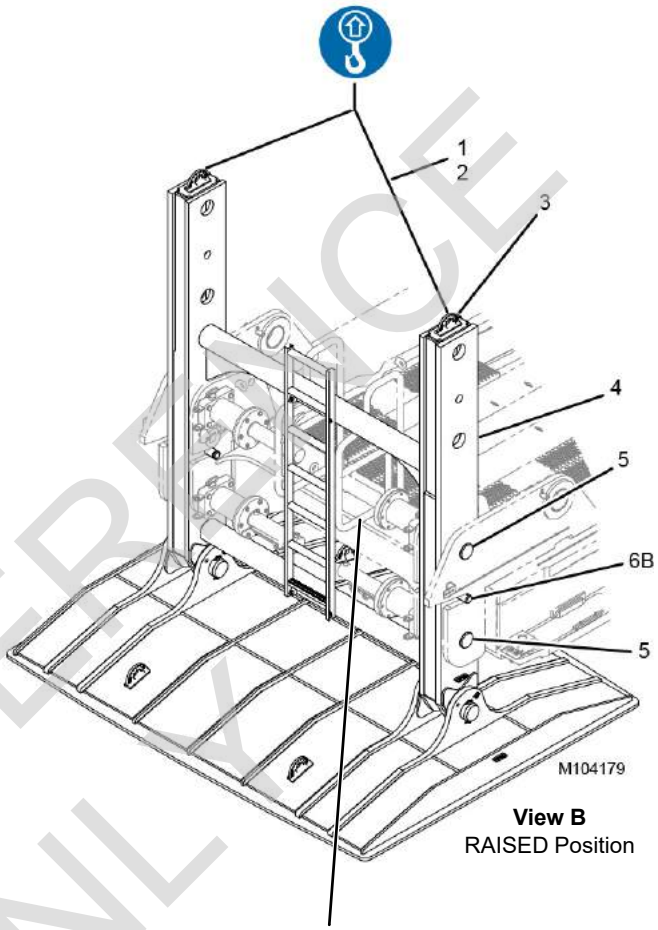
Item	Description
1	Upper Boom Point
2	Dead-End Link
3	Link
4	Swivel
5	Button Socket – 28 mm or 32 mm

FIGURE 4-79

THIS PAGE INTENTIONALLY LEFT BLANK

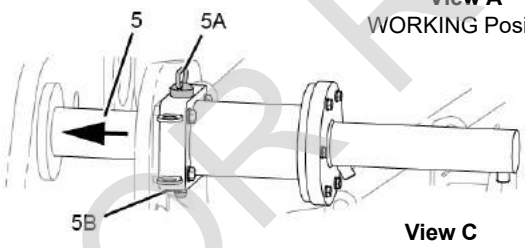


View A
WORKING Position

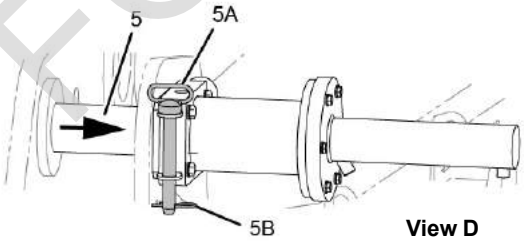


View B
RAISED Position

NOTE: The handrails on PAST production cranes must be rotated inward (180°) and reattached to the beam so the they do not interfere with the auxiliary frame assembly raised. Reattach the handrails in the working position when the auxiliary frame assembly is lowered to the working position.



View C



View D

Item	Description
1	**SH 2** Shackle – 17 t (18.70 USt) (qty 2)
2	**SL 4** Sling – 3,80 m (12.50 ft), 11 340 kg (25,000 lb) (qty 2)
3	Lifting Lug (qty 2)
4	Auxiliary Frame Assembly
5	Powered Retaining Pin (qty 4)
5A	Hitch Pin (qty 4)
5B	Hair-Pin Cotter (qty 4)
6	Alignment Pin with Retaining Ring and Cotter Pins (qty 2)
7	Pad Area = 7,09 m^2 (76.3 ft^2)

FIGURE 4-80

AUXILIARY FRAME OPERATING POSITIONS

WARNING

Structural Damage Hazard!

A sudden release of load and/or dynamic loading (due to swinging, hoisting, or lowering and adverse weather conditions to include wind) may cause structural damage due to shock loading and unintended motion of the crane.

The auxiliary frame assembly is provided to limit unintended motion of the VPC-MAX beam and counterweights during a sudden release of load and/or dynamic loading (due to swinging, hoisting, or lowering and adverse weather conditions to include wind).

The auxiliary frame assembly in no way substitutes for, or lessens, the requirement that the crane must be operated properly and safely, and that it must be inspected, serviced, and maintained regularly to minimize the potential for a sudden release of load and/or dynamic loading (due to swinging, hoisting, or lowering and adverse weather conditions to include wind).

See Figure 4-80 for the following procedure.

The auxiliary frame assembly has two operating positions:

WORKING Position (View A):

This is the recommended operating position.

RAISED Position (View B):

This position can be used if additional clearance is required for swinging over job site obstacles.

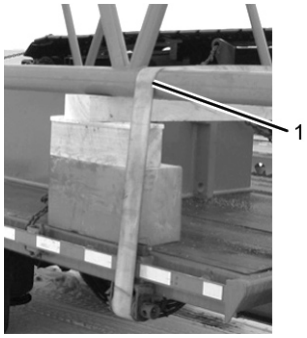
Lower the auxiliary frame assembly after the obstacle is cleared. Continued operation with the auxiliary frame assembly raised is not recommended.

To change the operating position, proceed as follows:

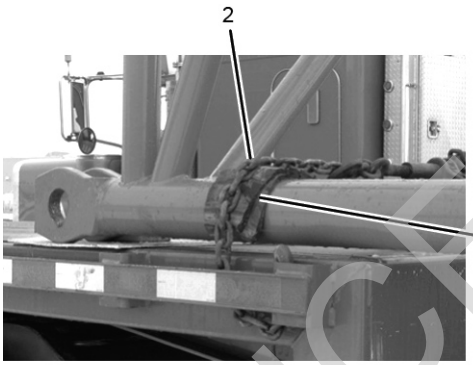
NOTE The auxiliary frame assembly weighs approximately 4 286 kg (9,450 lb).

1. Proceed as follows to move the auxiliary frame assembly to the ***RAISED position***:
   - **a.** Attach the **SH 2** shackles (1, View A) and the **SL 4** slings (2) to the lifting lugs (3) on the auxiliary frame assembly (4) and to the hook of an assist crane.
   - **b.** Hoist just enough to tighten the lifting slings.
   - **c.** Remove the hitch pins (5A) from the working position (View C) and store them (View D).
   - **d.** Using the remote control, disengage the powered retaining pins (5).
   - **e.** Lift the auxiliary frame assembly (4, View A) away from the VPC-MAX beam.
   - **f.** Move the alignment pins (6, View A) from the top holes (A, View A) in the auxiliary frame assembly to the bottom holes (B, View B) in the auxiliary frame assembly.
   - **g.** Lift the auxiliary frame assembly (4) into position at the end of the VPC-MAX beam so the alignment pins (6, View B) engage the notches in the beam.
   - **h.** Using the remote control, engage the powered retaining pins (5) to connect the auxiliary frame assembly (4) to the VPC-MAX beam.
   - **i.** Move the hitch pins (5A) from the stored position (View d) to the working position (View c) and install the hair pin cotters (5B).
   - **j.** Disconnect the shackles and lifting slings from the auxiliary frame assembly.
2. Proceed as follows to move the auxiliary frame assembly to the ***WORKING position***:
   - **a.** Attach the **SH 2** shackles (1, View B) and the **SL 4** lifting slings (2) to the lifting lugs (3) on the auxiliary frame assembly (4) and to the hook of an assist crane.
   - **b.** Hoist just enough to tighten the lifting slings.
   - **c.** Remove the hitch pins (5A) from the working position (View C) and store them (View D).
   - **d.** Using the remote control, disengage the powered retaining pins (5).
   - **e.** Lift the auxiliary frame assembly (4, View A) away from the VPC-MAX beam.
   - **f.** Move the alignment pins (6, View B) from the bottom holes (B, View B) in the auxiliary frame assembly to the top holes (A, View A) in the auxiliary frame assembly.
   - **g.** Lift the auxiliary frame assembly (1) into position at the end of the VPC-MAX beam so the alignment pins (6, View A) engage the notches in the beam.
   - **h.** Using the remote control, engage the powered retaining pins (5) to connect the auxiliary frame assembly (4) to the VPC-MAX beam.
   - **i.** Move the hitch pins (5A) from the stored position (View D) to the working position (View C) and install the hair pin cotters (5B).
   - **j.** Disconnect the shackles and lifting slings from the auxiliary frame assembly.

View A



M103130

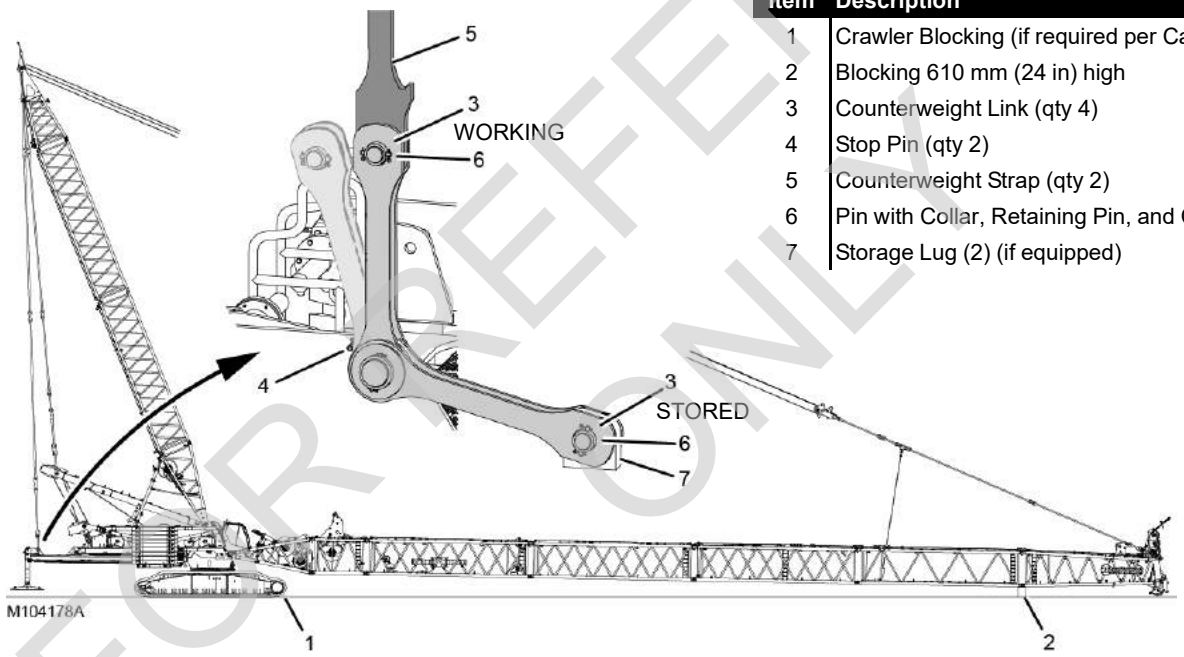


View B

M103131

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

FIGURE 4-81



Item	Description
1	Crawler Blocking (if required per Capacity Chart)
2	Blocking 610 mm (24 in) high
3	Counterweight Link (qty 4)
4	Stop Pin (qty 2)
5	Counterweight Strap (qty 2)
6	Pin with Collar, Retaining Pin, and Cotter Pins (2)
7	Storage Lug (2) (if equipped)

FIGURE 4-82

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 synthetic tie-downs to secure components as shown in Figure 4-81, View A.

    If chain tie-downs are used, install protective covering (such as sections of rubber tire) between the chain and the component being secured as shown in Figure 4-81, View B.

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

DISASSEMBLING THE VPC-MAX

Lowering the Boom

See Figure 4-82 for the following procedure.

1. Refer to the capacity chart in use for boom lowering limitations.

WARNING

Falling Boom/Tipping Hazard!

Before lowering the boom:

- Determine the proper counterweight position from the capacity chart that will allow lowering the boom length in use.
- Select the required counterweight position in the RCL/RCI Display when the boom is within the operating range of the capacity chart.
- Block under the crawlers if required.

2. Travel the ends of the crawlers onto blocking (1) if required per the Capacity Chart. See Crawler Blocking in the Capacity Chart Information Manual.
3. Swing the boom to either side of center and lower the load blocks and/or the hook-and-weight balls to the ground. Take every precaution to prevent damage to the load lines.
4. Swing the boom to the required lowering position:
   - Over the end of the blocked crawlers
   - Over the end or side of the crawlers
5. Slowly lower the boom while performing the following steps:
   a. If equipped with a luffing jib, refer to the Luffing Jib Operator Manual for lowering instructions.
   b. If equipped with a fixed jib, disengage the jib stops before the jib point contacts the ground.
   c. If equipped with an upper boom point, remove the bottom connecting pins (4, Figure 4-67 on page 4-78) when the upper boom point just contacts the ground.
6. Pay out the load lines as the boom lowers.
7. Position blocking (2) that is at least 610 mm (24 in) high under the bottom connectors between the boom top the adjacent boom section.

   To prevent damage to the boom sections caused by excessive sag, space additional blocking under the boom sections at the intervals specified under "Intermediate Blocking" requirement in the Boom Rigging Drawing at the end of this section.
8. Stop lowering the boom when the boom straps just start to lower.

Detaching the Counterweight Straps

See Figure 4-82 for the following procedure.

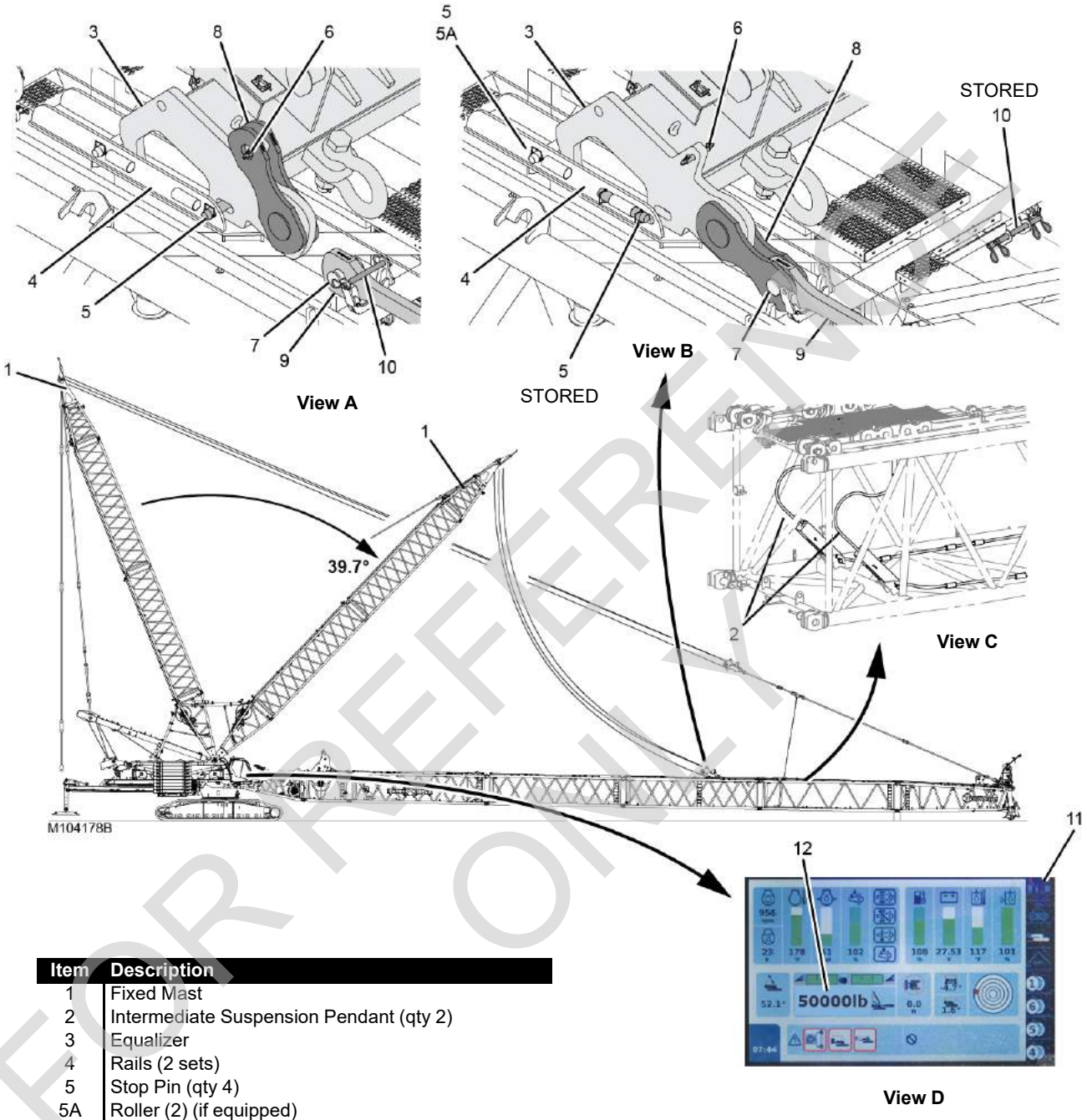
1. Once the boom is on blocking, enter the fixed mast configuration and select the proper fixed mast capacity chart in RCL/RCI display.
2. Check the following:
   - The counterweight tray is fully retracted to the minimum working position of 4 m as indicated in the VPC-MAX calibration screen (View C, Figure 4-38 on page 4-40). Drive the tray in with the remote control if necessary.
   - The VPC-MAX beam is resting on the hooks (View B, Figure 4-32 on page 4-33). Slacken the boom rigging if necessary.
3. Using the Drum 4 and 5 control handles, slowly haul in the mast hoist wire rope and pay out boom hoist wire rope so the counterweight straps are slack.

   This step will pull the fixed mast back to approximately 113°, at which point the counterweight links (3) should be reseting against the stop pins (4).

   The fixed mast angle can be monitored in the fixed mast working screen in the RCL/RCI display.
4. Disconnect the counterweight straps from the counterweight links on one side of the mast at a time:
   a. Attach a hand-held tagline approximately 9 m (30 ft) long to each counterweight strap (5).

      The taglines will be used to guide the straps rearward by assembly personnel when the pins are removed in step b.
   b. Remove the pin (6) connecting the counterweight links (3) to the counterweight strap (5).

      Repeat step 3 as necessary to loosen the pins.
   c. Using the tagline, payout the counterweight strap until it is hanging vertical.
   d. Rotate the counterweight links (3) forward onto the beam for storage.
   e. Reinstall the pin (6) in the counterweight links (3) and the storage lugs (7, if equipped).
   f. Repeat the steps for the other side of the fixed mast.
   g. Leave the taglines attached to the counterweight straps.



Item	Description
1	Fixed Mast
2	Intermediate Suspension Pendant (qty 2)
3	Equalizer
4	Rails (2 sets)
5	Stop Pin (qty 4)
5A	Roller (2) (if equipped)
6	Pin with Safety Pins (2)
7	Pin with Collar, Retaining Pin, and Cotter Pins (2)
8	Equalizer Links (4)
9	Boom Strap (2)
10	Pin with Hair-Pin Cotters (2
11	Main Display in Cab
12	Mast Tension

FIGURE 4-83

Lowering the Fixed Mast to the Boom Handling Position

See Figure 4-83 for the following procedure.

1. Using the Drum 4 and 5 control handles, raise the fixed mast (1) by slowly hauling in the boom hoist wire rope while paying out the mast out wire rope.
   - The operator must match the rate of speed at which the mast hoist wire rope is payed out with the rate of speed at which the boom hoist wire rope is hauled in.
   - ***The mast hoist wire rope must remain slack until the fixed mast nears vertical.***
   - Use care not to allow the equalizer and straps to bounce up and down against the boom sections.

NOTE: As the fixed mast rises, the crane control system monitors mast strap tension (left side only) and automatically slows down either Drum 4 or Drum 5 to maintain the constant target tension specified in Table 4-3 on page 77.

The left side mast strap tension (12, View C, Figure 4-83) can be monitored in the Crane Status Bar of the Main Display (11).

2. Guide the counterweight straps around the live mast with the hand-held taglines.
3. As the fixed mast nears vertical, tighten the mast hoist wire rope as required so the fixed mast moves smoothly forward past vertical.
4. Continue to slowly pay out the mast hoist wire rope and haul in the boom hoist wire rope to lower the fixed mast toward the boom.
5. If equipped with intermediate suspension, have an assistant watch the intermediate suspension pendants (2, View C) as the mast lowers. The pendants must fold into the insert.

   Signal the operator to STOP lowering the mast if the intermediate suspension pendants get caught on the insert. Correct the problem before continuing.
6. Continue to slowly pay out the mast hoist wire rope and haul in the boom hoist wire rope so the equalizer (3, View B) comes to rest on the rails (4) and the boom straps come to rest in the brackets on the top of the boom sections.

CAUTION

Mast Damage!

Do not lower the fixed mast below 39.7°. Structural damage could result.

7. Do not lower the fixed mast below 39.7°.
8. Make sure the equalizer is on the forward side of the rear stop pins (5, View B) and the rollers (5A, if equipped).
9. Remove the front stop pins (5, View B) from storage.
10. Install the front stop pins (5, View A) to pin the equalizer (3) to the rails (4).

Detaching the Equalizer Links from the Boom Straps

See Figure 4-83 for the following procedure.

1. Remove the pins (6, View B).
2. Remove the pins (7, View B) and rotate the equalizer links (8) rearward.
3. Pin the equalizer links (8, View A) to the equalizer (3) with the pins (6).
4. Reinstall the pins (7, View A) in the boom strap (9) pin holes.
5. Remove the pins (10, View B) from storage and install them (View A).

Disconnecting the Boom Straps

Starting at the boom top, disconnect the boom straps between all of the boom sections to include the 12 m (39.4 m) straps on the insert with equalizer rails.

- See the Disconnect Boom Straps topic in Section 4 of the Crane Operator Manual for instructions.

Item	Description
1	**SL 1** Sling – 5 m (16.40 ft), 31 751 kg (70,000 lb) (qty 2)
2	Shackle (qty 2, on equalizer)
3	Equalizer
4	Equalizer Insert
5	Stop Pin with Safety Pins (qty 4)
5A	Roller (2) (if equipped)
6	Rails (2 sets)
7	Storage Tube (qty 4)
8	Adjacent Insert
9	Tapered Connecting Pin (qty 2)
10	Bracket (qty 2)
11	Standard Connecting Pin (qty 2)
12	Bracket with Hardware (qty 2)

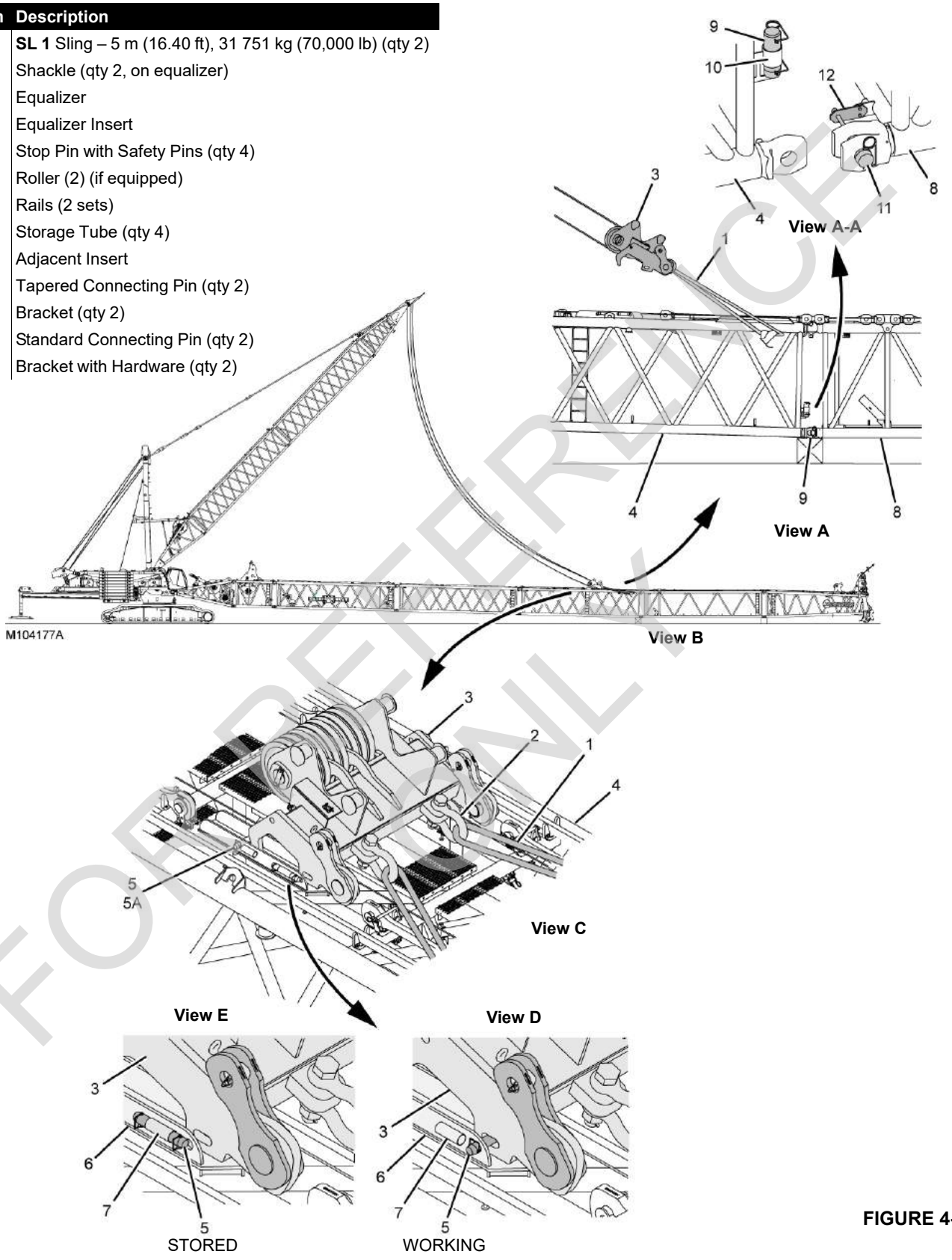


FIGURE 4-84

Opening the Boom Sections Using the Fixed Mast

WARNING

Tipping Hazard!

Do not exceed the boom closing (opening) limitations given in the Boom Rigging Drawing at the end of this section. Make sure the crane is equipped with the specified counterweight. Otherwise, tipping could occur.

CAUTION

Mast Damage!

Do not lower the fixed mast below 39.7° during the following steps. Structural damage could result.

See Figure 4-84 for the following procedure.

1. Attach two **SL 1** slings (1, View C) to the shackles (2) on the equalizer (3) and to the forward most lifting lugs on the equalizer insert (4, View A).

CAUTION

Boom or Mast Damage!

Do not attempt to open the boom with the fixed mast until the equalizer is unpinned from the rails in step 5. Damage will result,

2. Remove the front stop pins (5, View D) from the rails (6) and the equalizer (3) and store the pins in the front storage tubes (7, View E).
3. Do not remove the rear stop pins (5, View C) and the rollers (5A, if equipped).

CAUTION

Boom or Mast Damage!

Do not attempt to lift the entire boom during the following step. Damage to the fixed mast and/or boom could result.

Do not exceed a mast strap tension of 160,6 t (354,000 lb). Mast strap tension can be monitored in the Crane Status Bar of the Main Display (View C, Figure 4-64 on page 4-74).

4. Slowly haul in the boom hoist wire rope on the MLC650 until the boom hoist equalizer (3, View A) is out of the rails and the **SL 1** slings (1) are tight.

WARNING

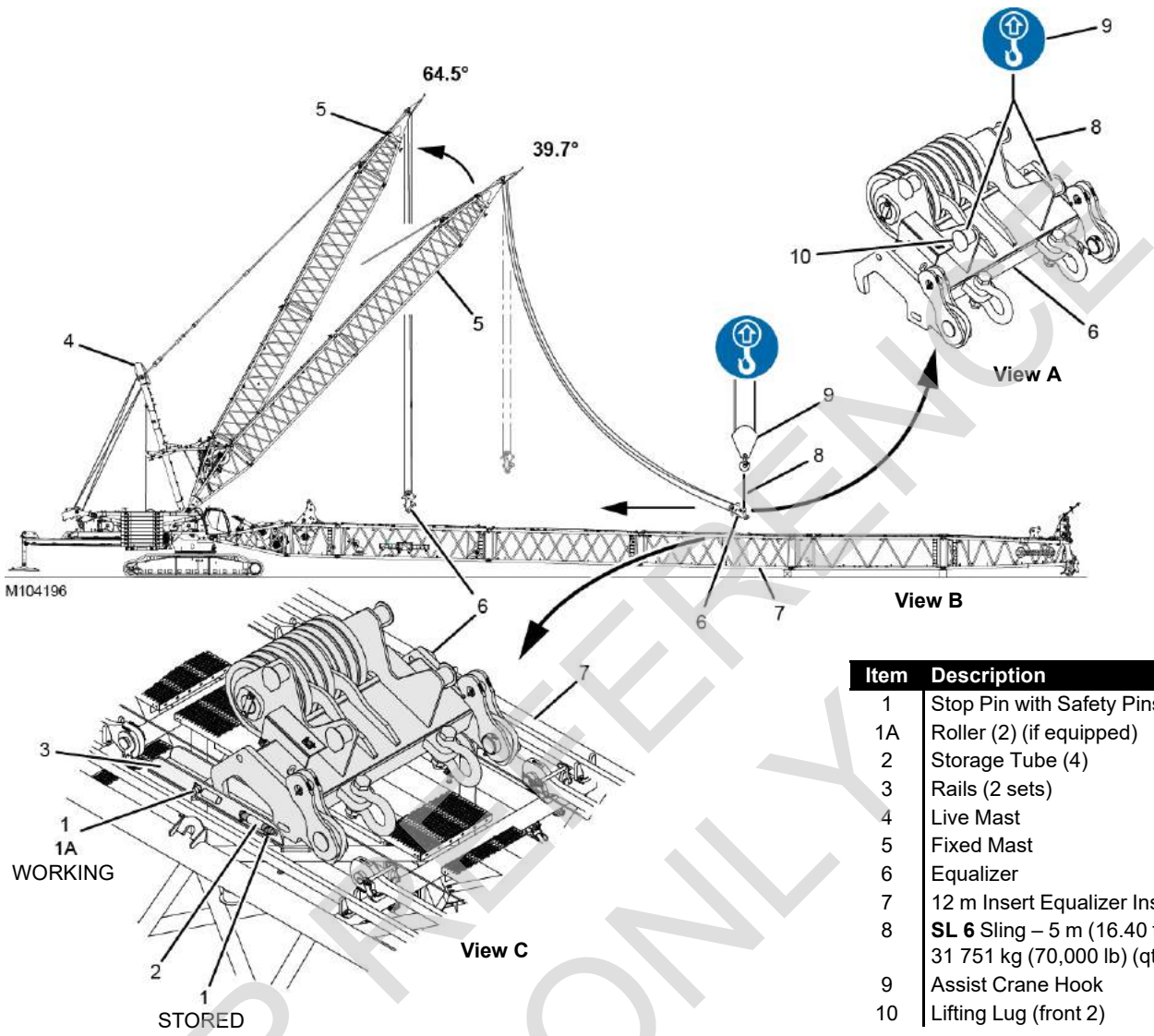
Crushing Injury Hazard!

Prevent serious crushing injury:

- Do not stand inside the boom sections while installing the tapered connecting pins — STAND OUTSIDE BOOM.

5. Manually remove the tapered connecting pins (9, View A).
6. Lower the inserts onto blocking that is at least 610 mm (24 in) high.

   To prevent damage to the boom sections caused by excessive sag, space the blocking at the intervals specified under “Intermediate Blocking” requirement in the Boom Rigging Drawing at the end of this section.
7. Store the tapered connecting pins (9, View A-A) in the brackets (10) on the equalizer insert (4).
8. Slowly pay out the boom hoist wire rope until the equalizer (3, View C) is resting on the rails and the **SL 1** slings (1) are slack.
9. Remove the front stop pins (5, View E) from the front storage tubes (7) and install the stop pins (5, View D) in the front holes of the rails (6) and the equalizer (3).
10. Disconnect the **SL 1** slings (1, View C) from between the shackles (2) on the equalizer (3) and the lifting lugs on the equalizer insert.
11. The shackles can remain attached to the equalizer.
12. To use the adjacent insert (8) in a different configuration, reinstall the standard connecting pins (11) and brackets with hardware (12). The parts are stored in the parts box.



Item	Description
1	Stop Pin with Safety Pins (4)
1A	Roller (2) (if equipped)
2	Storage Tube (4)
3	Rails (2 sets)
4	Live Mast
5	Fixed Mast
6	Equalizer
7	12 m Insert Equalizer Insert
8	**SL 6** Sling – 5 m (16.40 ft), 31 751 kg (70,000 lb) (qty 2)
9	Assist Crane Hook
10	Lifting Lug (front 2)

FIGURE 4-85

Item	Description
1	Tapered Connecting Pin (qty 2)
2	Bracket (qty 2)
3	Equalizer Insert
4	Adjacent Insert
5	Standard Connecting Pin (qty 2)
6	Bracket with Hardware (qty 2)
7	**SL 1** Sling – 5 m (16.40 ft), 31 751 kg (70,000 lb) (qty 2)

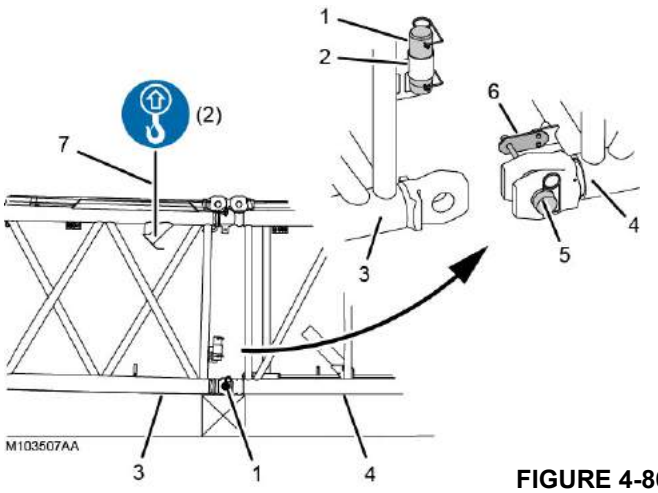


FIGURE 4-86

Opening the Boom Sections Using an Assist Crane

The assist crane must have a capacity of 74 843 kg (165,000 lb).

See Figure 4-86 for the following procedure.

1. Attach two **SL 1** slings (7) to the assist crane and to the forward most lifting lugs on the equalizer insert (3).

CAUTION

Boom Damage!

Do not attempt to lift the entire boom during the following step. Damage to the boom sections could result,

2. Hoist with the assist crane only enough to tighten the slings.

WARNING

Crushing Injury Hazard!

Prevent serious crushing injury:

- Do not stand inside the boom sections while installing the tapered connecting pins — STAND OUTSIDE BOOM.

3. Manually remove the tapered connecting pins (1).
4. Lower the inserts onto blocking that is at least 610 mm (24 in) high.

   To prevent damage to the boom sections caused by excessive sag, space the blocking at the intervals specified under “Intermediate Blocking” requirement in the Boom Rigging Drawing at the end of this section.
5. Store the tapered connecting pins (1) in the brackets (2) on the equalizer insert (3).
6. Detach the **SL 1** slings (7) from the equalizer insert (3).
7. To use the adjacent insert (4) in a different configuration, reinstall the standard connecting pins (5) and brackets with hardware (6). The parts are stored in the parts box.

Disconnecting the Equalizer from the Equalizer Rails

See Figure 4-85 for the following procedure.

CAUTION

Mast Damage!

Do not lower the fixed mast below 39.7° during the following steps. Structural damage could result.

1. If not already done, lower the fixed mast (5, View B) to no less than 39.7°.
2. Connect two **SL 6** slings (8, View A) from the hook of the assist crane (9) and to the front two lifting lugs (10) on the equalizer (6).
3. Remove the front pins (1, View C) from the rails (3) and the equalizer (6) and install the pins in the front storage tubes (2).

   Slacken or tighten the boom hoist wire rope as necessary to loosen the pins.

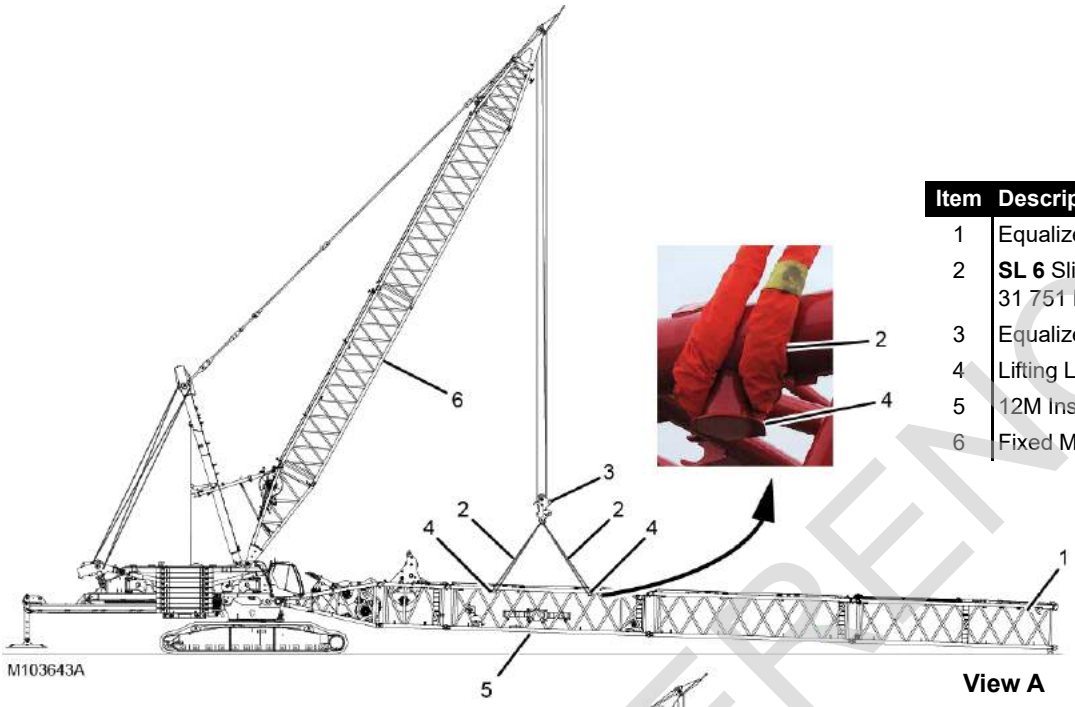
NOTE: It is not necessary to remove the rear stop pins (1, View C) and the rollers (1A, if equipped) if the insert will be used with a VPC-MAX.

The rear stop pins and rollers (if equipped) must be stored if the insert will be used in a boom rigging without fixed mast.

4. SLOWLY lift the equalizer clear of the rails by hoisting with the assist crane while hauling in the MLC650 boom hoist wire rope.
5. Continue to haul in the boom hoist wire rope while following with the assist crane until the equalizer (6, View B) is hanging vertical under the fixed mast point.
6. Raise the fixed mast to no higher than 64.5°.

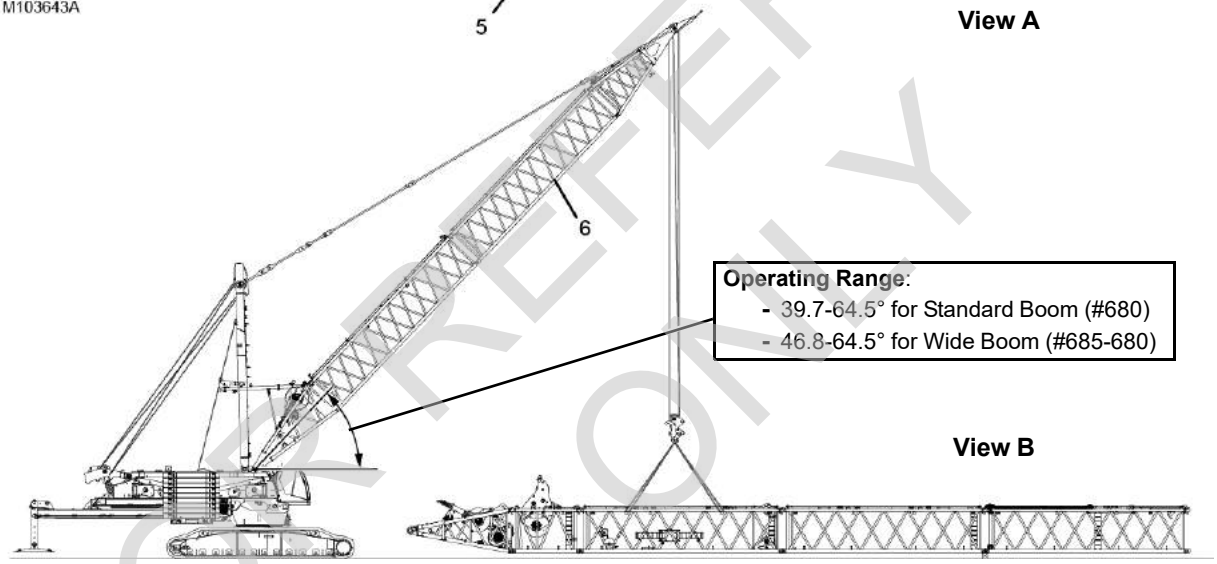
Disassemble the Boom Assembly

Completely disassemble the boom sections forward of the equalizer insert (7, Figure 4-85). Make sure all of the steps are performed under the topic Boom #680 Disassembly in Section 4 of the Crane Operator Manual.



Item	Description
1	Equalizer Insert
2	**SL 6** Sling – 5 m (16.40 ft), 31 751 kg (70,000 lb) (qty 4)
3	Equalizer
4	Lifting Lug (qty 4)
5	12M Insert
6	Fixed Mast

View A



View B

FIGURE 4-87

Removing the Partial Boom Assembly

See Figure 4-87 for the following procedure.

CAUTION

Mast Damage!

Do not lower the fixed mast below the minimum angle specified in Figure 4-87 during the following steps. Structural damage could result.

1. Attach four **SL 6** slings (2, View A) to the shackles on the equalizer (3, View A) and to the lifting lugs (4, View A) on the 12M insert (5, View A).
2. Remove the partial boom from the crane using the fixed mast (6, View B). See Section 4 of the Crane Operator Manual for boom butt to crane unpinning instructions.
3. Set the partial boom on blocking at ground level.
4. Detach the slings from the equalizer and from the insert.
5. Disassemble the partial boom and prepare it for storage or shipping:
   - See Section 4 of the Crane Operator Manual for boom disassembly instructions.
   - Either an assist crane or the fixed mast can be used to disassemble the partial boom.

Item	Description
1	Fixed Mast
2	Equalizer
3	Rope Guard with Cotter Pins
4	**SL 4** slings – 3,80 m (12.50 ft), 11 340 kg (25,000 lb)
5	Lifting Lug (qty 4)
6	Blocking — 900 mm (35.43 in)
7	Locking Pin (qty 2)
8	Clevis Pin (qty 2)

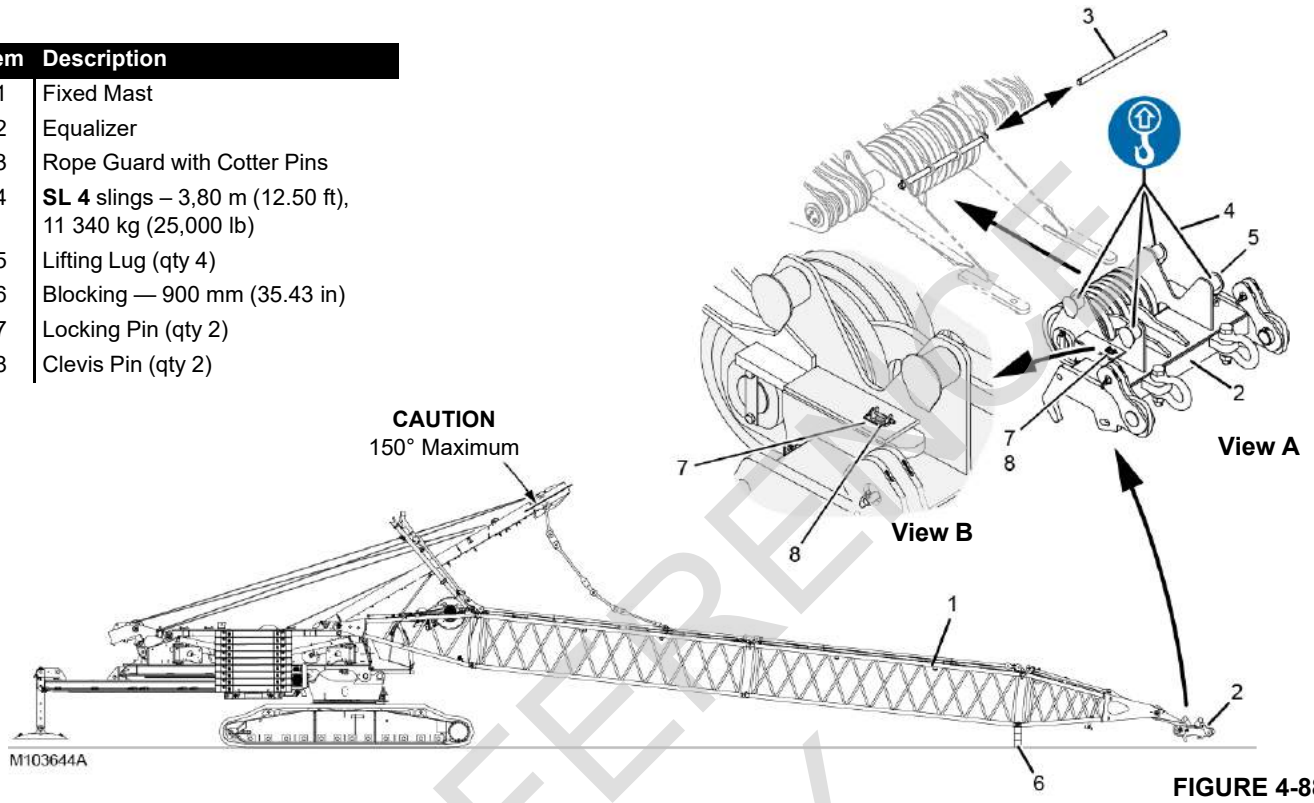


FIGURE 4-88

Attaching the Equalizer to the Fixed Mast Top

CAUTION

Avoid Mast Stop Damage

Do not lower the live mast below 150° maximum until the mast stops are lowered (page 4-109). Otherwise, the mast stops will hit the live mast possibly resulting in damage.

See Figure 4-88 for the following procedure.

1. Lower the fixed mast (1) until the equalizer (2) is near the ground.
2. Remove the rope guard (3, View A).

CAUTION

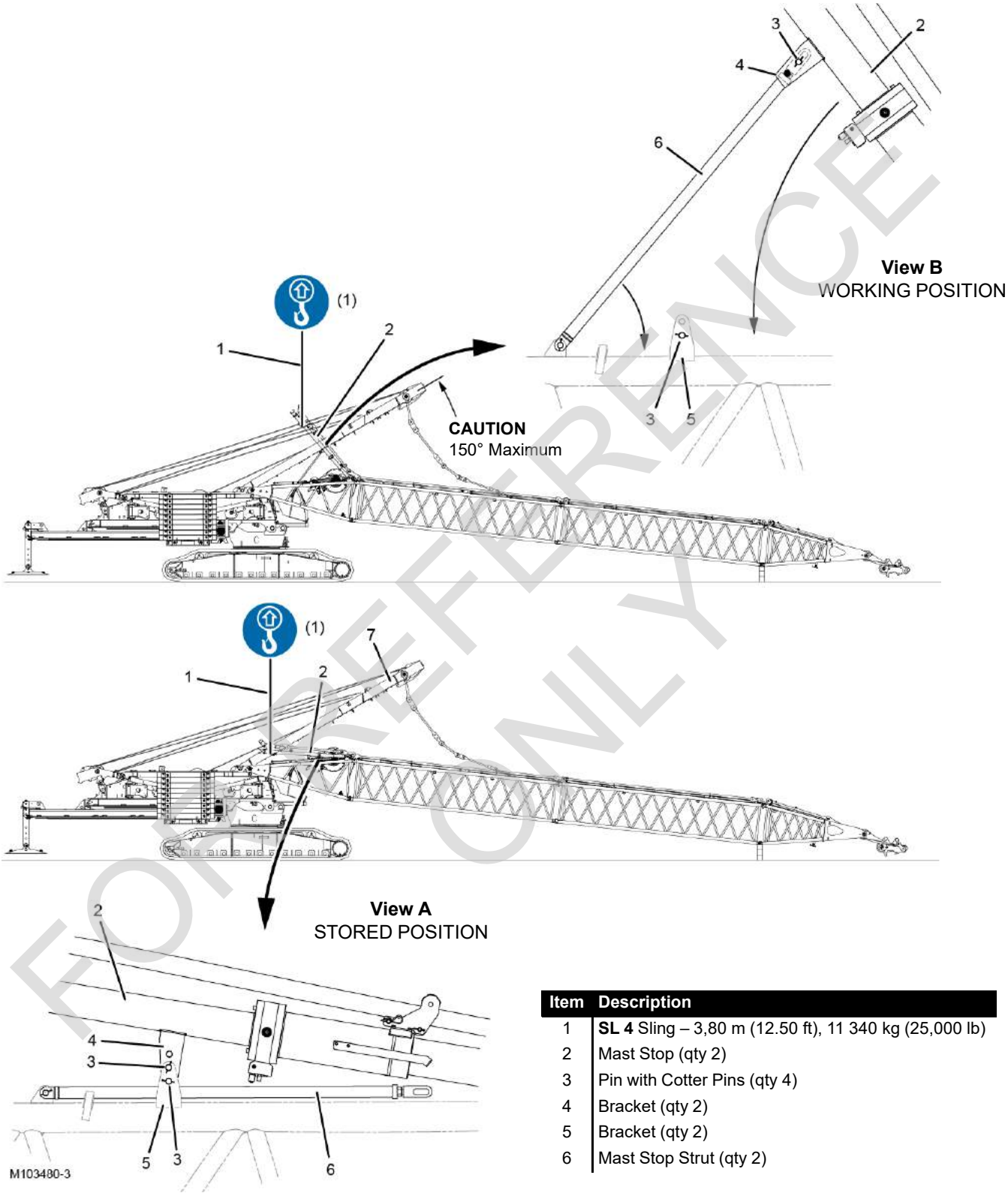
Avoid Wire Rope Damage

Remove the rope guard (3) and do not reinstall it until after the equalizer (2) is stored on the mast top.

The wire rope can be damaged if this step is not taken.

3. Attach four **SL 4** slings (4) from the assist crane to the four lifting lugs (5) on the equalizer (2).
4. Raise the equalizer to horizontal with the assist crane while paying out the MLC650 boom hoist wire rope.
5. While following with the assist crane, lower the fixed mast onto blocking (6) that is a minimum height of 900 mm (35.43 in) (1).

   Payout the boom hoist wire rope as needed so the equalizer clears the end of the mast as it lowers.
6. Lower the live mast so the fixed mast straps are resting in the strap supports on the mast sections.
7. Remove the locking pins (7, View A) and the clevis pins (8) from the equalizer (2).
8. Spool the wire rope onto the boom hoist drum in the mast butt while performing the next step.
9. Using the assist crane, install the equalizer (2, View B) onto the end of the fixed mast top.
10. Install the clevis pins (8, View B) and the locking pins (7)
11. Disconnect the **SL 4** slings (4) from the equalizer.
12. Reinstall the rope guard (3, View A).
13. Remove the hand-held taglines from the counterweight straps.



Item	Description
1	**SL 4** Sling – 3,80 m (12.50 ft), 11 340 kg (25,000 lb)
2	Mast Stop (qty 2)
3	Pin with Cotter Pins (qty 4)
4	Bracket (qty 2)
5	Bracket (qty 2)
6	Mast Stop Strut (qty 2)

FIGURE 4-89

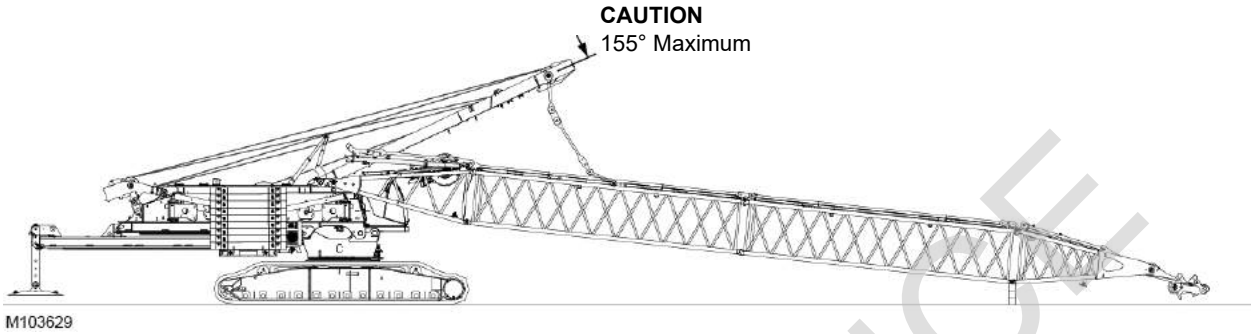


FIGURE 4-90

Lowering the Mast Stops

CAUTION

Avoid Mast Stop Damage

Do not lower the live mast below 150° maximum until the mast stops are lowered . Otherwise, the mast stops will hit the live mast possibly resulting in damage.

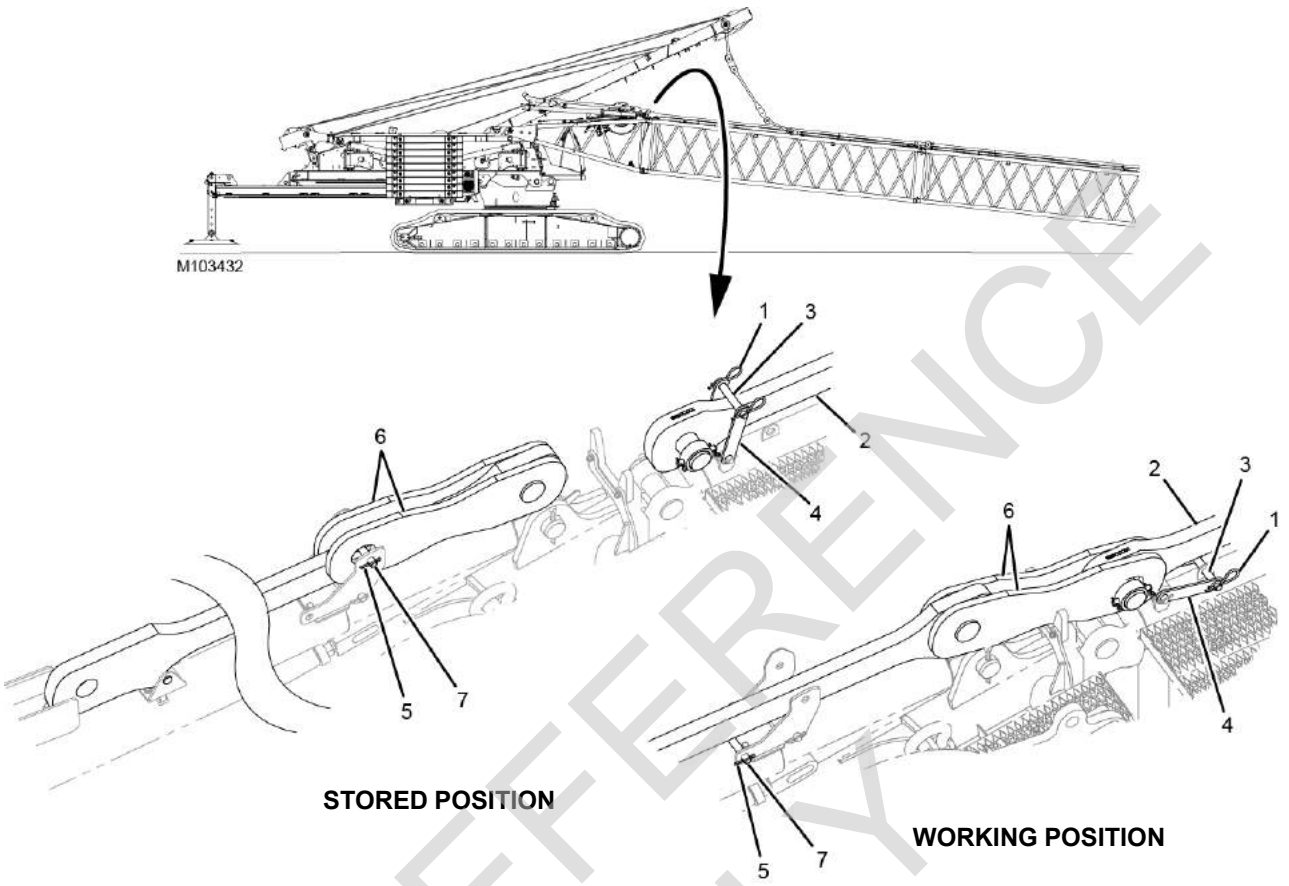
See Figure 4-89 for the following procedure.

1. Attach one **SL 4** sling (1) to one of the mast stops (2) in the working position.
2. Attach the other end of the sling to the assist crane.
3. Hoist with the assist crane just enough to support the weight of the mast stop (2).
4. Remove the pin (3, View B) from the bracket (4) and from the bracket (5).
5. Lower the mast stop strut (6, View A) to the stored position.
6. Install the bottom pin (3, View A) in the bracket (5).
7. Lower the mast stop to the stored position (View A).
8. Install the other pin (3, View A) in the top holes of bracket (5) and the bottom holes of the bracket (4).
9. Disconnect the sling and repeat the procedure for the other mast stop.

Disconnecting the Mast Straps

See Figure 4-90 for the following procedure.

1. Make sure the fixed mast is in a lowered and blocked position as shown.
2. The live mast can be lowered to a maximum angle of 155°.
3. Work from the mast butt up towards the mast top when disconnecting the mast straps. There are straps that connect the fixed mast to the live mast, and there are straps that connect the fixed mast to the VPC-MAX beam. There are two straps for the live mast and two straps for the beam.



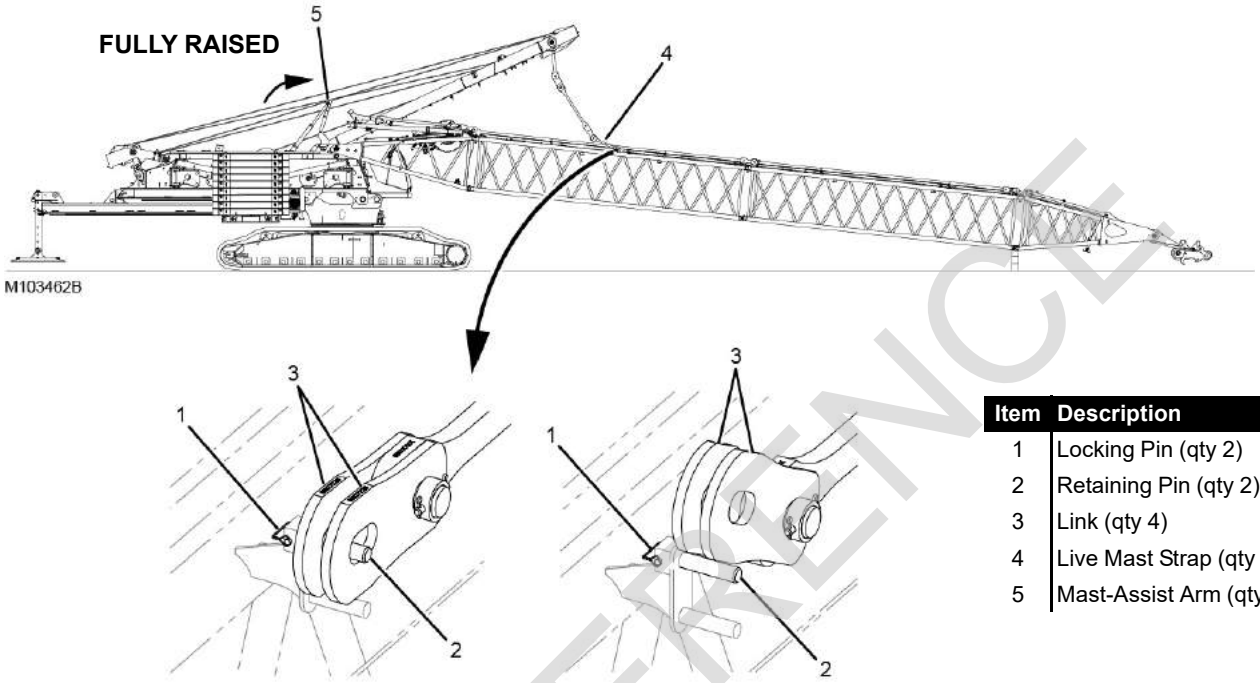
Item	Description
1	Hair Pin Cotter (qty 4)
2	VPC-MAX Beam Strap (qty 2)
3	Retaining Pin (qty 2)
4	Retaining Pin Bracket (qty 4)
5	Cotter Pin (qty 4)
6	VPC-MAX Beam Link (qty 4)
7	Retaining Pin (qty 2)

FIGURE 4-91

Disconnecting the First Insert and Mast Butt Straps

See Figure 4-91 for the following procedure.

1. Disconnect the strap from the links in the working position.
2. Remove the hair pin cotters (1) from the VPC-MAX beam strap (2) retaining pin (3).
3. Rotate the retaining pin brackets (4) from the working position to the stored position.
4. Place the strap in the stored position.
5. Install the retaining pin and hair pin cotters to the brackets in the stored position.
6. Remove the cotter pins (5) from the VPC-MAX beam link (6) retaining pin (7).
7. Rotate the links to the stored position.
8. Remove the retaining pin from the working position and install the pin in the stored position.
9. Install the cotter pins to the retaining pin.
10. Repeat this process for the other side of the mast butt and insert.



Item	Description
1	Locking Pin (qty 2)
2	Retaining Pin (qty 2)
3	Link (qty 4)
4	Live Mast Strap (qty 2)
5	Mast-Assist Arm (qty 2)

FIGURE 4-92

Disconnecting the Live Mast Straps from the First Insert

See Figure 4-92 for the following procedure.

1. Enter the live mast configuration and select the proper live mast capacity chart in RCL/RCI display.

NOTE: See the RCL/RCI Operation Manual for more information.

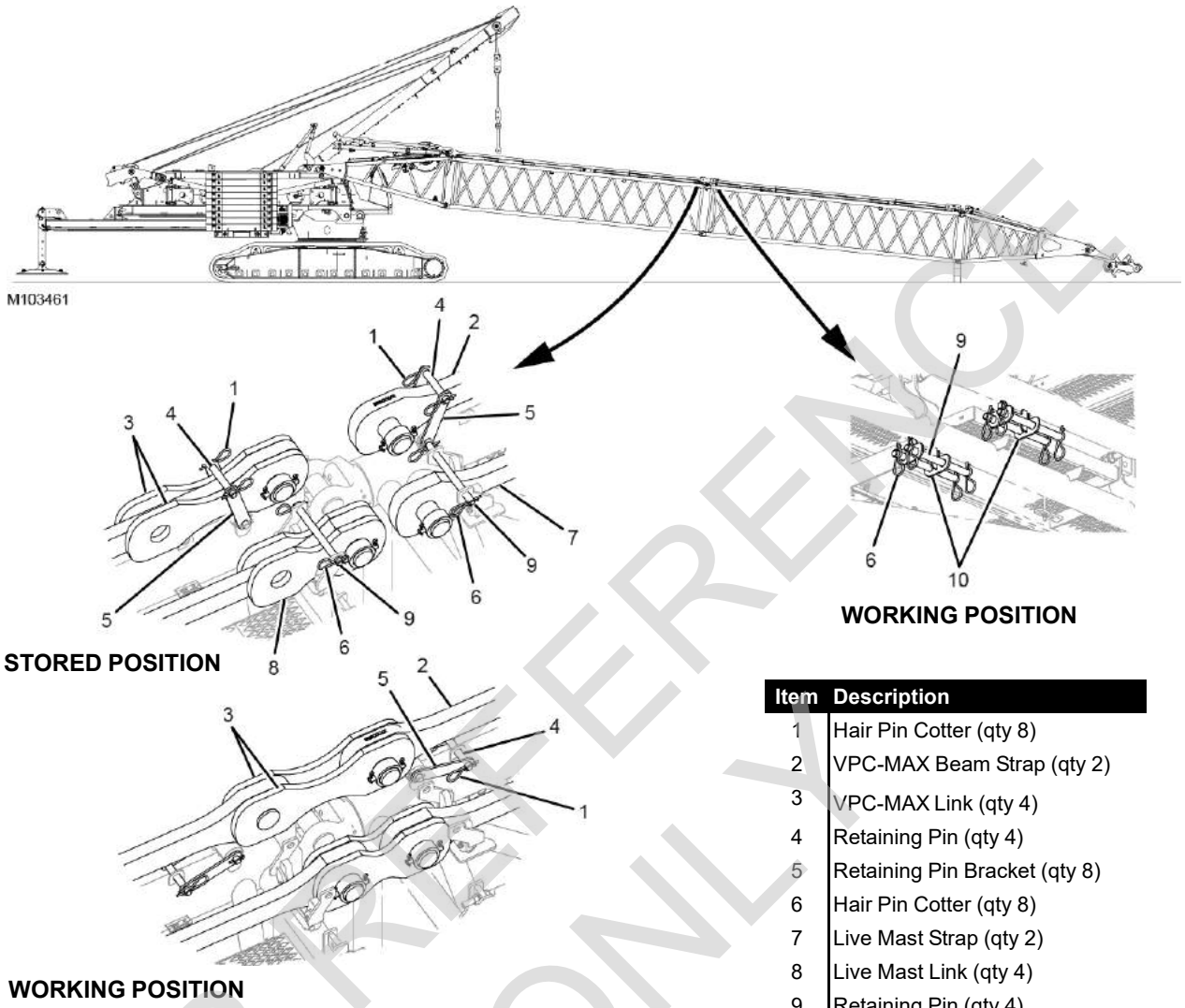
DANGER

Falling Mast Hazard!

Prevent the live mast from falling:

- Fully raise the mast-assist arms before disconnecting the live mast straps from the fixed mast. The live mast can fall over backwards if the arms are not raised.

2. Fully raise the mast-assist arms (5). See Section 4 of the Crane Operator Manual for instructions.
3. Disconnect the straps from the links in the working position.
4. Remove the locking pin (1) from the retaining pin (2).
5. Remove the retaining pin and rotate the links (3) down from the working position to the stored position.
6. Install the retaining pin and locking pin in their original positions.
7. Repeat this process for the other side of the insert.



Item	Description
1	Hair Pin Cotter (qty 8)
2	VPC-MAX Beam Strap (qty 2)
3	VPC-MAX Link (qty 4)
4	Retaining Pin (qty 4)
5	Retaining Pin Bracket (qty 8)
6	Hair Pin Cotter (qty 8)
7	Live Mast Strap (qty 2)
8	Live Mast Link (qty 4)
9	Retaining Pin (qty 4)
10	Bracket (qty 2)

FIGURE 4-93

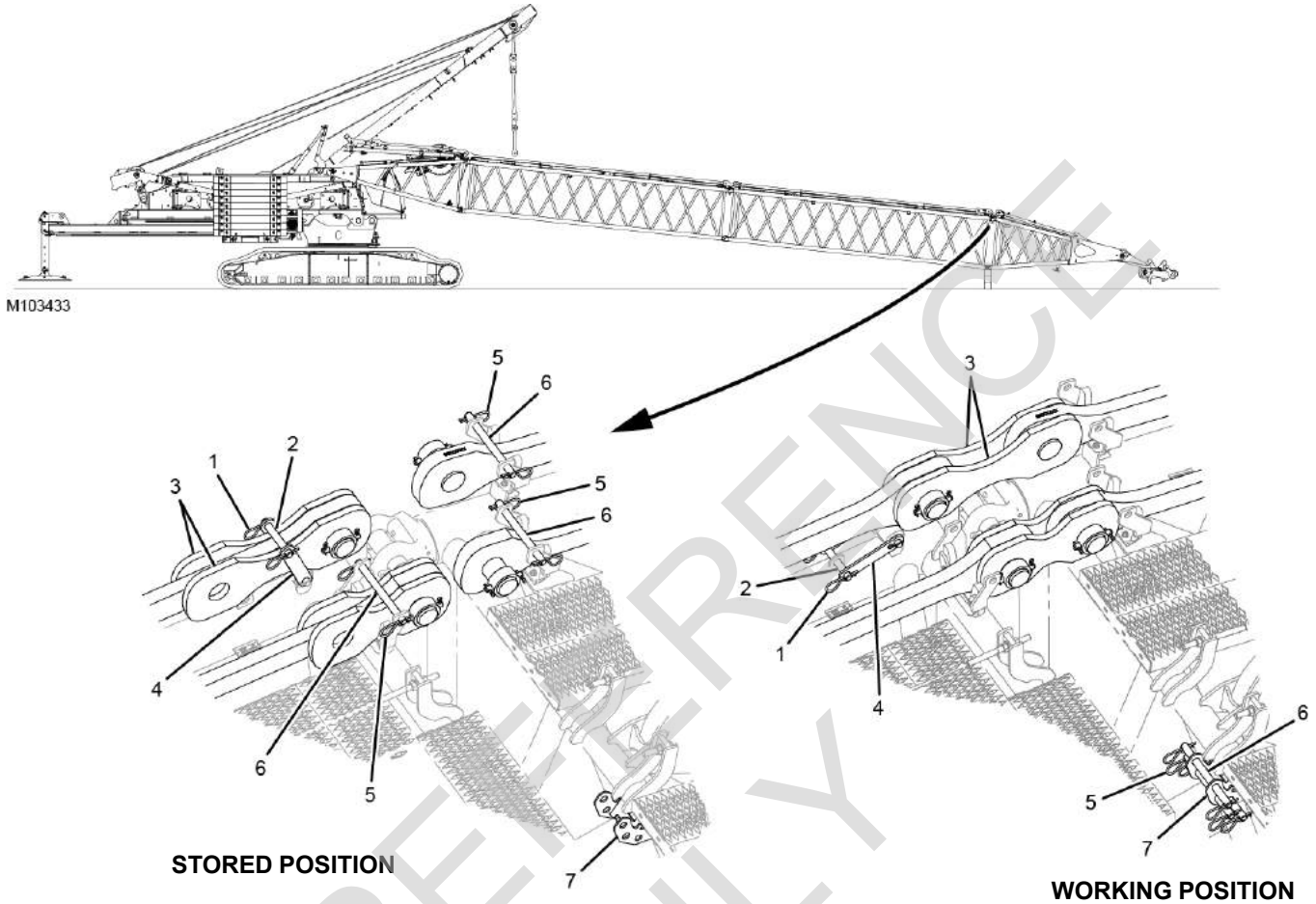
Disconnecting the First Insert and Second Insert Straps

See Figure 4-93 for the following procedure.

1. Disconnect the straps from the links in the working position.
2. Remove the hair pin cotters (1) from the VPC-MAX beam strap (2) and VPC-MAX link (3) retaining pins (4).
3. Make sure the strap and links are in the stored position.
4. Remove the retaining pins and rotate the retaining pin brackets (5) from the working position to the stored position.
5. Install the retaining pins and hair pin cotters to the brackets in the stored position.
6. Remove the hair pin cotters (6) from the live mast strap (7) and live mast link (8) retaining pins (9).
7. Make sure the strap and links are in the stored position.
8. Remove the retaining pins from the brackets (10) and install them in the stored position.

NOTE: Four pins are shown, two for each side.

9. Install the hair pin cotters to the retaining pins.
10. Repeat this process for the other side of the inserts.



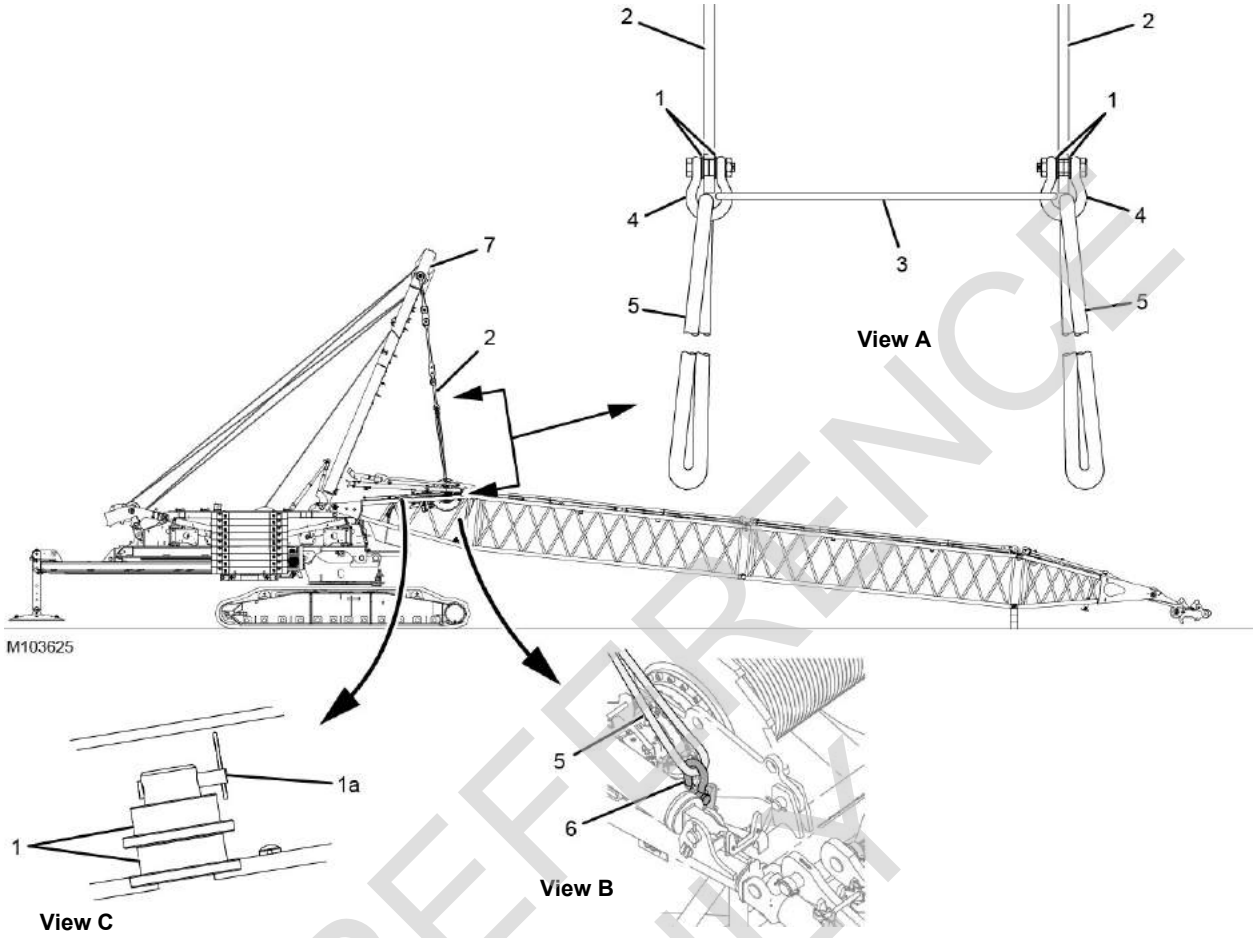
Item	Description
1	Hair Pin Cotter (qty 4)
2	Retaining Pin (qty 2)
3	VPC-MAX Beam Link (qty 4)
4	Beam Link Retaining Pin Bracket (qty 4)
5	Hair Pin Cotter (qty 12)
6	Retaining Pin (qty 6)
7	Bracket

FIGURE 4-94

Disconnecting the Mast Top and Second Insert Straps

See Figure 4-94 for the following procedure.

1. Disconnect the straps from the links in the working position.
2. Remove the hair pin cotters (1) from the retaining pin (2) that secures the VPC-MAX beam links (3).
3. Rotate the links from the working position to the stored position.
4. Remove the retaining pin and rotate the beam link retaining pin brackets (4) from the working position to the stored position.
5. Install the retaining pin and hair pin cotters to the retaining pin brackets.
6. Remove the hair pin cotters (5) and retaining pins (6) from the bracket (7) in the stored position.
7. Make sure the links and straps are in the stored position.
8. Install the retaining pins and hair pin cotters.
9. Repeat this process for the other side of the mast top and insert.



Item	Description
1	Bushing (qty 4)
1a	Pin with Hair-Pin Cotter (qty 2)
2	Live Mast Link (qty 2)
3	**SL 3** Sling Spreader – 1,60 m (5.25 ft), 9 072 kg (20,000 lb)
4	**SH 3** Shackle – 40 t (44.00 USt) (qty 2)
5	**SL 1** Sling – 3,30 m (10.83 ft), 45 360 kg (100,000 lb) (qty 2)
6	**SH 2** Shackle – 17 t (18.70 USt) (qty 2)
7	Live Mast

FIGURE 4-95

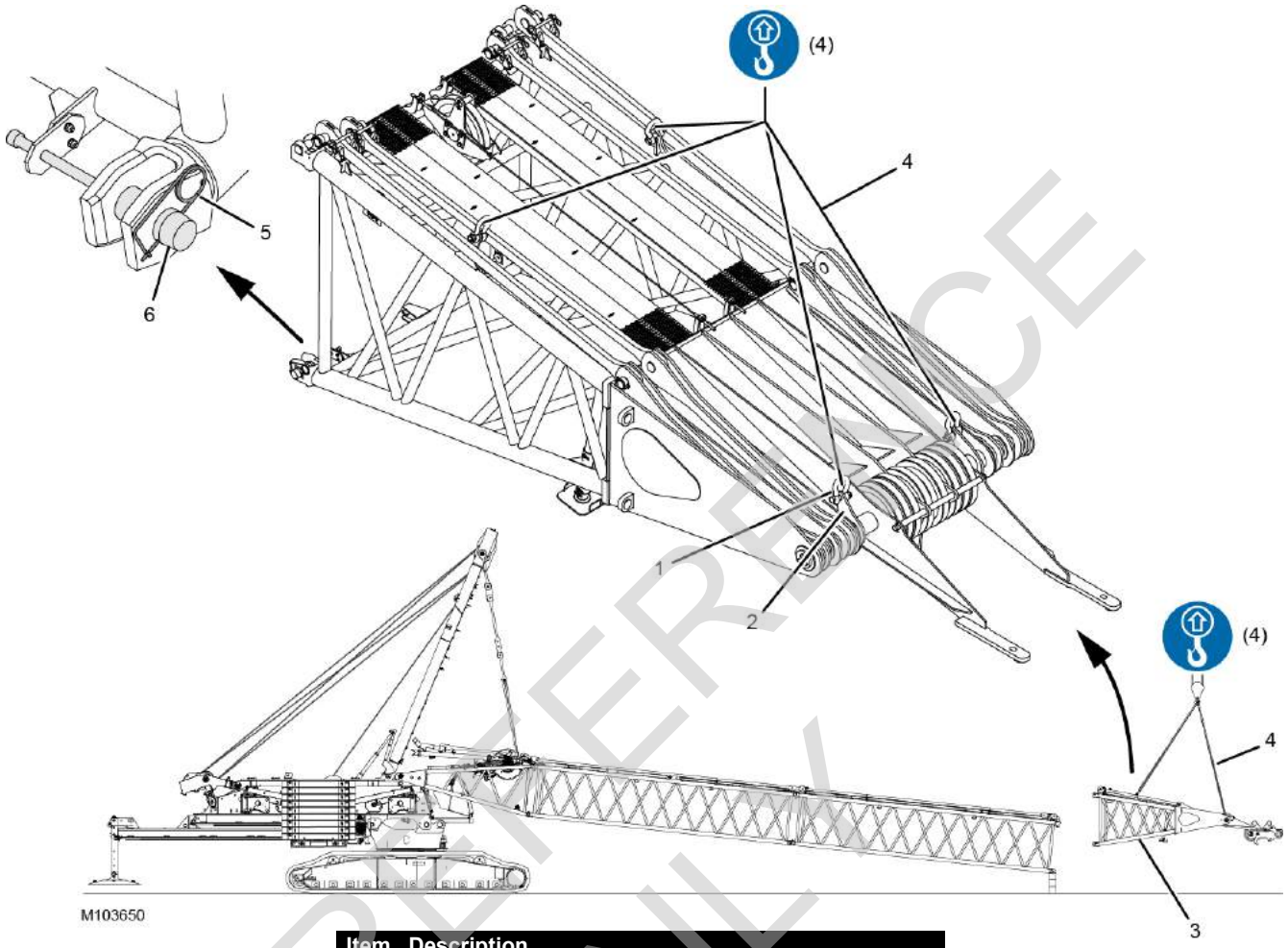
Disassembling the Fixed Mast

An assist crane is required to disassemble and remove the fixed mast.

Installing the Live Mast Lifting Slings

See Figure 4-95 for the following procedure.

1. Remove the bushings (1, View C) from storage on each side of the mast butt.
2. Insert the bushings (1) into the live mast links (2).
3. Attach the **SL 3** sling spreader (3) to the **SH 3** shackles (4).
4. Attach the **SL 1** slings (5) to the **SH 3** shackles (4).
5. Attach the **SH 3** shackles (4) to the live mast links (1).
6. Attach the **SL 1** slings (5) to the **SH 2** shackles (6) on the mast butt.
7. Raise the live mast until the slings are tight. Do not attempt to raise the entire mast or damage may occur.
8. Engage the mast hoist pawl.



Item	Description
1	**SH 2** Shackle – 17 t (18.70 USt) (qty 2)
2	Lifting Link (qty 2)
3	Mast Top
4	**SL 6** Sling – 5 m (16.40 ft), 31 751 kg (70,000 lb) (qty 4)
5	Safety Pin (qty 2)
6	Retaining Pin (qty 2)

FIGURE 4-96

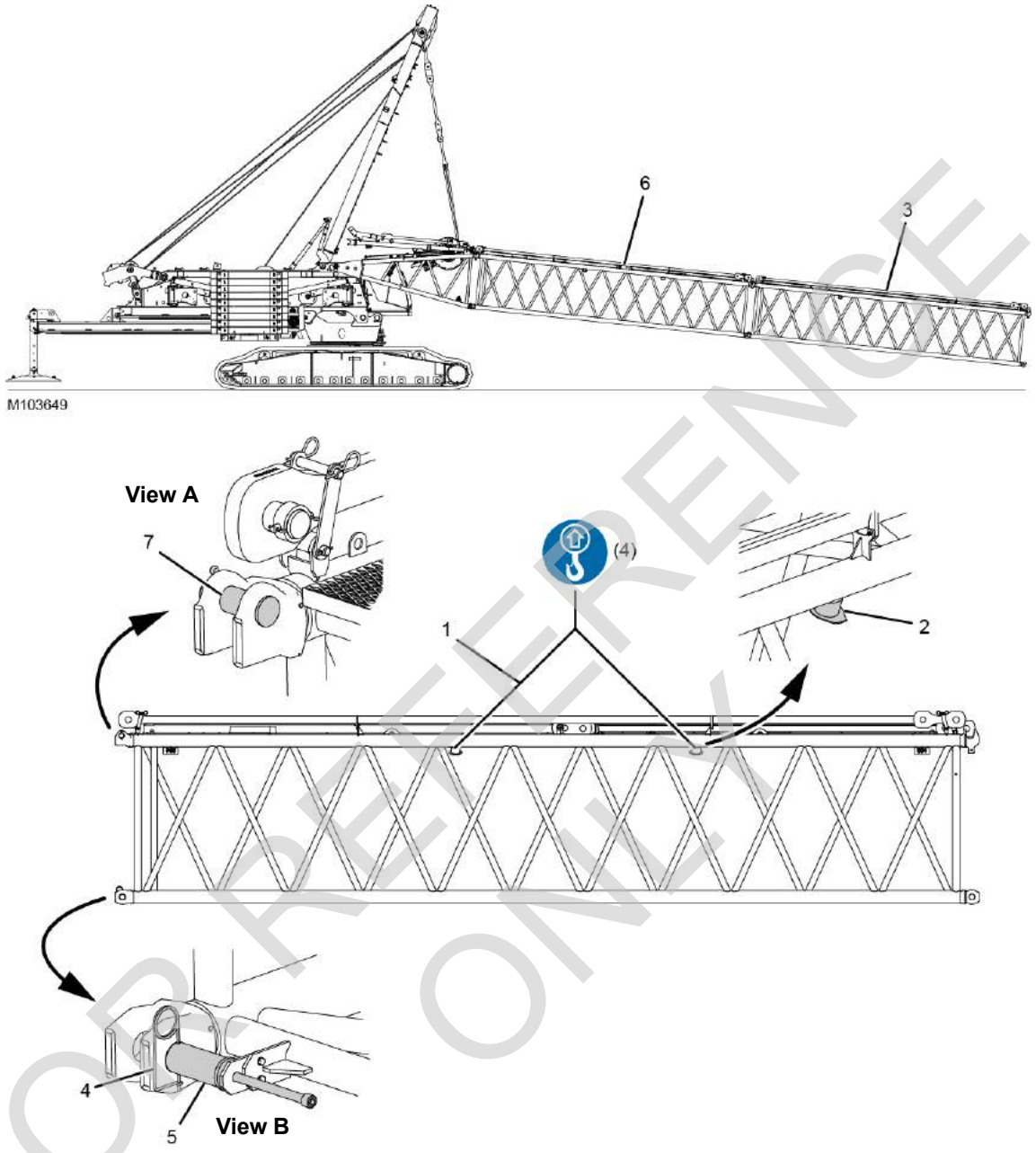
Removing the Fixed Mast Top

See Figure 4-96 for the following procedure.

1. Attach the rear **SL 6** slings (4) to the existing shackles on the mast top.
2. Attach two **SH 2** shackles (1) from the parts box to the front **SL 6** slings (4) and to the lifting link (2) on the mast top (3).
3. Attach the slings to the assist crane.
4. Remove the safety pins (5) and slide the retaining pins (6) out.

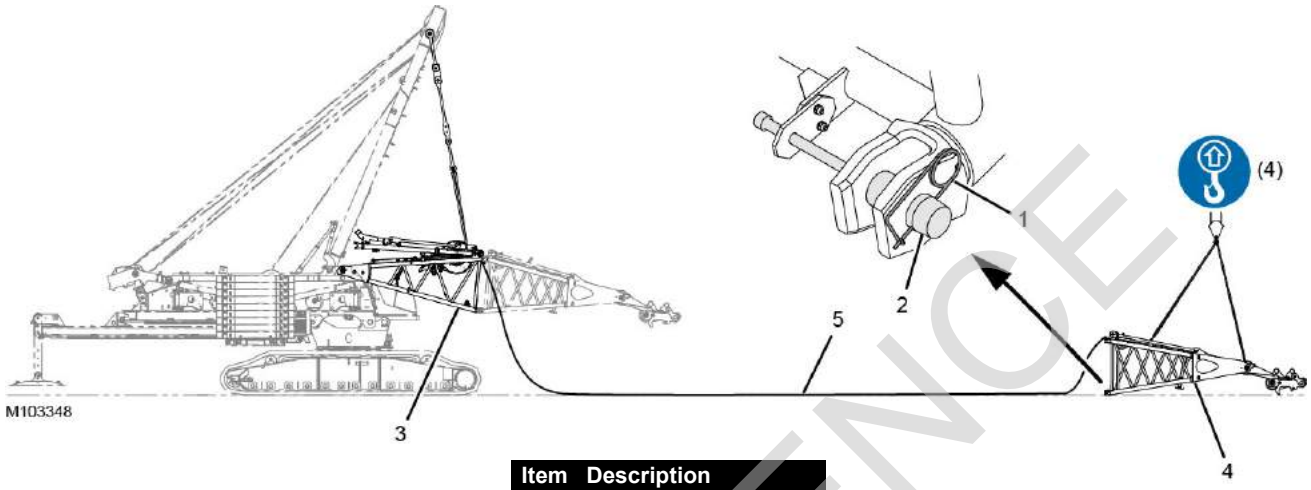
NOTE: Hoist with the assist crane if necessary to take the weight off the retaining pins.

5. Pay out wire rope from the boom hoist drum in the mast butt while performing the next step.
6. Lift the mast top up and away from the second mast insert so the fixed pins on the mast top disengage the hooked connectors on the insert.
7. Slide the retaining pins in.
8. Install the safety pins.
9. Place the mast top on the foundation in front of the second mast insert.
10. Disconnect the slings from the assist crane only. The slings can remain attached to the mast top.



Item	Description
1	**SL 4** Sling – 3,80 m (12.50 ft), 11 340 kg (25,000 lb) (qty 4)
2	Lifting Lug (qty 4)
3	Second Fixed Mast Insert
4	Safety Pin (qty 2)
5	Retaining Pin (qty 2)
6	First Fixed Mast Insert
7	Fixed Pin (qty 2)

FIGURE 4-97



Item	Description
1	Safety Pin (qty 2)
2	Retaining Pin (qty 2)
3	Fixed Mast Butt
4	Fixed Mast Top
5	Boom Hoist Wire Rope

FIGURE 4-98

Removing the Fixed Mast Inserts

See Figure 4-97 for the following procedure.

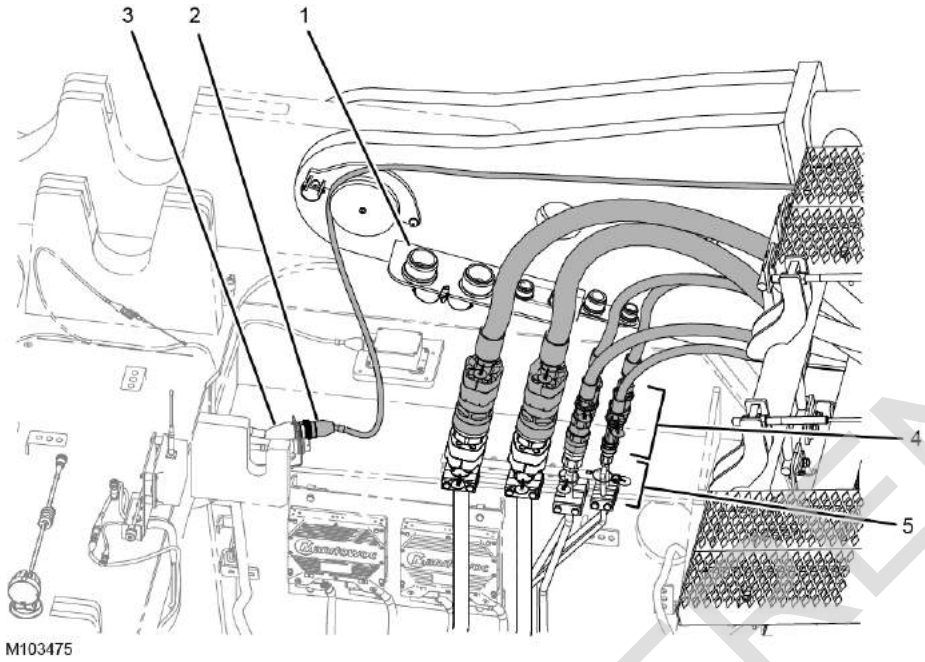
NOTE: It is acceptable to cantilever both inserts from the mast butt.

1. Attach four **SL 4** slings (1) to the lifting lugs (2) on the second fixed mast insert (3).
2. Attach the slings to the assist crane.
3. Remove the safety pins (4) from the retaining pins (5, View B) and slide the retaining pins out.
4. Using the assist crane, lift the insert up and away from the end of the first fixed mast insert (6) so the fixed pins (7, View A) on the second insert disengage the hooked connectors on the first insert.
5. Slide the retaining pins in.
6. Install the safety pins.
7. Disconnect the slings from the second insert.
8. Attach the slings to the lifting lugs on the first insert.
9. Remove the first insert from the fixed mast butt by repeating step 3 through step 7.
10. Disconnect the slings from the first insert.
11. Prepare the inserts for storage or shipping as necessary.

Attaching the Fixed Mast Top to the Butt

See Figure 4-98 for the following procedure.

1. Attach the four **SL 6** slings already on the fixed mast top (4) to the assist crane.
2. Remove the safety pins (1) from the lower retaining pins (2).
3. Slide the retaining pins out.
4. Spool the boom hoist wire rope (5) onto the boom hoist drum in the mast butt while performing the next step.
5. Using the assist crane, lift the mast top into position at the end of the fixed mast butt (3) so the fixed pins on the mast top engage the hooked connectors on the mast butt.
6. Lower the mast top until the bottom connection holes align.
7. Slide the retaining pins back in.
8. Install the safety pins.



Item	Description
1	Bracket
2	Electrical Plug WMB1-P1
3	Electrical Plug WRF2-J4
4	Hydraulic Hose (4 or 6)
5	Coupler (4 or 6)

FIGURE 4-99

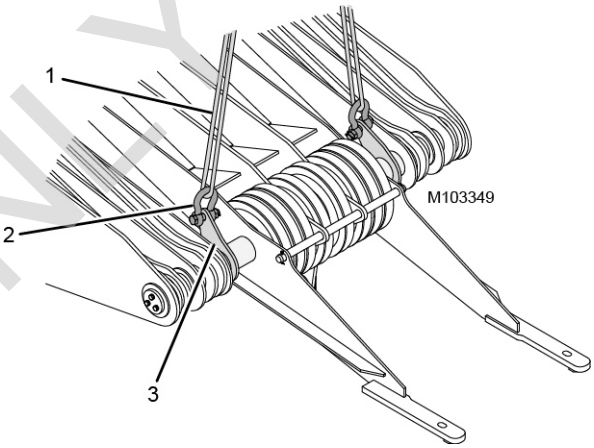
See Figure 4-99 for the following procedure.

9. Disconnect the hydraulic hoses (4) from the corresponding couplers (5) on the rotating bed.

10. Install the hydraulic hoses in their stored positions on the bracket (1) on the fixed mast butt.

11. Disconnect electrical plug WMB1-P1 (2) on the mast butt from electrical plug WRF2-J4 (3) on the rotating bed.

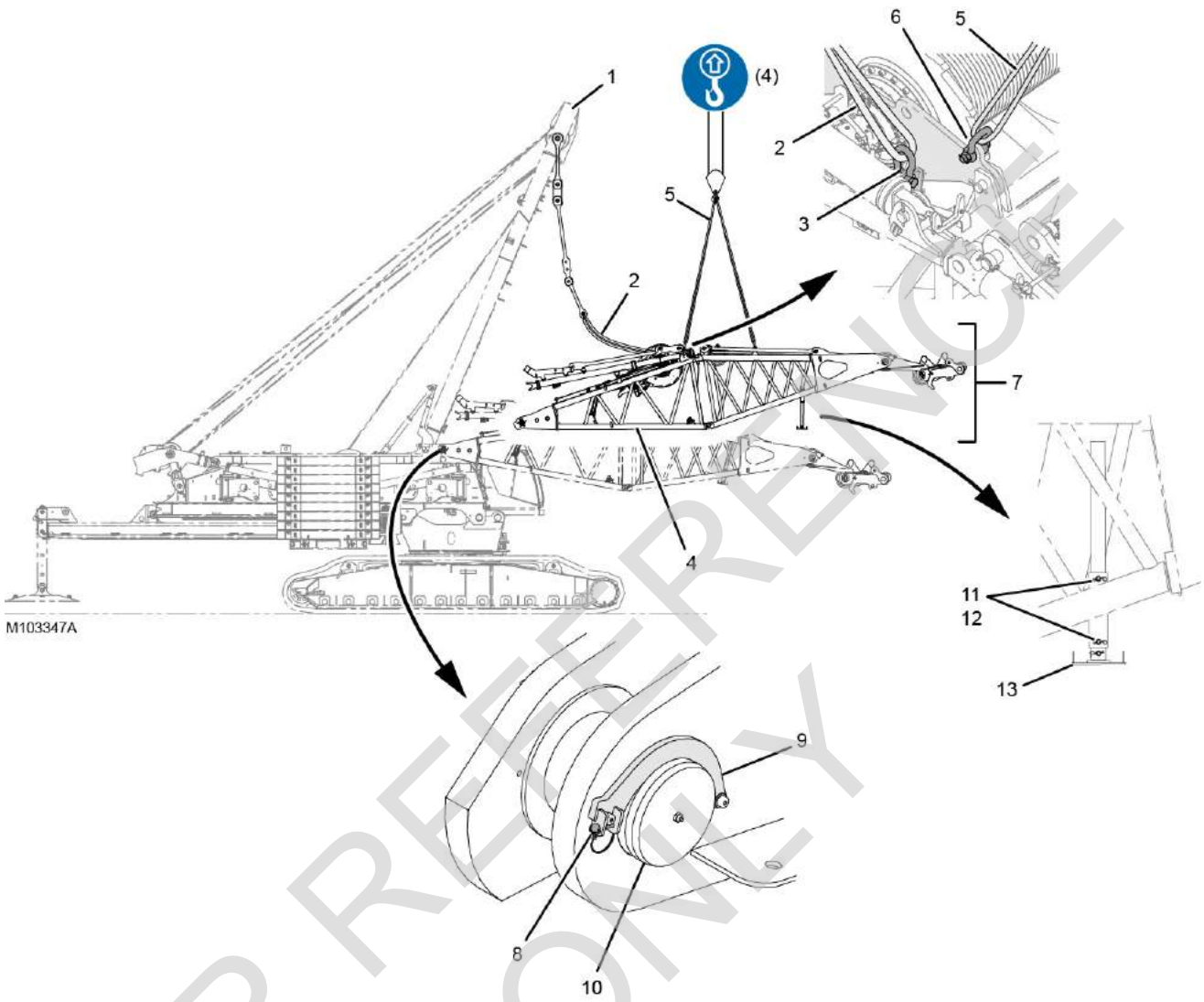
12. Disconnect the **SL 6** slings (1, Figure 4-100) and **SH 2** shackles (2) from the lifting links (3) on the mast top.



Item	Description
1	**SL 6** Sling – 5 m (16.40 ft), 31 751 kg (70,000 lb) (qty 2)
2	**SH 2** Shackle – 17 t (18.70 USt) (qty 2)
3	Lifting Link (qty 2)

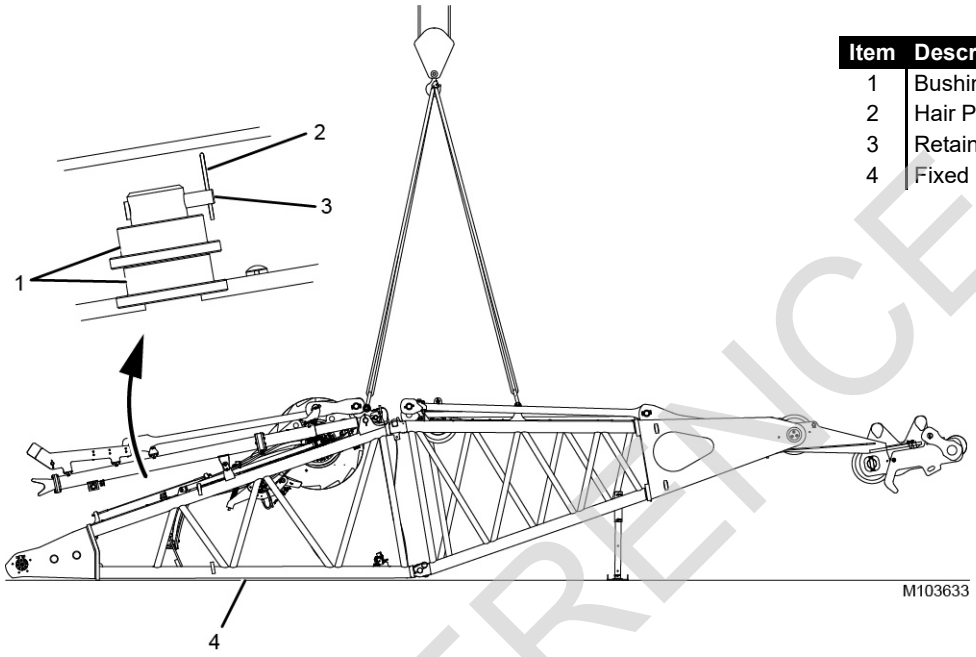
FIGURE 4-100

THIS PAGE INTENTIONALLY LEFT BLANK



Item	Description
1	Live Mast
2	**SL 1** Sling – 3,30 m (10.83 ft), 45 360 kg (100,000 lb) (qty 2)
3	**SH 2** Shackle – 17 t (18.70 USt) (qty 2)
4	Fixed Mast Butt
5	**SL 6** Sling – 5 m (16.40 ft), 31 751 kg (70,000 lb) (qty 2)
6	**SH 2** Shackle – 17 t (18.70 USt) (qty 2)
7	Fixed Mast Transport Package
8	Locking Pin (qty 2)
9	Pivot Pin Retainer (qty 2)
10	Pivot Pin (qty 2)
11	Hair Pin Cotter (qty 8)
12	Retaining Pin (qty 4)
13	Support Pedestal (qty 2)

FIGURE 4-101



Item	Description
1	Bushing (qty 4)
2	Hair Pin Cotter (qty 2)
3	Retaining Pin (qty 2)
4	Fixed Mast Butt

FIGURE 4-102

See Figure 4-101 for the following procedure.

WARNING

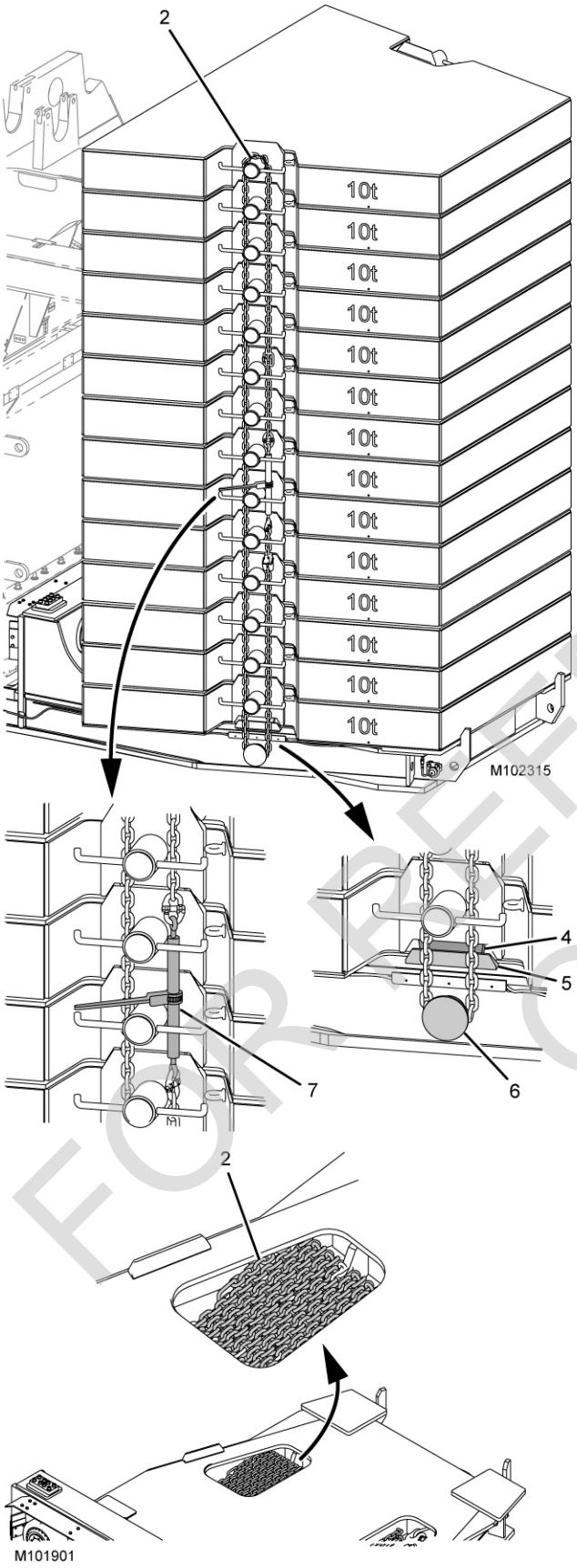
Equipment Damage!

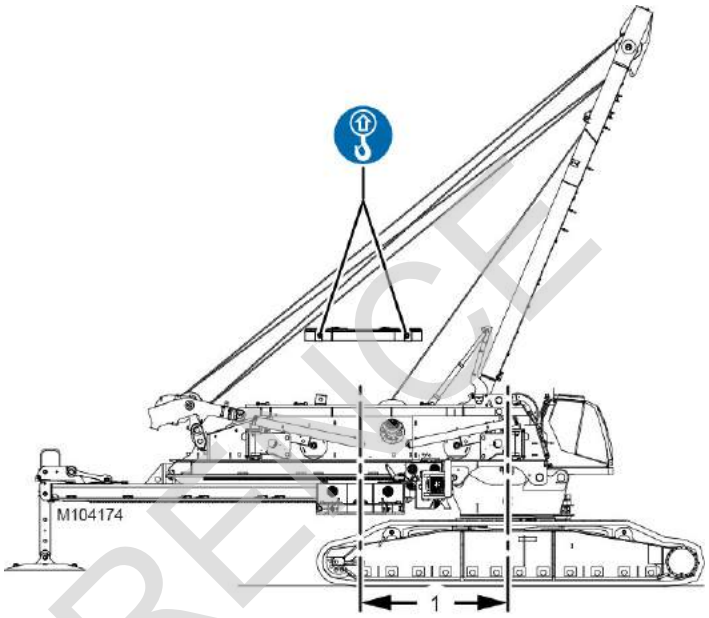
At this point in the assembly process, live mast angles greater than 113° will damage components.

Do not position the live mast to an angle greater than 113°.

13. Position the live mast at 107° and engage the mast hoist pawl.
14. Connect the **SH 2** shackles (6) and **SL 6** slings (5) to the mast butt.
15. Slowly hoist with the assist crane until the mast is supported by **SL 6** slings (5) and **SL 1** slings (2) are slack.

    The bottom chords of the mast butt should be parallel to the ground.
16. Disconnect the **SL 1** slings (2) from the **SH 2** shackles (3). Leave the shackles pinned to the fixed mast butt (4).
17. Remove the locking pin (8) and flip up the pivot pin retainer (9) at one of the pivot pins (10).
18. Install the pin puller cage and the hand-held pin puller.
19. Using the hand-held pin puller (see "Hand-Held Pin Puller" on page 4-8), remove the pivot pin.
20. Remove the hand-held pin puller and the pin puller cage.
21. Repeat step 17 through step 20 for the opposite pivot pin.
22. Lift the fixed mast transport package (7) away from the rotating bed.
23. Lower the fixed mast butt/top assembly until the support pedestals (13) are slightly above the ground.
24. Hold onto the support pedestal (13) and remove the hair pin cotters (11) and retaining pins (12).
25. Lower the support pedestal and install the hair pin cotters and retaining pins.
26. Repeat step 24 and step 25 for the second support pedestal.
27. Install and secure the pivot pins (10) with the pivot pin retainers (9) and the locking pins (8).
28. Remove the slings, shackles, and bushings from the live mast links (View A, Figure 4-95 on page 4-114.
29. Install the bushings on the mast butt (Figure 4-102).
30. Prepare the fixed mast transport package for storage or shipping as necessary.





Item	Description
1	Tray at Minimum Working Position
2	Counterweight Chain Assembly (qty 4)
3	**SL** 4 Sling – 3,80 m (12.50 ft), 11 340 kg (25,000 lb) (qty 2)
4	Counterweight Box Alignment Lug (qty 2 each box)
5	Counterweight Tray Alignment Lug (qty 4)
6	Counterweight Tray Lug (qty 4)
7	Turnbuckle (qty 4)

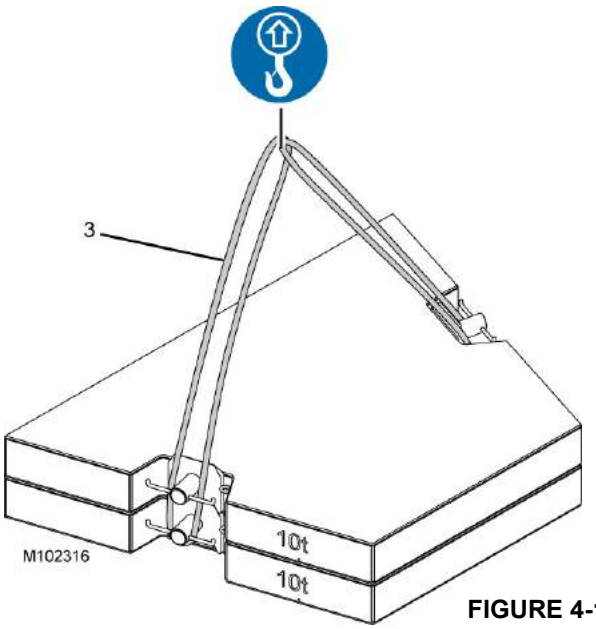


FIGURE 4-103

Positioning the Live Mast

Position the live mast at a minimum angle of 111.6° for the remainder of the procedures.

Removing the Counterweight Boxes

Remove the counterweight boxes using an assist crane.

- The counterweight tray weighs 20 000 kg (44,000 lb)
- Each counterweight box weighs 10 000 kg (22,000 lb)

NOTE: One or two counterweight boxes can be lifted at a time.

WARNING

Crushing Hazard!

To prevent the crane from tipping and the counterweight boxes from falling off the tray during assembly/disassembly, do not remove (or install) the boxes until the counterweight tray is at the ***minimum working position***. The crane will tip.

To prevent the counterweight boxes from falling and crushing personnel, do not lift more than two boxes at a time. The lifting lugs may break, resulting in the boxes falling.

See Figure 4-103 for the following procedure.

1. If not already done, drive the counterweight tray to the **minimum working position** of 4.00 m as indicted in the VPC-MAX calibration screen (View C, Figure 4-38 on page 4-40).
2. Loosen the turnbuckles until the counterweight chain assemblies are loose enough to remove.

NOTE: The ratchet on the turnbuckle must be flipped in one direction to tighten the turnbuckle and in the opposite direction to loosen the turnbuckle.

3. Remove the counterweight chain assemblies from the turnbuckle (7) hooks.
4. Remove the counterweight chain assemblies (2) from the counterweight lifting lugs and the counterweight tray lugs (6).
5. Attach the two **SL 4** slings (3) to the assist crane and around the lugs on one counterweight box.
6. Boom, swing, and hoist as necessary to remove the box from the crane.
7. Remove the slings from the box.
8. Attach the slings around the lifting lugs on two counterweight boxes on the opposite side of the counterweight tray.
9. Boom, swing, and hoist as necessary to remove the boxes from the crane.
10. Remove the slings from the boxes.
11. Continue to remove two boxes, alternating from side to side.
12. Remove the last box from the crane.
13. Place the chain assemblies in the storage pockets on the counterweight tray.

Placing the Counterweight Boxes on the Trailer

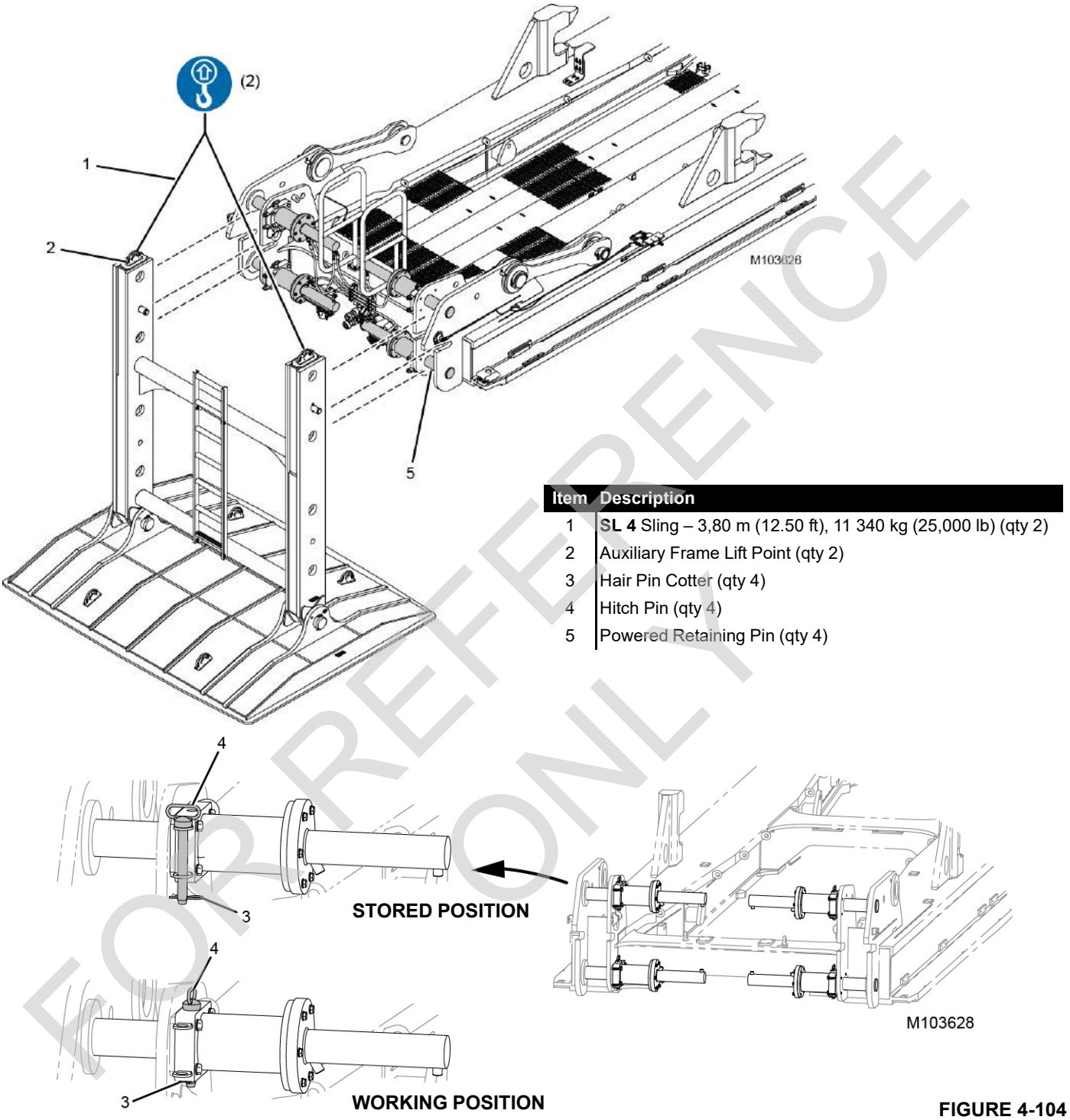
WARNING

Crushing Hazard!

Do not lift more than two counterweight boxes at a time. The lifting lugs may break, resulting in the boxes falling.

NOTE: One or two counterweight boxes can be lifted at a time.

1. Use two **SL 4** slings – 3,80 m (12.50 ft), 11 340 kg (25,000 lb) – to lift the counterweight box(es) from the counterweight tray or the disassembly area.
2. Move the trailer into place.
3. Place the box(es) on the trailer.
4. Disconnect the slings from the box(es).
5. Repeat step 1 through step 4 for all of the boxes.



Item	Description
1	**SL 4** Sling – 3,80 m (12.50 ft), 11 340 kg (25,000 lb) (qty 2)
2	Auxiliary Frame Lift Point (qty 2)
3	Hair Pin Cotter (qty 4)
4	Hitch Pin (qty 4)
5	Powered Retaining Pin (qty 4)

FIGURE 4-104

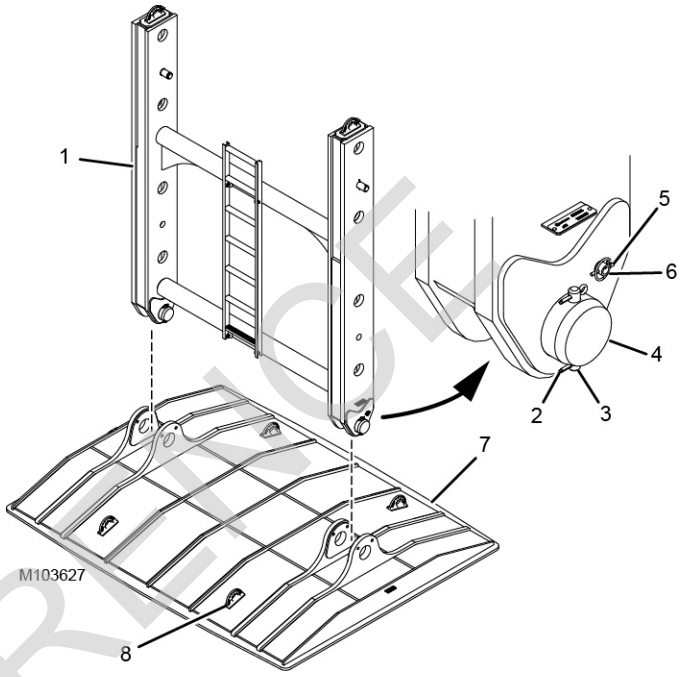
Removing the Auxiliary Member

See Figure 4-104 for the following procedure.

1. Using an assist crane, attach two **SL 4** slings (1) to the auxiliary frame lift points (2).
2. Remove the hair pin cotters (3) from the hitch pins (4).
3. Remove the hitch pins from the working position and install them in the stored position.
4. Install the hair pin cotters.
5. Retract the powered retaining pins (5).
6. Using the assist crane, remove the auxiliary frame assembly from the VPC-MAX beam.

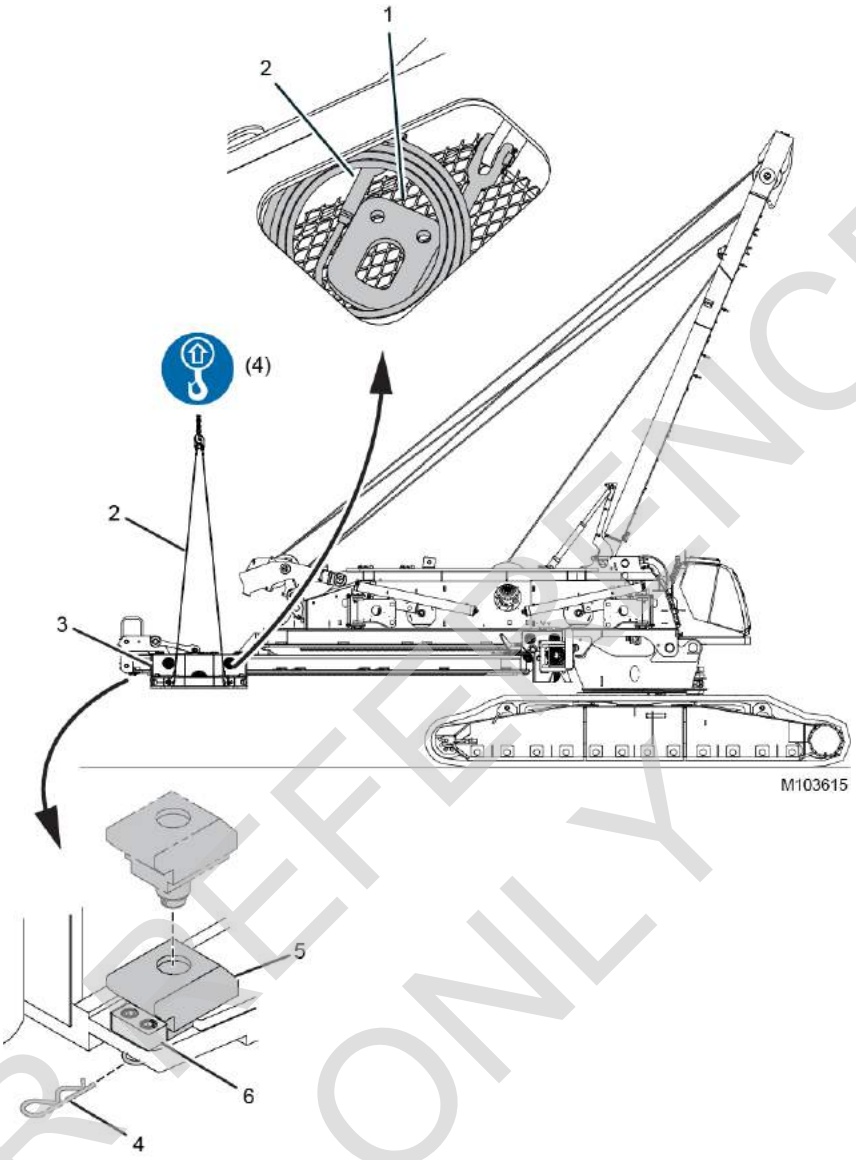
See Figure 4-105 for the following procedure.

7. Set the auxiliary frame assembly on the foundation while holding the auxiliary frame (1) upright with the assist crane.
8. Remove the cotter pins (2) from each of the retaining pins (3).
9. Remove the retaining pins from the clevis pins (4).
10. Remove the clevis pins.
11. Remove the lynch pins (5) from each of the secondary pins (6).
12. Remove the secondary pins.
13. Hoist with the assist crane to remove the auxiliary frame from the pad (7).
14. Reinstall the clevis pins, retaining pins, cotter pins, secondary pins, and lynch pins to the auxiliary frame.
15. Prepare the auxiliary frame for storage or shipping as necessary.
16. Attach two more **SL 4** slings to the assist crane.
17. Attach the four **SL 4** slings to the pad at the lifting lugs (8).
18. Prepare the pad for storage or shipping as necessary.



Item	Description
1	Auxiliary Frame
2	Cotter Pin (qty 8)
3	Retaining Pin (qty 4)
4	Clevis Pin (qty 2)
5	Lynch Pin (qty 4)
6	Secondary Pin (qty 2)
7	Pad
8	Lifting Lug (qty 4)

FIGURE 4-105



Item	Description
1	Plate (qty 2)
2	Pendant (qty 4)
3	Counterweight Tray
4	Hair Pin Cotter (qty 2)
5	Large Main Stop Block (qty 2)
6	Small Bolt-on Stop Block (qty 2)

FIGURE 4-106

Removing the Counterweight Tray

See Figure 4-106 for the following procedure.

NOTE: Remove the counterweight tray with an assist crane. Damage may occur if the tray is lifted too high.

WARNING

Falling Object Hazard!

The counterweight tray weighs approximately 20 000 kg (44,000 lb). Use the appropriate equipment and techniques for lifting and transporting the counterweight tray. Otherwise it could fall, possibly causing injury.

Handling the Counterweight Tray

1. Using the remote control, drive the counterweight tray to its maximum working position of 8500 mm (334.64 in) from the centerline of rotation.
2. Remove the two plates (1) and four pendants (2) from the storage pockets in the counterweight tray (3).
3. Attach the plates and pendants to the tray and to the assist crane.

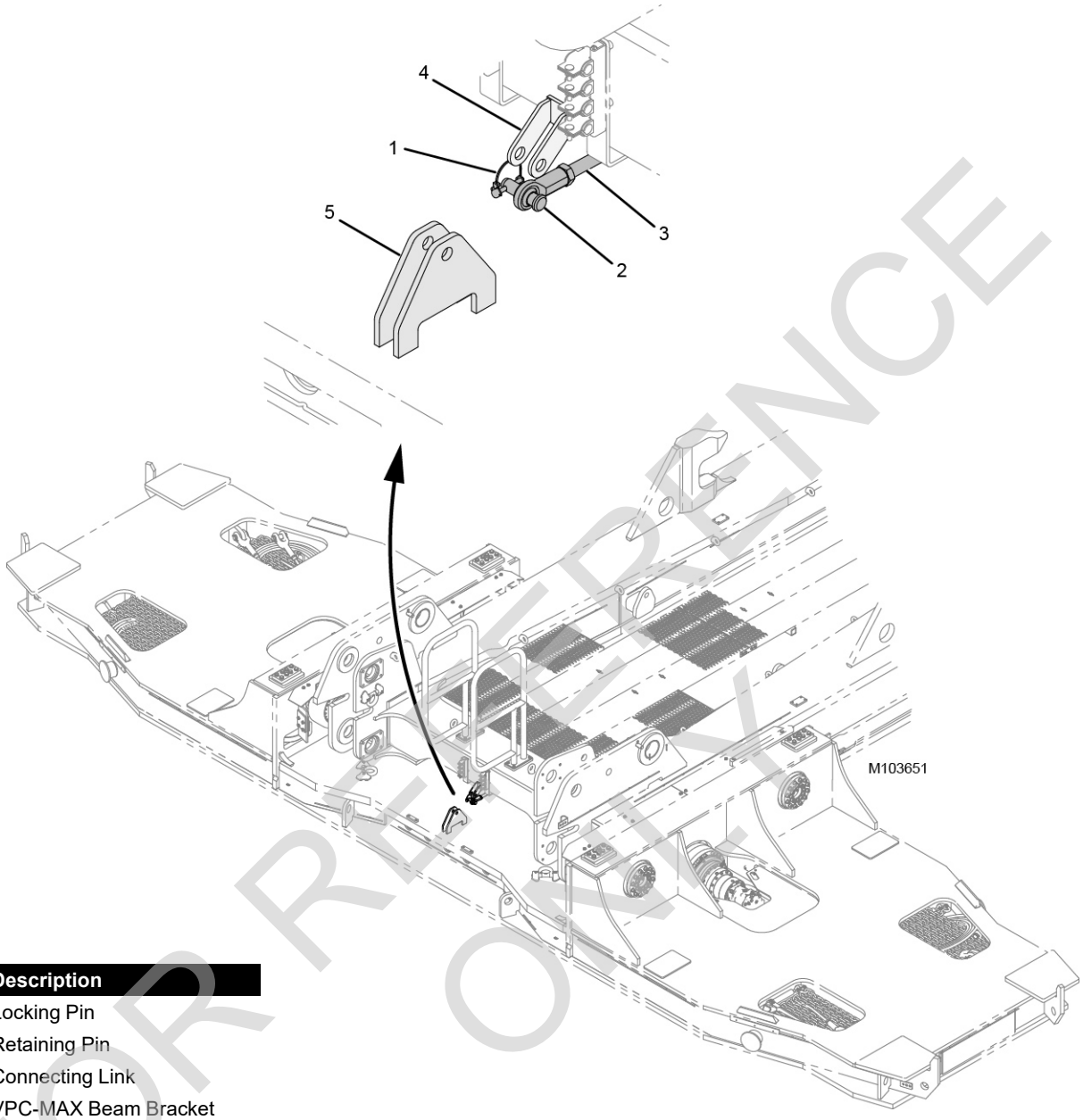
NOTE: Any additional rigging used between the assist crane hook block and plates must not exceed 3,6 m (12 ft) in length.

Make sure the pendants are slack.

Removing the Large Main Stop Blocks

1. Remove the hair pin cotters (4) from the large main stop blocks (5) on the VPC-MAX beam.
2. Remove the large main stop blocks.

NOTE: Do not remove the small bolt-on stop blocks (6) from the beam.



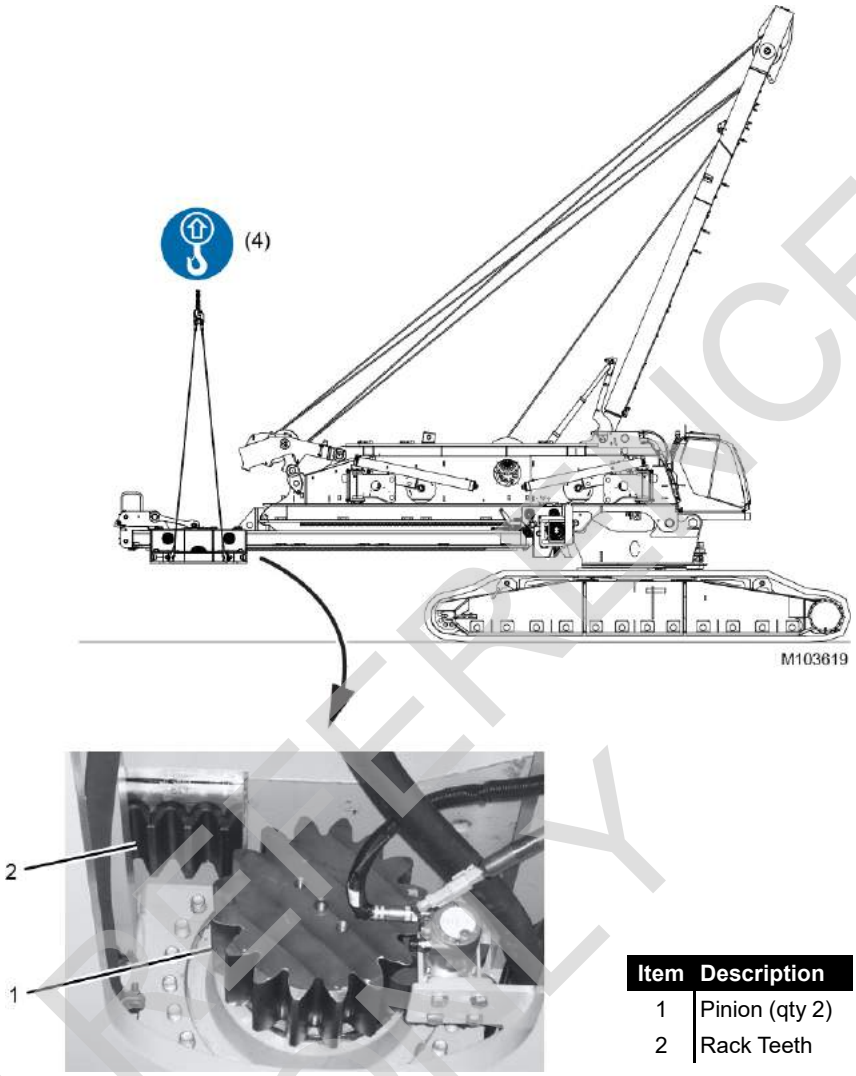
Item	Description
1	Locking Pin
2	Retaining Pin
3	Connecting Link
4	VPC-MAX Beam Bracket
5	Counterweight Tray Bracket

FIGURE 4-107

Detaching the Connecting Link

See Figure 4-107 for the following procedure.

1. Using the remote control, drive the counterweight tray back another 226 mm (8.898 in).
2. Remove the locking pin (1) and retaining pin (2) from the connecting link (3).
3. Remove the connecting link from the working position in the counterweight tray bracket (5).
4. Adjust the slide and/or tray position to align the connecting link with the VPC-MAX beam bracket (4).
5. Install the retaining pin and hair pin cotter to secure the connecting link in the stored position in the beam bracket.



Item	Description
1	Pinion (qty 2)
2	Rack Teeth

FIGURE 4-108

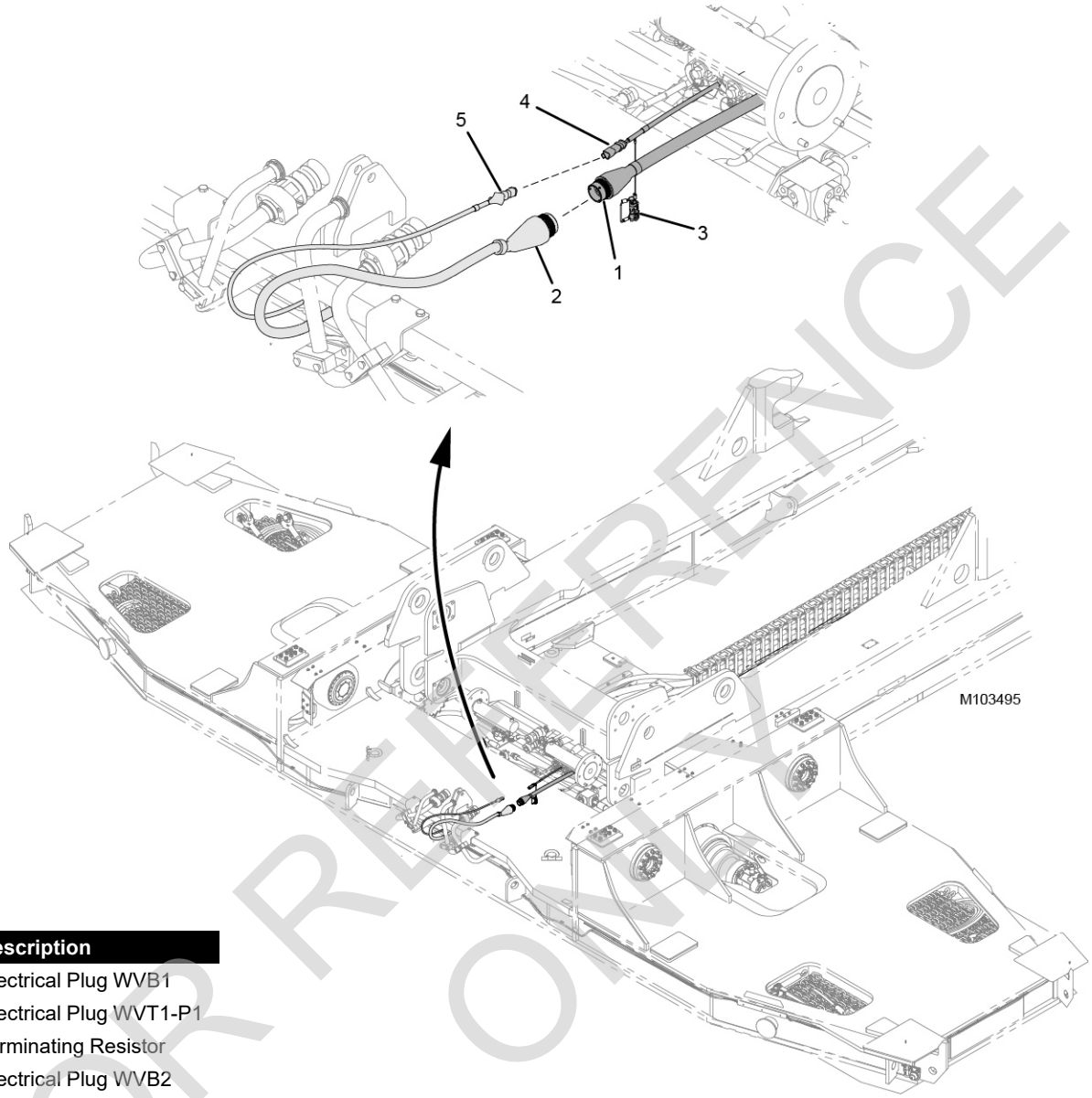
Moving Tray Pinions out of Mesh

See Figure 4-108 for the following procedure.

1. Using the assist crane, hoist just enough to remove the slack from the pendants.

NOTE: Do not hoist the tray off the VPC-MAX beam. The tray must still be supported by the rollers.

2. Using the remote control, move the tray back until the pinions (1) are no longer in mesh with the rack teeth (2).
3. Using the assist crane, move the tray back an additional 50 mm (1.97 in) to make sure the pinions are clear of the rack teeth.



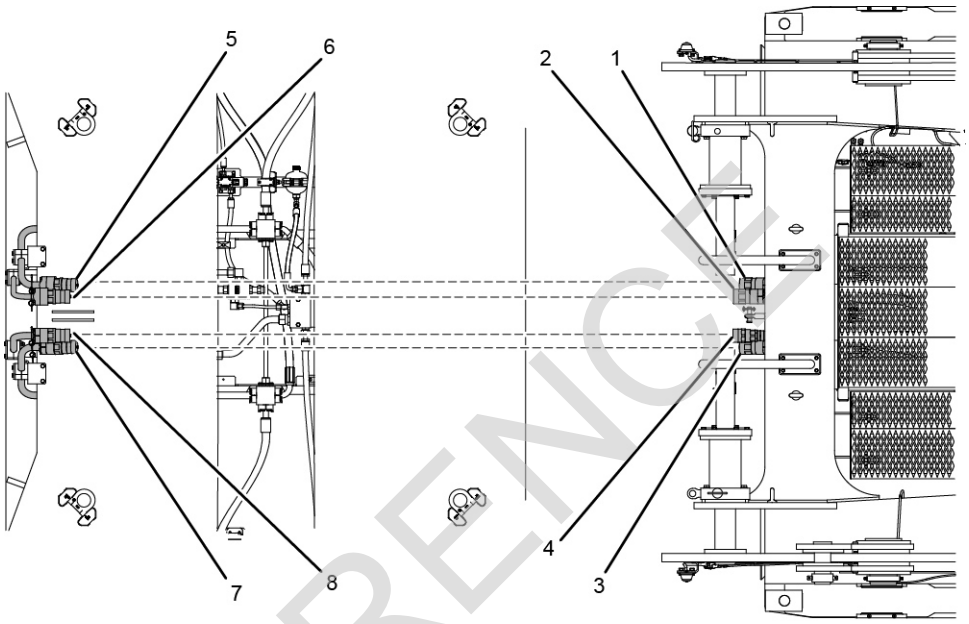
Item	Description
1	Electrical Plug WVB1
2	Electrical Plug WVT1-P1
3	Terminating Resistor
4	Electrical Plug WVB2
5	Electrical Plug WVT2-P1

FIGURE 4-109

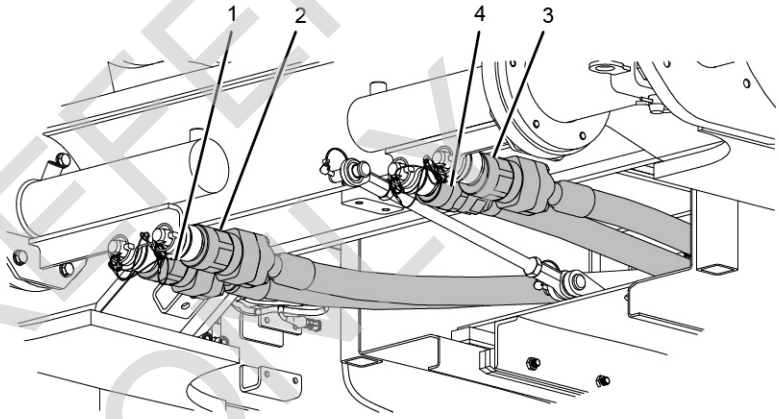
Disconnecting the Electrical Cables

See Figure 4-109 for the following procedure.

1. Disconnect electrical plug WVB2 (4) on the VPC-MAX beam from electrical plug WVT2-P1 (5) on the counterweight tray.
2. Remove the dust cap from the terminating resistor (3) and install the resistor to electrical plug WVB2 on the beam.
3. Disconnect electrical plug WVB1 (1) on the beam from electrical plug WVT1-P1 (2) on the tray.
4. Install the dust caps to the plugs.



Item	Description
1	Hydraulic Hose Number 31
2	Hydraulic Hose Number 32
3	Hydraulic Hose Number 33
4	Hydraulic Hose Number 34
5	Coupler Number 31
6	Coupler Number 32
7	Coupler Number 33
8	Coupler Number 34



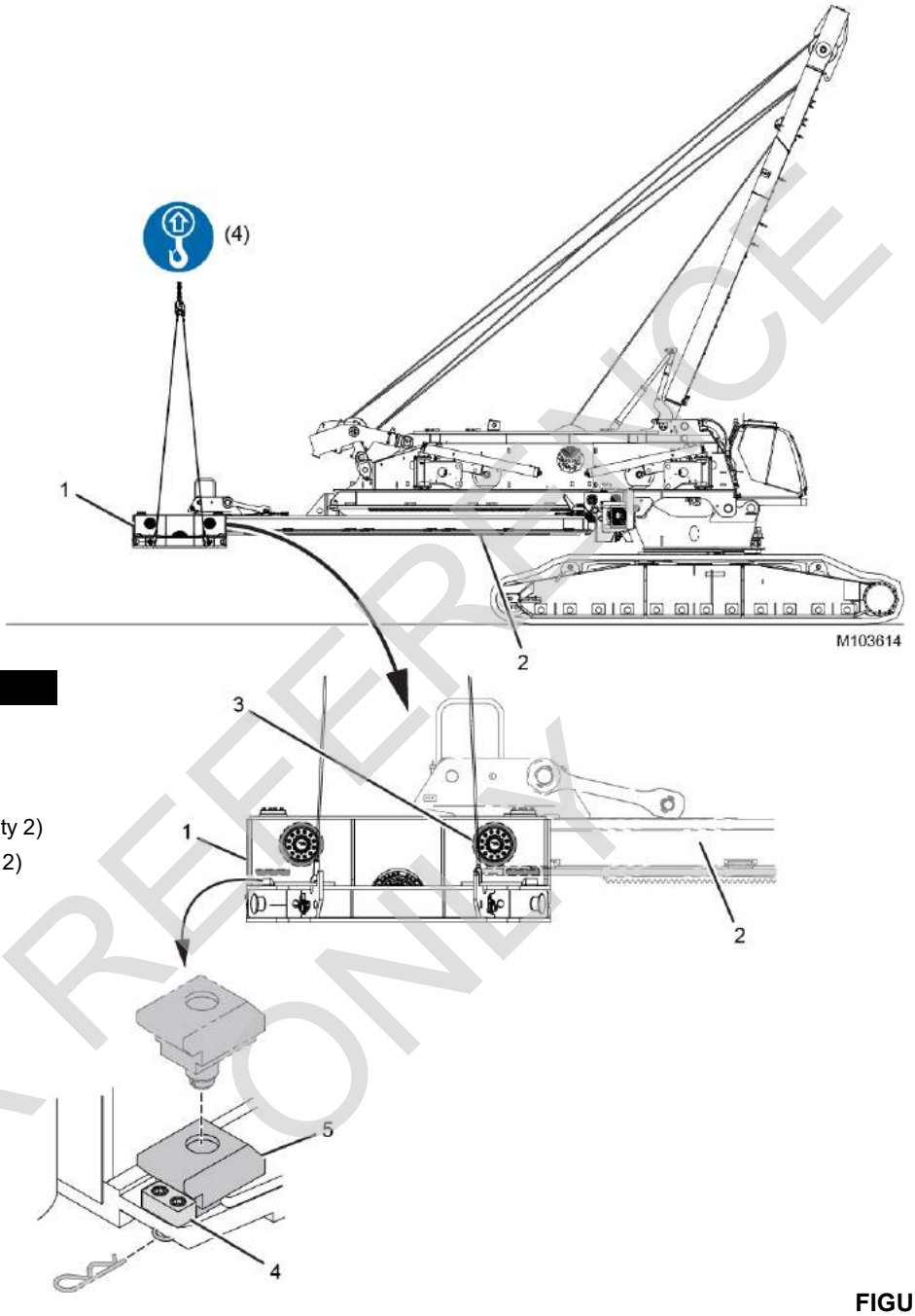
STORED POSITION

FIGURE 4-110

Disconnecting the Hydraulic Hoses

See Figure 4-110 for the following procedure.

1. Disconnect the hydraulic hoses (1–4) on the VPC-MAX beam from the couplers (5–8) on the counterweight tray.
2. Install the four hydraulic hoses in the stored position.



Item	Description
1	Counterweight Tray
2	VPC-MAX Beam
3	Tray Roller (qty 4)
4	Small Bolt-on Stop Block (qty 2)
5	Large Main Stop Block (qty 2)

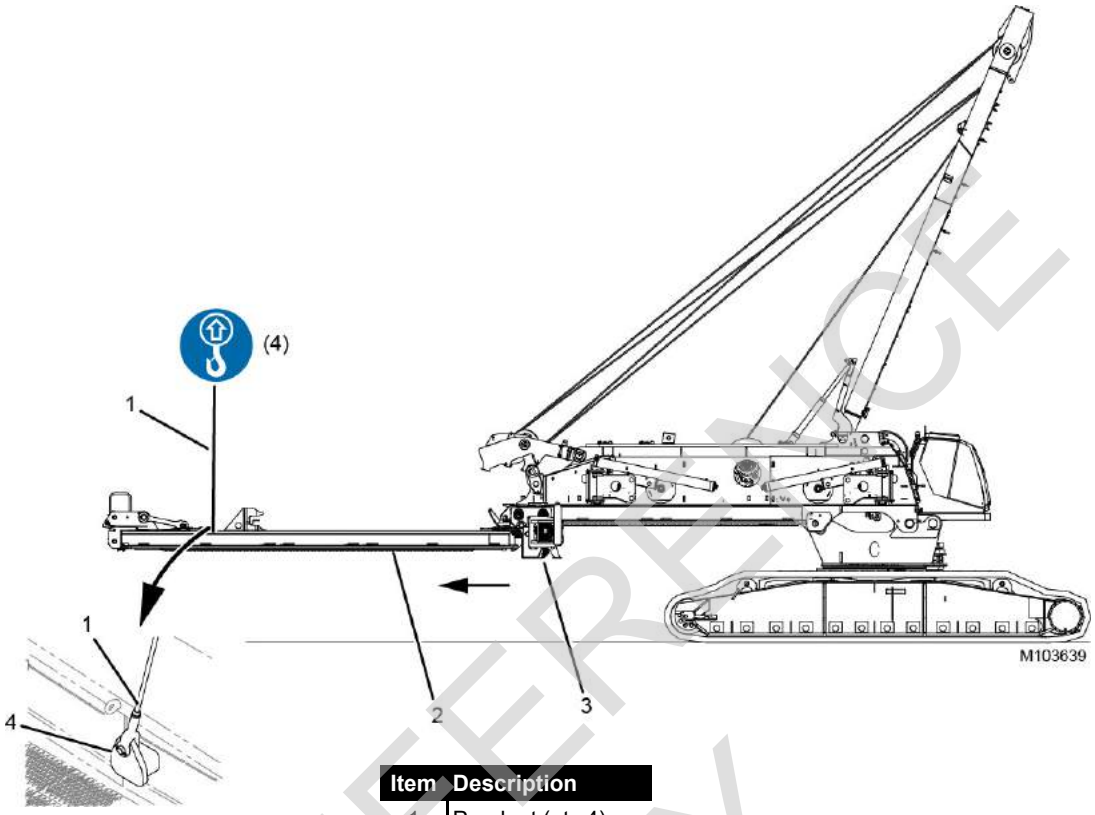
FIGURE 4-111

Removing the Tray

See Figure 4-111 for the following procedure.

1. Using the assist crane, draw the counterweight tray (1) off the VPC-MAX beam (2). The tray rollers (3) roll over the small bolt-on stop blocks (4) during this step.
2. Install the large main stop blocks (5) by reversing the removal procedure. See "Removing the Large Main Stop Blocks" on page 4-127.

NOTE: The counterweight tray plates and pendants are used for VPC-MAX beam removal and actuator removal. It is recommended to not prepare the tray for storage or shipping until these components have been removed.



Item	Description
1	Pendant (qty 4)
2	VPC-MAX Beam
3	Actuator
4	Lifting Lug (qty 4)

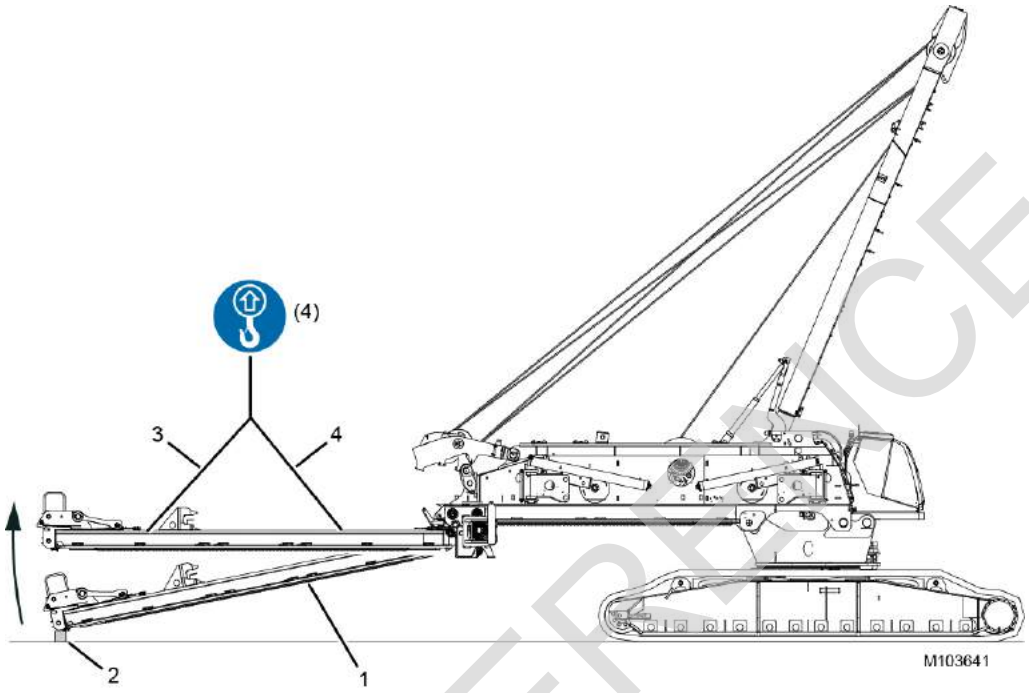
FIGURE 4-112

Removing the VPC-MAX Beam

Drawing the VPC-MAX Beam off the Rotating Bed

See Figure 4-112 for the following procedure.

1. Attach the two plates from the counterweight tray to the assist crane.
2. Attach two of the pendants (1) from the counterweight tray to one of the plates and to the rear lifting lugs (4) on the VPC-MAX beam (2).
3. Attach the other two pendants to the other plate and to the first two pendants so the second pendants cannot swing freely.
4. Using the assist crane, hoist just enough to raise the beam off the pins at the rear of the rotating bed.
5. With the assist crane continuing to support the rear of the beam, slowly drive the actuator (3) rearward using the remote control.
6. Stop when the actuator is at the beam removal/ installation position of 8.70 m as shown in the VPC-MAX Calibration Screen of the Main Display (View B, Figure 4-24 on page 4-23).

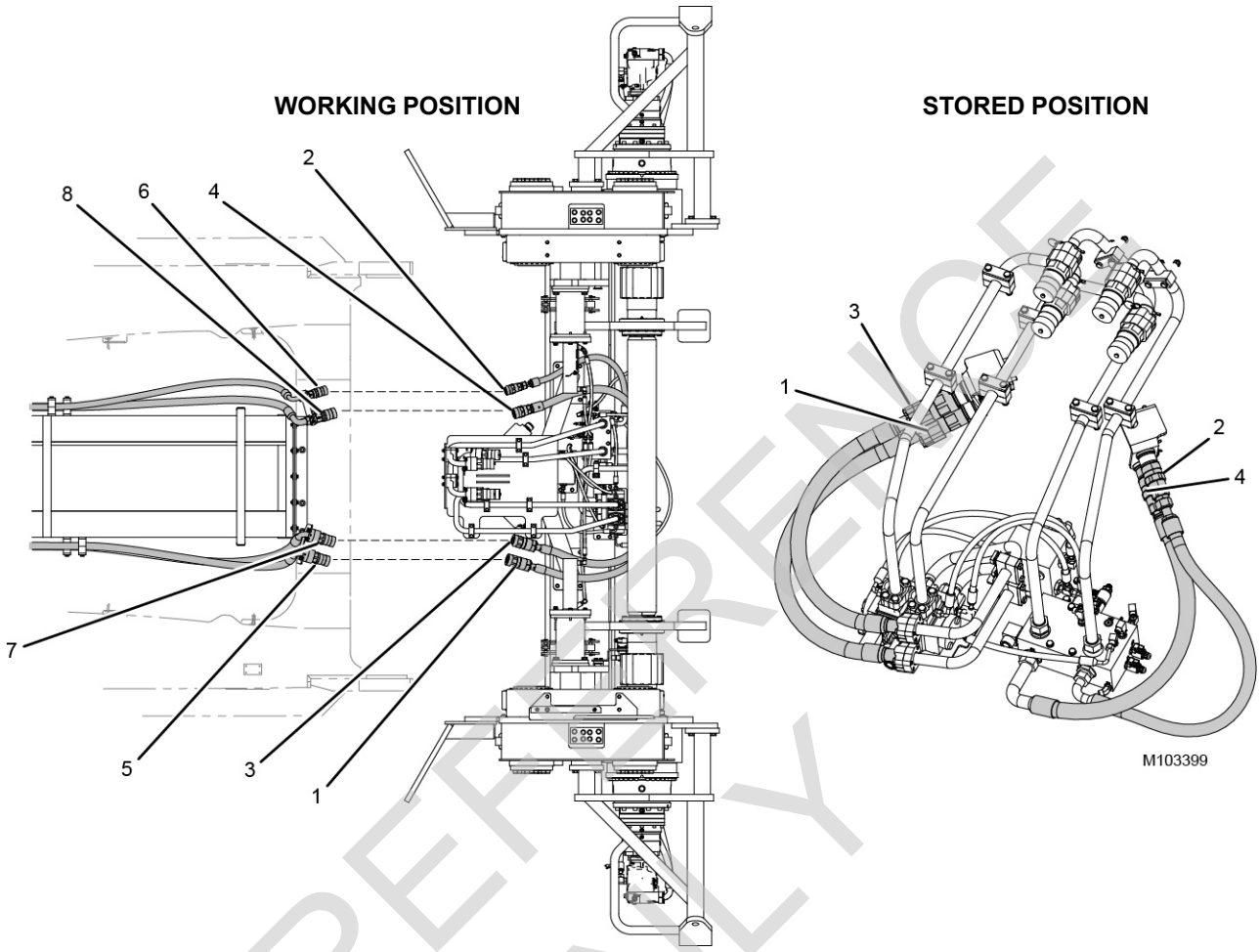


Item	Description
1	VPC-MAX Beam
2	Blocking
3	Rear Pendant (qty 2)
4	Forward Pendant (qty 2)

FIGURE 4-113

See Figure 4-113 for the following procedure.

7. Using the assist crane, lower the rear of the VPC-MAX beam (1) onto the blocking (2).
8. Leave the rear pendants (3) attached to the rear lifting lugs and detach the forward pendants (4) from the rear pendants.
9. Attach the forward pendants to the front lifting lugs on the beam.



Item	Description
1	Hydraulic Hose Number 31
2	Hydraulic Hose Number 32
3	Hydraulic Hose Number 33
4	Hydraulic Hose Number 34
5	Coupler Number 31
6	Coupler Number 32
7	Coupler Number 33
8	Coupler Number 34

FIGURE 4-114

Disconnecting the Hydraulic Hoses

See Figure 4-114 for the following procedure.

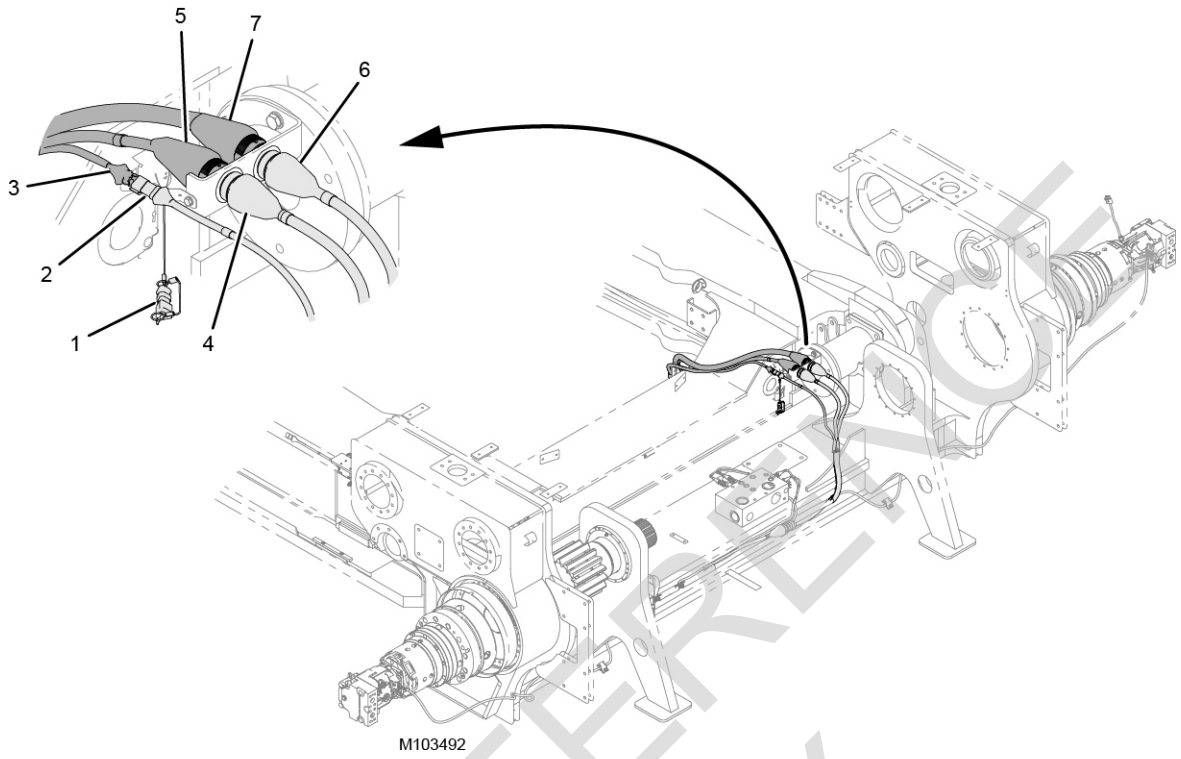
CAUTION

Equipment Damage!

The actuator will damage components if it moves unexpectedly.

Make sure to lock out the VPC-MAX actuator.

1. Turn off the cab power and the remote control key.
2. Disconnect the hydraulic hoses (1–4) on the actuator from the couplers (5–8) on the VPC-MAX beam.
3. Install the hydraulic hoses in the stored position on the actuator.
4. Using the assist crane, hoist slowly until the beam is horizontal (see Figure 4-113).



Item	Description
1	Terminating Resistor
2	CAN Plug WVH1-J2
3	CAN Plug WVB5-P1
4	Electrical Plug WVH1-J4
5	Electrical Plug WVB4-P1
6	Electrical Plug WVH1-J1
7	Electrical Plug WVB3-P1

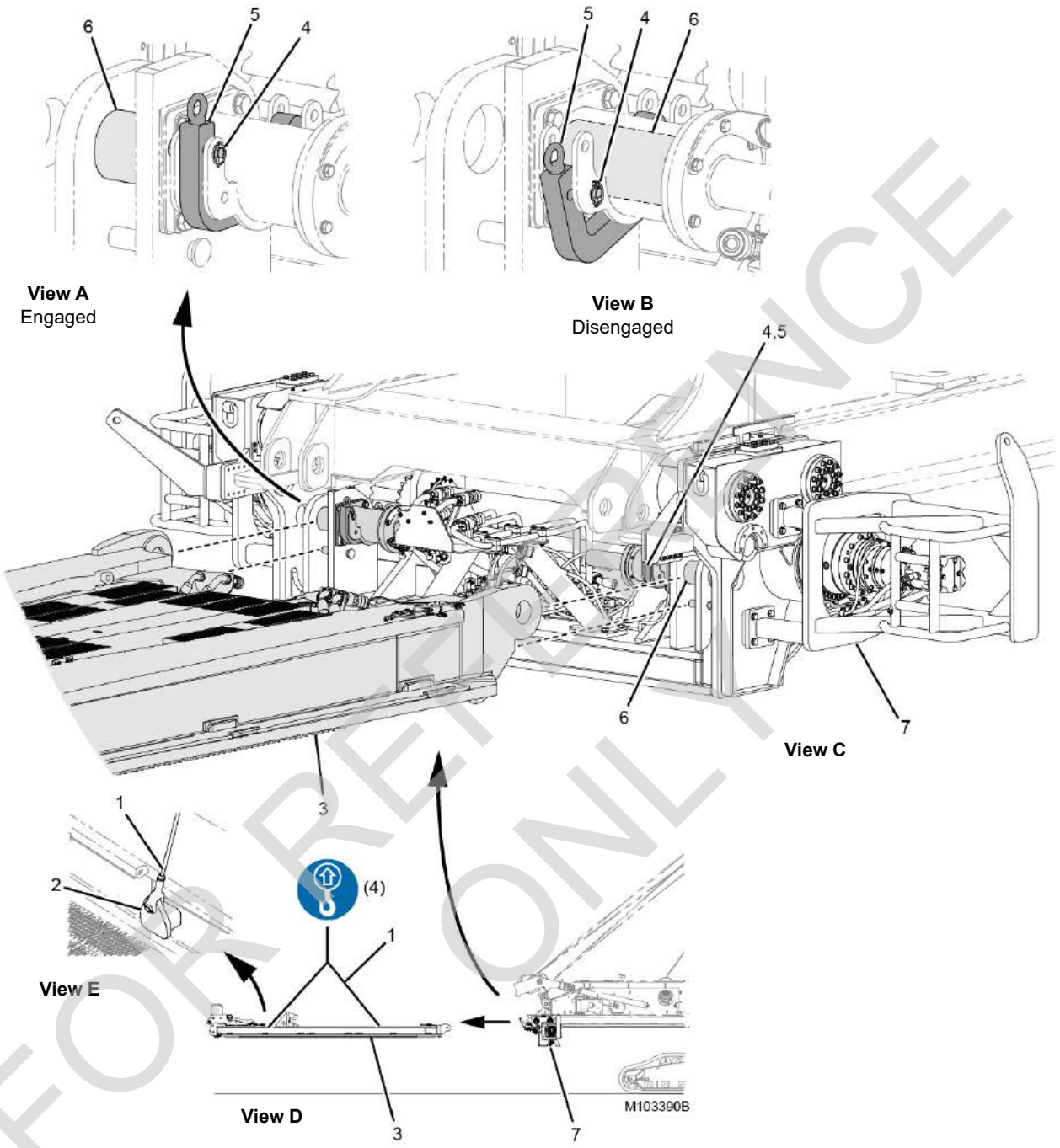
FIGURE 4-115

Disconnecting the Electrical Cables

See Figure 4-115 for the following procedure.

1. Disconnect electrical plug WVH1-J1 (6) on the actuator from electrical plug WVB3-P1 (7) on the VPC-MAX beam.
2. Disconnect electrical plug WVH1-J4 (4) on the actuator from electrical plug WVB4-P1 (5) on the beam.
3. Disconnect CAN plug WVH1-J2 (2) on the actuator from CAN plug WVB5-P1 (3) on the beam.
4. Remove the dust cap from the terminating resistor (1) and install the resistor to CAN plug WVH1-J2 on the actuator.
5. Install the dust caps to the plugs.

THIS PAGE INTENTIONALLY LEFT BLANK



Item	Description
1	Pendant with Pin and Cotter Pin (qty 4)
2	Lifting Lug (qty 4)
3	VPC-MAX Beam
4	Locking Pin with Lynch Pin (qty 2)
5	Pin Puller Keeper Plate (qty 2)
6	Pin Puller Pin (qty 2)
7	Actuator

FIGURE 4-116

Detaching the VPC-MAX Beam from the Actuator

See Figure 4-116 for the following procedure.

1. Make sure the pendants (1) are supporting the VPC-MAX beam (3).
2. Remove the locking pins (4, View A) and disengage both pin puller keeper plates (5, View B).
3. Store the locking pins (4, View B).
4. Disengage the pin puller pins (6, View B) using the remote control.
5. Lift the VPC-MAX beam (3, View C) away from the actuator (7).
6. Prepare the beam for storage or shipping as necessary.
7. Engage the pin puller pins (6, View A) with the remote control.
8. Remove the locking pins (4, View B) from storage.
9. Engage the pin puller keeper plates (5, View A) and install the locking pins (4).

Item	Description
1	Hair Pin Cotter (qty 2)
2	Large Main Stop Block (qty 2)
3	Small Bolt-on Stop Block (qty 2)

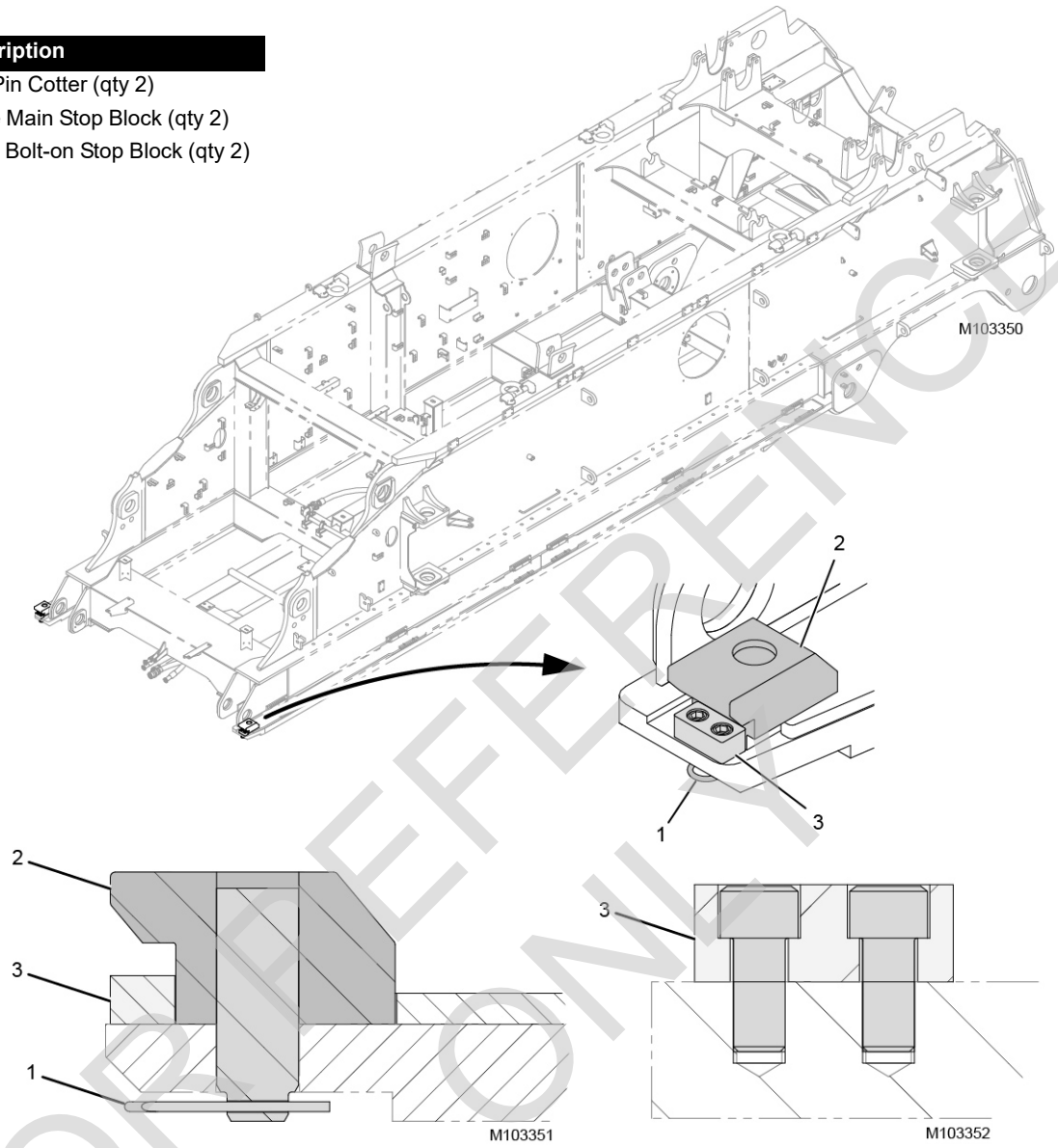


FIGURE 4-117

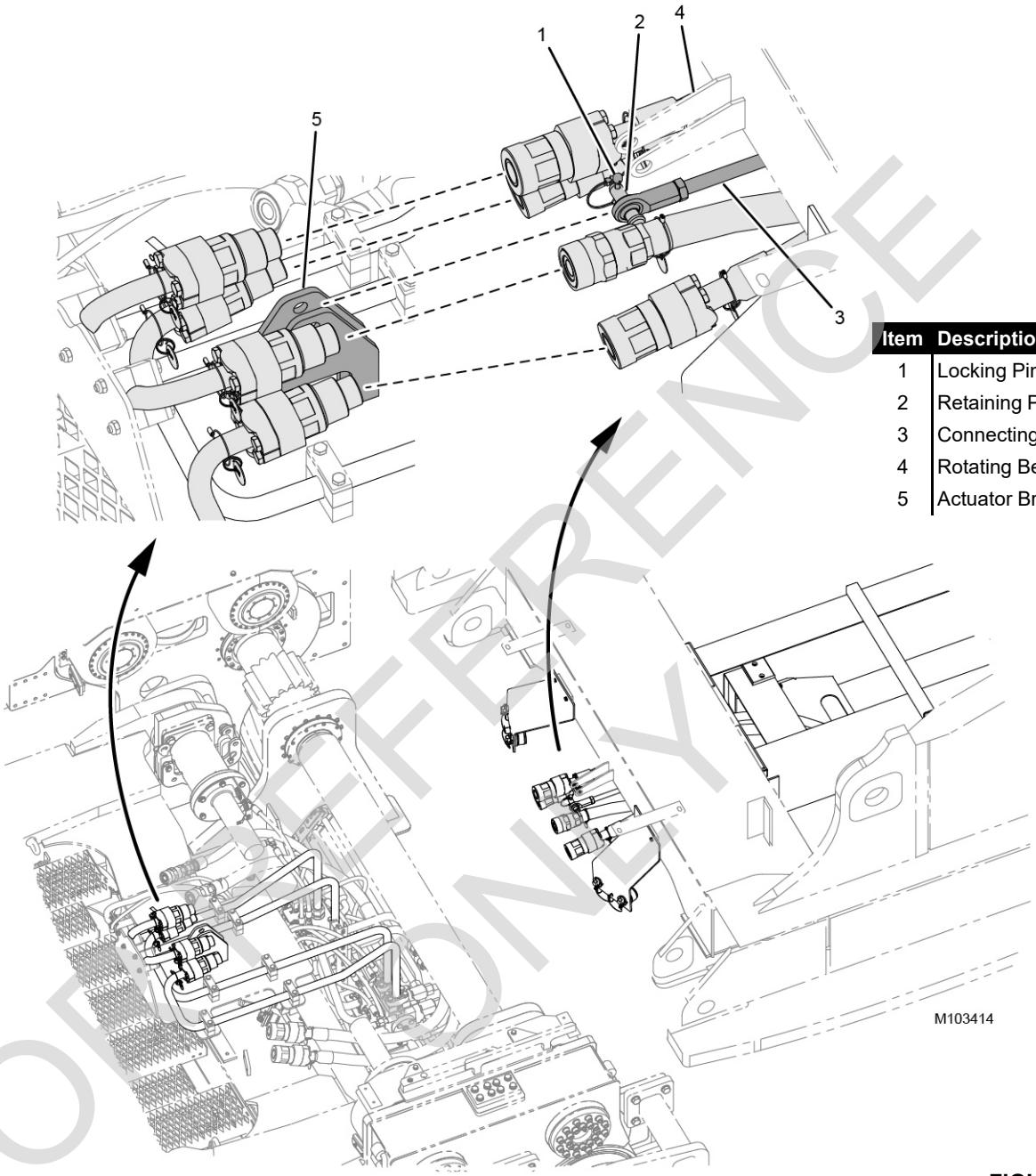
Removing the Actuator

Removing the Large Main Stop Blocks

See Figure 4-117 for the following procedure.

1. Remove the hair pin cotters (1) from the large main stop blocks (2) on the rear of the rotating bed.
2. Remove the stop blocks.

NOTE: Do not remove the small bolt-on stop blocks (3).



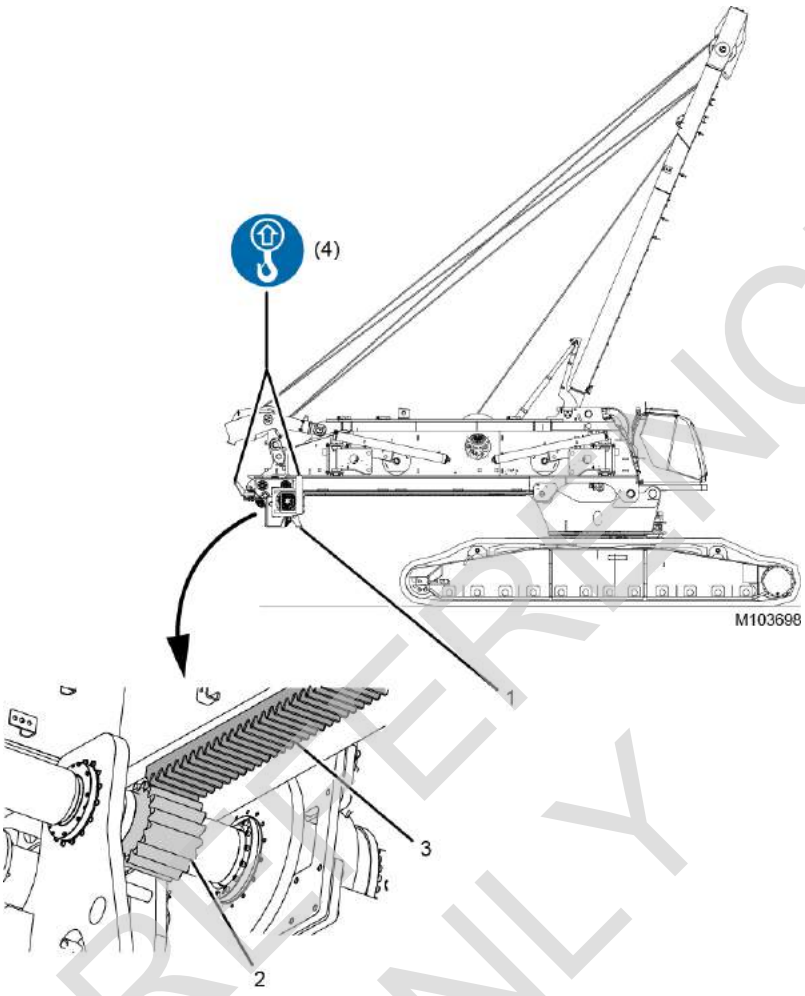
Item	Description
1	Locking Pin
2	Retaining Pin
3	Connecting Link
4	Rotating Bed Bracket
5	Actuator Bracket

FIGURE 4-118

Detaching the Connecting Link

See Figure 4-118 for the following procedure.

1. Remove the locking pin (1) and retaining pin (2) from the connecting link (3).
2. Remove the connecting link from the working position in the actuator bracket (5).
3. Adjust the slide and/or tray position to align the connecting link with the rotating bed bracket (4).
4. Install the retaining pin and hair pin cotter to secure the connecting link in the stored position in the rotating bed bracket.



Item	Description
1	Actuator
2	Pinion (qty 2)
3	Rack Teeth

FIGURE 4-119

Moving the Actuator Pinions out of Mesh

See Figure 4-119 for the following procedure.

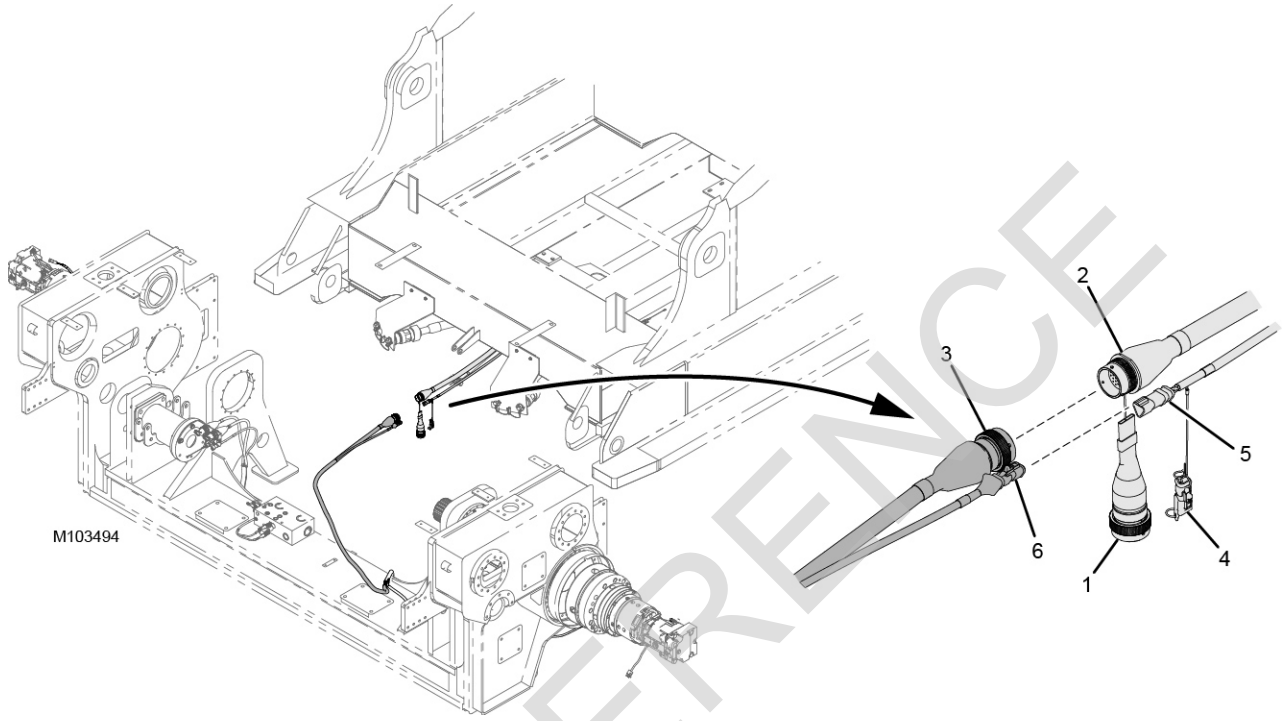
1. Attach the two plates and four pendants from the counterweight tray to the assist crane and to the actuator (1).

NOTE: Any additional rigging used between the assist crane hook block and plates must not exceed 3,6 m (12 ft) in length.

2. Using the assist crane, hoist just enough to remove the slack from the pendants.

NOTE: Do not hoist the actuator off the rotating bed. The actuator must still be supported by the rollers.

3. Using the remote control, move the actuator back until the pinions (2) are no longer in mesh with the rack teeth (3).



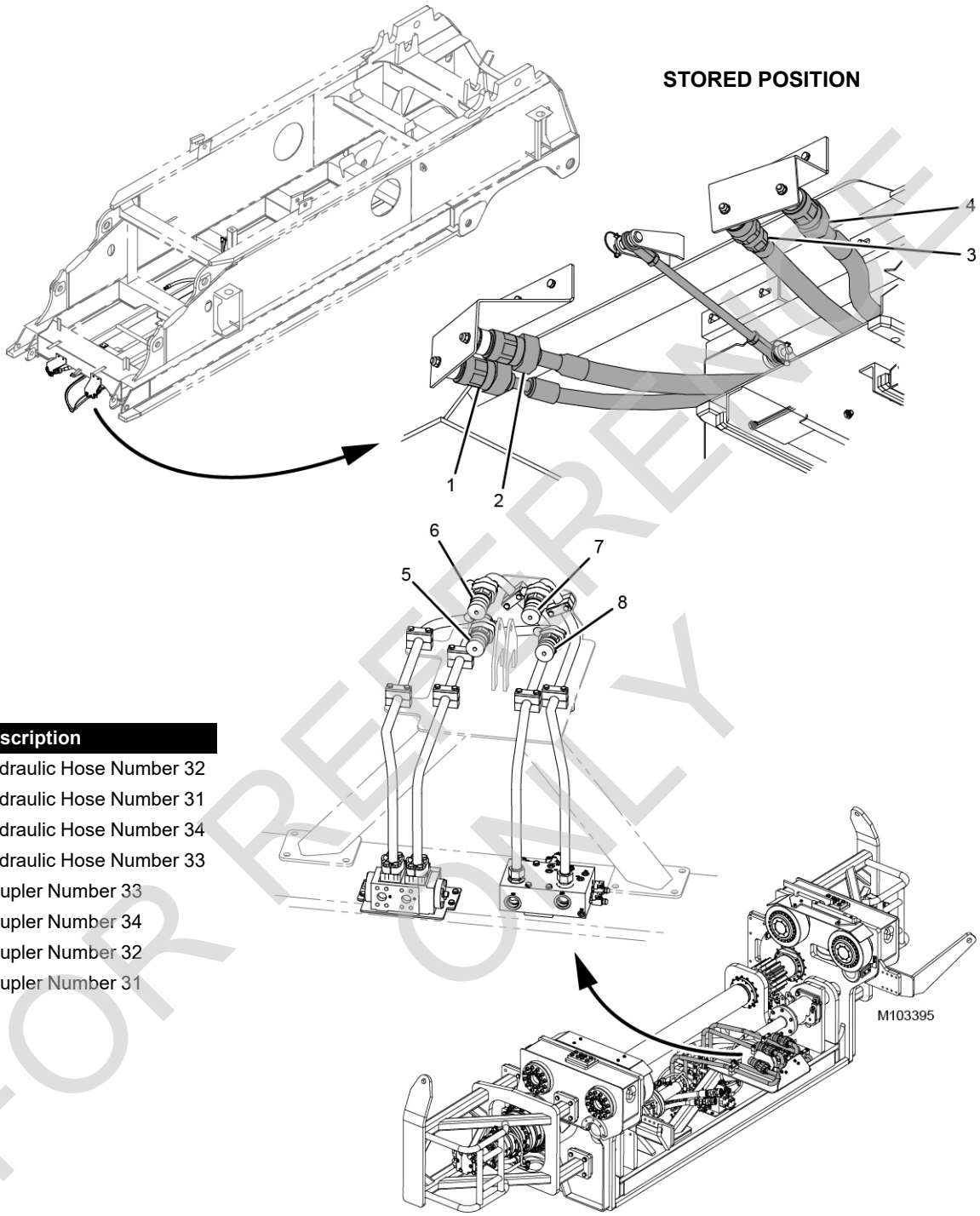
Item	Description
1	Dust Cap
2	Electrical Plug WVB1
3	Electrical Plug WVH1-P1
4	Terminating Resistor
5	Electrical Plug WVB2
6	Electrical Plug WVH1-P2

FIGURE 4-120

Disconnecting the Electrical Cables

See Figure 4-120 for the following procedure.

1. Disconnect electrical plug WVB2 (5) on the rotating bed from electrical plug WVH1-P2 (6) on the actuator.
2. Remove the dust cap from the terminating resistor (4) and connect the resistor to electrical plug WVB2.
3. Disconnect electrical plug WVB1 (2) on the rotating bed from electrical plug WVH1-P1 (3) on the actuator.
4. Install the dust cap (1) to electrical plug WVB1.



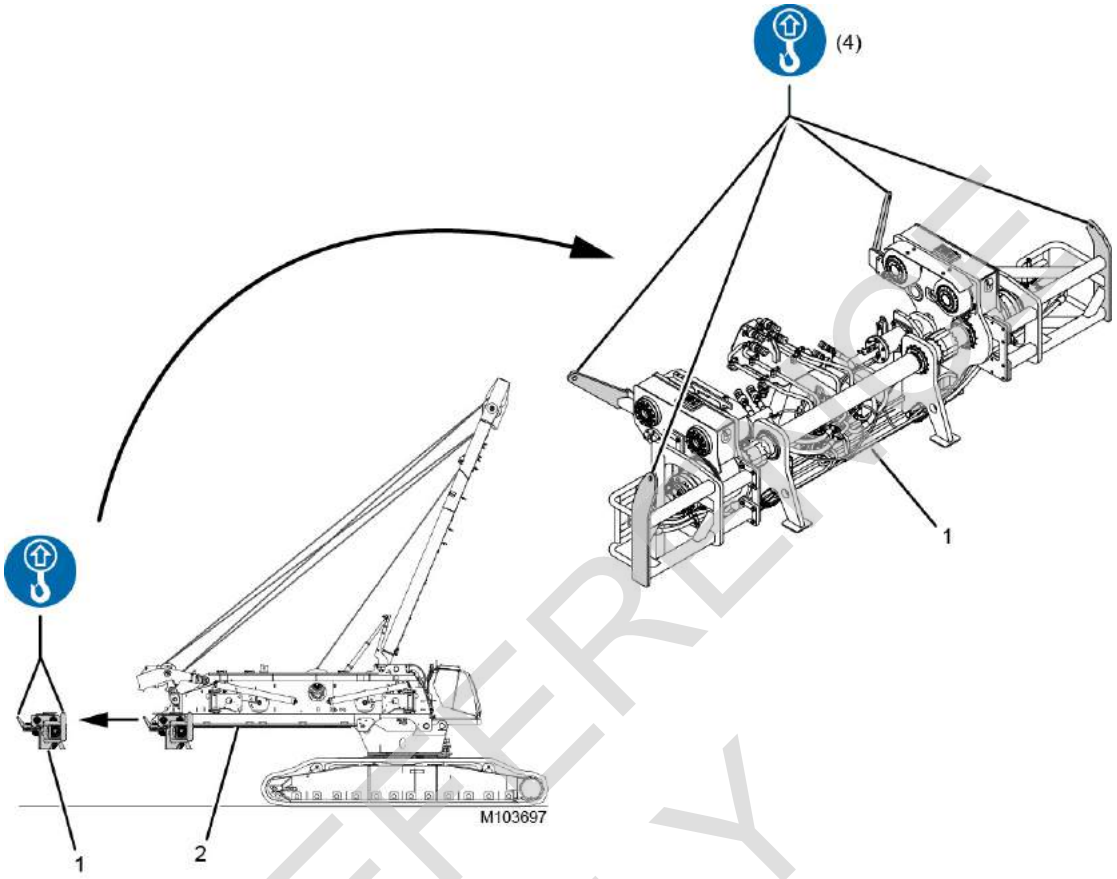
Item	Description
1	Hydraulic Hose Number 32
2	Hydraulic Hose Number 31
3	Hydraulic Hose Number 34
4	Hydraulic Hose Number 33
5	Coupler Number 33
6	Coupler Number 34
7	Coupler Number 32
8	Coupler Number 31

FIGURE 4-121

Disconnecting the Hydraulic Hoses

See Figure 4-121 for the following procedure.

1. Disconnect the hydraulic hoses (1–4) from the couplers (5–8) on the actuator.
2. Install the hydraulic hoses in the stored position by installing the hoses to the brackets.



Item	Description
1	Actuator
2	Rotating Bed

FIGURE 4-122

Removing the Actuator from the Rotating Bed

See Figure 4-122 for the following procedure.

1. Have assistants use taglines to help control the movement of the actuator and to help guide the actuator off the rotating bed.

CAUTION

Equipment Damage!

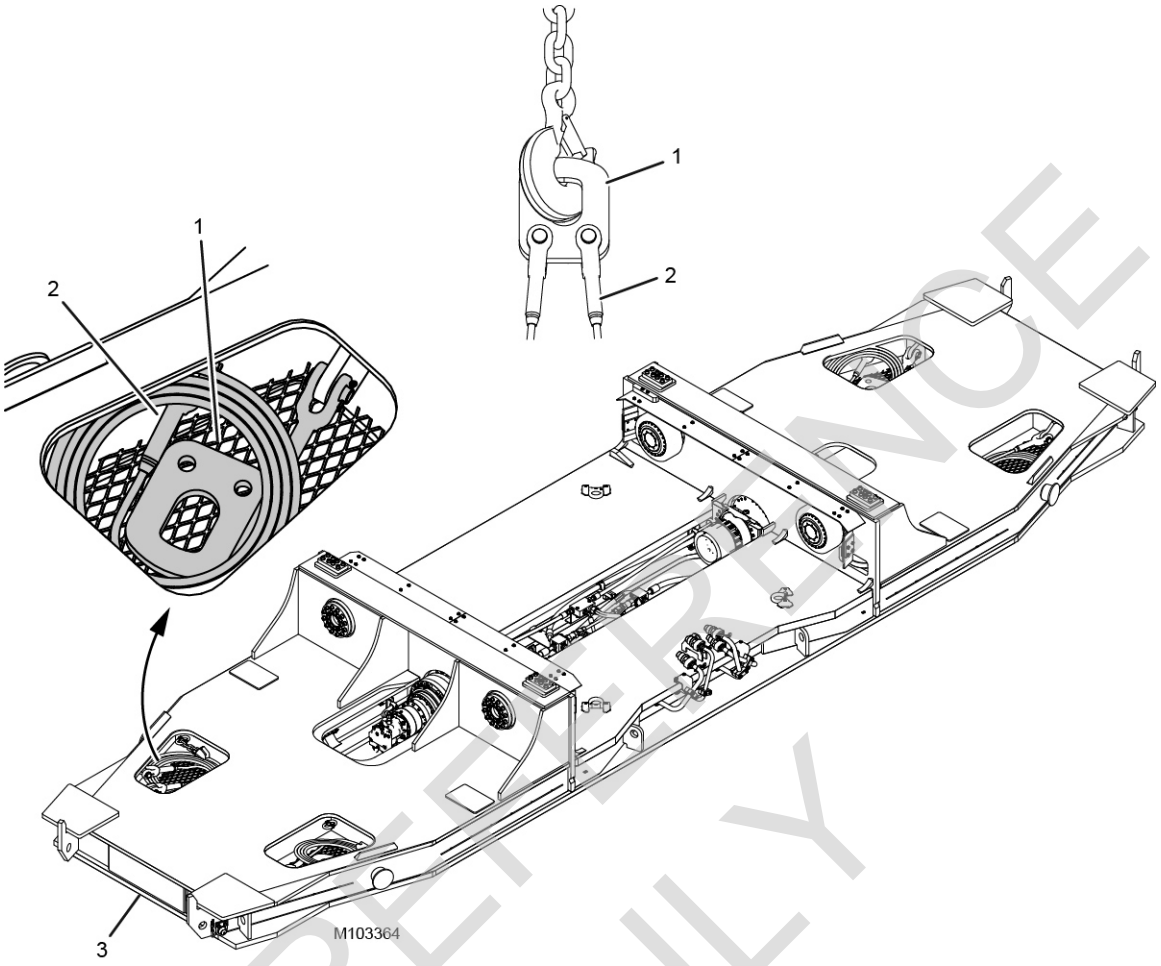
The top of the actuator can be damaged if it is lifted too high.

Make sure the rollers on the actuator maintain contact with the roller wear plates.

2. Using the assist crane, draw the actuator off the rotating bed (2).

NOTE: The actuator should be removed at a 2° angle with the rear rollers higher than the front rollers.

3. Prepare the actuator for storage or shipping as necessary.



Item	Description
1	Plate (qty 2)
2	Pendant (qty 4)
3	Counterweight Tray Assembly

FIGURE 4-123

See Figure 4-123 for the following procedure.

NOTE: The following instructions describe how to store the counterweight tray plates and pendants. If necessary, first attach the tray to the assist crane and place the tray in the necessary storage or shipping location.

4. Remove the plates (1) and pendants (2) from the assist crane.
5. Coil the pendants into the storage pockets in the counterweight tray assembly (3).
6. Place the plates in the storage pockets in the tray.
7. Prepare the counterweight tray for storage or shipping as necessary.

Installing the Large Main Stop Blocks

Install the large main stop blocks to the rotating bed by reversing the removal procedure. See "Removing the Large Main Stop Blocks" on page 4-140.

SECTION 5
LUBRICATION

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

Published 12-16-20, Control # 231-15

SECTION 5
LUBRICATION

LUBRICATION

See F2271 at the end of this section.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 6
MAINTENANCE

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

Published 12-16-20, Control # 231-15

SECTION 6
MAINTENANCE

This section contains maintenance and adjustment instructions for the limit devices used with the VPC-MAX attachment.

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

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

WARNING

Avoid Injury

Read, understand, and follow the safe maintenance practices in Section 1 of the Service Manual provided with your MLC650.

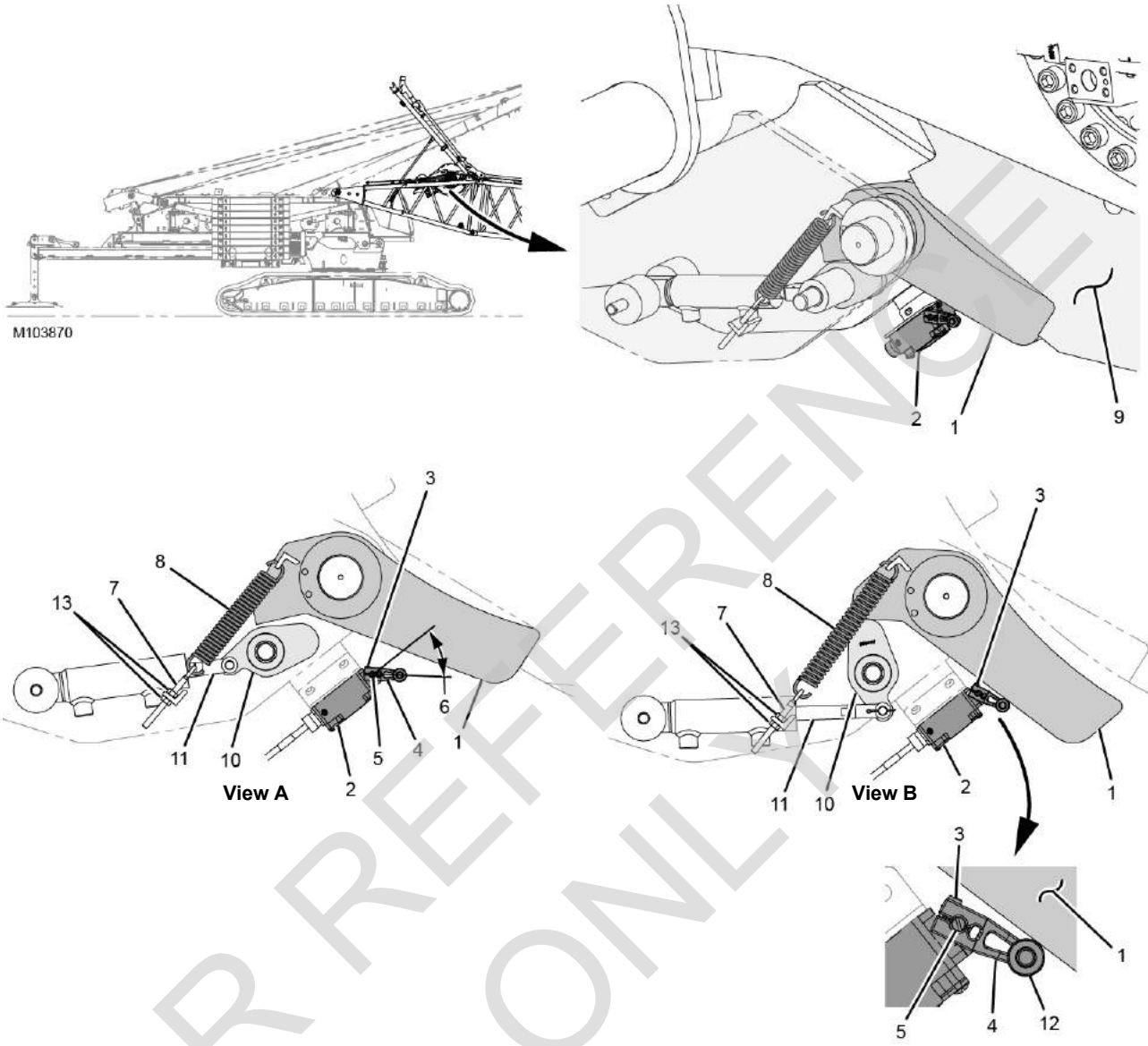
ANGLE SENSORS

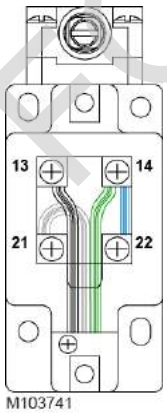
Angle sensors (Figure 6-1) are mounted at the following locations:

- Boom Top
- Boom Butt
- Luffing Jib Top
- Luffing Jib Butt

The sensors are calibrated in the RCL/RCI display and do not require adjustment.

FIGURE 6-1





Limit Switch Wiring

Wire Color	Switch Terminals		Function
Black	13		Normally Open
Green	14		Input
White	21		Normally Closed
Blue	14	22	Jumper

Item	Description
1	Drum 5 Pawl
2	Limit Switch
3	Set Screw
4	Limit Switch Lever
5	Limit Switch Shaft
6	54° Angle
7	Eye Bolt
8	Spring
9	Drum
10	Cam
11	Cylinder Rod
12	Roller
13	Jam Nut (qty 2)

FIGURE 6-2

DRUM 5 BOOM HOIST

For a detailed explanation of the Drum 5 boom hoist operation, reference the MLC650 Service/Maintenance Manual.

Drum 5 Pawl Operation

See Figure 6-2 for the following procedure.

The Drum 5 pawl (1) is controlled by the Drum 5 park switch.

When the Drum 5 park switch is turned on, the cylinder rod (11, View B) extends, engaging the Drum 5 pawl, thereby disengaging the pawl (1, View B) from Drum 5 (9).

When the Drum 5 park switch is turned off, the cylinder rod (11, View A) retracts, disengaging the Drum 5 pawl thereby engaging the pawl (1, View A) to the drum.

When the control system is not powered, the Drum 5 pawl engages Drum 5 by the return springs (8, View A) force.

WARNING

Moving Parts Hazard!

To make adjustments, the engine must be running and the boom hoist and the drum pawl must be operated.

Avoid injury from moving machinery. Stay clear of the drum and the pawl while either is being operated.

Maintain constant communication between the operator and the adjuster so the drum and pawl are not operated while the adjuster is in contact with parts.

Check the Drum 5 pawl for proper adjustment each time the VPC-MAX and fixed mast are installed.

Adjusting the Drum 5 Limit Switch

WARNING

Falling Boom Hazard!

Before performing the steps in this section, land the loads and lower the boom onto blocking at ground level. There is no positive means of holding the boom up when the pawl is being serviced.

The Drum 5 pawl limit switch (2) must be properly adjusted to ensure proper operation of Drum 5.

See Figure 6-2 for the following procedure.

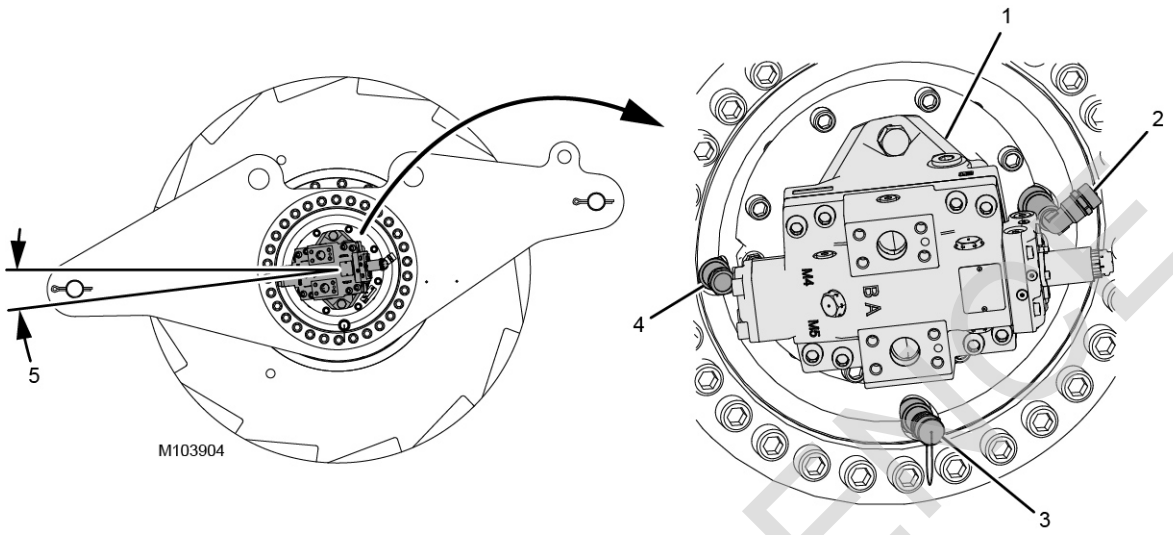
1. Loosen the set screw (3, View A) and rotate the limit switch lever (4, View A) to a 54° angle (6).
2. Disengage the Drum 5 pawl (1, View B) by moving the Drum 5 park switch to the unparked position. It may be necessary to boom up slightly before the pawl will disengage the drum.
3. Rotate the limit switch lever up and hold it so the roller (12, View B) is against the pawl.
4. Turn the limit switch shaft (5, View B) clockwise until the limit switch clicks open and hold.
5. Make sure the roller is against the pawl and securely tighten the set screw (3, View B).
6. Check for proper operation by performing the following:
   - Engage the Drum 5 pawl by moving the Drum 5 park switch to the parked position and try to boom down. The boom hoist should not be able to turn downward.
   - Disengage the boom hoist pawl by moving the Drum 5 park switch to the unparked position and try to boom down. The boom hoist should be able to turn downward.
7. Readjust the limit switch if required.

Adjusting the Drum 5 Return Spring

1. Loosen the jam nuts (13, View A) on the eye bolt (7, View A).
2. Adjust the eye bolt so the return spring (8, View A) has enough tension to fully engage and hold the Drum 5 pawl (1, View A) against Drum 5.
3. Tighten the jam nuts.

Lubricating the Drum 5 Pawl

Spray or brush an anti-seizing lubricant on the sliding surface between the cam (10) and the pawl.



Item	Description
1	Drum 5 Gearbox
2	Fill Plug
3	Drain Plug
4	Sight Glass
5	-7° Angle

FIGURE 6-3

Changing the Drum 5 Oil

The Drum 5 gearbox (1) is filled with gear oil and is not open to the inside of the drum. Only the gearbox itself contains oil.

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 6-3 for the following procedure.

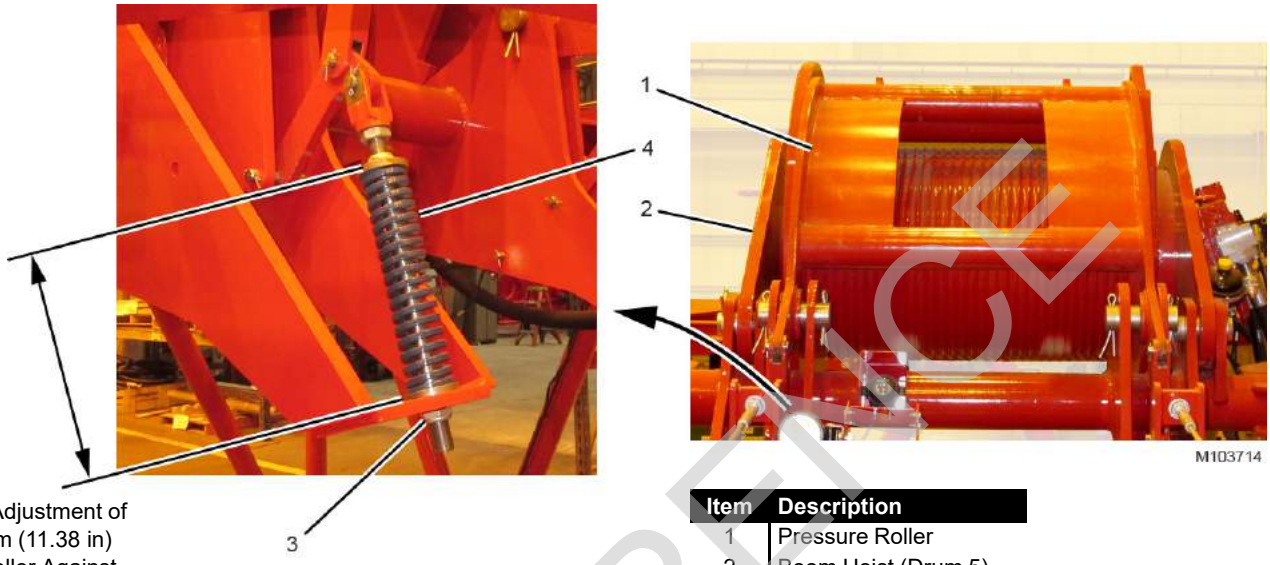
1. Position the crane in a level area.
2. Lower the fully assembled fixed mast onto 900 mm (35.43 in) high blocking in front of the crane.
3. Lock out/tag out the crane.
4. To prevent contaminants from entering the gearbox, clean the fill plug (2) and the area around the plug before removing the plug.
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 fixed mast needs to remain in its lowered position, which puts the sight glass at an approximately -7° angle (5).

11. Reinstall the fill plug.
12. Recheck the level after operating the mast.



Initial Adjustment of 289 mm (11.38 in) with Roller Against Bare Drum

Item	Description
1	Pressure Roller
2	Boom Hoist (Drum 5)
3	Lock Nut
4	Spring

FIGURE 6-4

Adjusting the Drum 5 Pressure Roller

See Figure 6-4 for the following procedure.

The spring-loaded pressure roller (1) assists in maintaining proper wire rope spooling by holding the wire rope firmly in place on the boom hoist (2).

WARNING

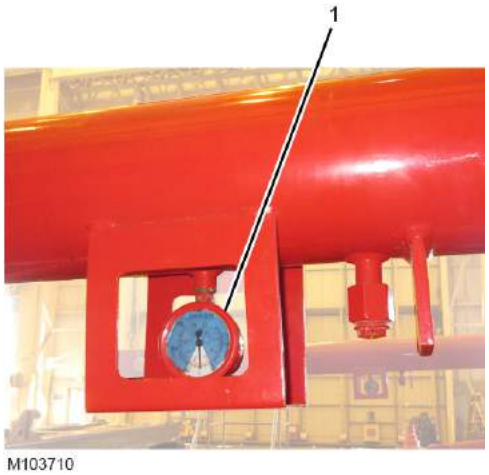
Crush Hazard!

The pressure roller is spring loaded. Stop the boom hoist drum and turn off the engine before adjusting the roller.

The operator should visually monitor drum spooling during daily operation.

If the wire rope jumps layers or does not wind smoothly onto the boom hoist drum, proceed as follows:

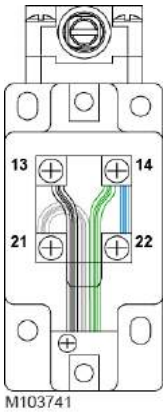
1. Correct the wire rope spooling.
2. Tighten the lock nut (3) to increase spring tension.



Item	Description
1	Hydraulic Pressure Gauge (qty 2)

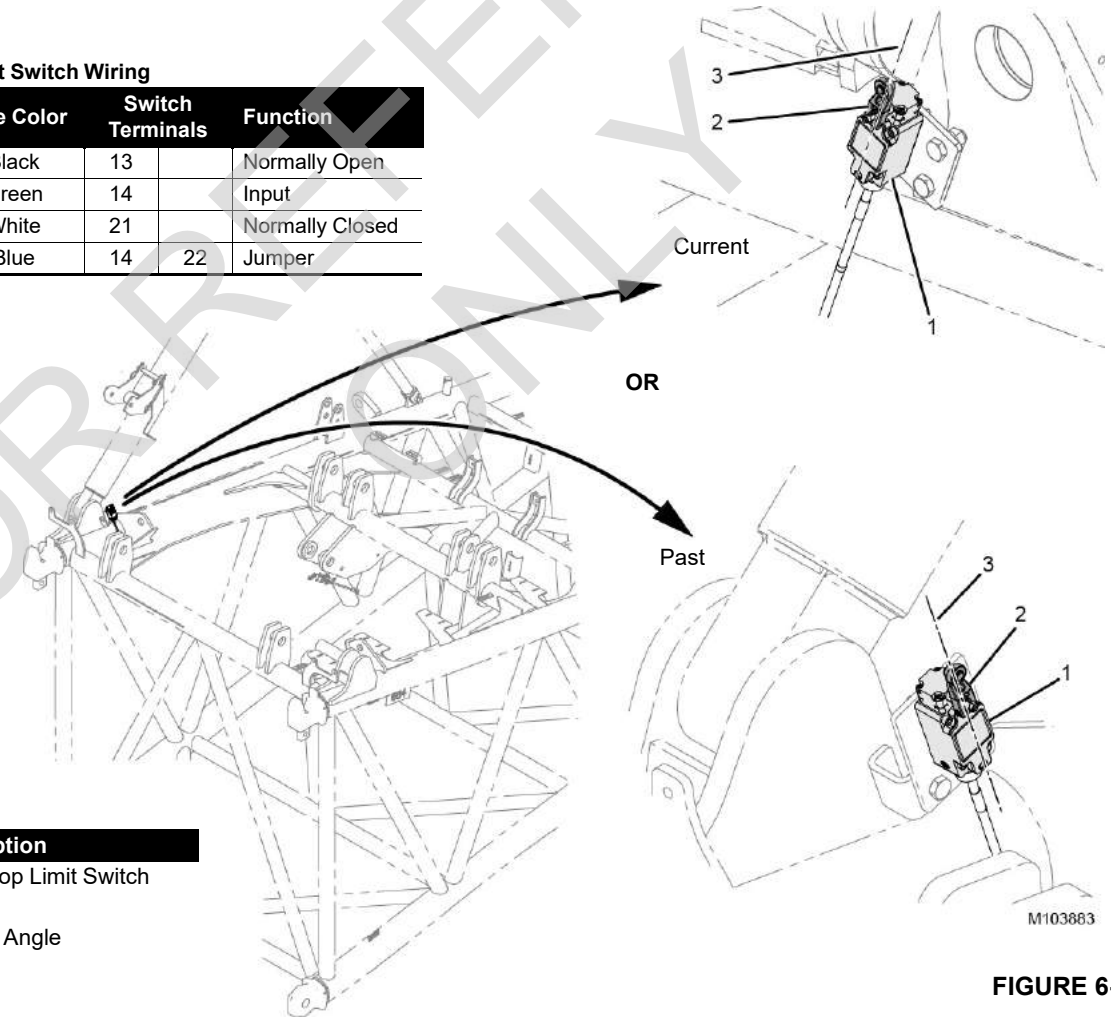
Pressure Reading	
12,7 bar at -1°C	185 psi at 30°F
13,0 bar at 4°C	189 psi at 40°F
13,3 bar at 10°C	192 psi at 50°F
13,5 bar at 16°C	196 psi at 60°F
13,8 bar at 21°C	200 psi at 70°F
14,0 bar at 27°C	204 psi at 80°F
14,3 bar at 32°C	208 psi at 90°F
14,6 bar at 38°C	211 psi at 100°F

FIGURE 6-5



Limit Switch Wiring

Wire Color	Switch Terminals		Function
Black	13		Normally Open
Green	14		Input
White	21		Normally Closed
Blue	14	22	Jumper



Item	Description
1	Mast Stop Limit Switch
2	Lever
3	Parallel Angle

FIGURE 6-6

MAST STOP

Checking the Mast Stop Pressure

WARNING

Explosion Hazard!

The mast stops are equipped with nitrogen precharged accumulators.

Do not adjust the accumulators unless authorized and trained to do so.

See Figure 6-5 for the following:

Each mast stop has a hydraulic pressure gauge (1).

Check both gauges weekly to verify that they read the proper pressure as listed in the table.

Take corrective action if either gauge does not read the proper pressure. Contact the Manitowoc Crane Care Lattice Team.

Checking the Mast Stop Limit Switch

See Figure 6-6 for the following procedure.

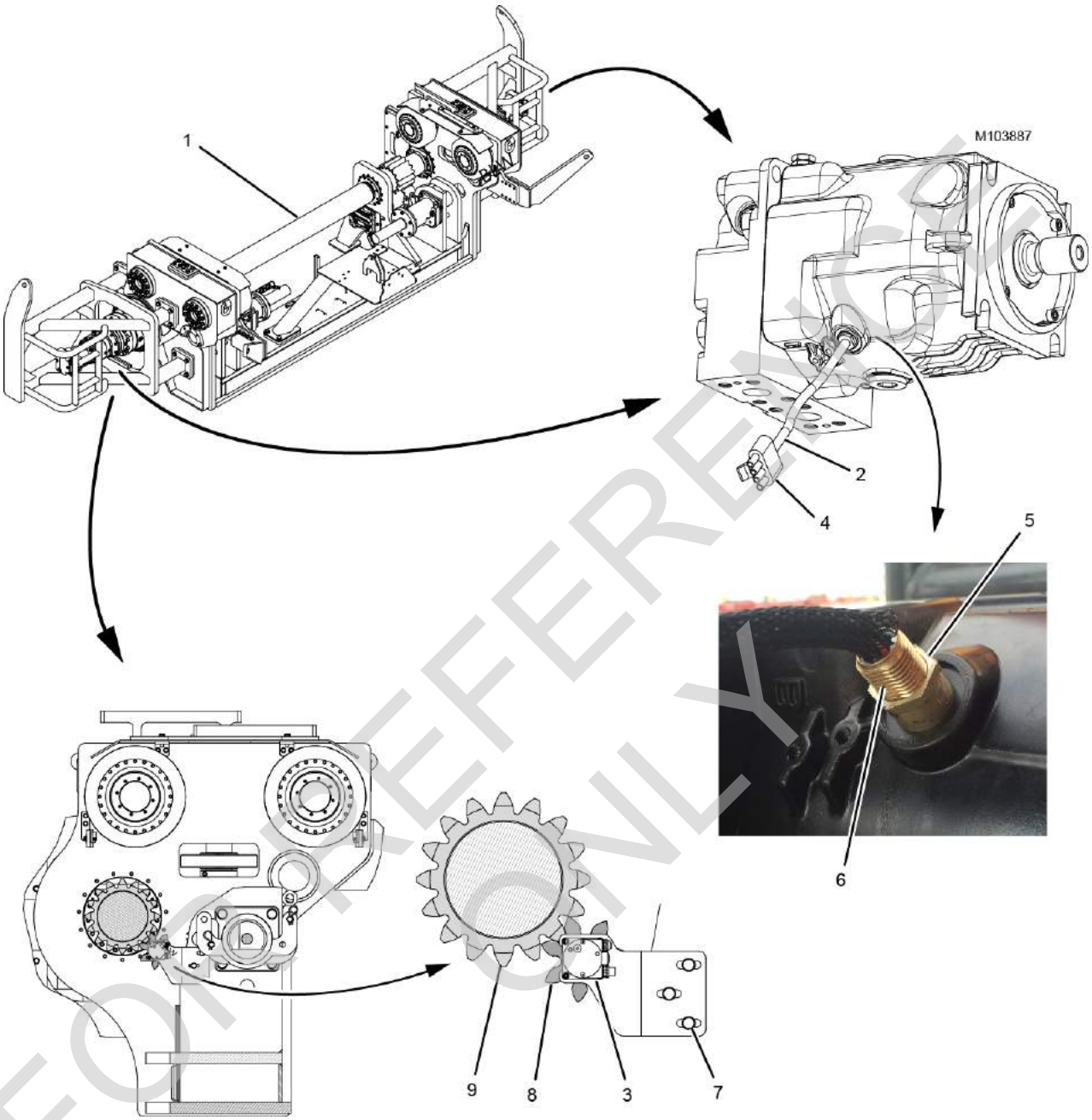
The mast stop limit switch (1) must be checked each time the VPC-MAX attachment is installed. Check the switch as follows:

1. If necessary, reposition the lever (2) so it is at a parallel angle (3) to the body of the mast stop limit switch as shown.
2. Make sure the engine is off and cab power is on.
3. Make sure Fixed Mast Handling Mode is selected in the RCL/RCI display.
4. Rotate the lever counterclockwise and try hoisting up on Drum 4 simultaneously.

   The alarm should sound and the Mast Stop Fault icon should turn on in the fault bar of the main display.

5. Release the lever. The alarm and Mast Stop Fault icon should turn off.
6. If the fault does not appear in the main display, troubleshoot the electrical control system and correct the problem.



Item	Description
1	Trolley
2	Speed Sensor (qty 2)
3	Absolute Encoder
4	Speed Sensor Cable (qty 2)
5	Locknut (qty 2)
6	Speed Sensor Body (qty 2)
7	Encoder Mounting Bolt (qty 3)
8	Encoder Gear
9	Pinion Gear

FIGURE 6-7

VPC-MAX TROLLEY

The VPC-MAX trolley (1) has two speed sensors (2) and an absolute encoder (3) that require adjustment.

VPC-MAX Trolley Speed Sensor

The speed sensor used in the VPC-MAX trolley is a sealed Hall effect, quad output, high current direction speed sensor with a magnetic pickup. A sensor is mounted in the case of each hydraulic motor and senses a rotating target ring that is mounted in the motor. This rotation generates a measurable voltage, which is used to determine the speed and direction of the tray.

Adjusting the VPC-MAX Trolley Speed Sensor

See Figure 6-7 for the following procedure.

1. Disconnect the speed sensor cable (4).
2. Loosen the locknut (5).
3. Turn the speed sensor body (6) clockwise by hand until the bottom end of the sensor gently touches the motor target ring.
4. Turn the sensor body counterclockwise 1/4 turn. Continue turning the sensor body out until the flats on the sensor body are 22° on either side of the motor shaft centerline.

NOTE: Do not turn the sensor body out more than 3/4 of a turn from touching the motor target ring.

5. Tighten the locknut to approximately 13,5 Nm (10 lb ft).
6. Connect the speed sensor cable.

VPC-MAX Trolley Absolute Encoder

The absolute encoder determines its position using a static reference point. Inside the encoder are two discs, both with concentric rings with offset markers. One of the discs is fixed to the shaft and the other moves freely. As the disc on the shaft turns, the markers along the track of the encoder change position on the fixed disc. Each configuration along the disc of an absolute encoder represents a unique binary code. When a program looks at the binary code, it can determine the absolute position of the tray.The relationship between the encoder value and the physical position of the tray is set at assembly. The system does not need to return to a calibration point to maintain position accuracy.

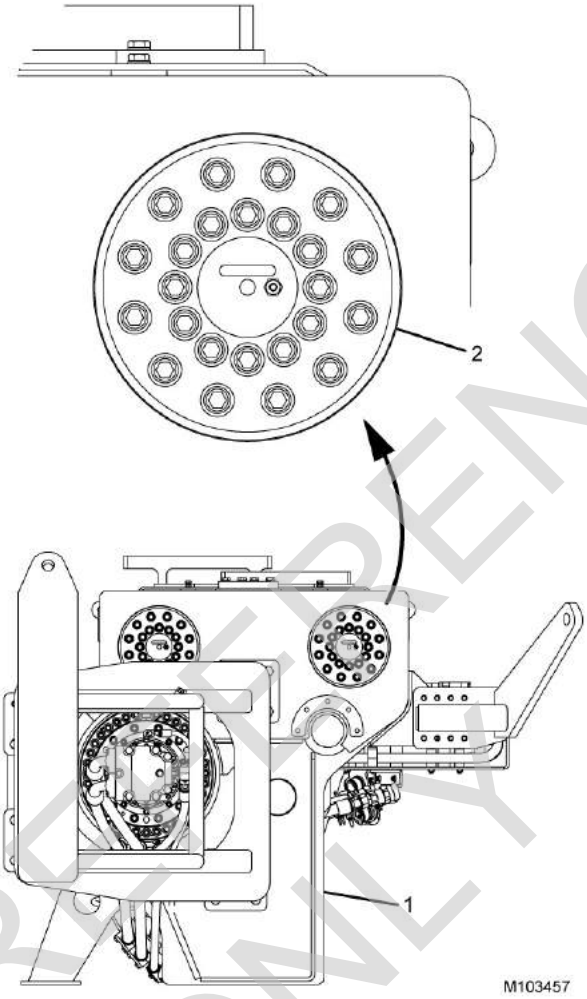
Adjusting the VPC-MAX Trolley Absolute Encoder Backlash

See Figure 6-7 for the following procedure.

1. Loosen the encoder mounting bolts (7).
2. Position the encoder so that the encoder gear (8) tightly meshes with the pinion gear (9).

NOTE: Do not apply radial load to the encoder shaft.

3. Slide the encoder mounting bracket back approximately 1,5 mm (0.06 in). This will create approximately 1,1 mm (0.04 in) of backlash.
4. Tighten the encoder mounting bolts.



Item	Description
1	VPC-MAX Trolley
2	Roller Assembly

Front Shaft Rotation Angle CCW	Rear Shaft Rotation Angle CCW	Resulting Decrease in Backlash
0°	0°	0 Initial Position
0°	30°	0,42 mm (0.02 in)
30°	30°	0,85 mm (0.03 in)
30°	60°	1,15 mm (0.05 in)
60°	60°	1,46 mm (0.057 in)
60°	90°	1,58 mm (0.06 in)
90°	90°	1,69 mm (0.07 in)

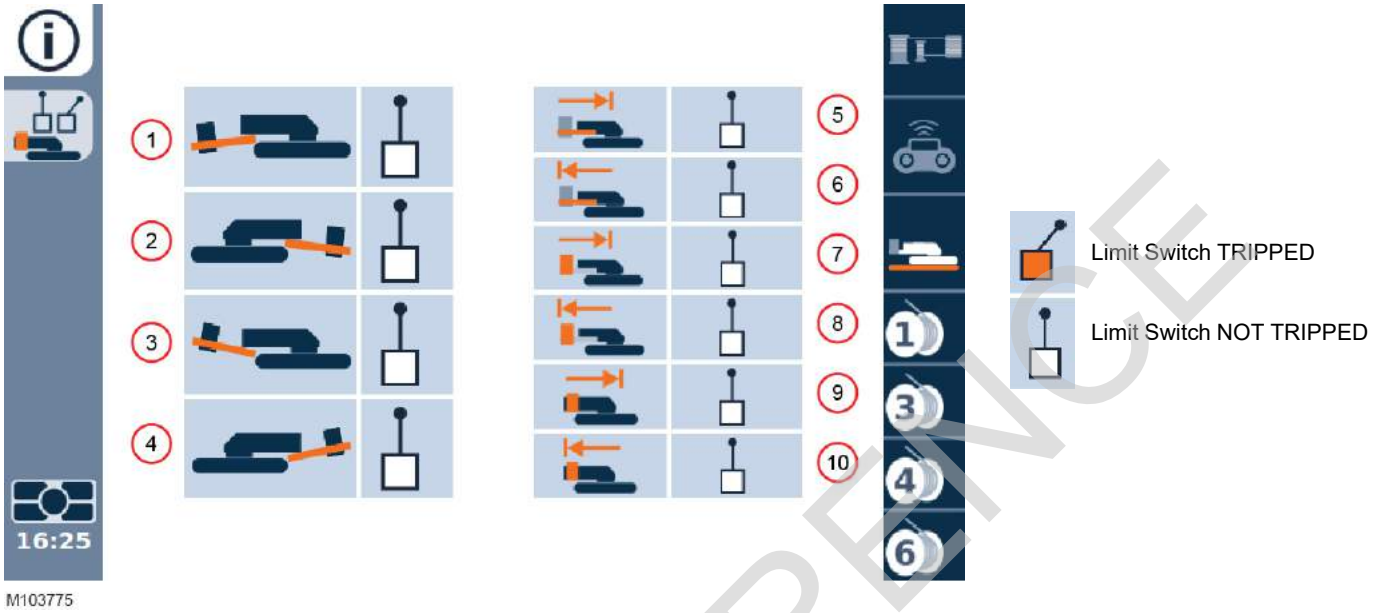
FIGURE 6-8

Adjusting the VPC-MAX Trolley Roller Backlash

See Figure 6-8 for the following procedure.

Initially position the VPC-MAX trolley (1) roller assembly (2) so that the slot is horizontal and above the roller axis as shown in Figure 6-8. The roller assembly shaft has 2 mm (0.08 in) of eccentricity. It is possible to adjust the rack and pinion backlash by rotating the shaft in the bore. See the table in Figure 6-8 for permissible front and rear adjustment combinations and the resulting change in backlash. To decrease the backlash, rotate the shaft counterclockwise. To increase the backlash, rotate the shaft clockwise. Corresponding increases in backlash will result. Adjust equally side to side.

THIS PAGE INTENTIONALLY LEFT BLANK



Item	Description
1	VPC-MAX Right Side Beam-on-Hook Limit Switch
2	VPC-MAX Left Side Beam-on-Hook Limit Switch
3	VPC-MAX Right Side Beam Up Limit Switch
4	VPC-MAX Left Side Beam Up Limit Switch
5	VPC-MAX Beam In Limit Switch.
6	VPC-MAX Beam Out Limit Switch.
7	VPC-MAX Tray In Limit Switch.
8	VPC-MAX Tray Out Limit Switch.
9	VPC Tray In Limit Switch.
10	VPC Tray Out Limit Switch.

FIGURE 6-9

VPC-MAX CALIBRATION

Calibrating the VPC-MAX Actuator

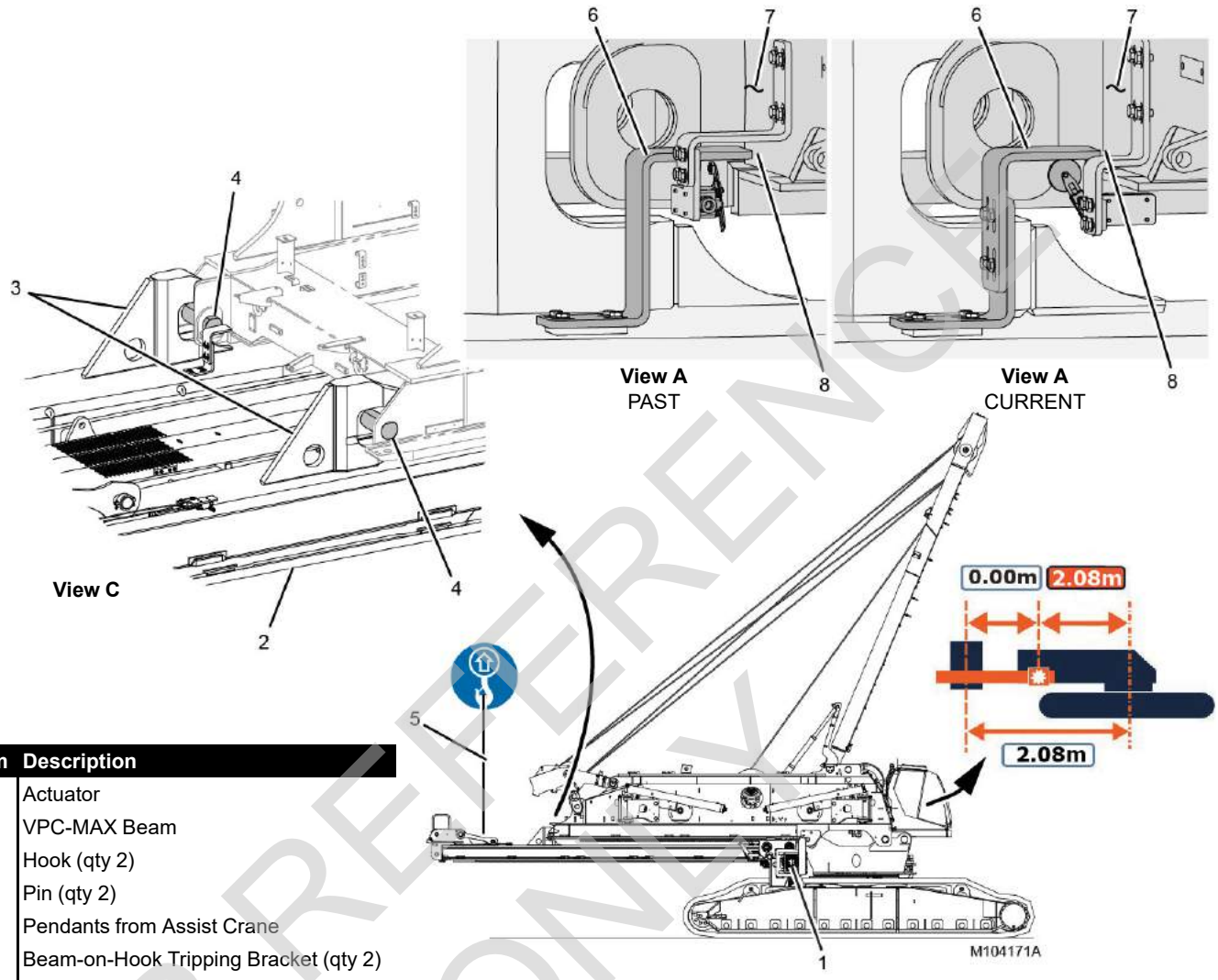
Calibrate the actuator in the VPC-MAX Calibration Screen of the Main Display.

See the Main Display Operation Manual for detailed instructions under the topic VPC-MAX Calibration at Installation.

Calibrating the Counterweight Tray

Calibrate the counterweight tray in the VPC-MAX calibration screen.

See the Main Display Operation Manual for detailed instructions under the topic VPC-MAX Calibration at Installation.



Item	Description
1	Actuator
2	VPC-MAX Beam
3	Hook (qty 2)
4	Pin (qty 2)
5	Pendants from Assist Crane
6	Beam-on-Hook Tripping Bracket (qty 2)
7	Rotating Bed
8	45-55 mm (1-25/32 to 2-5/32 in)

FIGURE 6-10

VPC-MAX LIMIT SWITCHES

Adjusting the Beam Limit Switches

See Figure 6-10 for the following procedure.

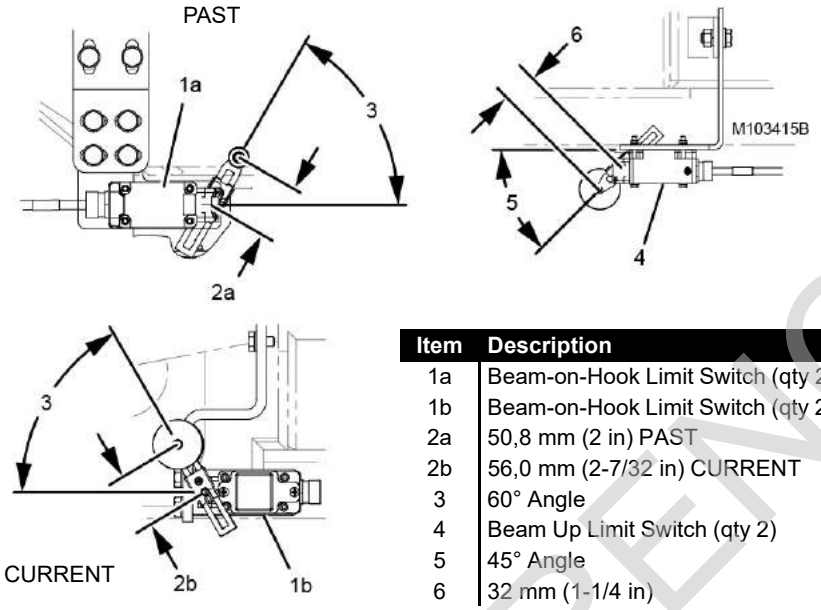
Adjust the beam limit switches during VPC-MAX assembly when the beam is in the following position:

- The rear of the VPC-MAX beam is supported by pendants (5) from the assist crane.
- The live mast configuration is selected in the RCL/ RCI display.
- The actuator (1) is forward at the **minimum working position.** The VPC-MAX calibration screen in the cab should read 2.08 as shown in View B.
- The VPC-MAX beam hooks (3, View C) should be positioned directly over the pins (4) at the rear of the rotating bed.

Positioning the Beam-on-Hook Tripping Brackets

See Figure 6-10 for the following procedure.

1. Loosen the mounting bolts that secure the beam-on-hook tripping brackets (6, View A) to the beam (2).
2. Once the actuator (1) is driven forward to the minimum working position, adjust the brackets to the clearance (8, View A) between the ends of the brackets and the rear of the rotating bed (vertical plate, not the bottom horizontal plate).
3. Securely tighten the mounting bolts.



Item	Description
1a	Beam-on-Hook Limit Switch (qty 2) PAST
1b	Beam-on-Hook Limit Switch (qty 2) CURRENT
2a	50,8 mm (2 in) PAST
2b	56,0 mm (2-7/32 in) CURRENT
3	60° Angle
4	Beam Up Limit Switch (qty 2)
5	45° Angle
6	32 mm (1-1/4 in)

FIGURE 6-11

Positioning the Limit Switch Levers

The limit switch levers are positioned at the dimensions and angles shown in Figure 6-11 at Manitowoc and should not require further adjustment.

If a new limit switch is installed, the corresponding lever must be positioned at the dimension and angle shown prior to installation.

Adjusting the Beam Up Limit Switches

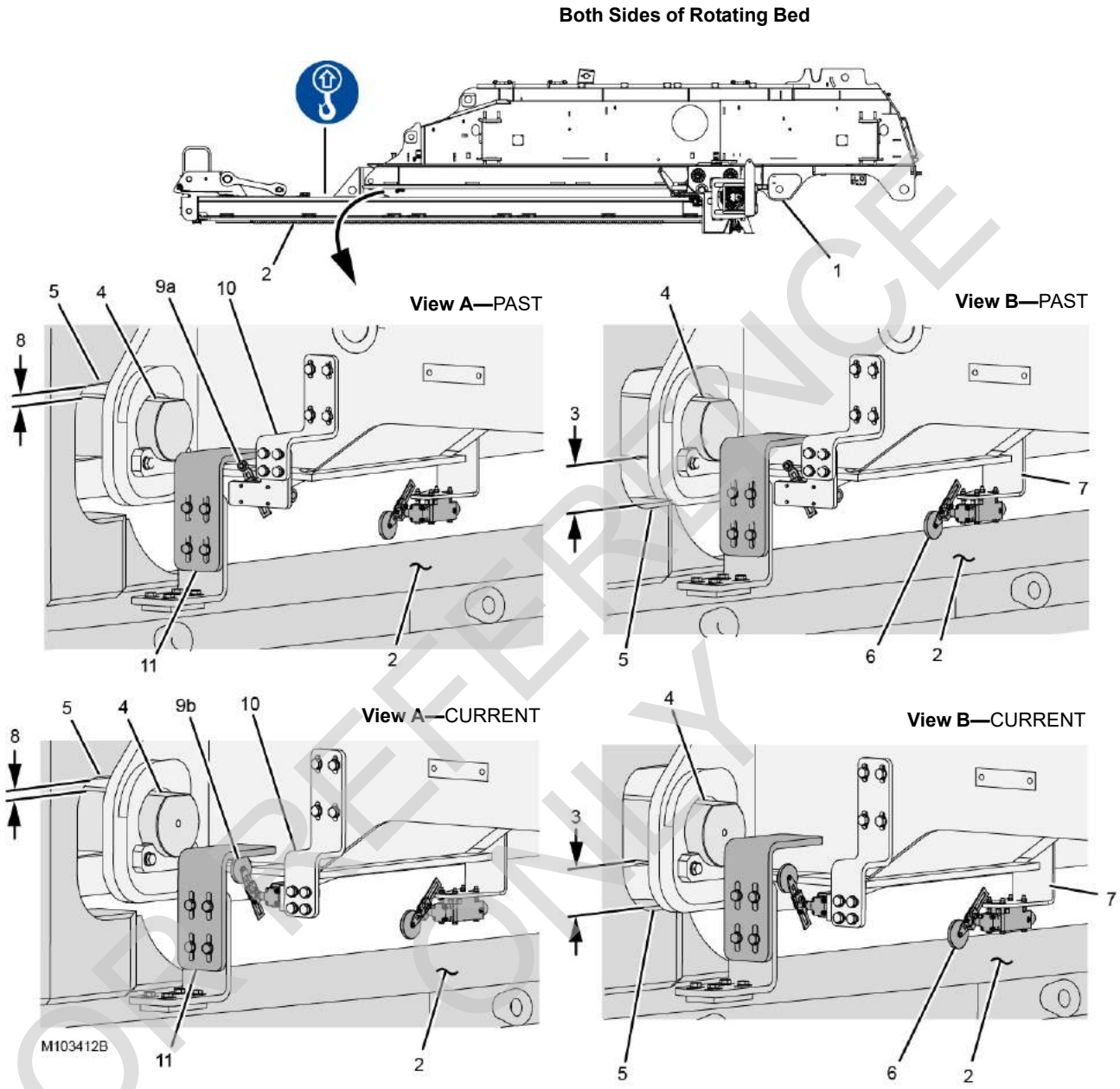
See View B, Figure 6-12 for the following procedure.

1. Slowly raise the VPC-MAX beam (2) with the assist crane to the dimension (3): 10 mm (13/32 in) between the underside of the rotating bed pins (4) and the bottom of the beam hooks (5).
2. At the specified dimension, both beam up limit switches (6) should trip (click) open. The beam up icons in Figure 6-9 on page 6-12 should be tripped.
3. If necessary, adjust the position of the brackets (7) so the beam up limit switches trip open at the specified dimension (3).
4. Securely tighten the bracket mounting bolts.

Adjusting the Beam-on-Hook Limit Switches

See Figure 6-12 for the following procedure.

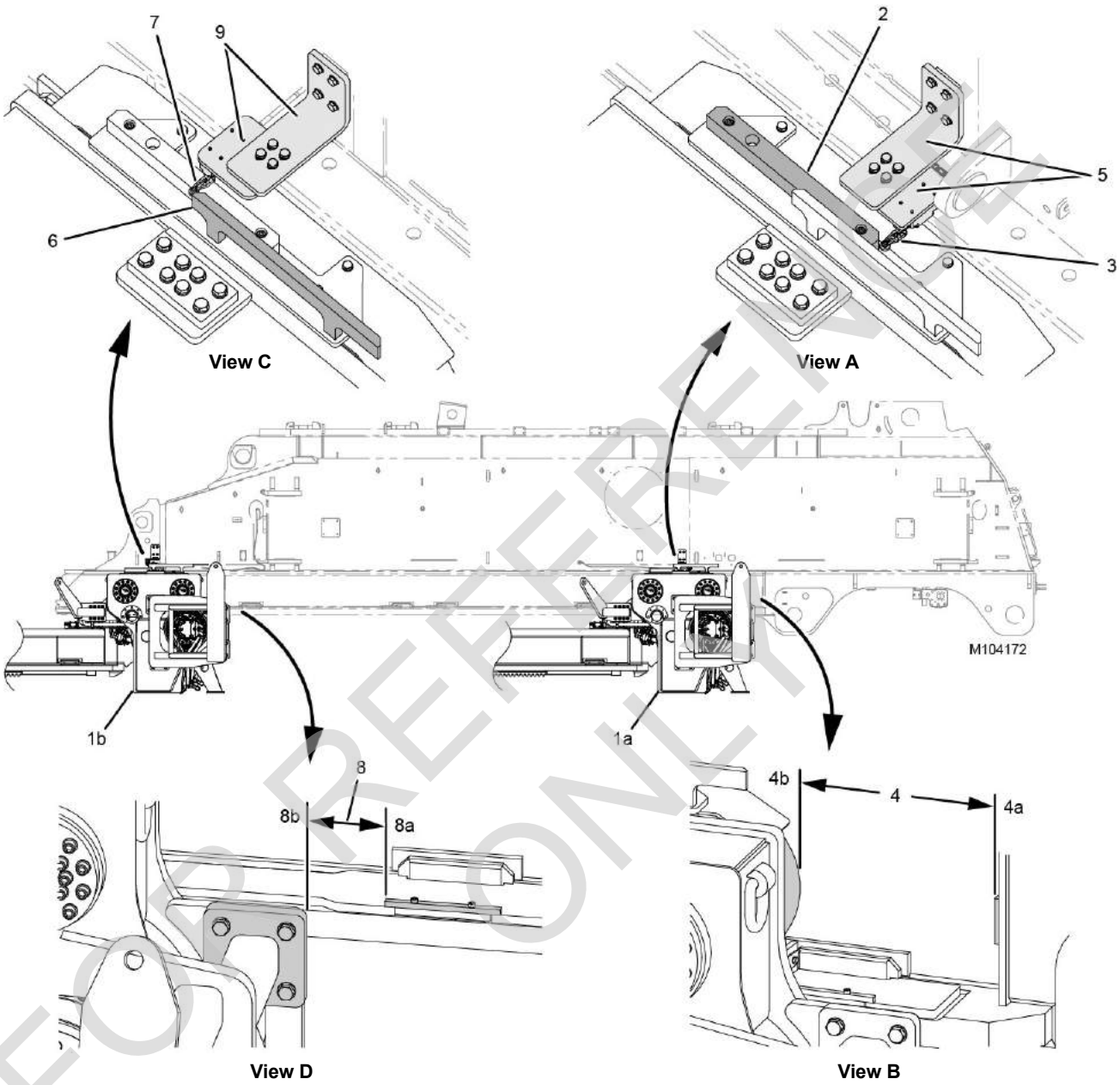
1. Slowly lower the VPC-MAX beam (2) with the assist crane to the dimension (8): 10 mm (13/32 in) between the top of the rotating bed pins (4) and the top of the beam hooks (5).
2. At the specified dimension, both beam-on-hook limit switches (9a or 9b) should trip (click) open. The beam-on-hook icons in Figure 6-9 on page 6-12 should be tripped.
3. If necessary, adjust the position of the brackets (10 or 11), so the beam-on-hook limit switches trip open at the specified dimension (7).
4. Securely tighten the bracket mounting bolts.



Item	Description
1	Rotating Bed
2	VPC-MAX Beam
3	10 mm (13/32 in)
4	Rotating Bed Pin (qty 2)
5	Beam Hook (qty 2)
6	Beam Up Limit Switch (qty 2)
7	Bracket
8	10 mm (1/4 in)
9a	Beam-on-Hook Limit Switch (qty 2) PAST
9b	Beam-on-Hook Limit Switch (qty 2) CURRENT
10	Bracket (qty 2)
11	Limit Switch Tripping Bracket (qty 2)

FIGURE 6-12

Right Side of Rotating Bed



Item	Description
1b	Beam OUT
6	Beam OUT Tripping Plate
7	Beam OUT Limit Switch
8	147 mm (5-25/32 in)
8a	Edge of Wear Pad Retainer
8b	Edge of Actuator Bracket
9	Limit Switch Brackets

Item	Description
1a	Beam IN
2	Beam IN Tripping Plate
3	Beam IN Limit Switch
4	409 mm (16-3/32 in)
4a	Edge of Physical Stop
4b	Edge of Actuator Roller
5	Limit Switch Brackets

FIGURE 6-13

Checking the Beam in and Out Limit Switches

See Figure 6-13 for the following procedure.

REMINDER: The rear of the VPC-MAX beam must be supported by pendants from the assist crane (Figure 6-10) so that the rotating bed pins are centered in the beam hooks.

1. Verify that both beam limit switch levers are installed parallel to the limit switch housings.
2. Using the remote control, travel the actuator IN until the beam IN tripping plate (2, View A) trips (clicks) open the beam IN limit switch (3).

   The trolley should be at the dimension (4, View B): 409 mm (16-3/32 in) between the physical stop (4a) and the actuator roller (4b).

   If necessary adjust the limit switch mounting brackets (5) so the limit switch trips open at the specified dimension.
3. In the main display (Figure 6-9 on page 6-12), the beam IN icon should be tripped.

   If the icon indicates that the limit switch is NOT TRIPPED, troubleshoot the electric control system and fix the problem.

   The actuator IN limit switch must TRIP open when it contacts the actuator IN tripping plate.
4. Using the remote control, travel the actuator OUT until the beam OUT tripping plate (6, View C) trips (clicks) open the beam OUT limit switch (7).

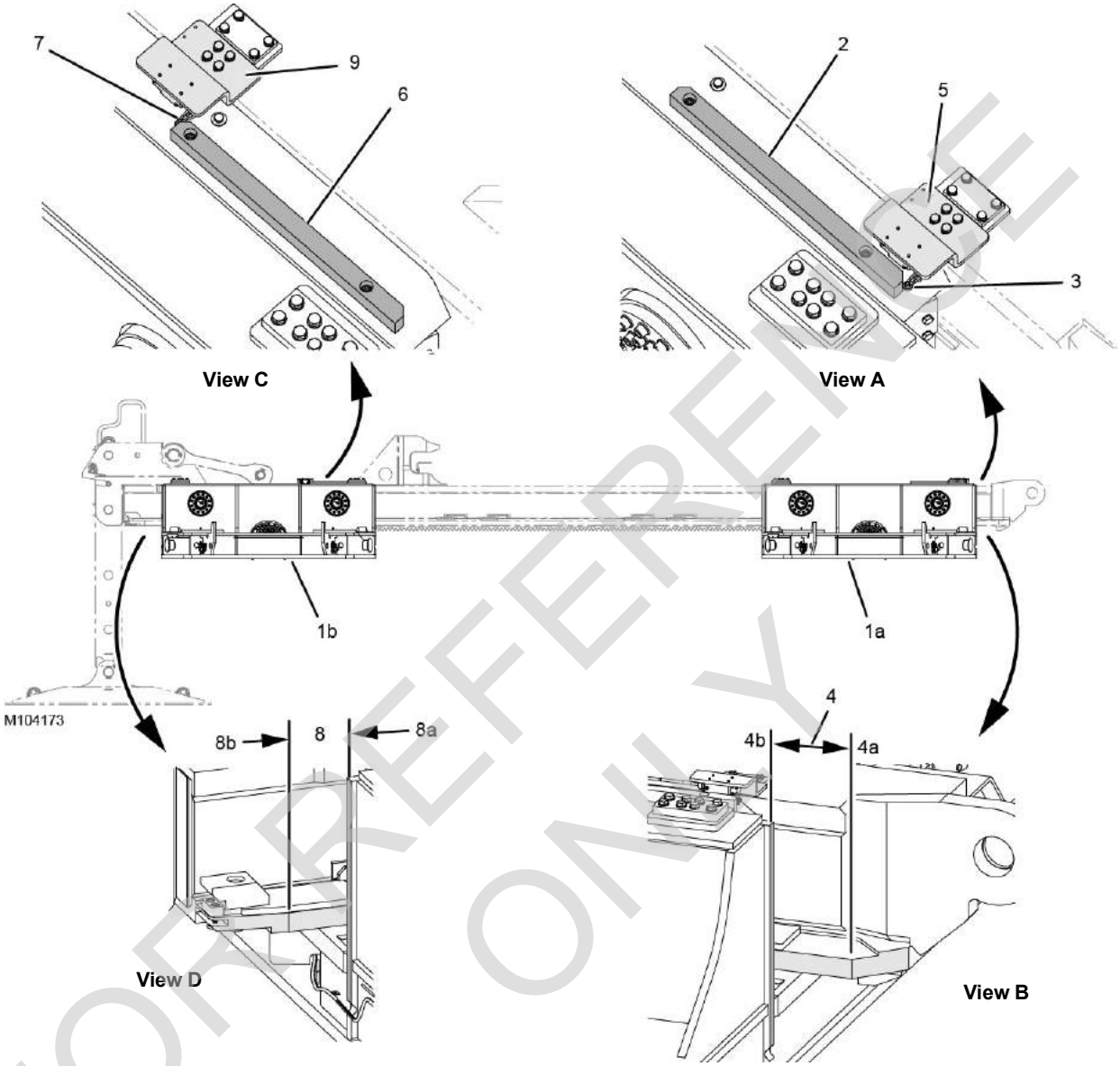
   The trolley should be at the dimension (8, View D): 147 mm (5-25/32 in) between the wear pad retainer (8a) and the actuator bracket (8b).

   If necessary adjust the limit switch mounting bracket so the limit switch trips open at the specified dimension.
5. In the main display (Figure 6-9 on page 6-12), the beam OUT icon should be tripped.

   If the icon indicates that the limit switch is NOT TRIPPED, troubleshoot the electric control system and fix the problem.

   The actuator OUT limit switch must TRIP open when it contacts the actuator OUT tripping plate.

Right Side of VPC-MAX Beam



Item	Description
1b	Tray OUT
6	Tray OUT Tripping Plate
7	Tray OUT Limit Switch
8	172 mm (6-25/32 in)
8a	Rear Edge of Tray
8b	Angled Edge of Roller Path
9	Limit Switch Bracket

Item	Description
1a	Tray IN
2	Tray IN Tripping Plate
3	Tray IN Limit Switch
4	235 mm (9-1/4 in)
4a	Angled Edge of Roller Path
4b	Front Edge of Tray
5	Limit Switch Bracket

FIGURE 6-14

Checking the Tray In and Out Limit Switches

See Figure 6-14 for the following procedure.

For this procedure, the actuator must be at the minimum working position (Figure 6-10) and the beam hooks must be resting on the pins.

1. Verify that both tray limit switch levers are installed perpendicular to the limit switch housings.
2. Using the remote control, travel the tray IN until the tray IN tripping plate (2, View A) trips (clicks) open the tray IN limit switch (3).

   The tray should be at the dimension (4, View B): 235 mm (9-1/4 in) between the angled edge of the roller path (4a) and the front edge of the tray (4b).

   If necessary adjust the limit switch mounting bracket (5) so the limit switch trips open at the specified dimension.
3. In the main display (Figure 6-9 on page 6-12), the tray IN icon should be tripped.

   If the icon indicates that the limit switch is NOT TRIPPED, troubleshoot the electric control system and fix the problem.

   The tray IN limit switch must TRIP open when it contacts the tray IN tripping plate.
4. Using the remote control, travel the tray OUT until the tray OUT tripping plate (6) trips (clicks) open the tray OUT limit switch (7).

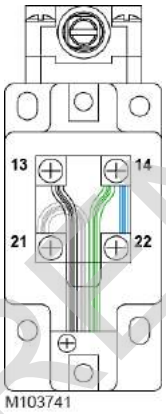
   The tray should be at the dimension (8, View B): 172 mm (6-25/32 in) between the rear edge of the tray (8a) and the angled edge of the roller path (8b).

   If necessary adjust the limit switch mounting bracket (9) so the limit switch trips open at the specified dimension.
5. In the main display (Figure 6-9 on page 6-12), the tray OUT icon should be tripped.

   If the icon indicates that the limit switch is NOT TRIPPED, troubleshoot the electric control system and fix the problem.

   The tray OUT limit switch must TRIP open when it contacts the actuator OUT tripping plate.

WIRING THE VPC-MAX LIMIT SWITCHES



Limit Switch Wiring

Wire Color	Switch Terminals		Function
Black	13		Normally Open
Green	14		Input
White	21		Normally Closed
Blue	14	22	Jumper

FIGURE 6-15

See Figure 6-15 for wiring of the following limit switches:

- Beam-on-Hook (qty 2)
- Beam Up (qty 2)
- Actuator IN
- Actuator OUT
- Tray IN
- Tray OUT

VPC AND VPC-MAX ROLLER PATH

Prior to using the crane each day, inspect the VPC and VPC-MAX roller paths on the rotating bed and the beam for obvious obstructions and/or signs of damage. Remove the obstructions. Contact the Manitowoc Crane Care Lattice Team for inspection and repair criteria.

THIS PAGE INTENTIONALLY LEFT BLANK

ALPHABETICAL INDEX