

Manitowoc MLC650

Operator Manual





WARNING



California Proposition 65

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

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

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

Do not modify or tamper with the exhaust system.

Do not idle the engine except as necessary.

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

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



California Spark Arrestor

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



OPERATOR MANUAL

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

MLC650

Crane Model Number

XXXXRef

Crane Serial Number

This Manual is divided into the following sections:


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

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
	<p>To prevent death or serious injury:</p> <ul style="list-style-type: none">• Avoid unsafe operation and maintenance. Crane and attachments must be operated and maintained by trained and experienced personnel. Manitowoc is not responsible for qualifying these personnel.• Do not operate or work on crane or attachments without first reading and understanding instructions contained in Operator Information Manual and Service Manual supplied with crane and applicable attachments.• Store Operator Information Manual and Service Manual in operator's cab. <p>If Operator Information Manual or Service Manual is missing from cab, contact your Manitowoc dealer for a new one.</p>

THE ORIGINAL LANGUAGE OF THIS PUBLICATION IS ENGLISH.

See end of this manual for Alphabetical Index

SECTION 1.	Introduction
Crane Data	1-1
Crane Weights	1-1
Outline Dimensions	1-1
Change of Ownership Registration	1-1
Manitowoc Dealer	1-1
Crane/Attachment Identification	1-1
Crane Orientation	1-1
Identification and Location of Components	1-2
VPC and VPC-MAX	1-4
English and Metric Conversions	1-4
Direct Conversion	1-4
Inverse Conversion	1-4
SECTION 2.	Safety Information
Continuous Innovation	2-1
Nameplates and Decals	2-1
Safety Messages	2-1
General	2-1
Safety Alert Symbol	2-1
Signal Words	2-1
Symbol Identification	2-1
Safety and Information Signs	2-3
Maintaining Signs	2-3
Ordering Signs	2-3
Crane Access Points	2-6
General	2-6
Getting On or Off Crane	2-6
Personal Fall-Protection	2-7
Operator Manual/Capacity Chart Storage	2-8
General	2-8
Storing Manuals	2-8
Safe Operating Practices	2-9
General	2-9
Read Operator Manual	2-9
Operator Qualifications	2-9
Operator Conduct	2-9
Handling Load	2-11
Signals	2-14
Safety Devices	2-15
Operational Aids	2-15
Category 1 Operational Aids	2-15
Category 2 Operational Aids	2-16
Assembling, Disassembling, or Operating Crane Near Electric Power and Transmission Lines	2-17
Electrocution Hazard	2-17
Set-Up and Operation	2-17
Electrocution Hazard Devices	2-18
Electrical Contact	2-18
Refueling	2-19
Fire Extinguishers	2-19
Accidents	2-19
Safe Maintenance	2-19
Maintenance Instructions	2-19
Safe Maintenance Practices	2-19
Environmental Protection	2-21

Boom Disassembly Safety 2-23
 General 2-23
 Location 2-23
 Pin Removal 2-23
 Disassembly Precaution 2-23
 Personnel Handling Policy 2-24
 Pedestal/Barge Mounted Cranes 2-25
 Pedestal Mounted Crane 2-26
 Barge Mounted Crane 2-26
 Capacity Charts for Barge Mounted Crane 2-27
 Shock Loading Caused by Barge Dynamics 2-27
 Operation on Barge 2-27
 Barge Mount Definitions 2-28
 Inspection of Barge-Mounted Crane 2-28
 Transporting Crane on Barge 2-28

SECTION 3 Operating Controls And Procedures

Standard Hand Signals for Controlling Crane Operations 3-2
 Symbols Used on Control Consoles 3-4
 Symbols Used on Remote Control 3-7
 Operating Controls 3-12
 Left Console 3-16
 Right Console 3-18
 Operation of Diverting Circuits 3-27
 Foot Pedals 3-28
 Seat Controls 3-29
 Climate Control Keypad 3-30
 Other Operator Aids 3-31
 Motion Warning Lights and Alarms 3-36
 Service Lights 3-38
 Remote Control Activation 3-40
 Remote Control Operation 3-42
 Operating Limits Identification and Operation 3-48
 Bypassing Limits in Luffing Jib Setup Mode 3-54
 Resetting Luffing Jib Limits 3-55
 Drum and Control Handle Identification 3-56
 Right Cab Window Operation 3-58
 Closing Window 3-58
 Opening Window For Ventilation 3-58
 Operator's Cab Emergency Exit 3-58
 Cab Door Adjustment 3-58
 Cab Tilt Adjustment 3-59
 Operating in Wind 3-59
 Crawler Blocking 3-60
 Intermediate Suspension 3-60
 Preparing Crane for Operation 3-60
 Startup Procedures 3-61
 Operating Procedures 3-65
 VPC Operation 3-65
 Boom Hoist Operation 3-66
 Luffing Hoist Operation 3-67
 Swing Operation 3-68
 Load Drum Operation 3-71
 Travel Operation 3-72
 Shutdown Procedure or Leaving the Crane Unattended 3-74
 Changing Counterweight with Boom/Jib In Air 3-75

VPC	3-75
VPC-MAX	3-75
Cold Weather Operation	3-77
Crane Limitations	3-77
Wire Rope	3-77
Cooling System	3-77
Batteries	3-77
Engine Oil, Gear Oil, and Hydraulic Oil	3-77
Cold Weather Heater Package	3-79
Turning Heaters ON	3-79
Turning Heaters OFF	3-79
AC Operation	3-81
Installing APU	3-81
Turning ON AC Powered Components	3-81
Turning OFF AC Powered Components	3-81
Removing APU	3-82

SECTION 4. Set-Up and Installation

Boom and Jib Assembly Drawings	4-1
Liftcrane Mast Handling Capacities	4-1
Optional Attachments	4-1
General Safety	4-1
Crane Orientation	4-1
Assembly and Disassembly Notes	4-1
Assembly And Disassembly Area	4-2
Accessing Parts	4-2
Retaining Connecting Pins	4-2
Crane Weights and Shipping Data	4-2
Personal Fall-Protection	4-3
Handling Components	4-3
Crane Assembly Components	4-5
Parts Box	4-5
Swing Limits	4-8
Hydraulic Hose Identification	4-10
Connecting/Disconnecting Hydraulic Hoses and Electric Cables	4-10
Hose and Cable Cleanliness	4-10
Pin and Connecting Hole Cleanliness	4-10
Tightening Hydraulic Couplers	4-10
Remote Control	4-12
Activating the Remote Control	4-13
Starting Engine with Remote Control	4-13
Rotating Bed Jacking Cylinders Function	4-13
Setup Mode	4-13
Identification and Location of Components	4-14
Crane Assembly	4-15
Remove Cab Window Covers	4-15
Perform Pre-Start Checks	4-17
Electric System	4-17
Hydraulic System	4-17
Gear Boxes	4-17
Deploy Operator Cab Platforms	4-19
Start Engine	4-19
Remove Rotating Bed from Trailer	4-23
Install Alignment Pendants	4-23
Deploy Rotating Bed Jacking Cylinders	4-23
Install Operator Cab Rear Platform	4-24
Install Operator Cab Ladder	4-25

Overview of Rotating Bed Platforms and Handrails	4-27
Deploy Rotating Bed Platforms	4-29
Install Platforms, Ladders and Handrails	4-31
Install Drum 3	4-33
Activate Auxiliary Hydraulic System	4-34
Connect Hand-Held Pin Puller	4-37
Install the Live Mast	4-38
Secure the Backhitch/Gantry Assemblies	4-41
Secure the Live Mast Hoist Drum	4-43
Disconnect the Live Mast Straps	4-43
Connect the Live Mast Hydraulic and Electrical	4-45
Activate Setup Mode	4-46
Raise Live Mast to Operating Position	4-46
Deploy the Self-Erect Cylinder	4-49
Use the Mast as a Boom	4-49
Connect Rotating Bed to Carbody	4-51
Installing Rotating Bed to Adapter Pins	4-53
Lower Crane onto Carbody Pedestals	4-54
Install Carbody Platforms	4-55
Install Carbody Ladders and Handrails	4-56
Store Front Rotating Bed Jacking Cylinders	4-58
Install Hydraulic Connections	4-59
Deploy Operator Cab (Working Position)	4-61
Install Platforms, Ladders, and Handrails	4-62
Install Crawlers	4-63
Install Crawlers (continued)	4-67
Store Rear Rotating Bed Jacking Cylinders	4-71
Install Drive Shafts	4-73
Install Counterweight Tray	4-75
Install the Hydraulic Hoses	4-79
Align the Counterweight Tray to the Pinions	4-79
Remove Counterweight Boxes from Trailer	4-81
Assemble Boom and Jib	4-81
Install Counterweight Boxes	4-81
Boom And Jib Rigging—General	4-86
Assist Crane Requirements	4-86
Blocked Crawlers	4-87
Boom Handling with Mast	4-87
Assembly Drawings	4-87
Identifying Boom and Jib Components	4-87
Handling Boom and Jib Sections	4-89
Boom Ladders	4-91
General	4-91
Removing Ladders from Insert	4-91
Installing Ladders on Boom Inserts	4-91
Storing Ladders in Insert	4-91
Boom Assembly	4-93
Assemble Boom Inserts and Top	4-93
Raise Boom Top Wire Rope Guide	4-103
Install/Remove Lower Boom Point	4-105
Install Position Light and Wind Speed Indicator	4-107
Connect Boom Straps	4-109
Install Upper Boom Point	4-111
Connect Terminator/Shorting Plugs at Boom Top	4-111
Prepare 4M Insert	4-115
Raise Wire Rope	4-115
Connect 4M Insert to Boom Butt	4-117

Lower Carbody Platform	4-117
Connect Boom Butt to Crane	4-119
Lower Boom Butt and 4M Insert	4-121
Raise Carbody Platform	4-121
Connect Hydraulic Hoses from Crane to Boom Butt	4-123
Connect Electric Cables from Boom Butt to Crane	4-123
Connect 4M to Boom	4-125
Connect Mast Straps to Boom Straps	4-127
Deactivate Setup Mode	4-127
Connect Camera and Electric Cables	4-129
Install the Boom Load Lines	4-131
Install the Boom Block-Up Limit Components	4-131
Prepare Intermediate Suspension Pendants	4-133
Raise Boom	4-134
Pre-Raising Checks	4-134
Boom Raising Procedure	4-134
Shipping Crane Components	4-135
Crane Disassembly	4-136
Preparing Crane	4-136
Lowering Boom	4-136
Removing Block-Up Limit Components	4-136
Storing the Load Lines	4-136
Removing Boom Top Cameras	4-136
Disconnecting Boom Butt Electric Cables	4-136
Disconnecting Boom Butt Hydraulic Hoses	4-136
Activating Setup Mode	4-139
Disconnecting Mast Straps from Boom Straps	4-139
Lowering Carbody Platform	4-139
Disconnecting Boom from 4M Insert	4-141
Deploying Self-Erect Cylinder	4-141
Removing Boom Butt and 4M	4-142
Separating 4M Insert from Boom Butt	4-145
Lowering the Wire Rope Guide	4-145
Loading Boom Butt	4-146
Raising Carbody Platform	4-146
Disassembling Boom	4-147
Removing Counterweight Boxes	4-148
Preparing Counterweight Tray for Removal	4-150
Disconnecting Counterweight Tray Hydraulics and Electrical Wiring	4-151
Removing Counterweight Tray	4-153
Removing Carbody Platforms	4-155
Disconnecting and Storing Drive Shafts	4-157
Deploying Rear Rotating Bed Jacking Cylinders	4-159
Removing First Crawler (continued)	4-163
Removing Second Crawler	4-165
Disconnecting Carbody from Rotating Bed	4-167
Disconnecting Hydraulic Hoses	4-168
Storing Self-Erect Cylinder	4-171
Securing Live Mast, Gantry, and Backhitch	4-173
Removing Drum 3	4-175
Disconnecting Live Mast Hydraulics and Electrical Connectors	4-177
Removing Live Mast	4-177
Removing Rotating Bed Handrails and Rear Platform	4-181
Removing Front Platform and Ladders From Rotating Bed and Cab	4-182
Storing Rotating Bed Platforms	4-184
Moving Operator Cab (Shipping Position)	4-186
Removing Operator Cab Ladder	4-187

Removing Operator Cab Rear Platform	4-188
Storing Operator Cab Front Platform	4-189
Securing Operator Cab	4-190
Extending Rotating Bed Jacking Cylinders	4-191
Lowering Rotating Bed Jacking Cylinders	4-193
Installing Cab Window Covers (If Equipped)	4-194
Wire Rope Installation	4-195
Wire Rope Specifications	4-195
Wire Rope Storage	4-195
Seizing and Cutting Wire Rope	4-195
Anchoring Wire Rope to Drum	4-196
Winding Rope onto Drum	4-196
Anchoring Wire Rope to Wedge Socket	4-199
Anchoring Wire Rope to Button Socket	4-199
Pad Eye Usage for Wire Rope Reeving	4-201
Breaking in Wire Rope	4-201
Rigging Winch Operation	4-202
Selecting Rigging Winch Mode	4-202
Operating Rigging Winch	4-203
Load Line Reeving	4-205
Guide Sheaves and Drums	4-205
Load Block Identification	4-205
Duplex Hook	4-205
Wire Rope Specifications	4-206
Load Block Reeving	4-206
Dead End Locations	4-206
SECTION 5	Lubrication
Lubrication	5-1
Lube and Coolant Product Guide	5-1
SECTION 6	Maintenance Checklist
Inspection and Maintenance Checklist	6-1
Fiberglass Maintenance	6-1

SECTION 1 INTRODUCTION

TABLE OF CONTENTS

Crane Data	1-1
Crane Weights	1-1
Outline Dimensions	1-1
Change of Ownership Registration	1-1
Manitowoc Dealer	1-1
Crane/Attachment Identification	1-1
Crane Orientation	1-1
Identification and Location of Components	1-2
VPC and VPC-MAX	1-4
English and Metric Conversions	1-4
Direct Conversion	1-4
Inverse Conversion	1-4

FOR REFERENCE ONLY

THIS PAGE INTENTIONALLY LEFT BLANK

FOR REFERENCE ONLY

SECTION 1 INTRODUCTION

CRANE DATA

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

- Basic Specifications
- EC Declaration (if applicable)

CRANE WEIGHTS

See the end of this section for crane weights.

OUTLINE DIMENSIONS

See the end of this section for outline dimensions.

CHANGE OF OWNERSHIP REGISTRATION

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

1. Go to www.manitowoccranes.com.
2. Go to Parts & Service > Service Support > Change of Ownership Form.
3. Complete the form.

MANITOWOC DEALER

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

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

CRANE/ATTACHMENT IDENTIFICATION

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

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

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

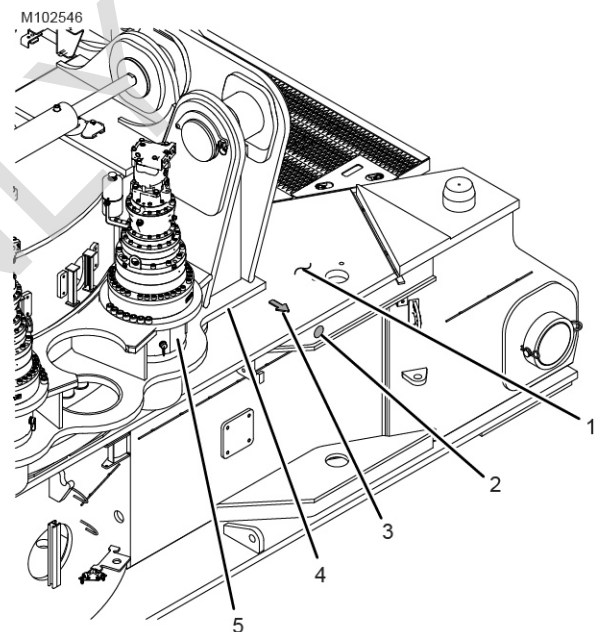


Figure 1-1. Identification Plate

CRANE ORIENTATION

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

- The swing drives are on the front of the adapter frame.
- 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 (see [Figure 1-2](#)) indicates the FRONT of the lowerworks.



Item	Description
1	Carbody
2	Yellow Dot on Front of Carbody
3	Arrow on Front of Carbody
4	Front of Rotating Bed
5	Swing Drives

Figure 1-2. Crane Orientation

IDENTIFICATION AND LOCATION OF COMPONENTS

Item	Description	Item	Description
1	Live Mast Sheaves	14	Adapter Frame / Rotating Bed Pin Puller
2	Self-Erect Cylinder (optional)	15	Crawler Drive
3	Live Mast Links/Straps	16	Crawler Shoe
4	Live Mast Hoist (Drum 4)	17	Intermediate Roller
5	Mast Assist Cylinder	18	Turntable Bearing
6	Fuel Tank	19	Adapter Frame
7	Whip Hoist (Drum 3)	20	Crawler Tensioning Assembly
8	Boom Stop Switch	21	Adapter Frame/Rot Bed Pin
9	Operator Cab	22	Rotating Bed Jacking Cylinders (optional)
10	Front Roller	23	Outrigger Pad (optional)
11	Carbody / Crawler Pin	24	Counterweight Tray
12	Boom Hinge Pin	25	Counterweight Box
13	Swing Drive	26	Counterweight Drive
		27	Counterweight Tray Roller
		28	Backhitch
		29	Gantry
		30	Live Mast

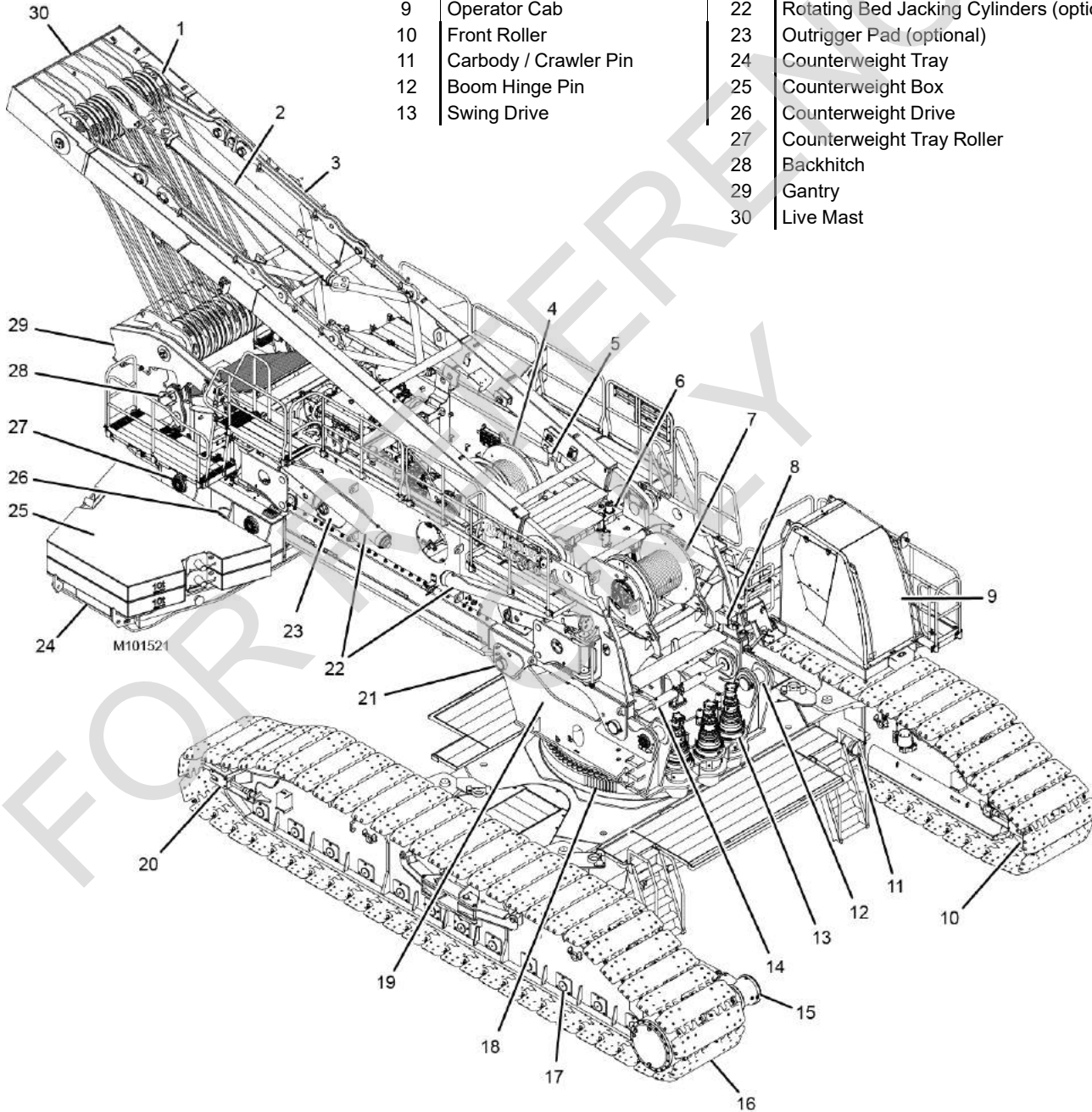


Figure 1-3. Component Identification

Item	Description
30-35	Not Used
36	Batteries (rear of rotating bed)
37	DEF Exhaust System
38	Air Intake
39	Pump Drive and Hydraulic Pumps
40	Hydraulic Tank
41	Engine with Pump Drive Disconnect
42	Cooler (coolant, hydraulic oil, charge air)

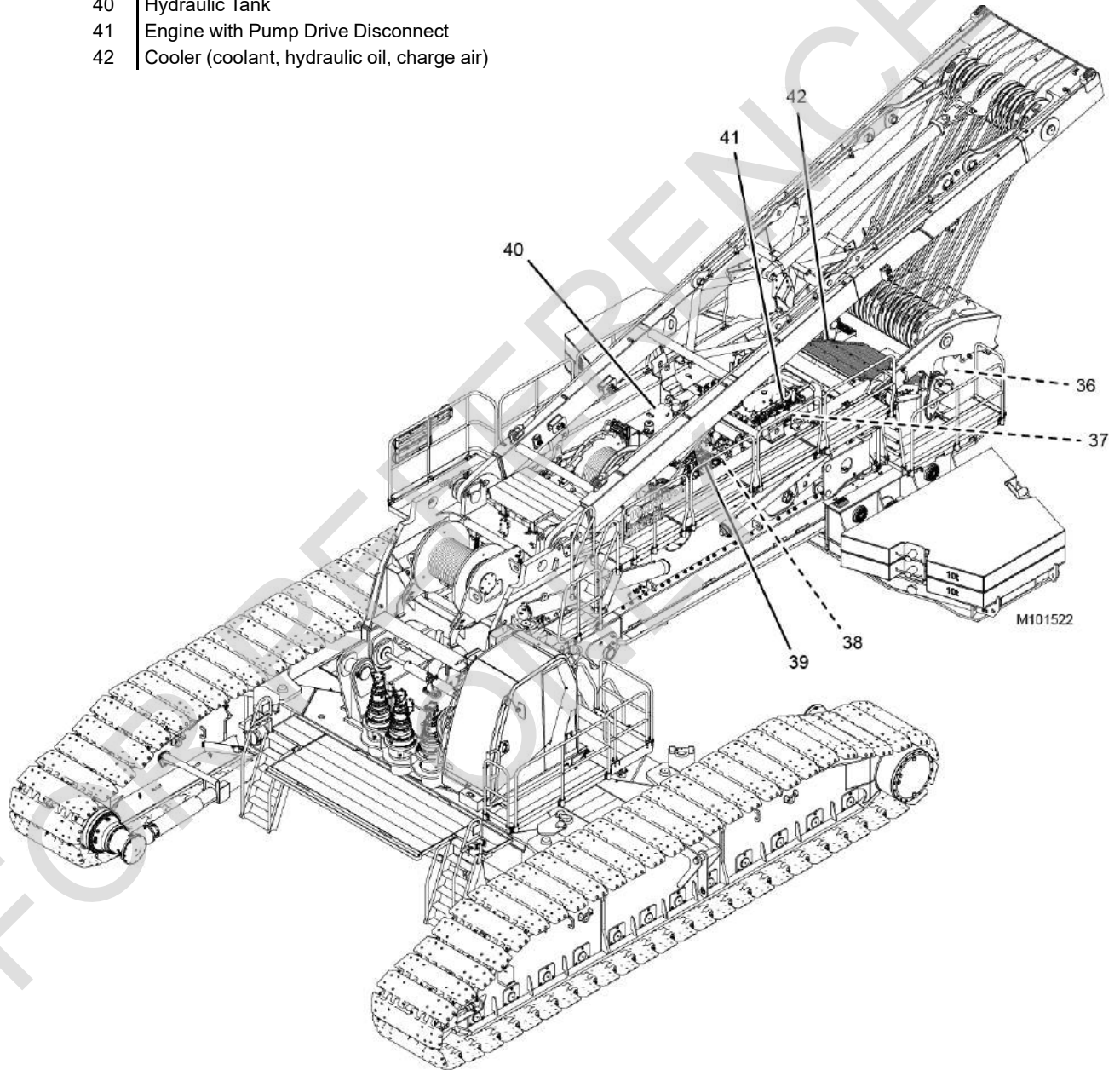


Figure 1-3 continued

VPC AND VPC-MAX

VPC™ and VPC-MAX™ are registered trademarks.

ENGLISH AND METRIC CONVERSIONS

Direct Conversion

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

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

Inverse Conversion

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

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

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

To Convert	Symbol	Application	To	Symbol	Multiply By
Cubic Inch	in ³	Pump Displacement	Cubic Centimeter	cm ³	16.3871
VOLUME (LIQUID)					
Ounce	oz	Fluid Capacities	Milliliter	mL	29.5735
Pint	pt		Liter	L	0.4732
Quart	qt		Liter	L	0.9464
Gallon	gal		Liter	L	3.7854
Gallon Per Minute	gpm	Pump Flow	Liters Per Minute	L/min	3.7854
WEIGHT					
Pound	lb	Unit/Component	Kilogram	kg	0.4536
Ton (2,000 lb.)	USt	Load Ratings	Metric Ton	t	0.9072
Ton (2,000 lb.)	USt		Kilogram	kg	907.1847

THIS PAGE INTENTIONALLY LEFT BLANK

FOR REFERENCE ONLY

SECTION 2

SAFETY INFORMATION

TABLE OF CONTENTS

Continuous Innovation	2-1
Nameplates and Decals	2-1
Safety Messages	2-1
General	2-1
Safety Alert Symbol	2-1
Signal Words	2-1
Symbol Identification	2-1
Safety and Information Signs	2-3
Maintaining Signs	2-3
Ordering Signs	2-3
Crane Access Points	2-6
General	2-6
Getting On or Off Crane	2-6
Personal Fall-Protection	2-7
Operator Manual/Capacity Chart Storage	2-8
General	2-8
Storing Manuals	2-8
Safe Operating Practices	2-9
General	2-9
Read Operator Manual	2-9
Operator Qualifications	2-9
Operator Conduct	2-9
Handling Load	2-11
Size of Load	2-11
Attaching Load	2-11
Lifting/Moving Load	2-12
Multiple Load Line Operation	2-13
Holding Load	2-14
Signals	2-14
Safety Devices	2-15
Operational Aids	2-15
Category 1 Operational Aids	2-15
Category 2 Operational Aids	2-16
Assembling, Disassembling, or Operating Crane Near Electric Power and Transmission Lines	2-17
Electrocution Hazard	2-17
Set-Up and Operation	2-17
Electrocution Hazard Devices	2-18
Electrical Contact	2-18
Refueling	2-19
Fire Extinguishers	2-19
Accidents	2-19
Safe Maintenance	2-19
Maintenance Instructions	2-19
Safe Maintenance Practices	2-19
Environmental Protection	2-21
Boom Disassembly Safety	2-23
General	2-23
Location	2-23
Pin Removal	2-23
Disassembly Precaution	2-23
Personnel Handling Policy	2-24

Pedestal/Barge Mounted Cranes	2-25
Pedestal Mounted Crane	2-26
Definition	2-26
Examples	2-26
Barge Mounted Crane	2-26
Definition	2-26
Examples	2-26
Capacity Charts for Barge Mounted Crane	2-27
Shock Loading Caused by Barge Dynamics	2-27
Operation on Barge	2-27
Barge Mount Definitions	2-28
Inspection of Barge-Mounted Crane	2-28
Transporting Crane on Barge	2-28

FOR REFERENCE ONLY

SECTION 2

SAFETY INFORMATION



WARNING

California Proposition 65

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

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

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

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





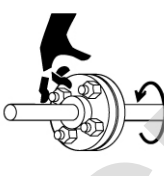


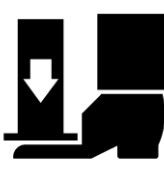












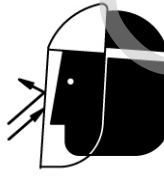









Cut or Crush Hazards					Cut Hazard
 M100090	 M100091	 M100066	 M100065	 M100069	 M100067
Crush Hazards					Fire Extinguisher
 M100070	 M100071	 M100072	 M100073	 M100074	 M100082
Fall Hazards			Falling Boom (Crush) Hazards		Explosion Hazard
 M100083	 M100084	 M100085	 M100068	 M100075	 M100080
Falling Load Hazards		Flying Objects Hazards			Overhead Obstruction Hazard
 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








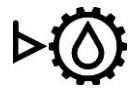

Emergency Cab Exit				
 M102486				

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.

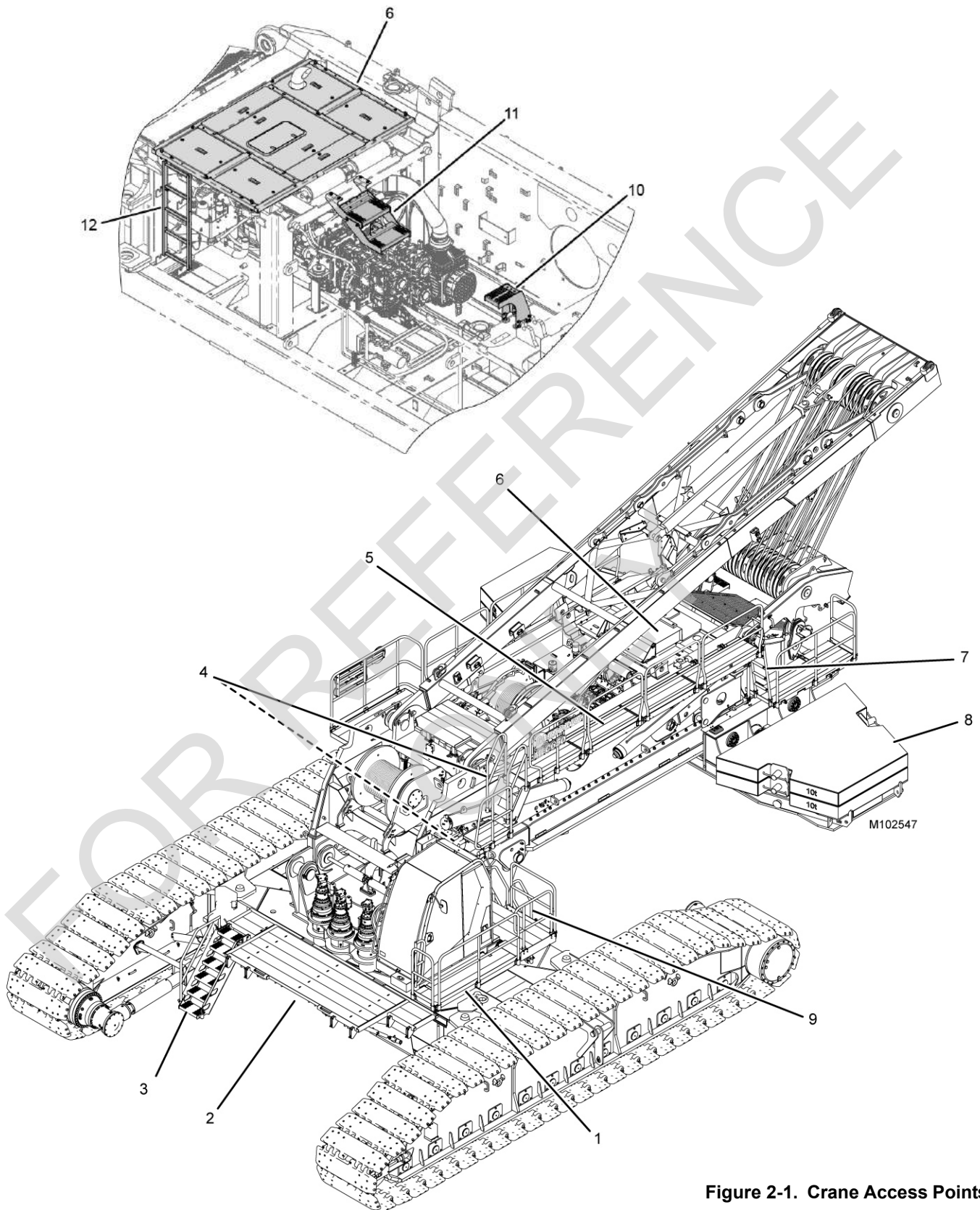


Figure 2-1. Crane Access Points

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	Step
11	Steps
12	Ladder with Snap Pin (two positions to provide personnel with clearance in the engine area)
13	Catwalk (each boom section)
14	Ladder (each boom section)

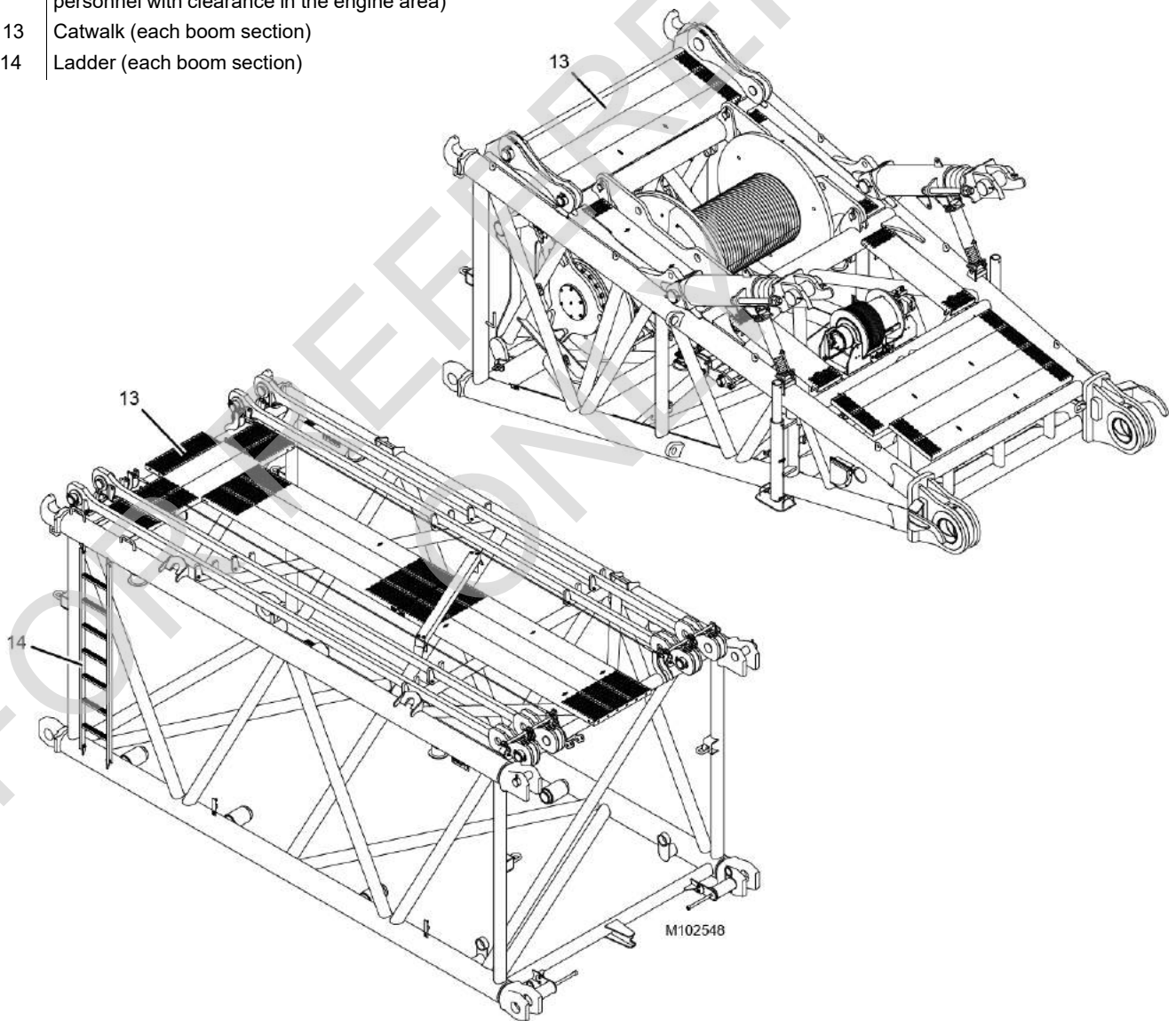


Figure 2-1 continued

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 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 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

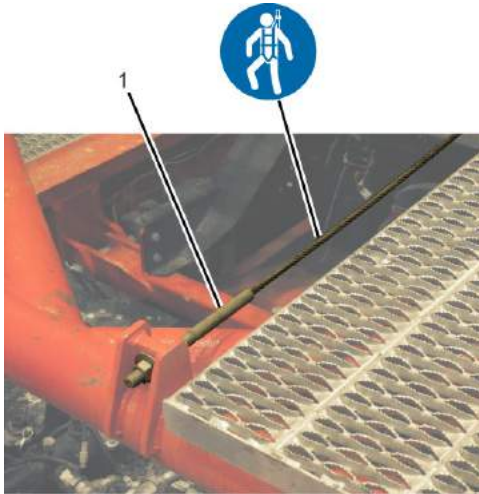
Personnel getting on and off the crane shall do so only at the ladders provided and only **while the crane is parked**.

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.**

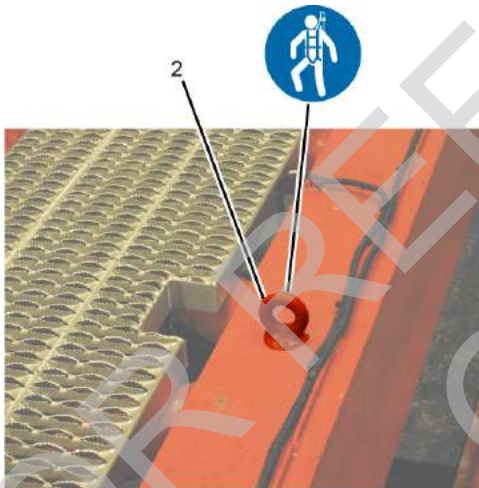
When personnel use ladders to get on or off the crane, their hands shall be free of any objects. Objects which cannot be carried in pockets or tool belts must be lifted into place with a hand line or hoist.

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

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.

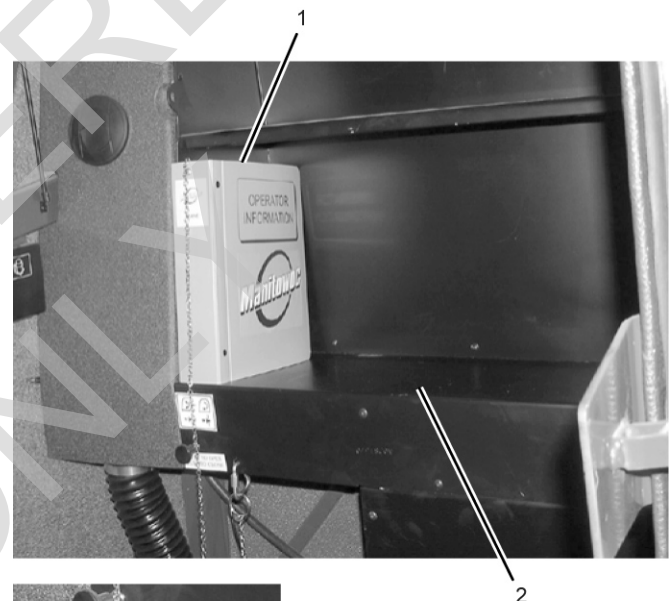
Do not operate crane or attachment if proper Capacity Chart is not in cab.

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.



M101903

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

The Operator Manual shall be read to personnel who 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 shall be limited to the crane functions needed to perform the

inspection or to verify the crane's performance after maintenance procedures

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

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

Operator training and qualification is crane owner's responsibility.

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

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

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

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

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

Operator Conduct

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

4. The operator shall be thoroughly familiar with operation of the crane and its proper care. If adjustments or repairs are necessary or if there are known defects that impair safe operation, the crane must not be operated until unsafe conditions have been corrected.
5. If there is a warning sign at the start controls, the operator shall not start the engine until the warning sign has been removed by the person who installed it.
6. Before starting the engine, the operator shall make sure that:
 - a. All daily inspection and maintenance services have been performed.
 - b. All controls are in 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.
10. The operator shall verify that the Capacity Chart being used is the correct one for the cranes configuration (boom length, load line reeving, counterweight, etc.).
11. The operator shall verify that:
 - a. All attachments are properly assembled and attached to the crane according to the rigging drawings called for in the Capacity Chart.
 - b. The counterweight — to include applicable auxiliary counterweight — is in place and of proper weight. **Maximum required counterweight shall not be exceeded.**

**WARNING**

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

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

- See Size of Load later in this section.
 - For a description of each safety device and operational aid, see Safety Devices and Operational Aids in this section and Section 3 of this manual.
7. The operator shall test all controls, limits, and communication systems at the start of each shift. Any defects found shall be corrected before operation is begun.
 8. The operator must 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.**

**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 shall 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 shall 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 and, if equipped, drum pawls engaged).
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 shall be blocked or cribbed before personnel are allowed to work under or between them.
 - j. Before lifting a load which requires the use of outriggers (or anytime outriggers are used), fully extend the outrigger beams and jacks so the truck tires do not bear any load.

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

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

Wood blocking or steel plates used under the jack pads or floats must be:
 - Free of defects
 - Strong enough to prevent crushing, bending, or shear failure
- k. All personnel are clear of the swing radius of the crane's counterweight.

- 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 shall be in accordance with the designated person's decision.

- m. Do not lower the load or the boom to a point where less than three full wraps of wire rope 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 shall be in accordance with the designated person's decision.
- b. Maintain specified tire pressures (truck cranes).
- c. Avoid sudden starts and stops. Use taglines or other restraints to control the position of the load.

Multiple Load Line Operation



WARNING

Avoid Over Load and Side Load Damage to Crane

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

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

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

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

SAFETY DEVICES



WARNING

Do not operate 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 shall 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 shall not be used.

Manitowoc provides the following safety devices on its cranes.

1. Horn activated by a switch on the control console in the operator's cab
If the horn is not working properly, it must be tagged-out or removed if possible.
2. Crane level indicator: either electronic (viewable in crane's electronic display) or mechanical (viewable from operator's cab seat). If the crane level indicator is not working properly, it must be tagged-out or removed, if possible.
3. Cranes operating on a barge require: a trim indicator, a swing brake, and a wind direction indicator if the wind is a factor (supplied by crane owner or user).
4. Boom stops, both physical and automatic
If a boom stop is damaged or not working properly, it must be tagged-out or removed if possible.
5. Jib stops, both physical and automatic (for fixed jib and luffing jib)
If a jib stop is damaged or not working properly, it must be tagged-out or removed if possible.
6. Pedal locks for all foot-operated brakes (if applicable)
If a pedal lock is damaged or not working properly, it must be tagged-out or removed if possible.
7. An integral holding device or check valve on each jacking cylinder

OPERATIONAL AIDS



WARNING

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

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

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

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

Category 1 Operational Aids

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

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

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

Temporary alternative measures if inoperative or malfunctioning:

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

- a. Measure radius using a tape measure.
- b. Measure the boom angle with a protractor-level on the centerline of boom.
- c. Clearly mark the boom or luffing hoist cable (so it can easily be seen by the operator) at a point that gives the operator sufficient time to stop the boom or jib within the minimum allowable radius.

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

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

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

2. Anti-Two-Block Device

Temporary alternative measures if inoperative or malfunctioning:

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

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

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

Category 2 Operational Aids

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

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

1. Rated Capacity Indicator/Limiter

Temporary alternative measures if inoperative or malfunctioning:

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

The weight of the load shall 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.

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 shall 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.

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

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

REFUELING

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

FIRE EXTINGUISHERS

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

ACCIDENTS

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

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

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

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

SAFE MAINTENANCE



WARNING

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

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

Maintenance Instructions

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

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

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

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

Safe Maintenance Practices

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

- f. Place a warning sign at the start controls alerting other personnel that 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.

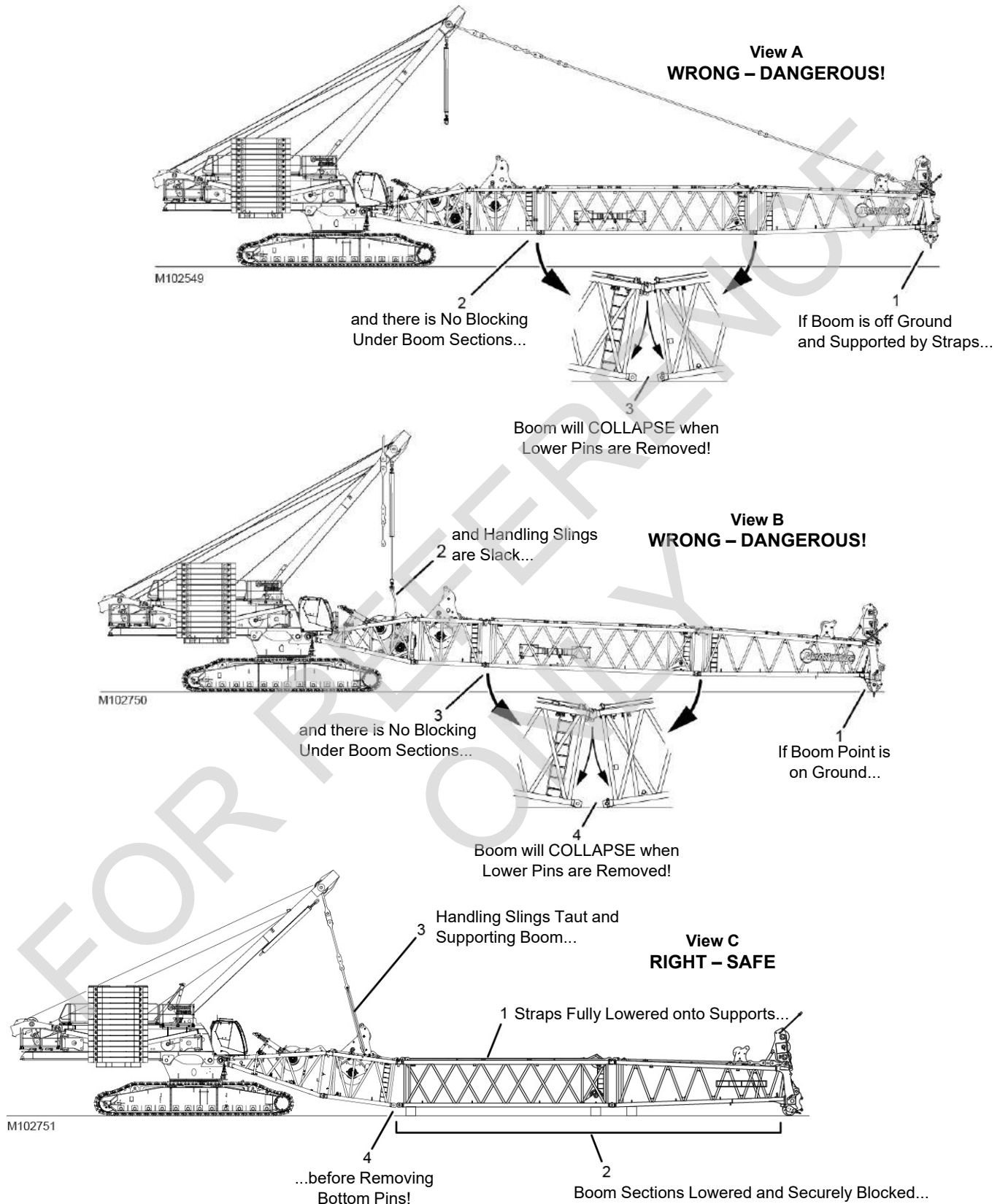


Figure 2-4. Boom Disassembly

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.**

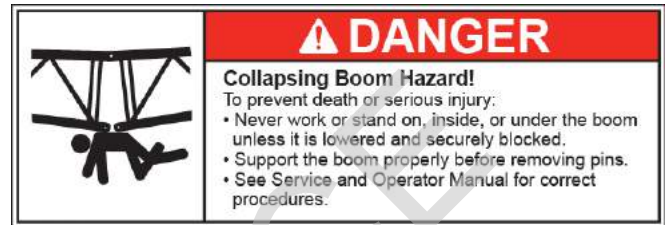
Location

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.



M101904

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 shall 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 shall be

engaged when the occupied personnel platform is in a stationary position.

- The crane must be equipped with a boom angle indicator that is visible to the crane operator.
- The crane must be equipped with boom hoist limiting device.
- If the luffing jib is used for hoisting personnel, the crane must be equipped with a luffing jib angle indicator that is visible to the crane operator.
- If the luffing jib is used for hoisting personnel, the crane must be equipped with a luffing hoist limiting device.
- The crane is equipped with a positive acting device which prevents contact between the load block or overhaul ball and the boom tip (anti-two-block device).

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

Free fall of the hoist line is prohibited.

- The Operator Manual is in the cab, readily accessible to the operator.
 - The crane's load Capacity Chart is affixed inside the crane cab, readily accessible to the operator. The total weight of the loaded personnel platform and related rigging must not exceed 50 percent of the rated capacity for the radius and configuration of the crane.
 - The crane is uniformly level within one percent of level grade and located on a firm footing. Some Capacity Charts require more stringent levelness criteria.
- Cranes with outriggers or stabilizers must have them all extended and locked. All outriggers or stabilizers must be extended equally in accordance with the Capacity Charts and operating procedures.
- Handling personnel from a platform suspended by wire rope from a luffing jib is acceptable, but only when it is not possible to accomplish the task using a less hazardous means. The crane user and operator shall take into account hazards that may be present when using a luffing jib.
 - Direct attachment of a personnel platform to a luffing jib is prohibited.
 - The platform meets the requirements as prescribed by applicable standards and regulations.
 - Applicable personal protection equipment is provided (for example, personal fall-protection system).

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

For operation outside the United States, the requirements of the applicable national, state and local regulations and safety codes shall 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).

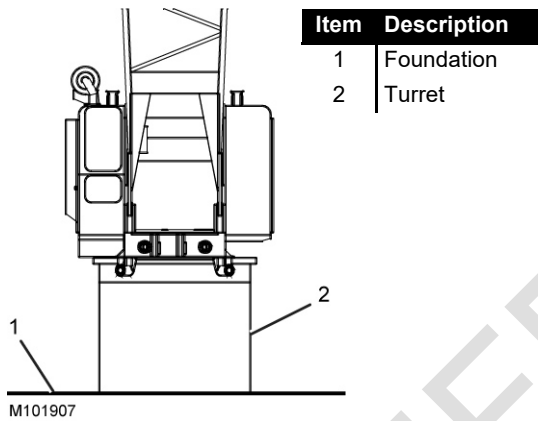


Figure 2-6. Turret-Mounted Crane

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.

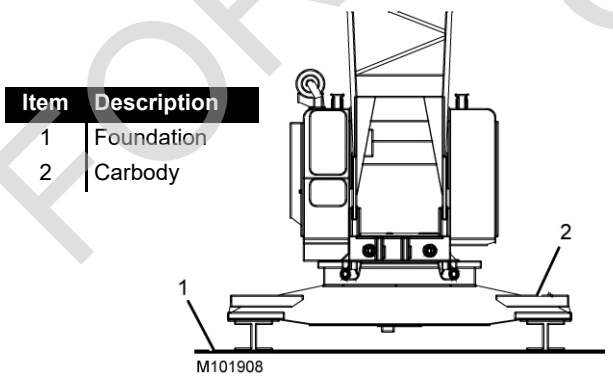


Figure 2-7. Carbody-Mounted Crane

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).

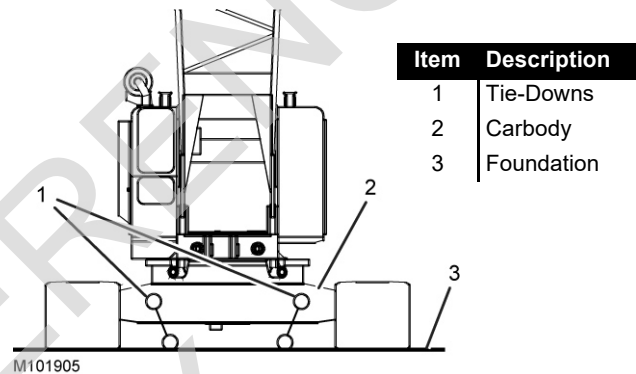


Figure 2-8. Crawler-Mounted Crane

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.

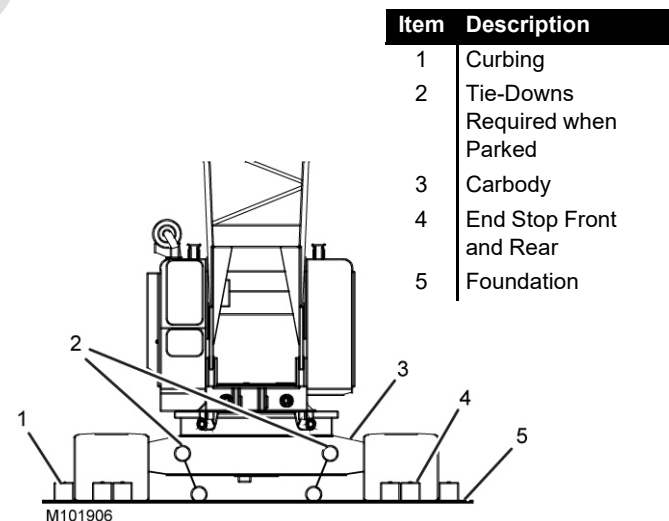


Figure 2-9. Crawler-Mounted Crane

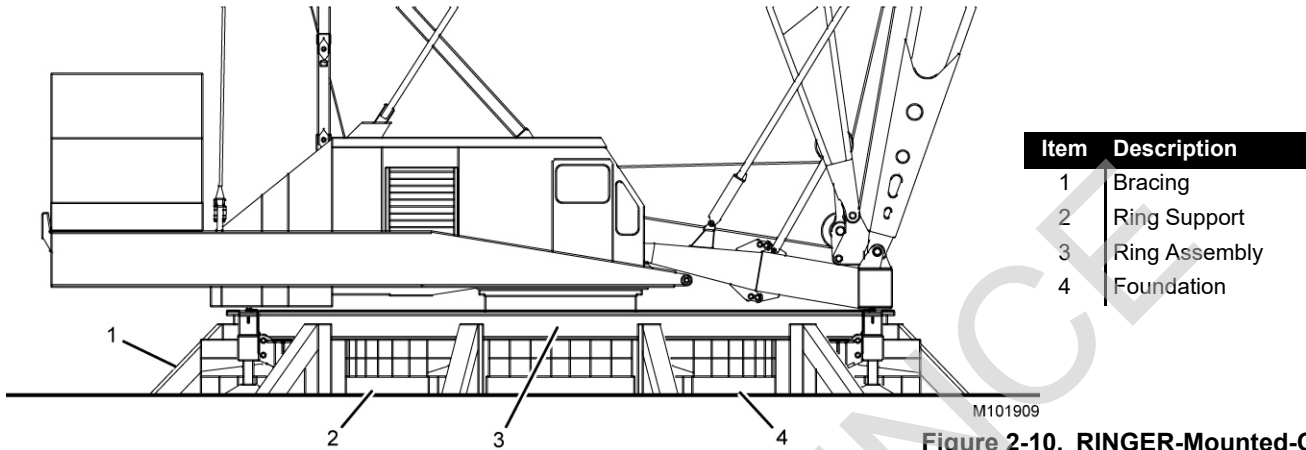
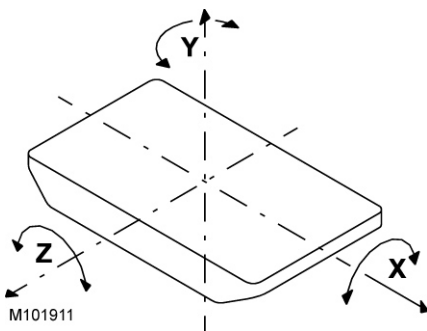


Figure 2-10. RINGER-Mounted-Crane



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.

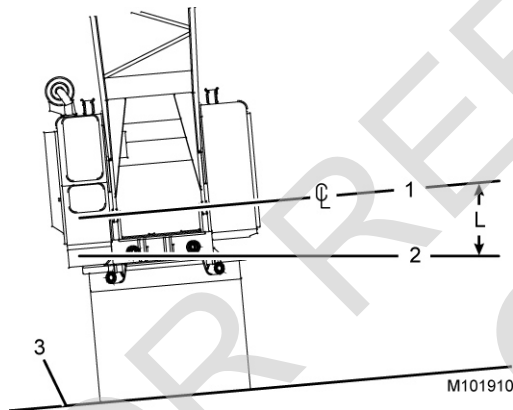
**WARNING****Tipping Crane Hazard!**

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

Standard Hand Signals for Controlling Crane Operations	3-2
Symbols Used on Control Consoles	3-4
Symbols Used on Remote Control	3-7
Operating Controls	3-12
Left Console	3-16
Right Console	3-18
Operation of Diverting Circuits	3-27
Foot Pedals	3-28
Seat Controls	3-29
Climate Control Keypad	3-30
Other Operator Aids	3-31
Boom Angle Indicator	3-31
Crane Capacity Beacons	3-31
Upperworks Level	3-31
Crane Cameras	3-34
Crane Camera Monitor	3-35
Motion Warning Lights and Alarms	3-36
Service Lights	3-38
Remote Control Activation	3-40
Remote Control Operation	3-42
Operating Limits Identification and Operation	3-48
Bypassing Limits in Luffing Jib Setup Mode	3-54
Resetting Luffing Jib Limits	3-55
Drum and Control Handle Identification	3-56
Right Cab Window Operation	3-58
Closing Window	3-58
Opening Window For Ventilation	3-58
Operator's Cab Emergency Exit	3-58
Cab Door Adjustment	3-58
Cab Tilt Adjustment	3-59
Operating in Wind	3-59
Crawler Blocking	3-60
Intermediate Suspension	3-60
Preparing Crane for Operation	3-60
Startup Procedures	3-61
Operating Procedures	3-65
VPC Operation	3-65
Boom Hoist Operation	3-66
Luffing Hoist Operation	3-67
Swing Operation	3-68
Load Drum Operation	3-71
Travel Operation	3-72
Shutdown Procedure or Leaving the Crane Unattended	3-74
Changing Counterweight with Boom/Jib In Air	3-75
VPC	3-75
VPC-MAX	3-75
Cold Weather Operation	3-77
Crane Limitations	3-77
Wire Rope	3-77
Cooling System	3-77
Batteries	3-77



Engine Oil, Gear Oil, and Hydraulic Oil	3-77
Cold Weather Heater Package	3-79
Turning Heaters ON	3-79
Turning Heaters OFF	3-79
AC Operation	3-81
Installing APU	3-81
Turning ON AC Powered Components	3-81
Turning OFF AC Powered Components	3-81
Removing APU	3-82

FOR REFERENCE ONLY

SECTION 3
OPERATING CONTROLS AND PROCEDURES




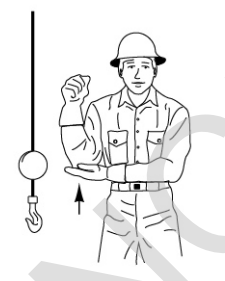
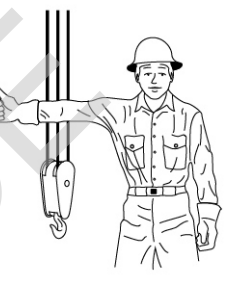

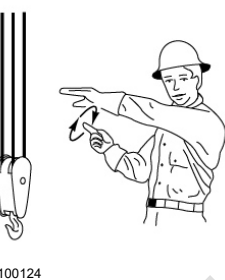

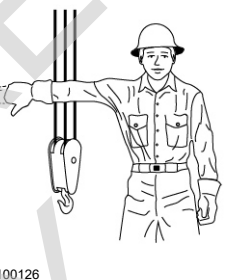
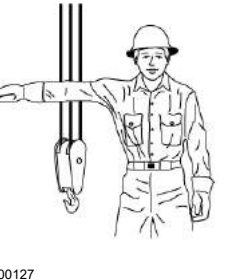

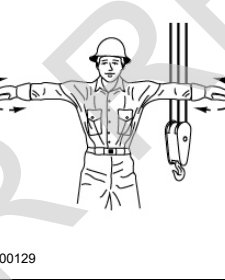
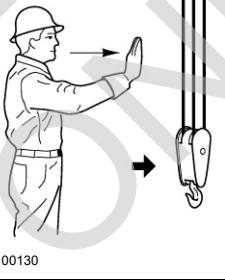

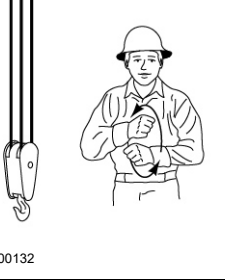
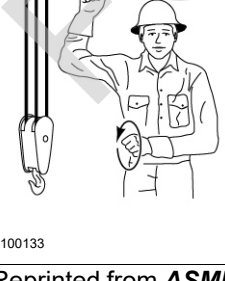
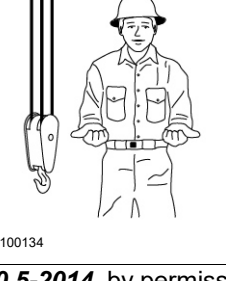
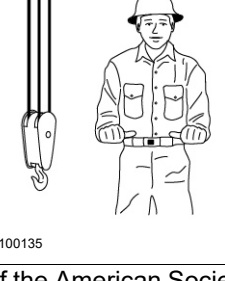

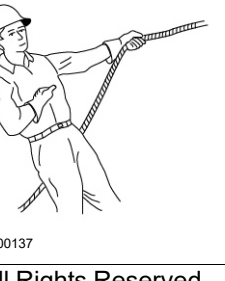
FOR REFERENCE ONLY

THIS SECTION STARTS ON THE NEXT PAGE

STANDARD HAND SIGNALS FOR CONTROLLING CRANE OPERATIONS

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

Table 3-1. Standard Hand Signals for Controlling Crane Operations

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

Reprinted from *ASME B30.5-2014*, by permission of the American Society of Mechanical Engineers. All Rights Reserved.


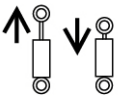












Table 3-1. Standard Hand Signals for Controlling Crane Operations

















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.









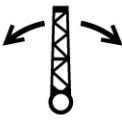

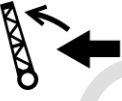

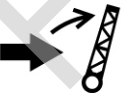

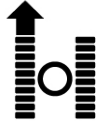
SYMBOLS USED ON CONTROL CONSOLES

The following symbols are used on the control consoles to identify the operating controls and their operation.

Table 3-2. Symbol Identification — Control Consoles

 <p>M100168</p>	<p>Battery, 12 Volt Supply</p>	 <p>M100144</p>	<p>Cylinders, Mast Assist Arms, Extend and Retract</p>
 <p>M100168</p>	<p>Bypass, Crane Limits</p>	 <p>M100148</p>	<p>Drum</p>
 <p>M101690</p>	<p>Cab Tilt Down</p>	 <p>M100150</p>	<p>Drum, Lower</p>
 <p>M101689</p>	<p>Cab Tilt Up</p>	 <p>M100151</p>	<p>Drum Number (location of number varies)</p>
 <p>M101960</p>	<p>Camera</p>	 <p>M100152</p>	<p>Drum, Raise</p>
 <p>M100191a</p>	<p>Crawlers</p>	 <p>M100155</p>	<p>Engine or Auxiliary Engine</p>
 <p>M102256</p>	<p>Counterweight, VPC (variable position counterweight)</p>	 <p>M100284</p>	<p>DPF Inhibit On (Tier 4)</p>







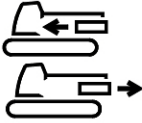

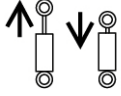

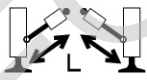
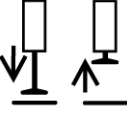
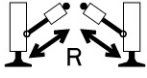
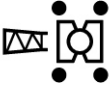
 <p>M100284</p>	<p>DPF Regeneration (Tier 4)</p>	 <p>M100165</p>	<p>Light, Consoles</p>
 <p>M100159</p>	<p>Engine Run</p>	 <p>M100291</p>	<p>Light, Position</p>
 <p>M100160</p>	<p>Engine Start</p>	 <p>M100166</p>	<p>Light, Work (and camera)</p>
 <p>M100161</p>	<p>Engine Stop</p>	 <p>M100167</p>	<p>Lighter</p>
 <p>M100142</p>	<p>Fan</p>	 <p>M100162a</p>	<p>Lock and Unlock</p>
 <p>M100163</p>	<p>Heater</p>	 <p>M100170</p>	<p>Off</p>
 <p>M100164</p>	<p>Horn</p>	 <p>M100171</p>	<p>On</p>
	<p>Light, Dome</p>	 <p>M101959</p>	<p>Park Off</p>

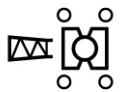
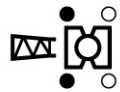
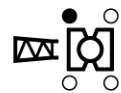
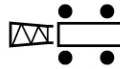
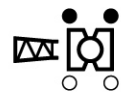
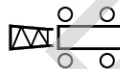
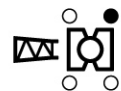

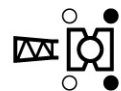


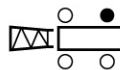

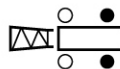

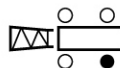
 M100172	Park On	 M100193	Travel Forward—Right Crawler
 M100183	Speed, Fast	 M100194	Travel Reverse—Left Crawler
 M100184	Speed, Slow	 M100195	Travel Reverse—Right Crawler
 M100185	Stop, Emergency	 M100196a	Travel Speed
 M100186	Swing	 M101957	Winch, Tagline (Drum 7)
 M100189	Swing Left	 M101957	Windshield Washer, Front
 M100190	Swing Right	 M101958	Windshield Washer, Overhead
 M100192	Travel Forward—Left Crawler		

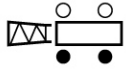

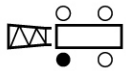

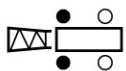











SYMBOLS USED ON REMOTE CONTROL



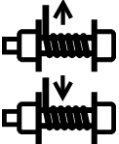
The following symbols are used on the remote control to identify the operating controls and their operation.

Table 3-3. Symbol Identification — Remote Control

 M100141	Alert	 M100146	Data, Confirm
 M101677	Battery	 M100146a	Data, Select
 M1024338	Counterweight Tray	 M100154	Energize
 M1024338A	Counterweight Tray (In/Out)	 M100160	Engine
 M100144	Cylinder, Mast Assist (Extend/Retract)	 M100160	Horn
 M102752	Cylinder, Rotating Bed Jack Storage, Front	 M100145	Jack (Extend/Retract)
 M102753	Cylinder, Rotating Bed Jack Storage, Rear	 M102429	Jack, Carbody (all)

 <p>M102430</p>	<p>Jack, Carbody (individual)</p>	 <p>M102443</p>	<p>Jack, Carbody Left Front and Right Front</p>
 <p>M102442</p>	<p>Jack, Carbody Right Front</p>	 <p>M102754</p>	<p>Jack, Rotating Bed (all)</p>
 <p>M102446</p>	<p>Jack, Carbody Right Front and Right Rear</p>	 <p>M102755</p>	<p>Jack, Rotating Bed (individual)</p>
 <p>M102447</p>	<p>Jack, Carbody Right Rear</p>	 <p>M102759</p>	<p>Jack, Rotating Bed Right Front</p>
 <p>M102448</p>	<p>Jack, Carbody Right Rear and Left Rear</p>	 <p>M102760</p>	<p>Jack, Rotating Bed Right Front and Right Rear</p>
 <p>M102449</p>	<p>Jack, Carbody Left Rear</p>	 <p>M102761</p>	<p>Jack, Rotating Bed Right Rear</p>
 <p>M102445</p>	<p>Jack, Carbody Left Rear and Left Front</p>	 <p>M102762</p>	<p>Jack, Rotating Bed Right Rear and Left Rear</p>
 <p>M102444</p>	<p>Jack, Carbody Left Front</p>	 <p>M102763</p>	<p>Jack, Rotating Bed Left Rear</p>

 M102764	Jack, Rotating Bed Left Rear and Left Front	 M102756	Pin, Adapter Frame to Rotating Bed, Front
 M102765	Jack, Rotating Bed Left Front	 M102757	Pin, Adapter Frame to Rotating Bed, Rear
 M102766	Jack, Rotating Bed Left Front and Right Front	 M102758	Pins, Crawler Left
 M102435	Mast, Live	 M102759	Pins, Crawler Right
 M100170	Off	 M102758	Pins, VPC-MAX Beam
 M100171	On	 M102441	Signal, Transmission
 M100177	Pin (Disengage)	 M100183	Speed, Fast
 M100178	Pin (Engage)	 M100184	Speed, Slow

 <p>M102439</p>	<p>Trolley, Beam Mounted (In/Out)</p>
 <p>M101687</p>	<p>Winch, Rigging</p>
 <p>M101687b</p>	<p>Winch, Rigging (Pay Out/Haul In)</p>

FOR REFERENCE ONLY

FOR REFERENCE ONLY

THIS PAGE INTENTIONALLY LEFT BLANK

OPERATING CONTROLS

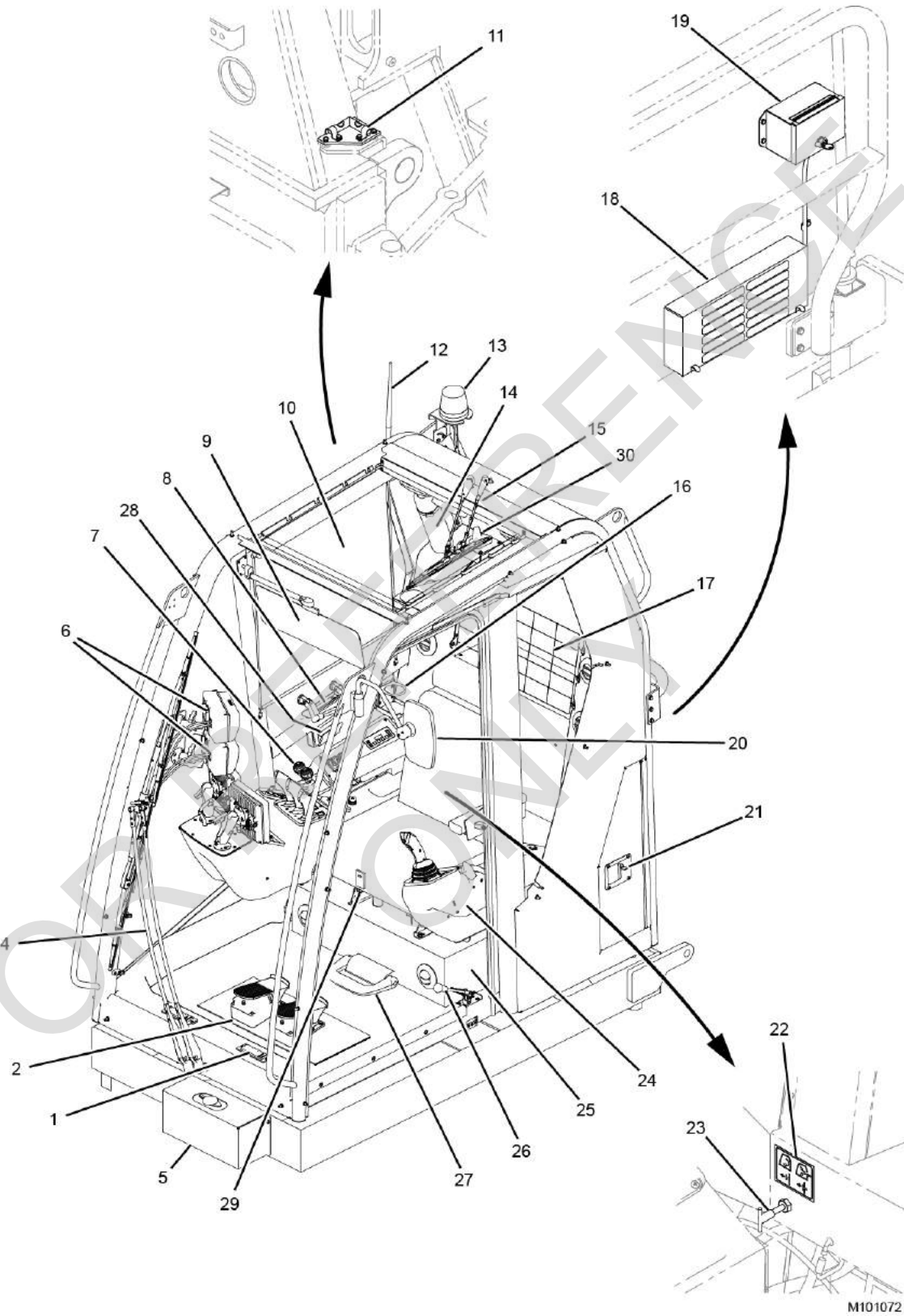
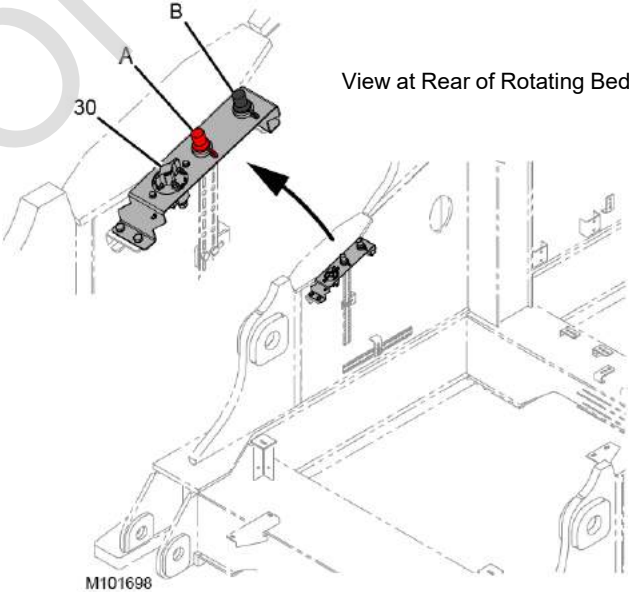
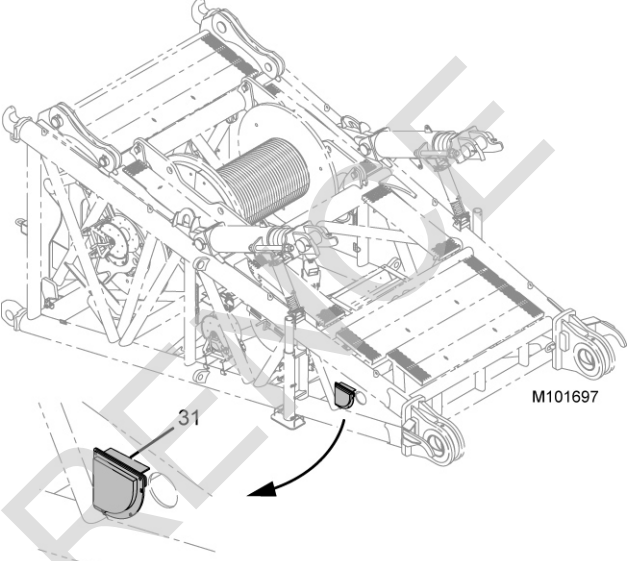


Figure 3-1. Cab Controls and Indicators

Table 3-4. Cab Controls and Indicators

Item	Name	Description
1	Louvers	Vents to circulate air in the operator's cab.
2	Travel Foot Pedals	See page 3-28 for more information.
3	Not Used	
4	Front Windshield Wiper	See page 3-23 for more information.
5	Windshield Washer Fluid Reservoir	Container for washer fluid.
6	Camera Monitors	The camera screen displays camera options and items for selecting and operating. Camera options include up to eight different cameras to monitor drum spooling and area behind the crane. See page 3-35 for more information.
7	Right Console	See page 3-18 for more information.
8	Right Window Latch	Right window latch is used to open the window for ventilation and as an emergency exit. See page 3-58 for more information.
9	Sun Visor	A visor is provided for the front window. Position the visor as desired to shade the sunlight.
10	Sun Shade	Shades are provided for the roof and side windows. Position the shades as desired to shade the sunlight.
11	Upperworks Level	See page 3-31 for more information.
12	Radio Antenna	See page 3-18 for radio information.
13	Rated Capacity Limiter (RCL) Light	The beacon rotates and the alarm sounds whenever the crane's capacity is near an overload condition (when RCL system is ON). See page 3-31 .
14	Fire Extinguisher	Used to extinguish class A, B, and C fires. Standard extinguisher is in the cab. An optional extinguisher is mounted on the left side of the rotating bed to the rear of the cab.
15	Upper Windshield Wiper	See page 3-23 for more information.
16	Cup Holder	Provided for operator convenience.
17	Cargo Net	Provided for storage.
18	HVAC Outdoor Air Ventilation	Air terminal supplies outdoor air.
19	RCL Override Assembly Switch	On cranes meeting CE requirements, an RCL/RCI override switch is provided outside the cab in a lockable box. The override switch allows emergency operation of the crane functions in case of RCL/RCI component failures: boom angle sensor, luffing jib angle sensor, and load sensing sheaves (load pins). <ul style="list-style-type: none"> When the external override is on, the speed of the crane functions is limited to 15% of their maximum speed for load increasing actions. Actuation of the external override and all relevant data is recorded in a data recorder.
20	Rear View Mirror	Adjustable rear-view mirror. Standard mirror is mounted on the cab. An optional mirror is mounted on the right-front side of rotating bed.
21	Storage Compartment	Store the setup remote control and the portable crane service lights in this compartment. The door latch can be locked with the provided key.
22	Decal - Outside Air Ventilation	Displays the positions of the air control handle.

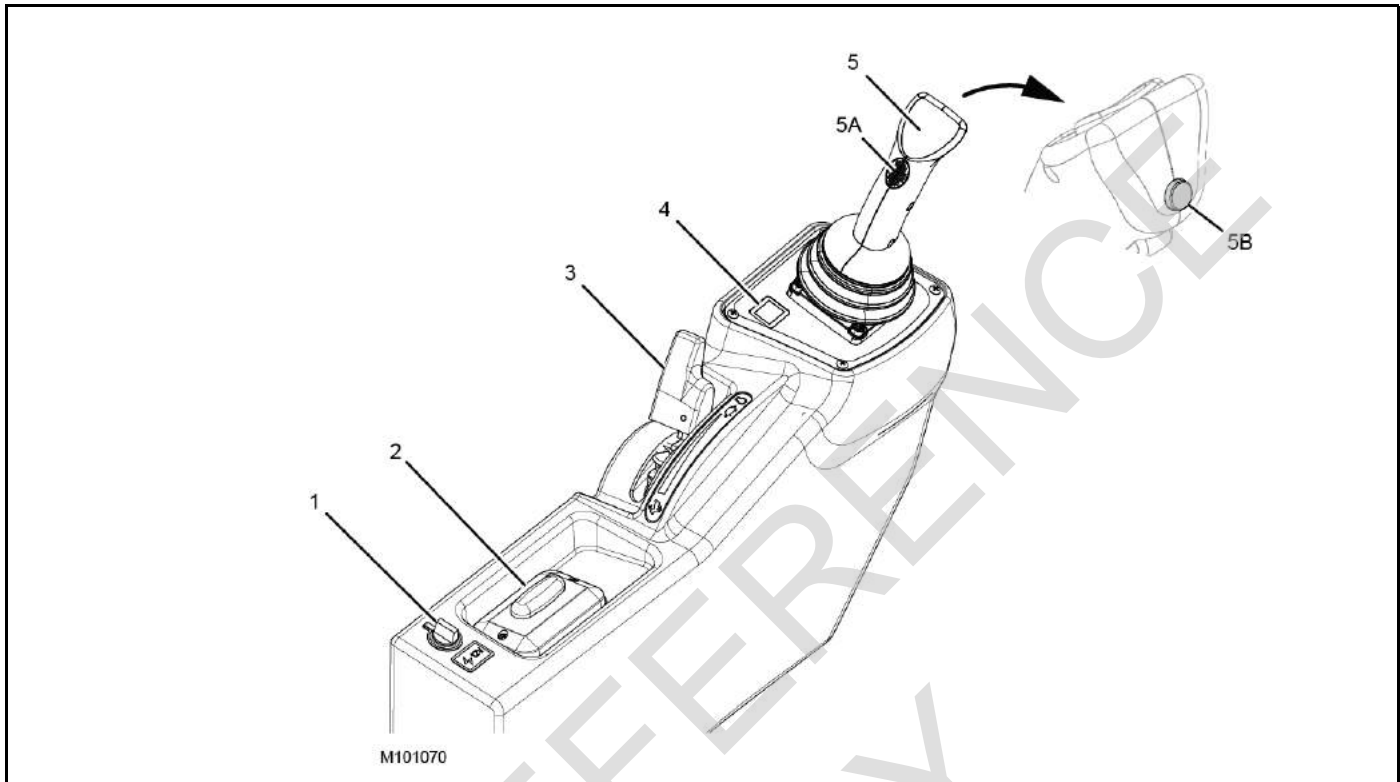
23	Outside Air Control Handle	Pull out to close the vents and push to open the vents.								
24	Left Console	See page 3-16 for more information.								
25	HVAC Housing	Houses the main components for the operator cab heating and cooling system (fan, heating and cooling coils, valves).								
26	Cab Door Brake	Manual handle for locking the cab door in any position. Push the handle down to apply and pull up to release.								
27	Engine Foot Throttle	See page 3-28 for more information.								
28	Ash Tray	Provided for operator convenience.								
29	Door Latch	Self-acting latch that secures the door closed. The door latch can be locked with the provided key.								
30	GPS/GSM Antenna	Contact your Manitowoc dealer for CraneSTAR information.								
31	Battery Disconnect Switch	<p>Turn the knob CLOCKWISE to CONNECT the battery circuit. Turn the knob COUNTERCLOCKWISE to DISCONNECT the battery circuit for the following reasons:</p> <ul style="list-style-type: none"> • When servicing the crane’s electrical control system. • If desired, to prevent batteries from discharging when the crane is stored for extended periods of time. • If desired, to prevent the crane from being started by unauthorized personnel. <p>The handle can be padlocked to prevent unauthorized use.</p> <table border="1" data-bbox="764 1014 1341 1163"> <thead> <tr> <th>Item</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>30</td> <td>Battery Disconnect Switch</td> </tr> <tr> <td>A</td> <td>Positive – Remote Battery Terminal</td> </tr> <tr> <td>B</td> <td>Negative – Remote Battery Terminal</td> </tr> </tbody> </table>  <p>The diagram shows a detailed view of the Battery Disconnect Switch (30) with terminals A and B. It also shows the switch's location on the rear of the rotating bed. The part number M101698 is indicated at the bottom of the diagram.</p>	Item	Description	30	Battery Disconnect Switch	A	Positive – Remote Battery Terminal	B	Negative – Remote Battery Terminal
Item	Description									
30	Battery Disconnect Switch									
A	Positive – Remote Battery Terminal									
B	Negative – Remote Battery Terminal									

<p>32</p>	<p>Boom Angle Indicator</p>	<p>See page 3-31 for more information.</p> 
-----------	-----------------------------	---

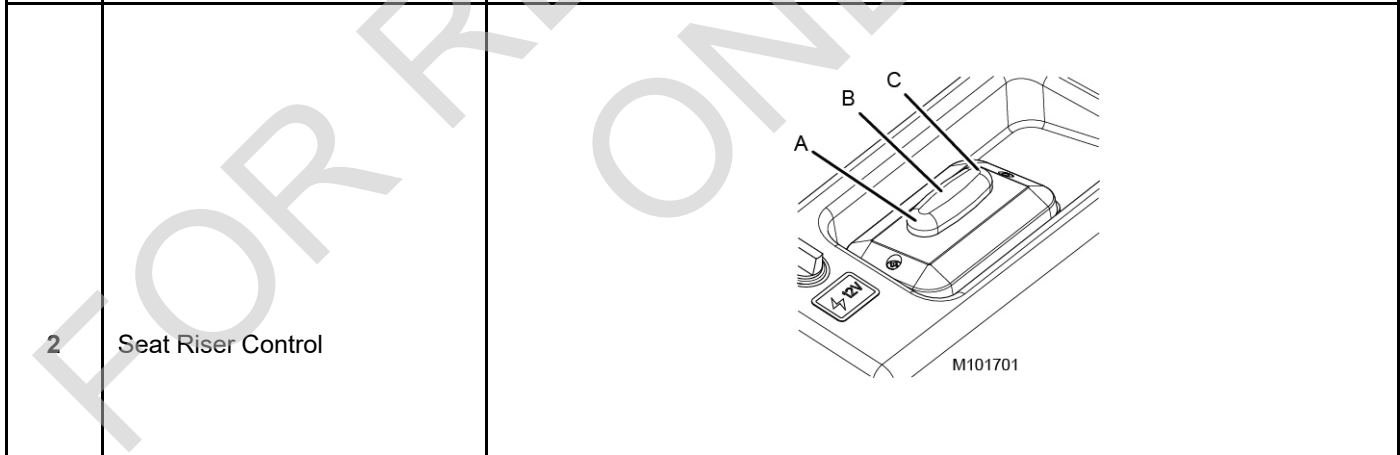
FOR REFERENCE ONLY

Left Console

Table 3-5. Left Console




Item	Name	Description
1	12VDC Power Source	Maximum current draw is 10A. For fuse location, see Section 3 of the Service Manual.



Item	Description
A	Engage switch in this location to raise or lower the rear riser.
B	Engage switch in this location to raise and lower the seat and to move the seat forward or backward.
C	Engage switch in this location to raise or lower the front riser.

Table 3-5. Left Console

3	Hand Throttle	<ul style="list-style-type: none"> • Move the handle FORWARD to DECREASE the engine speed. • Move the handle BACK to INCREASE the engine speed. <p>Engine speed must be fast enough to provide sufficient power for the work being done. The engine can stall under the load if the engine speed is too slow.</p>						
4	Drum Identifier	<p>Displays the drum number controlled by the corresponding control handle. The location of the boom control handle can vary depending on crane configuration. See Drum and Control Handle Identification on page 3-56.</p> <div style="text-align: right;">  </div>						
5	Boom and Swing Control Handle	<p>Boom Control Handle: See Boom Hoist Operation on page 3-66.</p> <p>The location of the boom control handle can vary depending on crane configuration. See Drum and Control Handle Identification on page 3-56.</p> <ul style="list-style-type: none"> • Move the control handle BACK to RAISE the boom. The boom hoist brake releases and speed changes in relation to control handle movement. • Release the control handle to CENTER to STOP the boom. Speed decreases to off and the boom hoist brake applies to hold the boom in position. • Move the control handle FORWARD to LOWER the boom. The boom hoist brake releases and speed changes in relation to the control handle movement. <p>Swing Control Handle: See Swing Operation on page 3-68.</p> <ul style="list-style-type: none"> • Move the control handle to the LEFT to SWING LEFT. • Release the control handle to CENTER to STOP swinging. Swing speed decreases and the rotating bed slows to a stop. Move the control handle in the opposite direction to stop the swing motion faster. • Move the control handle to the RIGHT to SWING RIGHT. <p>The swing and travel alarm beeps to warn personnel when the crane is swung.</p> <table border="1" data-bbox="634 1339 1511 1661"> <thead> <tr> <th data-bbox="634 1339 732 1373">Item</th> <th data-bbox="732 1339 1511 1373">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="634 1373 732 1476">5A</td> <td data-bbox="732 1373 1511 1476">Drum rotation indicator—a pin-type actuator in the top of the control handle moves up and down to signal the operator by feel that the drum is turning.</td> </tr> <tr> <td data-bbox="634 1476 732 1661">5B</td> <td data-bbox="732 1476 1511 1661"> Swing holding brake switch—holds the rotating bed in position for short periods of time. The swing control handle is not operable while the swing holding brake switch is pressed. <ul style="list-style-type: none"> • PRESS the switch to APPLY the swing holding brake. • RELEASE the switch to RELEASE the swing holding brake. </td> </tr> </tbody> </table>	Item	Description	5A	Drum rotation indicator—a pin-type actuator in the top of the control handle moves up and down to signal the operator by feel that the drum is turning.	5B	Swing holding brake switch—holds the rotating bed in position for short periods of time. The swing control handle is not operable while the swing holding brake switch is pressed. <ul style="list-style-type: none"> • PRESS the switch to APPLY the swing holding brake. • RELEASE the switch to RELEASE the swing holding brake.
Item	Description							
5A	Drum rotation indicator—a pin-type actuator in the top of the control handle moves up and down to signal the operator by feel that the drum is turning.							
5B	Swing holding brake switch—holds the rotating bed in position for short periods of time. The swing control handle is not operable while the swing holding brake switch is pressed. <ul style="list-style-type: none"> • PRESS the switch to APPLY the swing holding brake. • RELEASE the switch to RELEASE the swing holding brake. 							

Right Console

Table 3-6. Right Console

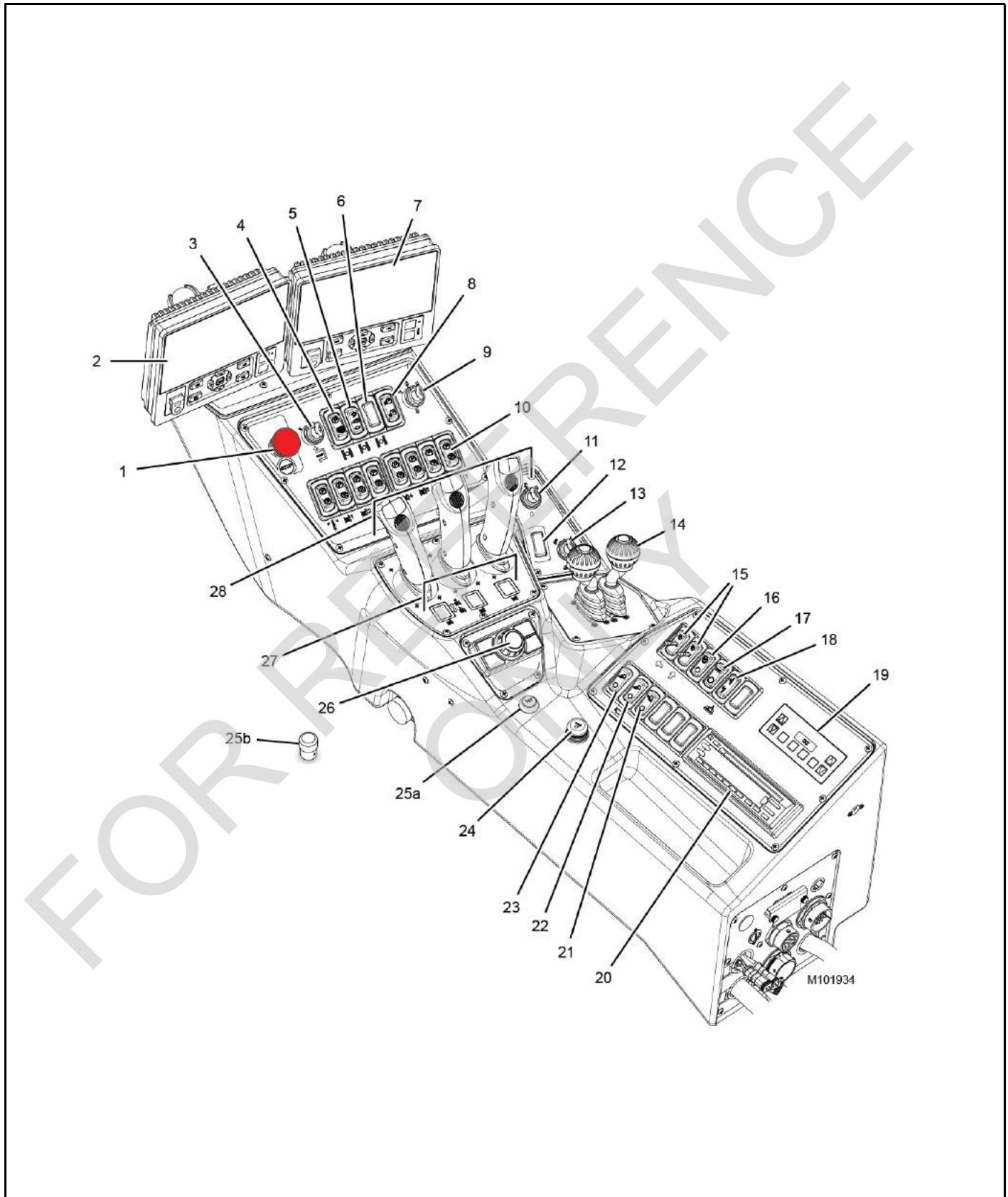


Table 3-6. Right Console


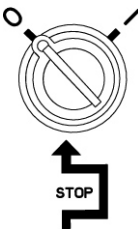
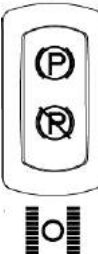
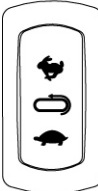
Item	Name	Description
1	Emergency Stop Button	<p>When this button is depressed, the crane engine shuts off, the motor brakes apply, and the currently operated functions come to a complete stop.</p> <p>For normal engine shut down, use the engine ignition switch.</p> <p>NOTE The button must be pulled up before the engine can be restarted.</p> <p>If the emergency stop switch has been activated while functions were being operated, test the corresponding disk brakes for proper operation before putting the crane back into service.</p> 
2	Rated Capacity Indicator and Rated Capacity Limiter Display (RCL/RCI)	<p>Displays load lifting information and alerts the operator to overload conditions. See the MLC650 RCL/RCI Operation Manual at the end of this section for detailed information.</p>
3	Limit Bypass Key Switch	<p>This key bypasses the limits described in Operating Limits Identification and Operation on page 3-48:</p> <ul style="list-style-type: none"> To BYPASS an operating limit, turn the key to I and hold the key in this position. To ENABLE operating limits, release the key to O. This position allows a limit to stop a crane function in the normal matter. The key must be in this position for all normal operation. Otherwise, structural damage can occur. <p>Remove the key to prevent unauthorized operation.</p> 
4	Travel Park Switch	<ul style="list-style-type: none"> Press the TOP of the rocker to PARK travel. With park on, the travel control handles are inoperable and the travel brakes are applied. Press the bottom of the rocker UN-PARK travel. With park off, the travel control handles are operable and the travel brakes are applied and released in conjunction with control handle movement. 
5	Travel Speed Switch	<ul style="list-style-type: none"> Press the TOP of the rocker to operate the travel motors in HIGH speed. High speed operation provides maximum available travel speed for traveling long distances. Press the BOTTOM of the rocker to operate the travel motors in LOW speed. Low speed operation provides smooth starts and stops and allows more precise control of the travel motors than high speed. 
6	Not Used	
7	Main Display	<p>Displays operating conditions, faults, and diagnostic information. See the MLC650 Main Display Operation Manual at the end of this section for detailed information.</p>

Table 3-6. Right Console

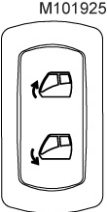
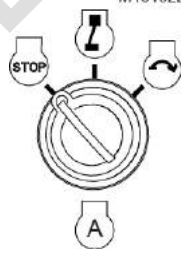
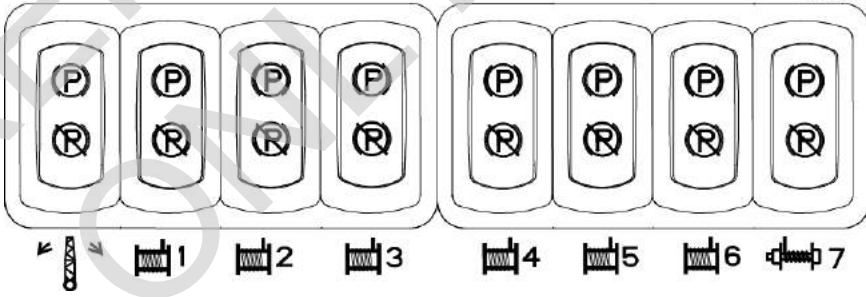
<p>8</p>	<p>Cab Tilt</p>	<ul style="list-style-type: none"> • Press and hold the TOP of the rocker to tilt the front of the cab UP to a maximum of 21° above horizontal. • Release the rocker CENTER to LOCK the cab in the desired position. • Press and hold the BOTTOM of the rocker to tilt the front of the cab DOWN to a minimum of horizontal.  <p>M101925</p>
<p>9</p>	<p>APU Ignition Switch (Auxiliary Power Unit)</p>	<p>This switch is used for starting and stopping the optional APU. The APU powers the cab accessories (heater, A/C, lights) when the crane engine is off.</p> <p>Refer to the APU manufacturers manual for detailed operation and maintenance of the APU.</p> <p>The APU engine ignition switch has the following positions:</p> <ul style="list-style-type: none"> • Stop (A) • Run (B) • Start (C) <p>NOTE The APU will not start from the cab or from the APU if the APU doors are removed.</p> <p>See AC Operation on page 3-81 for APU installation and starting instructions.</p>  <p>M101922</p>
<p>10</p>	<p>Park Switches</p>	<p>A separate switch is provided for each crane function: swing, drums, and crawlers.</p>  <p>M101921</p> <ul style="list-style-type: none"> • Press the TOP of the rocker to PARK the corresponding crane function. With drum park on, the corresponding control handle is inoperable, the brake is applied, and (if equipped) the pawl is engaged. • Press the bottom of the rocker to UN-PARK the corresponding crane function. With park off, the corresponding control handle is operable, the brake is applied and released in conjunction with control handle movement, and (if equipped) the pawl is disengaged. <p>Continued on next page.</p>

Table 3-6. Right Console



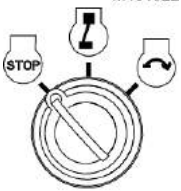
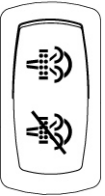
<p>10</p>	<p>Park Switches (continued)</p>	<p>Alternatively, each of the crane functions can be parked in the Main Display Speed and Torque Settings Screen. See the Main Display Operation Manual for instructions.</p> <p>If the operator moves a control handle for a function that is parked, the corresponding fault icon will appear in the Alerts Bar of the Main Display Working Screen and the function will be inoperable until un-parked.</p> <p> if the function was parked with a park switch.</p> <p> If the function was parked in the speed and torque settings screen.</p>
<p>11</p>	<p>Engine Ignition Switch</p>	<p>The engine ignition switch has the following positions:</p> <ul style="list-style-type: none"> • Stop (A) • Run (B) • Start (C) 
<p>12</p>	<p>Engine Regeneration/Inhibit Switch</p>	<p>The regeneration/inhibit switch is a three-position rocker switch. The top position is momentary. The center and bottom positions are maintained. For more information on this switch, see Section 7 of the MLC650 Service Manual.</p> <p>Active Position</p> <p>The active center position is for normal engine operation. The position does not require operator assistance under normal conditions. This position allows the exhaust system to actively (automatically) regenerate.</p> <p>Manual Regeneration</p> <p>If the Engine Information Screen in the Main Display indicates the exhaust system requires a manual regeneration, press and release the top of the rocker. The engine ECM will control a regeneration cycle.</p> <p>The top of the rocker switch is momentary and the switch will return to the active position after the top of the switch is pressed.</p> <p>A manual regeneration will begin only if the following conditions are met:</p> <ul style="list-style-type: none"> • The engine is at low idle. • The accelerator pedal is not pressed. <p>NOTE The top end of the switch has a guard that prevents accidental manual regeneration.</p> <p>The High Exhaust System Temperature (HEST) lamp may come on during regeneration and remain on for a short time after regeneration.</p> <p><i>Continued on next page.</i></p> 

Table 3-6. Right Console


<p>12</p>	<p>Engine Regeneration/Inhibit Switch (continued)</p>	<p>Regeneration Inhibit</p> <p>To prevent the exhaust system active (automatic) regeneration, press the bottom of the rocker. The switch will remain depressed. The amber LED in the rocker will glow. To re-enable active regeneration, manually return the switch to the active position.</p> <p>Do not use the Inhibit switch unless specifically instructed by a Manitowoc or Cummins technical advisor.</p> <p>The exhaust system regen inhibited icon indicates the aftertreatment system active (automatic) regeneration is prevented because the inhibit switch is in the inhibit position.</p> <p>For information on exhaust system-related faults, see the MLC650 Main Display Operation Manual.</p> <p>See engine manufacturer's operation and maintenance manual for information on the after-treatment system and engine faults.</p>
<p>13</p>	<p>VPC Lockout Switch</p>	<p>VPC = Variable Position Counterweight</p> <ul style="list-style-type: none"> • Turn the key CLOCKWISE to LOCK the VPC counterweight (for example, before traveling onto a grade). With the VPC locked, the counterweight cannot move in either direction. • Turn the key COUNTERCLOCKWISE to UNLOCK the VPC counterweight. With the VPC unlocked, the counterweight can move in response to changing load conditions. <p>NOTE Refer to F2372 at the end of this section for Locked VPC Operation.</p>  <p>M102257</p>

Table 3-6. Right Console

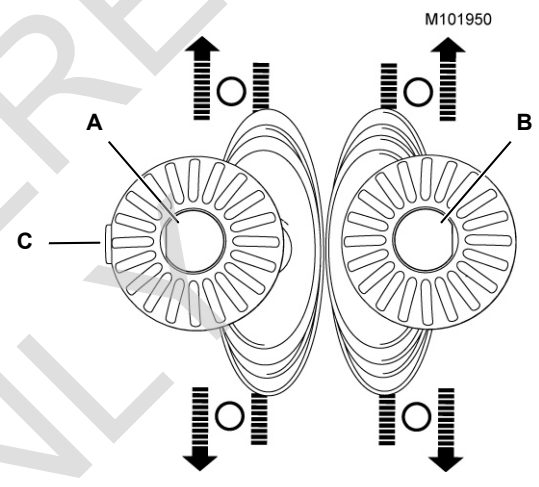
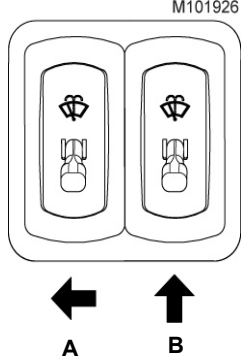
<p>14</p>	<p>Crawler Handles</p>	<p>See Travel Operation on page 3-72.</p> <p>The following directions of travel are with the front of the rotating bed and the front of carbody facing the same direction.</p> <p>The swing and travel alarm beeps to warn personnel when the crane is traveled.</p> <p>A = left crawler handle, B = right crawler handle, and C = cruise control switch.</p> <ul style="list-style-type: none"> • Pull the control handle BACK to travel the corresponding crawler in REVERSE. The travel brake releases and speed increases in relation to control handle movement. • Release the control handle to CENTER to STOP the crawler. Speed decreases to off and the travel brake applies to stop and hold the crawler in position. • Push the control handle FORWARD to travel the corresponding crawler FORWARD. The travel brake releases and speed increases in relation to control handle movement.  <p>The diagram shows two circular crawler handles, A on the left and B on the right. Handle A has a button labeled C. Four sets of arrows indicate directions: up and down from both handles, and left and right from handle A.</p> <ul style="list-style-type: none"> • To turn travel CRUISE ON, press and release the button (C) while traveling in the desired direction and speed. The crane will continue to travel in the selected direction and speed when the operator release the crawler handles. • To turn travel CRUISE OFF, push either crawler control handle in the opposite direction or press and release the button again. Travel cruise will also turn off if an operating limit that prevents operation is reached (for example, seat switch or park switch).
<p>15</p>	<p>Windshield Wiper Switches</p>	<p>A = front windshield and B = upper windshield wiper.</p> <ul style="list-style-type: none"> • Toggle fully down = OFF. • Toggle up = INTERMITTENT depending on how far up the toggle is moved. • Toggle fully up = HIGH speed. • Press the TOP END of the switch to SPRAY WASHER FLUID onto the windows. <p>During cold weather, fill the windshield washer tank with a non-freezing cleaning fluid.</p>  <p>The diagram shows two rectangular wiper switches, A on the left and B on the right. Each has a wiper icon and a spray icon. Arrows A and B point to the respective switches.</p>

Table 3-6. Right Console

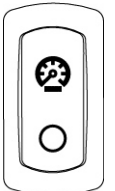
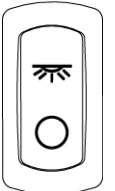
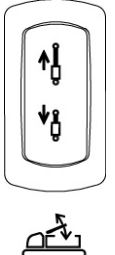
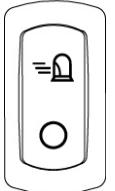
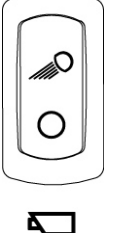
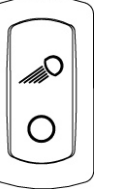
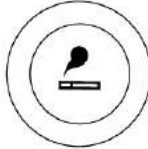

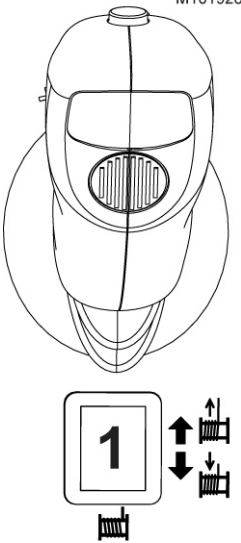
16	Panel Lights	<ul style="list-style-type: none"> Press the TOP of rocker to TURN ON the panel switch backlights. Press the BOTTOM of rocker to TURN OFF the panel switch backlights. 	<p>M101918</p> 
17	Dome Lights	<ul style="list-style-type: none"> Press the TOP of rocker to TURN ON the dome light. Press the BOTTOM of rocker to TURN OFF the dome light. 	<p>M101919</p> 
18	Mast Assist Arms Switch	<p>The setup mode must be on (live mast configuration selected) to operate the mast assist arms. See Section 4 of the MLC300 Operator Manual for instructions.</p> <ul style="list-style-type: none"> Press and hold the TOP of the rocker to EXTEND the mast arm cylinders. Release the rocker to CENTER to STOP the cylinders. The valves on the cylinders lock them in position. Press and hold the BOTTOM of the rocker to RETRACT the mast arm cylinders. 	<p>M101933</p> 
19	Climate Control Keypad	See page 3-30 for more information.	
20	AM/FM Radio	See the radio manufacturer's instructions.	
21	Boom and Jib Position Light	<ul style="list-style-type: none"> Press the TOP of the rocker to TURN ON the flashing red position light at the top of the boom or the jib. Press the BOTTOM of the rocker to TURN OFF the position light at the top of the boom or the jib. 	<p>M101932</p> 
22	Camera Lights	<ul style="list-style-type: none"> Press the TOP of the rocker to TURN ON the camera lights. Press the BOTTOM of the rocker to TURN OFF the camera lights. 	<p>M101930</p> 
23	Crane Work Lights Switch	<ul style="list-style-type: none"> Press the TOP of the rocker to TURN ON the work lights. Press the BOTTOM of the rocker to TURN OFF the work lights. 	<p>M101931</p> 

Table 3-6. Right Console

<p>24</p>	<p>Cigarette Lighter</p>	<ul style="list-style-type: none"> • Push IN to TURN ON lighter. • The lighter will pop out when the coil is hot. <p>This receptacle can be used to power other 12VDC devices. Maximum current draw is 10A.</p>  <p>M101923</p>
<p>25A</p>	<p>Horn Switch (on console)</p>	<ul style="list-style-type: none"> • Press and hold the TOP of the rocker to TURN ON the horn. • RELEASE the rocker to TURN OFF the horn. <p>Before swinging or traveling, sound the horn to alert nearby personnel.</p> 
<p>25B</p>	<p>Horn Switch (on floor)</p>	<ul style="list-style-type: none"> • PRESS and hold with your foot to TURN ON the horn. • RELEASE to TURN OFF the horn. <p>Before swinging or traveling, sound the horn to alert nearby personnel.</p>
<p>26</p>	<p>Jog Dial</p>	<p>Used in conjunction with the Crane Control System (CCS). See the MLC650 Main Display Operation Manual and the RCL/RCI Operation Manual for more information.</p>
<p>27</p>	<p>Drum Identifier</p>	<p>Displays the drum number controlled by the corresponding control handle. See Drum and Control Handle Identification on page 3-56.</p>  <p>M101928</p>
<p>28</p>	<p>Drum Control Handles</p>	<p>See Load Drum Operation on page 3-71.</p> <p>The position of the drum handles can vary depending on crane configuration. See Drum and Control Handle Identification on page 3-56.</p> <ul style="list-style-type: none"> • Pull the control handle BACK to RAISE the load. The drum brake releases and speed increases in relation to control handle movement. • Release the control handle to CENTER to STOP the load. Speed decreases to off and the drum brake applies to stop and hold the drum in position. • Push the control handle FORWARD to LOWER the load. The drum brake releases and speed increases in relation to control handle movement. <p>NOTE Some items cannot be operated at the same time. See Operation of Diverting Circuits on page 3-27 for a list of diverting conditions.</p>

THIS PAGE INTENTIONALLY LEFT BLANK

Operation of Diverting Circuits

Diverting Circuit 1			
Condition	Drum 1	Left Crawler	Drum 6
1	Full	Parked	Parked
2	Parked	Full	Parked
3	Parked	Parked	Full
4	1/2	Full	Parked
5	1/2	Parked	Full
6	Parked	Full	Full

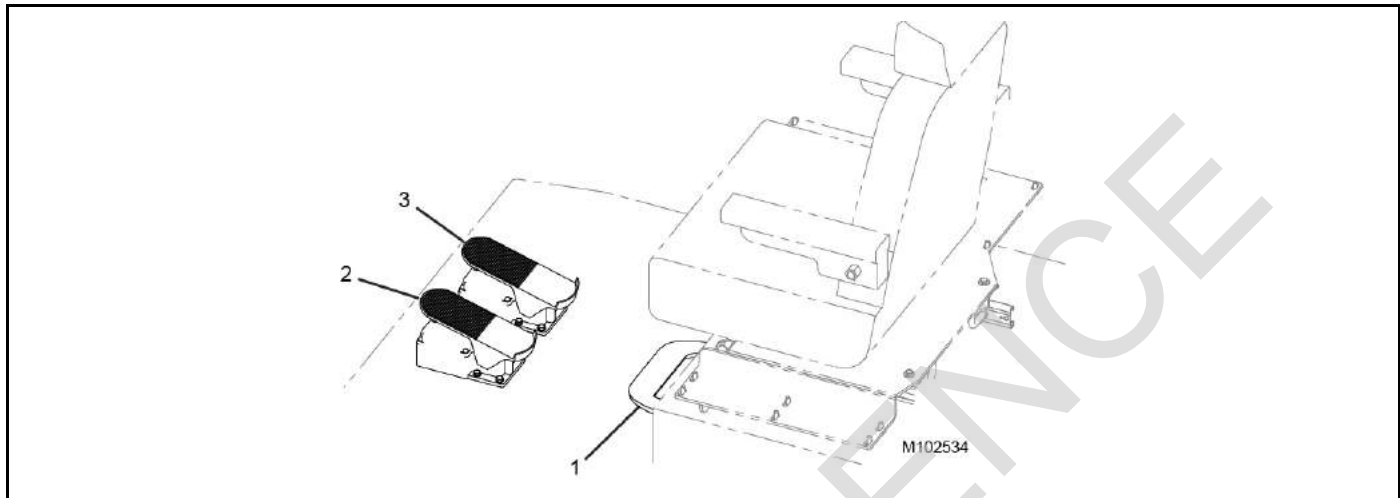
Diverting Circuit 2			
Condition	Drum 2	Right Crawler	Drum 3
1	Full	Parked	Parked
2	Parked	Full	Parked
3	Parked	Parked	Full
4	1/2	Full	Parked
5	1/2	Parked	Full
6	Parked	Full	Full

NOTES

- For either diverting circuit, only two of the functions can be operated at a time
- Unused functions must be parked
- Full = indicated function can be operated up to full speed
- 1/2 = indicated function can be operated up to half speed

Foot Pedals

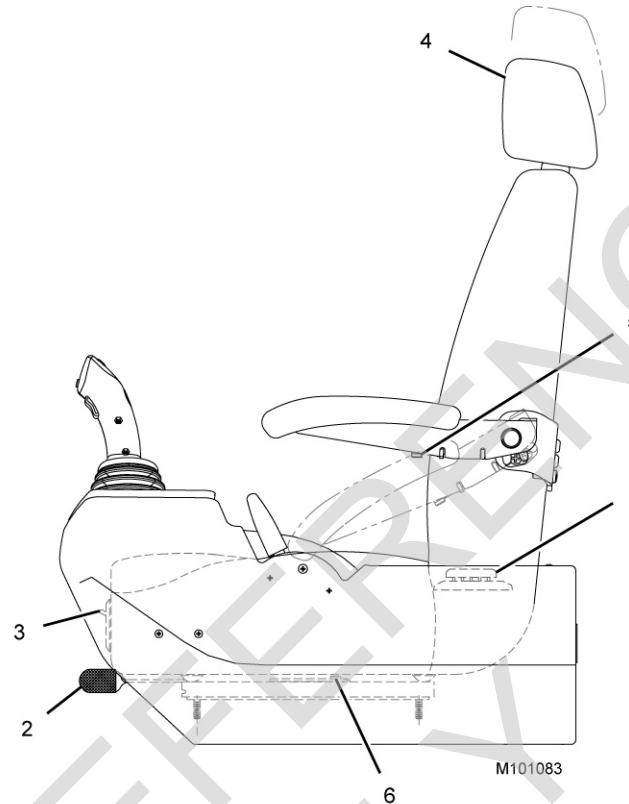
Table 3-7. Foot Pedals



Item	Name	Description
1	Engine Foot Throttle	<ul style="list-style-type: none"> • Press DOWN on the foot throttle to INCREASE engine speed <i>above</i> the hand throttle setting. • RELEASE the foot throttle to DECREASE engine speed to idle or to the hand throttle setting.
2 3	Left Travel Foot Pedal Right Travel Foot Pedal	<p>The following directions of travel are with the front of the rotating bed and the front of carbody facing the same direction.</p> <p>The swing and travel alarm beeps to warn personnel when the crane is traveled.</p> <ul style="list-style-type: none"> • Depress the FRONT of pedal to travel the corresponding crawler FORWARD. The corresponding crawler brake release and speed increases in relation to pedal movement. • Release the pedal to CENTER to STOP the corresponding crawler. Speed decreases to off and the crawler brake applies to hold the crawler in position. • Depress the REAR of pedal to travel the corresponding crawler in REVERSE. The corresponding crawler brake releases and speed increases in relation to pedal movement.

Seat Controls

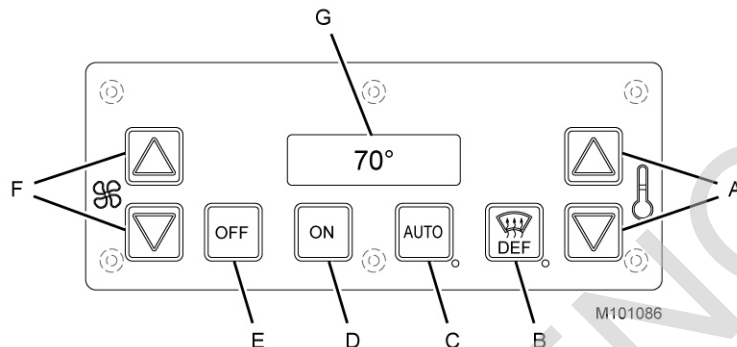
Table 3-8. Seat Controls



Item	Name	Description
1	Seat Riser on Left Console	See page 3-16 for operating instructions.
2	Fore-Aft Control	<ul style="list-style-type: none"> • Push the lever to the LEFT to UNLOCK the seat. • Use body weight to slide the seat to the desired position. • RELEASE lever and ensure that it is latched to LOCK the seat in position.
3	Reclining Backrest Adjustment	<ul style="list-style-type: none"> • Move the switch UP to RELEASE the backrest. • Use body weight to adjust the backrest to the desired position. • RELEASE the switch to lock position of the backrest.
4	Adjustable Headrest	From the default position, the headrest may be raised up 65 mm (2.5 in)
5	Armrest Adjustment Knob	<p>The knob located on the underside of armrest.</p> <ul style="list-style-type: none"> • Turn the knob CLOCKWISE to RAISE armrest. • Turn the knob COUNTERCLOCKWISE to LOWER armrest.
6	Seat Switch	<p>Prevents the crane from being operated until the operator is seated.</p> <p>When the operator is not seated, all control handles are inoperable, all brakes are applied, and travel cruise is turned off.</p>

Climate Control Keypad

Table 3-9. Climate Control Keypad



Item	Name	Description
A	Temperature Set Switches	Adjusts the desired cab temperature UP or DOWN.
B	Windshield Defrost	Turns the fan on and opens the fresh air door to bring in air from outside the cab.
C	Automatic Fan Control Switch	Places the system in a fully automatic temperature control mode including fan speed. The system will adjust the fan speed to the lowest setting necessary to maintain the cab temperature at the displayed set point temperature.
D	Power ON Switch	Turns the control panel ON.
E	Power OFF Switch	Turns the control panel OFF.
F	Fan Speed Set Switches	Overrides the automatic fan speed control feature. Increments the fan speed UP or DOWN in 11 steps. The fan speed set is maintained until it is changed or AUTO is pressed.
G	Cab Temperature Display	Displays the desired cab temperature. To change from Fahrenheit to Celsius, press the temperature UP and DOWN switches at the same time.

NOTE If the optional APU is installed, the climate control system can be operated when the crane engine is off. See [AC Operation on page 3-81](#) for instructions.

Other Operator Aids

Boom Angle Indicator

The boom angle indicator (Figure 3-2), located on the boom butt, shows the angle of the boom in degrees above horizontal.

NOTE The boom, luffing jib, and mast angles can be viewed in the RCL/RCI Display or in the Main Display.

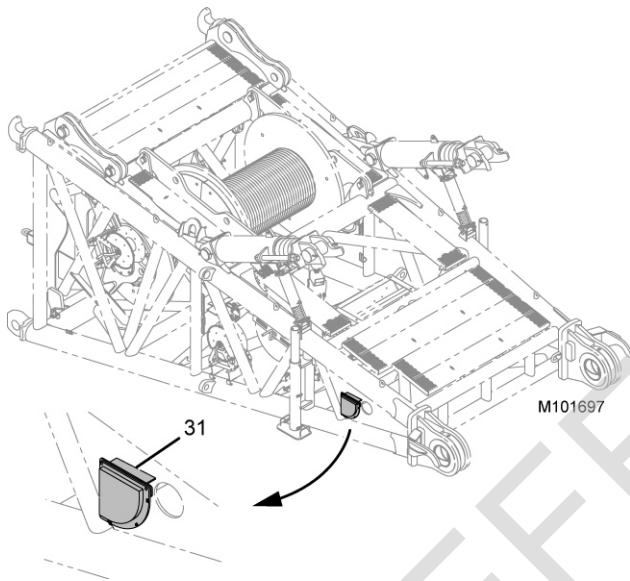


Figure 3-2. Boom Angle Indicator

! WARNING Overload Hazard

Use the boom angle indicator only as a guide to position the boom near the angle corresponding to the radius for a given load.

In all cases, the radius must govern the capacity. Exceeding the radius given in the capacity chart can result in tipping or structural damage.

Crane Capacity Beacons

The purpose of the crane capacity beacons is to alert personnel in the vicinity of the crane of the degree to which the crane is operating within its rated capacity:

- Green Beacon ON = Crane's rated capacity is at a safe level.

- Amber Beacon ON = Crane's rated capacity is approaching the maximum level.
- Red Beacon ON = Crane's rated capacity has been exceeded.

The signal beacons correspond to the color shown in the rated capacity bar or triangle in the RCL/RCI Display in the crane cab.

Upperworks Level

! WARNING

Crane Tipping Hazard

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

Either a 2-way level or a circular level is located on the cab support. Both levels indicated crane levelness from front-to-rear and from side-to-side.

A level is also provided on the front of the carbody for use during crane setup.

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

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

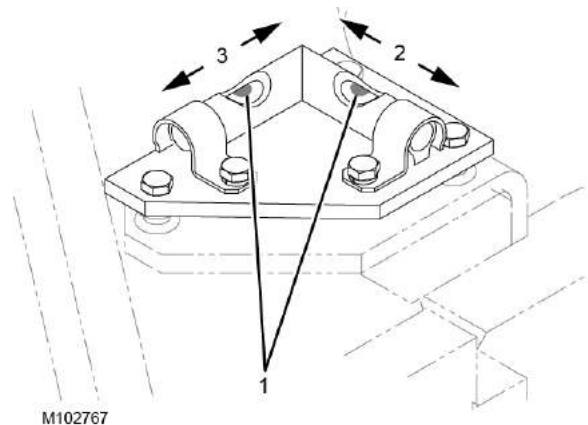


Figure 3-3. 2-Way Level

The circular level (Figure 3-4) indicates crane levelness from front-to-rear and from side-to-side using four concentric rings (2).

- The crane is level when the bubble (1) is centered in the 0° ring of the glass.
- The crane is 1°, 3°, or 5° out of level in the corresponding direction when the bubble is centered in the corresponding ring of the glass.

NOTE Crane pitch and roll can be monitored in the Crane Position Bar of the Main Display Working Screen. See Main Display Operation Manual for instructions.

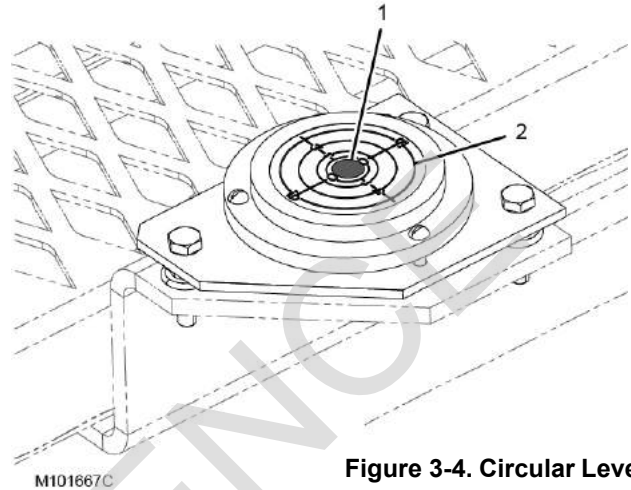


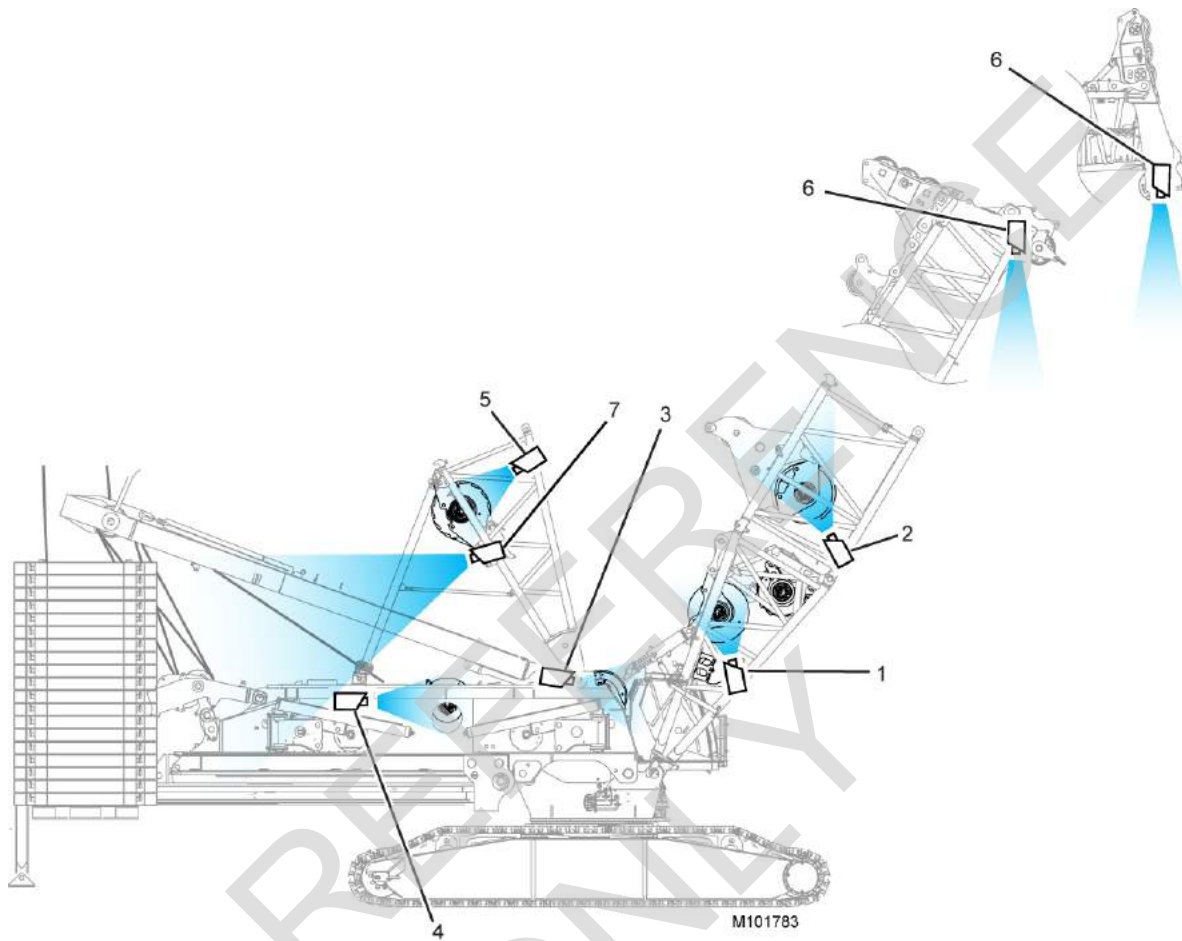
Figure 3-4. Circular Level

FOR REFERENCE ONLY

THIS PAGE INTENTIONALLY LEFT BLANK

Crane Cameras

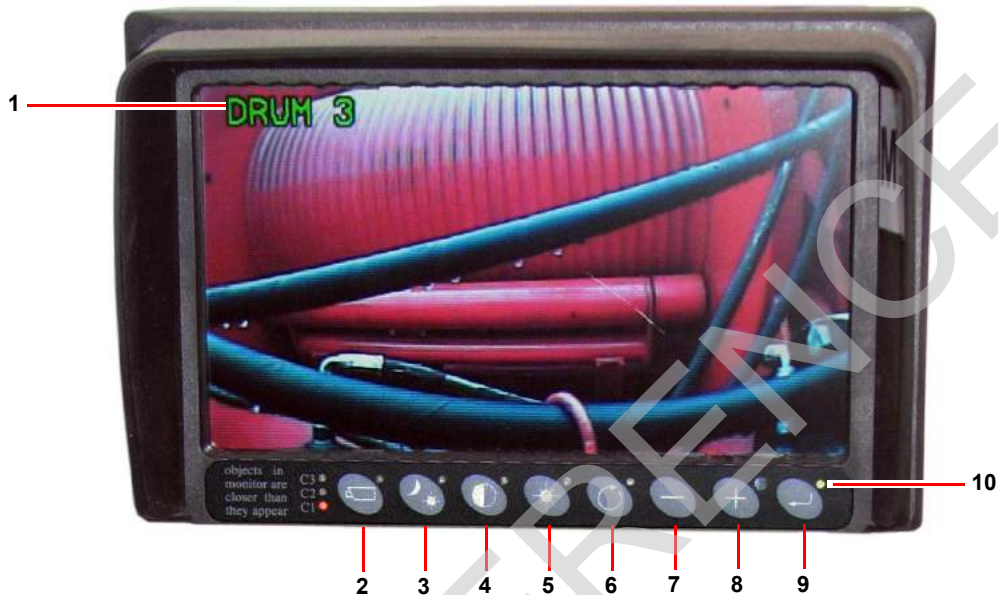
Table 3-10. Crane Camera Locations



Item	Name
1	Camera Points at DRUM 1 and DRUM 6 if equipped (reposition camera to view both drums)
2	Camera Points at DRUM 2
3	Camera Points at DRUM 3
4	Camera Points at DRUM 4
5	Camera Points at DRUM 5
6	Camera Points at LOAD from boom point or from luffing jib point

Crane Camera Monitor

Table 3-11. Camera Monitor Operating Controls



NOTE For detailed information about the camera monitors, refer to the camera manual that is supplied with the crane.

Item	Name	Description
1	Camera label	To change the label (“DRUM 3” in this case), refer to the vendor manual.
2	CAMERA button	After pressing CAMERA, use PLUS or MINUS to select the desired camera.
3	AUTOMATIC BRIGHTNESS button	Press AUTOMATIC BRIGHTNESS. The monitor brightness will adjust automatically to changing light conditions.
4	CONTRAST button	After pressing CONTRAST, use PLUS and MINUS to adjust the monitor contrast.
5	BRIGHTNESS button	After pressing BRIGHTNESS, use PLUS and MINUS to adjust the monitor brightness.
6	OPTION button	Used to go to a previous menu item. Press button for 3 seconds to exit menu screens.
7	MINUS button	After pressing BRIGHTNESS, <i>decreases</i> the monitor brightness. After pressing CONTRAST, <i>decreases</i> the monitor contrast. In the Operator Menu, go to the <i>previous</i> menu option.
8	PLUS button	After pressing BRIGHTNESS, <i>increases</i> the monitor brightness. After pressing CONTRAST, <i>increases</i> the monitor contrast. In the Operator Menu, go to the <i>next</i> menu option.
9	ENTER button	Press once to enter the monitor Operator Menu.
10	Power LED	Glows green when the monitor is powered.

MOTION WARNING LIGHTS AND ALARMS

Table 3-12. Motion Warning Lights and Alarms

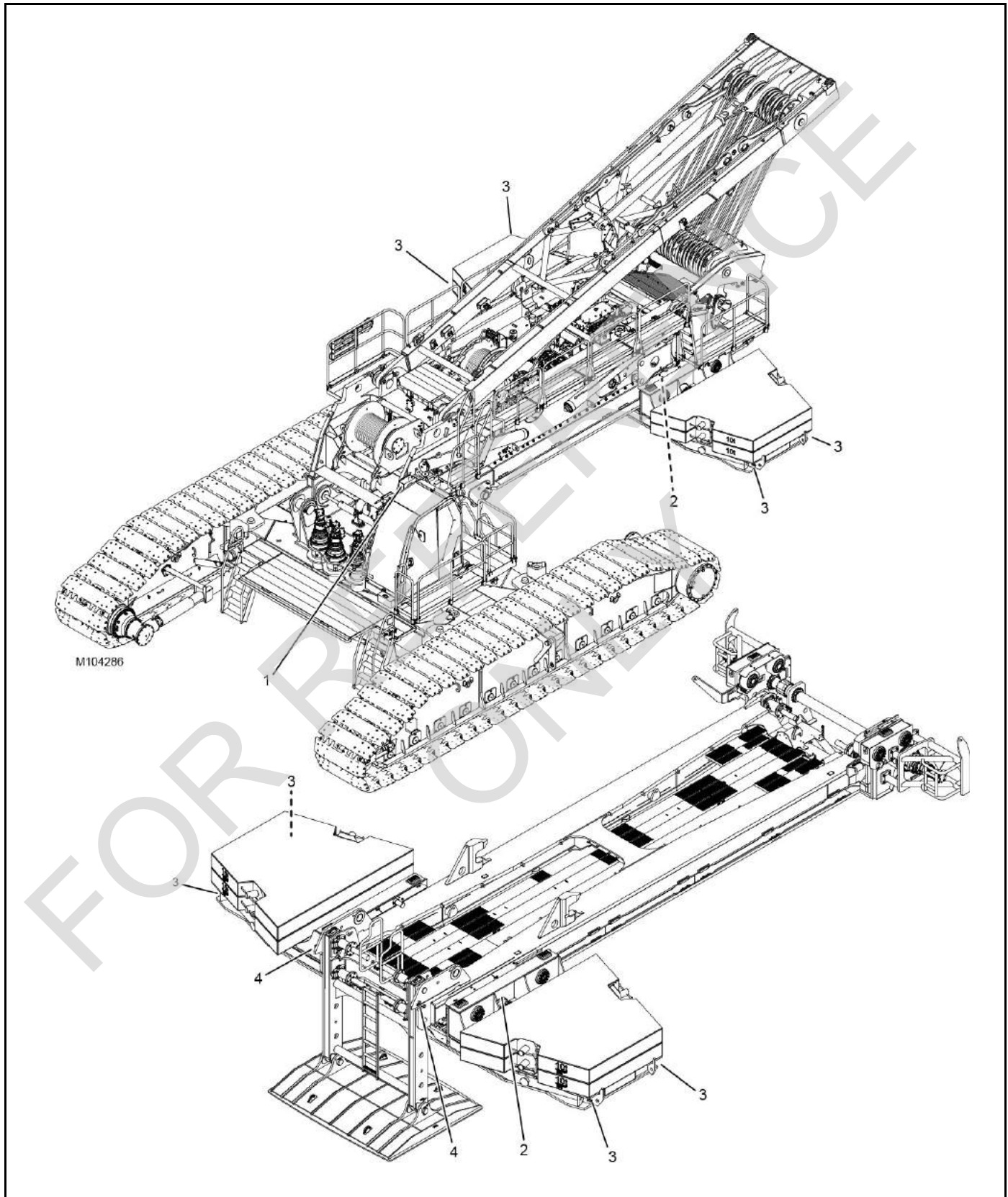


Table 3-12. Motion Warning Lights and Alarms

Item	Name	Description
1	Swing and Travel Alarm	Dual-tone, interrupted alarm that sounds when the swing or either travel control handle is moved in either direction from off. The alarms turn off when the control handles are moved to off.
2	VPC/VPC-MAX Alarm ¹	Dual-tone, interrupted alarm that sounds when the VPC or VPC-MAX actuator or beam moves in either direction. The alarm turns off when the trolley or beam stops moving.
3	VPC/VPC-MAX Counterweight Tray Lights ¹	Amber LED lights that flash when the counterweight tray moves in either direction. The lights turn off when the counterweight tray stops moving. A light is located on each corner of the counterweight tray.
4	VPC-MAX Beam Lights ¹	Amber LED lights that flash when the VPC-MAX beam moves in either direction. The lights turn off when the beam stops moving. A light is located on each rear side of the beam.
¹ The VPC/VPC-MAX alarm and lights will come shortly before the tray or beam starts moving.		

SERVICE LIGHTS

Table 3-13. Service Light Components

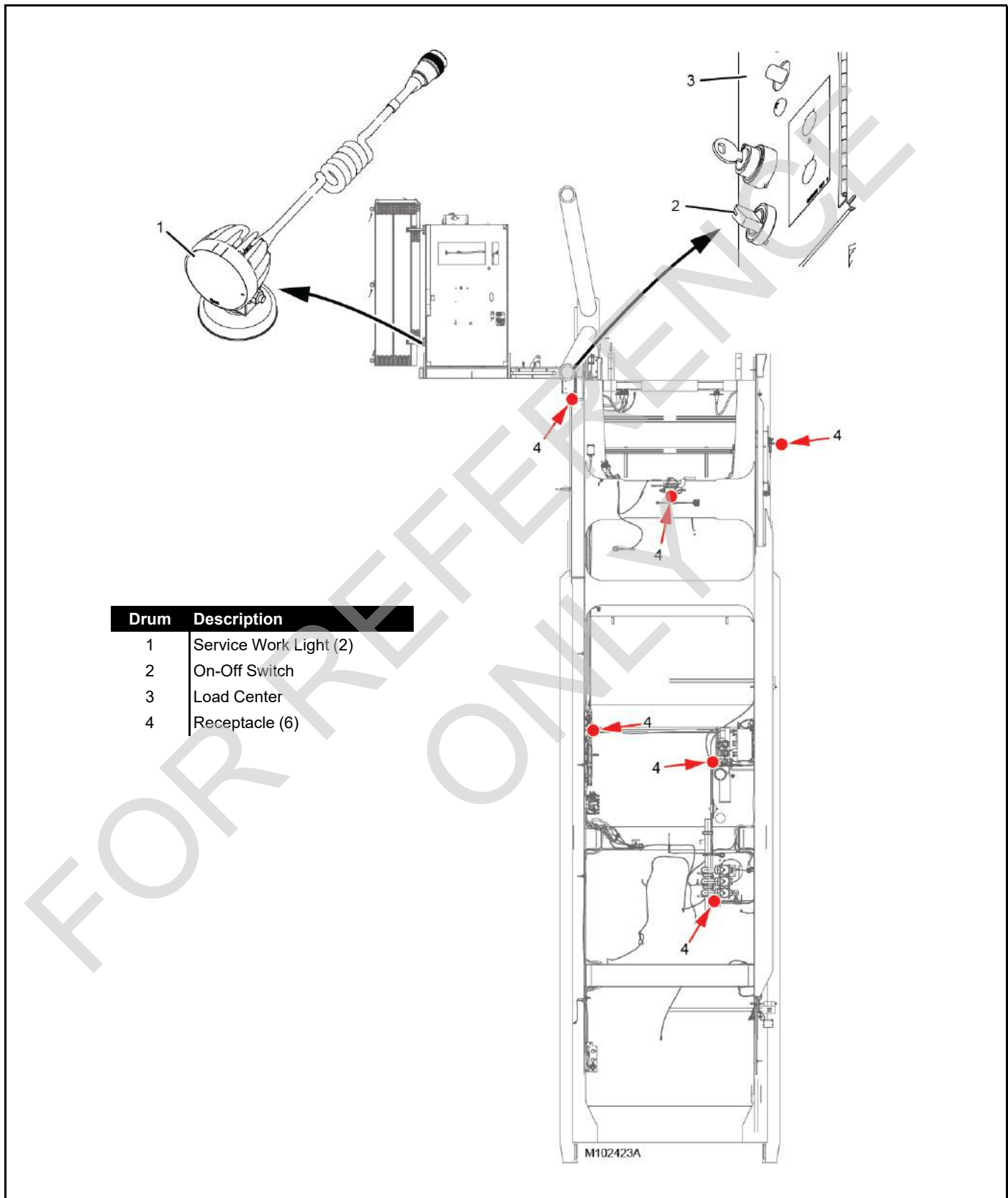
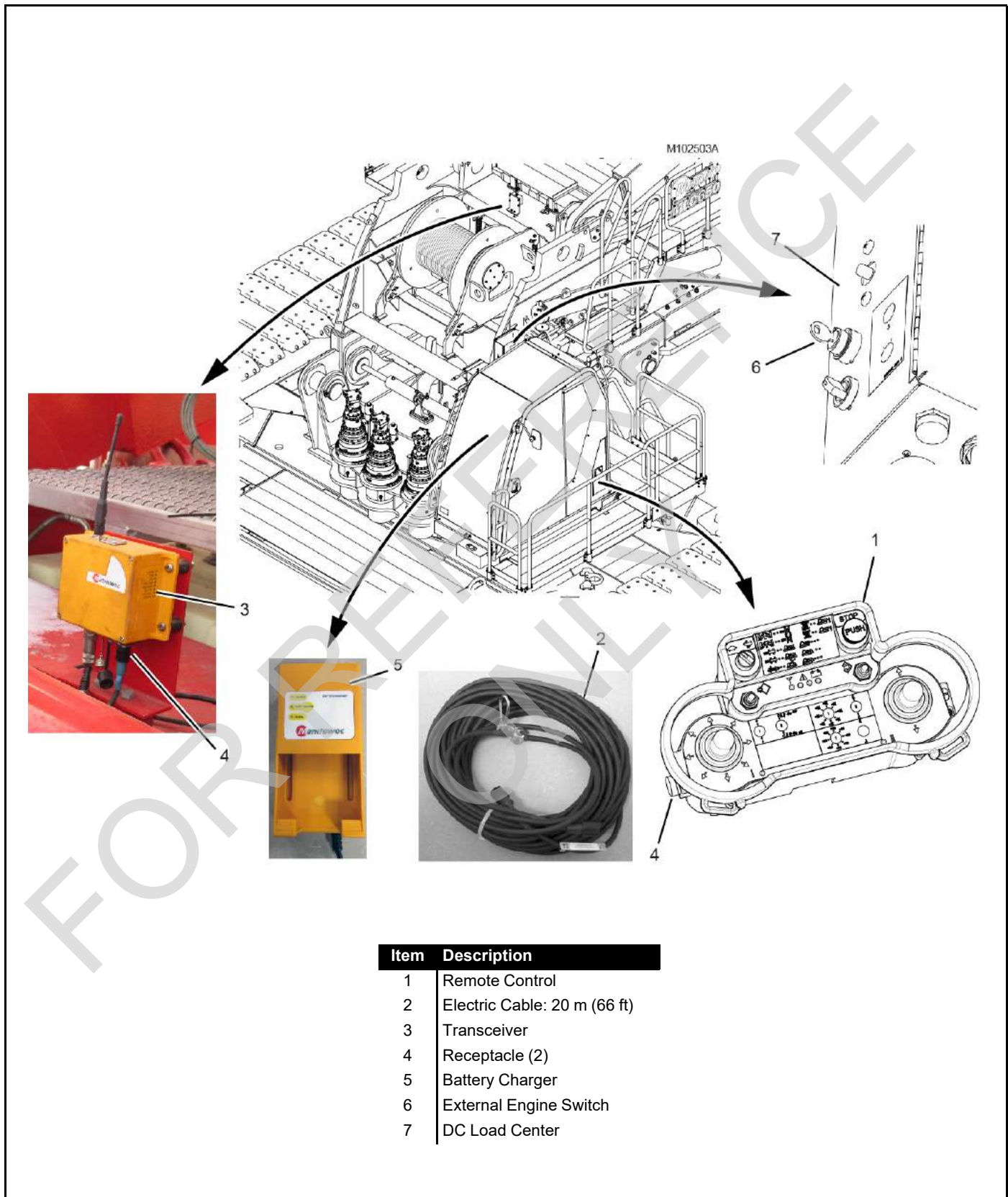


Table 3-13. Service Light Components

Item	Name	Description
1	Portable Service Light	This crane is equipped with two portable service lights (1) stored in the lockable storage compartment on the left side of the operator cab. Each light has an extension cord and magnetic base that allows the light to be mounted and directed in the desired direction.
2	On-Off Switch	The on-off switch is located on the load center (3) on the left-front side of the rotating bed. Turn the knob CLOCKWISE to TURN ON the service lights. Turn the knob COUNTERCLOCKWISE to TURN OFF the service lights. When not in use, turn off the service lights and store them. The crane's batteries could die if the lights are left on when the engine is off.
3	DC Load Center	The DC load center contains fuses and relays for the crane's electric system. It is mounted on the left front corner of the rotating bed.
4	Receptacle	Six receptacles are provided.

REMOTE CONTROL ACTIVATION

Table 3-14. Remote Control Components



Item	Description
1	Remote Control
2	Electric Cable: 20 m (66 ft)
3	Transceiver
4	Receptacle (2)
5	Battery Charger
6	External Engine Switch
7	DC Load Center

Table 3-14. Remote Control Components

Item	Name	Description
1	Remote Control	See Remote Control Operation on page 3-42 . The remote control (1) and the electric cable (2) are stored in the compartment on the left side of the operator's cab. The remote control is powered by a 3.6V, 1.2AH NIMH battery. Two batteries are supplied.
2	Electric Cable	The remote control can be operated without the electric cable (2) (wireless) if job site conditions allow a wireless signal. If you are unable to get a wireless signal, connect the electric cable (2) between the receptacle (4) on the remote control (1) and the receptacle (4) on the transceiver (3).
3	Transceiver	The transceiver transmits and receives signals from the remote control. It is mounted on the front of the rotating bed.
4	Electric Cable	For use if you cannot get a wireless signal.
5	Battery Charger	The battery charger is mounted on the wall in the operator's cab. It charges the batteries supplied with the remote control. The engine must be running to charge the battery.
6	Cab Power Switch	This switch turns on cab power and activates the remote control.
7	DC Load Center	The DC load center contains fuses and relays for the cranes electric system. It is mounted on the left front corner of the rotating bed.

To turn on the remote control:

- Using the key provided, turn the external engine switch (6, [page 3-40](#)) to the RUN position.
- Turn the remote control power switch (1, [page 3-43](#)) CLOCKWISE to the ON (I) position. The communication light (28, [page 3-44](#)) will flash green.
- Press the remote control communication switch (2, [page 3-43](#)) for approximately one second and release it. The remote control function light (9, [page 3-43](#)) for the last function used will glow green.

The remote control will remain on until the external engine switch (6, [page 3-40](#)) is turned COUNTERCLOCKWISE to the STOP position or the remote control is turned off in the Remote Control Selection Screen in the Main Display (see MLC300 Main Display Operation Manual).

The remote control will also turn off (go to sleep) after 10 minutes of non-use. If this happens, press the remote control communication switch (2, [page 3-43](#)) for approximately one second and release it to re-establish communication.

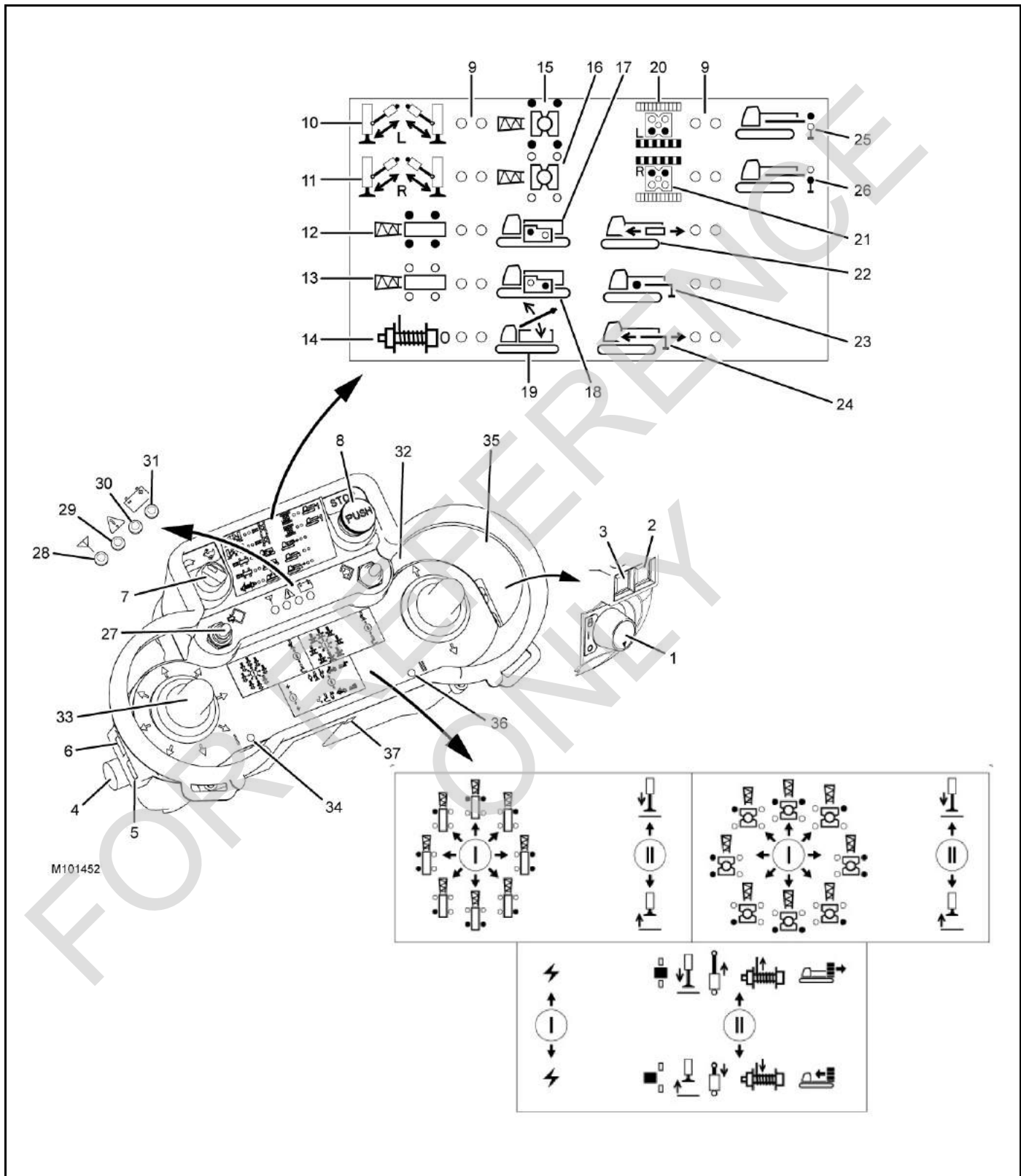
NOTE The remote control can also be turned on in the Remote Control Selection Screen in the Main Display (see MLC650 Main Display Operation Manual).

To start the engine using the remote control:

- Turn on the remote control as instructed above.
- Read [Startup Procedures on page 3-61](#).
- Rotate the remote control power switch (1, [page 3-43](#)) CLOCKWISE to the START position to start the engine.
- Release the power switch (1, [page 3-43](#)) to the ON (I) position as soon as the engine starts.

REMOTE CONTROL OPERATION

Table 3-15. Identification and Operation of Remote Controls



NOTE See Section 4 in this manual for Assembly and Disassembly procedures using the remote control.

Table 3-15. Identification and Operation of Remote Controls

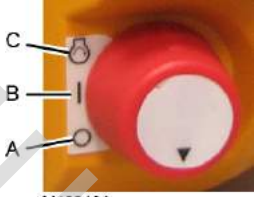

Item	Name	Description
1	Power Switch	<p>The power switch has the following positions:</p> <ul style="list-style-type: none"> • OFF (A): maintained position that turns off the remote control's internal power circuit. • ON (B): maintained position that turns on the remote control's internal power circuit. • Start (C): momentary position that starts the engine. When released, the switch spring returns to the ON (B) position. <p>See Startup Procedures on page 3-61 for engine start precautions.</p>  <p style="text-align: right; font-size: small;">M102464</p>
2	Communication Switch	<p>Press and release the button to TURN ON communication between the remote control and the transceiver. The communication light (27) will flash green.</p> <p>Press and release the button again to TURN OFF communication between the remote control and the transceiver. The communication light (27) will turn off.</p>
3	Horn Switch	<p>PRESS and hold to TURN ON the crane's horn.</p> <p>RELEASE to TURN OFF the crane's horn.</p>
4	Receptacle	<p>The remote control can be operated without an electric cable (wireless) if job site conditions allow transmission of a wireless signal.</p> <p>If you are unable to get a wireless signal, the electric cable (A) supplied by Manitowoc can be connected between the remote control receptacle (4) and the transceiver receptacle (B).</p>  <p style="text-align: right; font-size: small;">M102422C</p>
5-6	Not Used	
7	Speed Switch	<p>Rotate CLOCKWISE to INCREASE engine speed (high).</p> <p>Rotate COUNTERCLOCKWISE to DECREASE engine speed (low).</p>
8	Emergency Stop Switch	<p>When this button is depressed, the engine shuts off and all functions come to a complete stop and are inoperable.</p> <p>For normal engine shut down, use the external engine switch (6, page 3-40).</p> <p>NOTE The button must be pulled up before the engine can be restarted.</p>
9	Function Light	<p>Glow GREEN to indicate which setup function (10 through 25) has been selected.</p>

Table 3-15. Identification and Operation of Remote Controls


10	Upperworks Jack Storage Cylinders, Left	The function light (9) glows GREEN next to the icon for the setup function that has been selected.	
11	Upperworks Jack Storage Cylinders, Right		
12	Upperworks Jacks: ALL jacks operated at the same time.		
13	Upperworks Jacks: Individual jack can be operated.		
14	Rigging Winch		
15	Carbody Jacks: ALL jacks operated at the same time.		
16	Carbody Jacks: Individual jack can be operated.		
17	Rotating Bed Pins, Front		
18	Rotating Bed Pins, Rear		
19	Live Mast Assist Arms		
20	Crawler Pins, Left		
21	Crawler Pins, Right		
22	Counterweight Tray, In/Out		
23	VPC-MAX Pins		
24	VPC-MAX Beam Travel, In/Out		
25	VPC-MAX Beam Pins, Upper		
26	VPC-MAX Beam Pins, Lower		
27	Selector Switch		Move this switch UP or DOWN to scroll through the set up functions (10 through 25) until the green light appears next to the desired function.
28	Communication Light		Flashes GREEN to indicate that there is a good signal between the transceiver and the remote control. If the signal is lost, troubleshoot the system (dead battery or connection, faulty electric cable, faulty electric cable connection).
29	Operating Limit Light		Glows RED to indicate that an operating limit has been reached. See MLC650 Main Display Operation Manual.
30	System Fault Light		Glows AMBER to indicate that a system fault exists. See MLC650 Main Display Operation Manual.
31	Battery Light		Glows RED when the remote control battery (A) is dead. Replace the battery.  Push in and lift out to remove the battery. Reverse the step to install a new battery. M102463
32	Confirm Switch		Move this switch UP and release it to CONFIRM the selected function.

Table 3-15. Identification and Operation of Remote Controls




33	I Control Handle	Controls the functions identified by this icon  on the decals next to the control handle.
34	Handle Indicator Light	Glows BLUE when the control handle I is operated.
35	II Control Handle	Controls the functions identified by this icon  on the decals next to the handle.
36	Handle Indicator Light	Glows BLUE when the control handle II is operated.
37	Identification Number	<p>Each remote control has a unique identification number (A) on the side of the unit. This number must be entered in the Main Display when turning on the remote control in the Remote Control Selection Screen. See MLC650 Main Display Operation Manual for instructions.</p> 
Setup Function Operation		
Upperworks Jack Storage Cylinders, Left	<ul style="list-style-type: none"> • Select and confirm item 10. • Move the control handle I in either direction to energize the function. • Move the control handle II FORWARD to EXTEND the left side storage cylinders (lower jacks) or move the control handle II REARWARD to RETRACT the left side storage cylinders (raise jacks). 	
Upperworks Jack Storage Cylinders, Right	<ul style="list-style-type: none"> • Select and confirm item 11. • Move the control handle I in either direction to energize the function. • Move the control handle II FORWARD to EXTEND the right side storage cylinders (lower jacks) or move the control handle II REARWARD to RETRACT the right side storage cylinders (raise jacks). 	
All Rotating Bed Jacks (at same time)	<ul style="list-style-type: none"> • Select and confirm item 12. • Move the control handle I either in direction to energize the function. • Move the control handle II FORWARD to EXTEND all of the jacks or move the control handle II REARWARD to RETRACT all of the jacks. 	
Individual Rotating Bed Jack	<ul style="list-style-type: none"> • Select and confirm item 13. • Move the control handle I in the required direction to select the desired jack. • Move the control handle II FORWARD to EXTEND the jack or move the control handle II REARWARD to RETRACT the jack. 	
Rigging Winch (Drum 0)	<ul style="list-style-type: none"> • Select and confirm item 14. • Move the control handle I in either direction to energize the function. • Move the control handle II FORWARD to PAY OUT the rigging line or move the control handle II REARWARD to HAUL IN the rigging line. 	

Table 3-15. Identification and Operation of Remote Controls

All Rotating Carbody Jacks (at same time)	<ul style="list-style-type: none"> • Select and confirm item 15. • Move the control handle I either in direction to energize the function. • Move the control handle II FORWARD to EXTEND all of the jacks or move the control handle II REARWARD to RETRACT all of the jacks.
Individual Carbody Jack	<ul style="list-style-type: none"> • Select and confirm item 16. • Move the control handle I in the required direction to select the desired jack. • Move the control handle II FORWARD to EXTEND the jack or move the control handle II REARWARD to RETRACT the jack.
Adapter Frame to Rotating Bed Pins, Front	<ul style="list-style-type: none"> • Select and confirm item 17. • Move the control handle I in either direction to energize the function. • Move the control handle II FORWARD to ENGAGE the front rotating bed pins or move the control handle II REARWARD to DISENGAGE the front rotating bed pins.
Rotating Bed to Adapter Frame Pins, Rear	<ul style="list-style-type: none"> • Select and confirm item 18. • Move the control handle I in either direction to energize the function. • Move the control handle II FORWARD to ENGAGE the rear rotating bed pins or move the control handle II REARWARD to DISENGAGE the rear rotating bed pins.
Live Mast Assist Arms	<ul style="list-style-type: none"> • Select and confirm item 19. • Move the control handle I in either direction to energize the function. • Move the control handle II FORWARD to EXTEND the mast assist arms and cylinders or move the control handle II REARWARD to RETRACT the mast assist arms and cylinders.
Crawler Pins, Left	<ul style="list-style-type: none"> • Select and confirm item 20. • Move the control handle I in either direction to energize the function. • Move the control handle II FORWARD to ENGAGE the left crawler pins or move the control handle II REARWARD to DISENGAGE the left crawler pins.
Crawler Pins, Right	<ul style="list-style-type: none"> • Select and confirm item 21. • Move the control handle I in either direction to energize the function. • Move the control handle II FORWARD to ENGAGE the right crawler pins or move the control handle II REARWARD to DISENGAGE the right crawler pins.
Counterweight Tray, In/Out	<ul style="list-style-type: none"> • Select and confirm item 22. • Move the control handle I in either direction to energize the function. • Move the control handle II FORWARD to travel the counterweight tray OUT or move the control handle II REARWARD to travel the counterweight tray IN.
VPC-MAX Trolley to Beam Pins	<ul style="list-style-type: none"> • Select and confirm item 23. • Move the control handle I in either direction to energize the function. • Move the control handle II FORWARD to ENGAGE the pins or move the control handle II REARWARD to DISENGAGE the pins.
VPC-MAX Beam Travel, In/Out	<ul style="list-style-type: none"> • Select and confirm item 24. • Move the control handle I in either direction to energize the function. • Move the control handle II FORWARD to travel the beam OUT or move the control handle II REARWARD to travel the beam IN.

Table 3-15. Identification and Operation of Remote Controls

VPC-MAX Beam Rear Pins, Upper	<ul style="list-style-type: none"> • Select and confirm item 25. • Move the control handle I in either direction to energize the function. • Move the control handle II FORWARD to ENGAGE the upper pins or move the control handle II REARWARD to DISENGAGE the upper pins.
VPC-MAX Beam Rear Pins, Lower	<ul style="list-style-type: none"> • Select and confirm item 26. • Move the control handle I in either direction to energize the function. • Move the control handle II FORWARD to ENGAGE the lower pins or move the control handle II REARWARD to DISENGAGE the lower pins.

OPERATING LIMITS IDENTIFICATION AND OPERATION

The following table lists the operating limits this crane is equipped with and identifies which of those limits are bypassable. When a limit is reached, the operating limit fault is activated and the corresponding fault icon appears in the fault bar of the Main Display Working Screen (see [Table 3-17. Operating Limits Description on page 3-49](#)).

Table 3-16. Operating Limits Identification

Limit	Bypassable		Bypassable with Luffing Jib Setup Mode On ¹		Bypassable with External Override Switch ²
	See Limit Bypass Key Switch on page 3-19				
	Non-CE ³	CE ³	Non-CE ³	CE ³	CE ³
Bail, Minimum (each drum)	No	No	No	No	No
Block Up (each drum)	Yes	Yes ⁴	Yes	Yes	No
Boom Max Up	No	No	No	No	No
Crane Out of Level	No	No	No	No	No
Function Diverted	No	No	No	No	No
Function Parked	No	No	No	No	No
Gantry Down	Yes	Yes	No	No	No
Inactive Control Station (CE only)	No	No	No	No	No
Luffing Jib Maximum Down 1	Yes	No	Yes	Yes	No
Luffing Jib Maximum Down 2	No	No	No	No	No
Luffing Jib Maximum Up 1	Yes	No	Yes	Yes	No
Luffing Jib Maximum Up 2	Yes ⁵	No	Yes ⁵	Yes ⁵	No
Luffing Jib Stop Misaligned	Yes ⁷	Yes ⁷	Yes ⁵	Yes ⁵	No
Mast (live) Accessory Fault	No	No	No	No	No
Mast Arms Down	Yes	Yes	No	No	No
Mast Arms Up	Yes	Yes	No	No	No
Mast Too Far Back	Yes	Yes	No	No	No
Mast Too Far Forward	Yes	Yes	No	No	No
Mast (fixed) Stop	No	No	No	No	No
Operator Out of Seat	No	No	No	No	No
Pawl Engaged	No	No	No	No	No
Rated Capacity Indicator/Limiter	Yes	Yes ⁴	Yes	Yes ⁴	Yes ⁶
Transducer Fault	No	No	No	No	No
Travel on Grade with VPC Unlocked	No	No	No	No	No
VPC Setup Prohibited	No	No	No	No	No
VPC Setup Required	No	No	No	No	No
VPC Sensor	No	No	No	No	No

¹ Use only for rigging. See [Bypassing Limits in Luffing Jib Setup Mode on page 3-54](#).

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

³ CE = Cranes that comply with 2010 European requirements.

⁴ Only if boom or luffing jib is below allowable angle given in capacity chart (while raising or lowering boom and luffing jib from or to ground level).




⁵ Only when boom is below 50°.









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






⁷ Only when boom is below 30°.










The following table describes the operating limits this crane is equipped with. When a limit is reached, the operating limit fault is activated and the corresponding fault icon appears in the fault bar of the Main Display Working Screen.

Table 3-17. Operating Limits Description

Operating Limit	Icon
<p>Bail, Minimum</p> <p>This limit stops the corresponding drum from lowering when there are three to four wraps of wire rope remaining on the drum.</p> <ul style="list-style-type: none"> • The load can be raised after the limit is contacted. • This limit can only be bypassed by disconnecting the electric cable from the limit switch and connecting the shorting plug. <p style="text-align: center;">! WARNING Falling Load Hazard!</p> <p>When lowering a load below the minimum bail limit, do so slowly with extreme caution. Do not lower the load to the point where less than three full wraps of wire rope are on the drum. The wire rope could be pulled out of the drum allowing the load to fall.</p>	 <p>M102775</p>
<p>Block Up</p> <p>In the non-setup mode, this limit stops the boom or luffing jib from lowering and the load drum from hoisting when the load contacts a block-up limit switch.</p> <ul style="list-style-type: none"> • The load on the corresponding drum can be lowered and the boom or luffing jib can be raised after a block-up limit switch is contacted. • The limit bypass switch must be turned to the bypass position before a load can be hoisted above the limit. <p style="text-align: center;">! WARNING Two-Blocking Hazard!</p> <p>If it is necessary to hoist a load above the block-up limit, do so slowly with extreme caution to prevent two-blocking.</p> <p>Do not hoist the load above the minimum block clearance given in the Reeving Diagrams (see Section 4 of the MLC650 Operator Manual).</p> <p>Do not use the limit bypass switch to lower the boom or the luffing jib after the block-up limit is contacted, or two-blocking could occur. The load could fall.</p>	 <p>M102773</p>
<p>Boom Max Up</p> <p>This limit stops the boom when the boom is raised to one of the following maximum angles:</p> <ul style="list-style-type: none"> • 84.5° for boom only WITH VPC-MAX attachment • 86.4° for boom with luffing jib and WITH VPC-MAX attachment • 86.4° for boom only WITHOUT VPC-MAX attachment • 86.4° for boom with luffing jib and WITHOUT VPC-MAX attachment <p>The boom can be lowered after this limit is reached.</p>	 <p>M102777</p>

Operating Limit	Icon
<p>Crane Out of Level</p> <p>This limit stops the rotating bed jacks and prevents further jacking with the ALL jacking function of the remote control if the rotating bed is out of level the following amount:</p> <ul style="list-style-type: none"> • 4-1/2° from side to side. • 3° from front to rear. <p>The amber warning light on the remote control will come on.</p> <p>Level the rotating bed with the INDIVIDUAL jacking function of the remote control.</p>	 <p>M102778</p>
<p>Function Diverted</p> <p>This limit prevents the selected crane function from being operated if hydraulic oil is being diverted away from the circuit. Park the function that the hydraulic oil is currently being diverted to. See Operation of Diverting Circuits on page 3-27.</p>	 <p>M102779</p>
<p>Function Parked</p> <p>This limit prevents the selected crane function from being operated until the park switch is turned off (un-parked).</p>	 <p>M102772</p>  <p>M104949</p>
<p>Gantry Down</p> <p>With the Setup Mode ON, this limit stops the mast if the gantry is down during the following operations:</p> <ul style="list-style-type: none"> • Booming down with the mast above 70°. • Booming up with the mast below 113°. <p>With the Setup Mode OFF, this limit stops all booming when the gantry is down.</p> <p style="text-align: center;"> WARNING Falling Boom!</p> <p>Do not operate the live mast or the boom until the gantry is properly raised and pinned. Structural damage could result, possibly causing the boom and luffing jib to collapse.</p> <p>See Section 4 of the MLC650 Operator Manual for gantry raising instructions.</p>	 <p>M102780</p>
<p>Inactive Control Station</p> <p>This limit applies only to cranes meeting CE requirements.</p> <p>This limit prevents the cab controls from being operated when the remote control is being operated.</p> <p>The remote control has priority. Therefore, if the cab controls are being operated and the remote control becomes active, the cab controls will be disabled.</p>	 <p>M102791</p>
<p>Luffing Jib Maximum Down 1 (minimum working angle)</p> <p>This programmed limit stops the luffing jib from lowering when the boom-to-luffing jib angle is 70°.</p> <ul style="list-style-type: none"> • The luffing jib can be raised after this limit is reached. • The limit bypass switch must be turned to the bypass position to lower the jib to the Luffing Jib Maximum Down 2 limit. 	 <p>M102792</p>

Operating Limit	Icon
<p>Luffing Jib Maximum Down 2 (minimum angle)</p> <p>A limit switch stops the luffing jib before the boom-to-luffing jib angle is 68.5°.</p> <ul style="list-style-type: none"> • This limit cannot be bypassed. • If this limit is contacted on cranes meeting CE requirements, the luffing jib cannot be raised until the limit is reset. See Resetting Luffing Jib Limits on page 3-55. <p style="text-align: center;">! WARNING Falling Boom/Jib Hazard!</p> <p>Do not lower the luffing jib below the minimum angle given in the Luffing Jib Raising (and lowering) Procedure chart. Structural damage could result, possibly causing the boom and luffing jib to collapse.</p>	 <p>M102781</p>
<p>Luffing Jib Maximum Up 1 (maximum working angle)</p> <p>This programmed limit stops the luffing jib when the boom-to-luffing jib angle is 170°.</p> <ul style="list-style-type: none"> • The luffing jib can be lowered after this limit is reached. • The limit bypass switch must be turned to the bypass position to raise the jib an additional 1.5° to the Luffing Jib Maximum Up 2 limit. <p style="text-align: center;">! WARNING Falling Boom/Jib Hazard!</p> <p>Proceed slowly when operating the luffing jib above the Luffing Jib Maximum Up 1 limit.</p> <p>Do not raise the luffing jib above the Luffing Jib Maximum Up 2 limit. Structural damage will occur, possibly causing the boom and luffing jib to be pulled over backwards.</p>	 <p>M102782</p>
<p>Luffing Jib Maximum Up 2 (maximum angle)</p> <p>A limit switch stops the luffing jib before the boom-to-luffing jib angle is 171.5°.</p> <ul style="list-style-type: none"> • This limit cannot be bypassed. • If this limit is contacted on cranes meeting CE requirements, the luffing jib cannot be raised until the limit is reset. See Resetting Luffing Jib Limits on page 3-55. 	 <p>M102783</p>
<p>Luffing Jib Stop Misaligned</p> <p>This limit stops the corresponding hoist if:</p> <ul style="list-style-type: none"> • you try to luff up when either jib stop is not fully extended (raised). The limit can be bypassed in the luffing jib setup mode only if the boom angle is less than 50°. • you try to boom down or luff up when either jib stop is fully extended (raised) and the boom angle is less than 30°. 	 <p>M103337</p>
<p>Mast (live) Accessory Fault</p> <p>If the crane is configured with a live mast only, this limit stops the mast hoist from operating in either direction. Check the pressure transducers for the live mast hoist and the accessory system.</p>	 <p>M102783</p>

Operating Limit	Icon
<p>Mast Arms Down</p> <p>With the Setup Mode ON, this limit stops the boom hoist if you attempt to raise the live mast when the mast arms are down.</p> <p style="text-align: center;"> WARNING Falling Mast/Boom Hazard!</p> <p>Prevent the mast from falling over backwards:</p> <ul style="list-style-type: none"> Fully raise the mast-assist arms before raising the live mast to vertical. The mast can fall over backwards if this precaution is not taken. 	 M102799
<p>Mast Arms Up</p> <p>With the Setup Mode OFF (any boom or jib configuration selected in RCL/RCI), this limit stops the boom hoist if you attempt to raise the boom when the mast assist arms are up.</p> <p style="text-align: center;"> WARNING Falling Mast/Boom Hazard!</p> <p>Prevent the mast and the boom from falling:</p> <ul style="list-style-type: none"> Fully lower the mast-assist arms before raising the boom. The mast can buckle and collapse if it contacts the mast-assist arms with a fully rigged boom. 	 M102798
<p>Mast too Far Back</p> <p>This limit stops the boom hoist when the live mast is lowered rearward to 2°. Finish lowering the mast to the transport position (0°) manually with the switch on the remote control or on the right console in the cab.</p>	 M102784
<p>Mast too Far Forward</p> <p>The fault alarm for this limit is activated when the live mast is lowered forward to 158° during crane assembly and disassembly.</p> <p style="text-align: center;"> WARNING Falling Mast Hazard!</p> <p>Do not lower the mast below the specified angle. Raise the live mast when this fault is activated. Further lowering is not approved - <i>the mast could fall.</i></p>	 M102785
<p>Mast (fixed) Stop</p> <p>This limit stops boom hoist operation if the mast stop cylinders retract for any reason. The cylinders must be extended at all times.</p>	 M103337
<p>Operator Out of Seat</p> <p>This limit prevents the crane functions from being operated when the operator is out of the seat. Sit down in the seat to operate the crane functions.</p>	 M102790

Operating Limit	Icon
<p>Pawl Engaged</p> <p>This limit prevents the drum from lowering until the pawl is disengaged from the ratchet. It may be necessary to hoist slightly to fully disengage the pawl.</p>	 <p>M102794</p>
<p>Rated Capacity Limiter</p> <p>This fault is activated for the following conditions. Take immediate corrective action.</p> <ul style="list-style-type: none"> • Overload • Sensor fault • Out of the capacity chart (a condition that is not covered by the current capacity chart) • Unconfirmed or invalid RCL/RCI configuration. 	 <p>M102787</p>
<p>Transducer Fault</p> <p>In the setup mode, this limit stops operation if there is a transducer fault. Troubleshoot the hydraulic system using the screens in the Main Display to determine the faulty transducer. Take corrective action to correct the fault.</p>	 <p>M102793</p>
<p>Travel on Grade with VPC Unlocked (only for a crane without VPC-MAX)</p> <p>This limit prevents travel on a grade greater than 7%. Always lock VPC before traveling onto any grade.</p>	 <p>M103070</p>
<p>VPC Setup Required</p> <p>NOTE The VPC setup mode must be ON anytime the boom is suspended and operated out of the capacity chart.</p> <p>It is normal for the counterweight to move in or out when the VPC setup mode is on.</p> <p>This limit prevents the boom from being raised from ground level until the VPC Setup Mode is turned on.</p> <p>When the boom angle is out of the capacity chart, this limit stops the boom from being lowered until the VPC setup mode is turned on.</p>	 <p>M102795</p>
<p>VPC Setup Prohibited</p> <p>NOTE The VPC setup mode must be OFF anytime the boom is suspended and operated within the capacity chart.</p> <p>When the boom angle is within the capacity chart, this limit stops the boom from being raised or lowered until the VPC setup mode is turned off.</p>	 <p>M102796</p>
<p>VPC Sensor</p> <p>This limit prevents operation if the VPC has not been properly calibrated or if there is a boom angle or jib angle sensor fault.</p>	 <p>M102797</p>

BYPASSING LIMITS IN LUFFING JIB SETUP MODE

1. Go to the Luffing Jib Setup Screen (1) in the Main Display (Figure 3-5).

See the MLC650 Main Display Operation Manual for detailed instructions.

2. Turn the luffing jib setup mode ON (2).

The luffing jib setup icon (3) in the Status Bar of the Main Display will turn orange.

3. Rotate the limit bypass key CLOCKWISE and release it. The limits will remain bypassed for 10 seconds.

4. Move the desired control handle (luffing hoist, boom hoist, load drum) in the required direction. The limits will remain bypassed for as long as the control handle is moved in either direction.

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

6. Turn the luffing jib setup mode OFF (4) for normal operation when done with luffing jib setup.

The luffing jib setup icon (5) in the Status Bar of the Main Display will turn light blue.

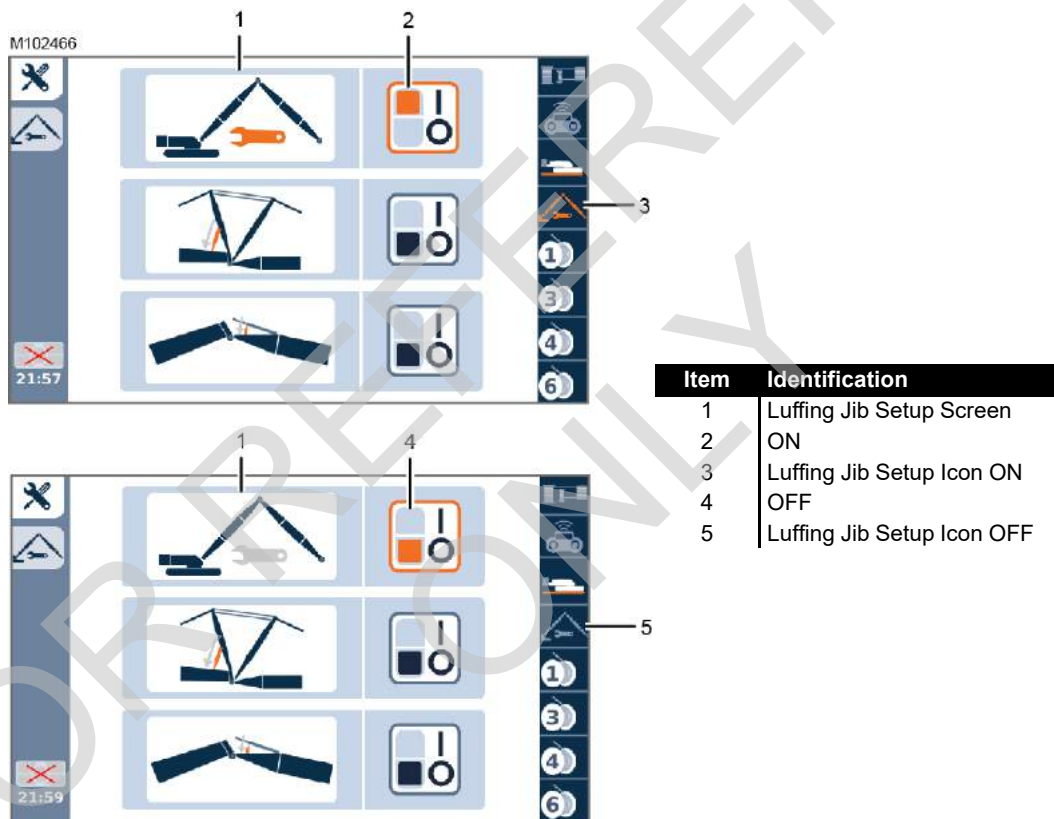


FIGURE 3-5

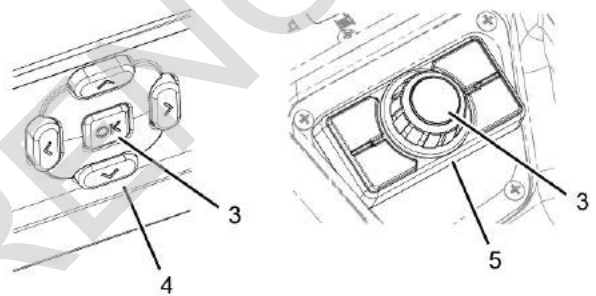
Resetting Luffing Jib Limits

This procedure applies only to cranes meeting CE requirements. See [Figure 3-6](#).

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

When either prompt appears:

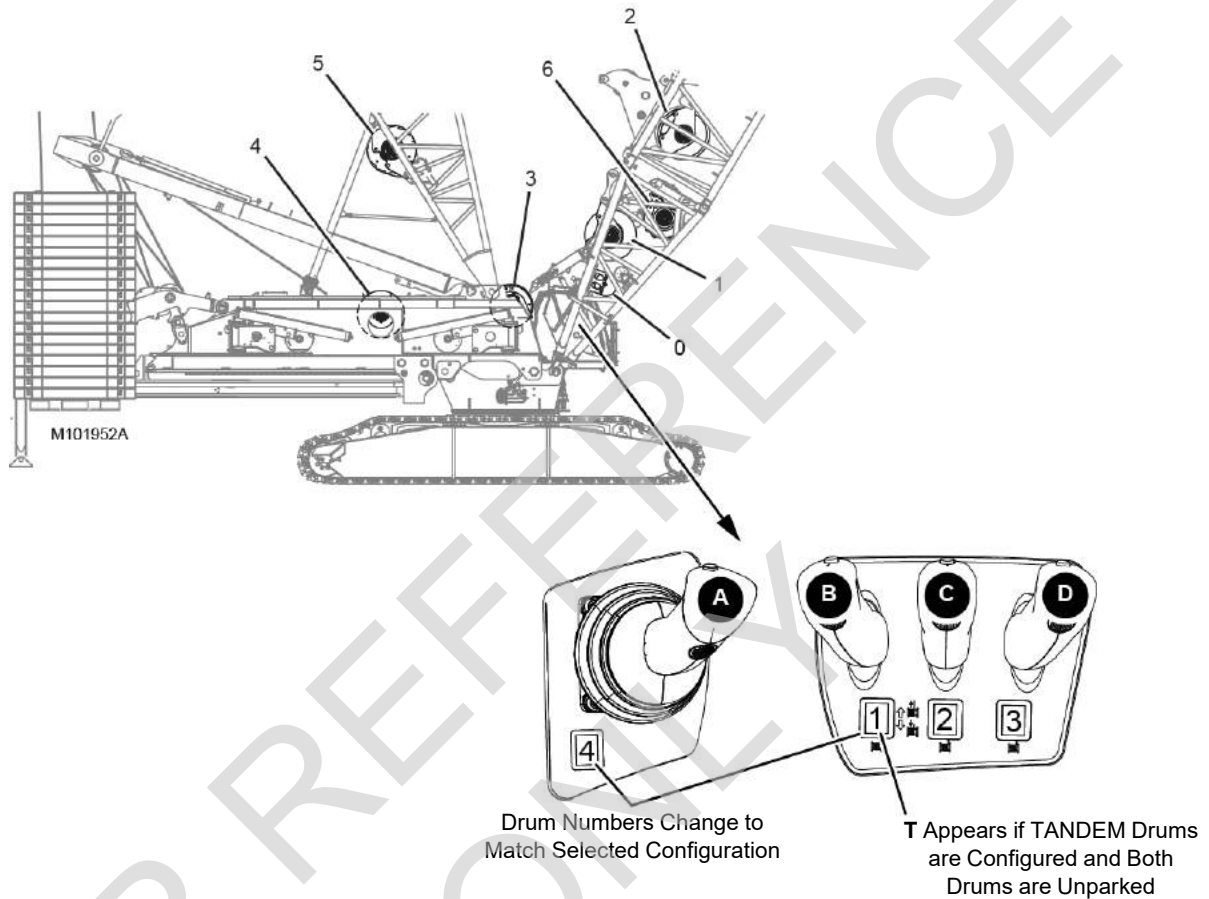
1. Release the control handle to off.
2. Press either select button (3) to reset the limit.
3. The prompt will go off and you will be able to operate the luffing jib in the opposite direction, down or up.



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

Figure 3-6. Resetting Luffing Jib Limits

DRUM AND CONTROL HANDLE IDENTIFICATION



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

Figure 3-7. Drum Identification

Configuration	HANDLE A Controls Drum	HANDLE B ⁶ Controls Drum	HANDLE C Controls Drum	HANDLE D Controls Drum
With Live Mast (without fixed mast)				
Live Mast Handling (crane assembly) ¹	4	1	3 or 2 ²	AC ³ or 5 ⁴
Boom only	4	1	2	3
Boom with Fixed Jib	4	1	2	3
Boom with Luffing Jib	6	1	3 or 2 ²	4 or 3 ²
Boom with Luffing Jib and Fixed Jib	6	1	3 or 2 ²	4 or 3 ²
With Live Mast and Fixed Mast				
Fixed Mast Handling (crane assembly) ⁵	4	1	3 or 2 ²	5
Boom only	5	1	2	3
Boom with Fixed Jib	5	1	2	3
Boom with Luffing Jib	6	1	3 or 2 ²	5 or 3 ²
Boom with Luffing Jib and Fixed Jib	6	1	3 or 2 ²	5 or 3 ²

¹ Live Mast Configuration selected in RCL/RCI display.

² Combination of parked and un-parked drums determines which drums are operable.

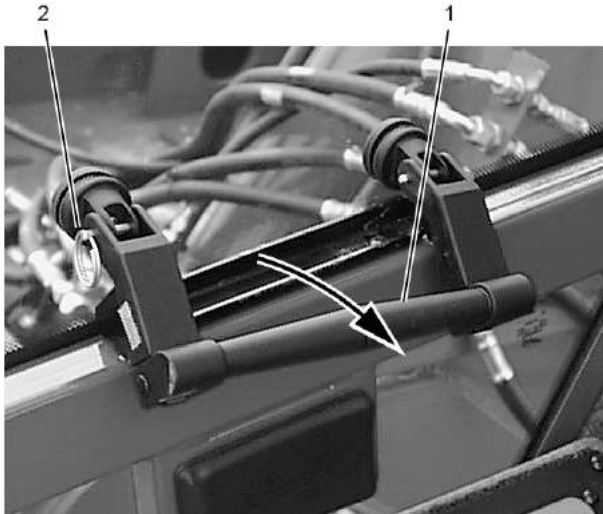
³ AC: Handle D provides proportional control of the self-erect cylinder (assembly cylinder). For current production cranes (CCM-10 software version 0.022 and newer), the self-erect cylinder must be turned ON in the Mode Selection Group of the main display.

⁴ For past production cranes, Drum 2 parked and Drum 5 un-parked allows Drum 5 operation. For current production cranes, turning off the self-erect cylinder in the Mode Selection Group of the main display allows Drum 5 operation.

⁵ Fixed Mast Configuration selected in RCL/RCI display.

⁶ When TANDEM drums are configured in the RCL/RCI, Handle B controls both drums simultaneously when both drums are un-parked. To control the drums independently when TANDEM drums are configured, see the NOTE on [page 71](#).

Figure 3-7 continued. Drum Identification



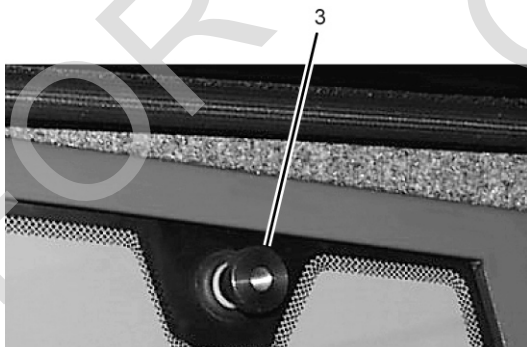
M101948

View A



M101947

View B



View C

Item	Description
1	Window Latch Handle
2	Quick-Release Pin (2)
3	Knob

Figure 3-8. Right Cab Window

RIGHT CAB WINDOW OPERATION

See [Figure 3-8](#) for the following procedure.

Closing Window

Rotate the window latch handle DOWN to the position shown in View A.

Opening Window For Ventilation

Rotate the window latch handle UP to the position shown in View B. The window can be swung open approximately 76 mm (3 in) for ventilation.

OPERATOR'S CAB EMERGENCY EXIT

The operator has two choices for exiting the cab in an emergency if the cab door is not operable:

Through the right cab window ([Figure 3-8](#)), as follows:

1. Pull out both quick-release pins (2, View A) at the handle (1).
2. Remove both knobs (3, View C) at top of the window.
3. Push the window out to exit the operator's cab.

Or, using the life hammer provided ([Figure 3-9](#)), smash the front window to exit the operator's cab.

The hammer is stored on the left wall inside the operator's cab.



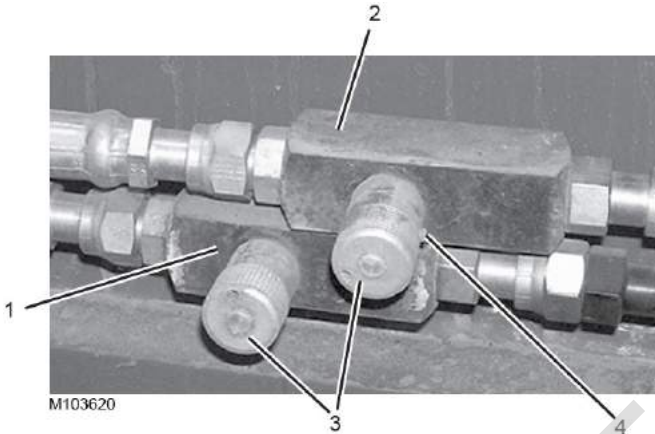
M102486

Figure 3-9. Life Hammer

CAB DOOR ADJUSTMENT

Refer to F2297 at the end of this section for Vision Cab Door Adjustment procedures (for example: door brake and door damper).

Item	Description
1	Tilt DOWN Flow Control Valve
2	Tilt UP Flow Control Valve
3	Adjusting Knob
4	Set Screw



Near Cab On Left Side of the Rotating Bed

Figure 3-10. Cab Tilt Valves

CAB TILT ADJUSTMENT

To adjust the speed at which the cab tilts up and down, proceed as follows.

See [Figure 3-10](#) for the following procedure:

1. Loosen the set screws.
2. Turn the knobs fully clockwise to close the valves.
3. Open both valves slightly.
4. Test the cab tilt operation with the switch on the control console in the cab.

5. Repeat the steps until the cab tilt starts and stops smoothly in both directions.
6. Securely tighten the set screws.

OPERATING IN WIND

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

Do not raise boom for the purpose of measuring the wind speed with the crane's anemometer.



WARNING

Tipping Crane Hazard

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

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

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

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

As a general rule, ratings and operating speeds must be reduced when the **wind causes load to swing forward past allowable operating radius or sideways past either boom hinge pin.**

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

CRAWLER BLOCKING



DANGER

Tipping Hazard!

Do not attempt to raise or lower the boom or the boom and jib from or to ground level until the crawlers are blocked, if required. Otherwise, the crane will tip.

To prevent the crane from tipping, some boom and jib lengths require blocked crawlers. See the appropriate Liftcrane Boom or Jib Capacities chart for blocked crawler requirements.

For crawler blocking dimensions and instructions, see the Crawler Blocking topic in the Capacity Chart Information folio located in the Capacity Chart Manual supplied with the crane.

INTERMEDIATE SUSPENSION

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 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.

PREPARING CRANE FOR OPERATION



WARNING

Read Capacity Charts

Do not attempt to operate the crane without first reading and understanding the capacity charts located in the Capacity Chart Manual provided with the crane.

The crane must be rigged and operated according to the instructions given in the capacity charts, in Section 4 of the MLC650 Operator Manual, and in Section 4 of the MLC650 Luffing Jib Manual.

Unless otherwise specified in the capacity charts, all crane operations must be performed with the crane level to within one 1% of grade in all directions — 0,3 m in 30 m (1 ft in 100 ft); otherwise, crane could tip.

Do not operate the crane—including raising the boom from ground level—if the wind speed exceeds the limits given in the capacity charts. Contact your local weather station for the wind velocity in your area.

Failing to comply with the requirements of the capacity charts can result in tipping or structural failure of the boom or luffing jib.

Equipment Failure Hazard

At low ambient temperatures, dynamic loads (impact and shock) can affect the steels used in Manitowoc cranes when operating in cold weather. Read and comply with [Cold Weather Operation on page 3-77](#) before operating the crane.

Moving Load Hazard

The operator shall select the proper crane capacity chart in the RCL/RCI Display before operating.

Unexpected drum motion or improper limit responses can result if the wrong capacity chart is selected.

The limit bypass switch shall be in the enable position (on) and all the limits with which the crane is equipped shall be operational before operating the crane.

Avoid Injuring Personnel in Operating Area

Sound the horn to alert personnel that operation is about to begin.

CAUTION

Machinery Damage Hazard

Before operating the crane at the start of each shift:

- Perform the preventative maintenance checks and lubrication requirements listed in Sections 5 and 6 of the MLC650 Operator Manual.
- Adjust the operator’s seat. See [Seat Riser Control on page 3-16](#) and [Seat Controls on page 3-29](#).
- Adjust the cab door if needed. See [Cab Door Adjustment on page 3-58](#).

STARTUP PROCEDURES



WARNING

Moving Machinery Hazard

To avoid injuring personnel or damaging the crane and property:

- Do not start the engine if an out-of-order sign or do not operate tag is present at the start controls.
- Check that all controls are off so the crane and load do not move when the engine is started.
- Check that all personnel are clear of the crane before starting the engine. **Sound horn to alert personnel.**

Read and understand the starting instructions in the engine manufacturer’s operation and maintenance manual provided with this crane.

1. If used, unplug or turn off the engine block heater, engine oil pan heater, hydraulic tank heaters, and any other crane heaters.

NOTE Manitowoc recommends the use of the Cold Weather Package to aid startup when the ambient temperature will be 0°C (32°F) and below.

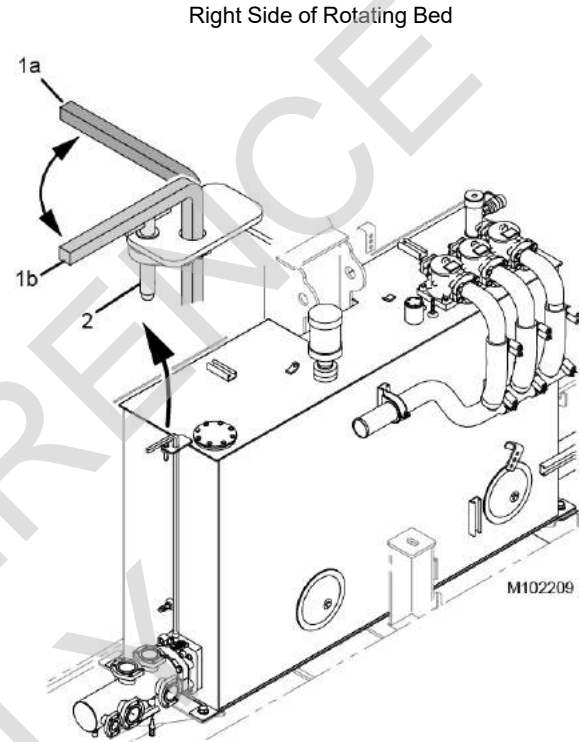
CAUTION

Pump Damage

Do not start the engine until the hydraulic tank shutoff valve is open. Otherwise, the pumps could cavitate and be damaged.

2. Make sure the battery disconnect switch is in the CONNECT position (see [Battery Disconnect Switch on page 3-14](#)). The engine will not start if the batteries are disconnected.

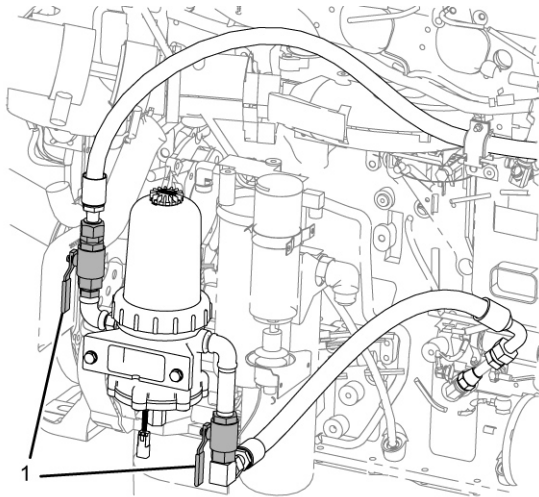
3. Make sure the emergency stop button is UP. The engine will not start if the button is depressed (see [Emergency Stop Button on page 3-19](#)).
4. Make sure the hydraulic tank shutoff valve is open as shown in [Figure 3-11](#).



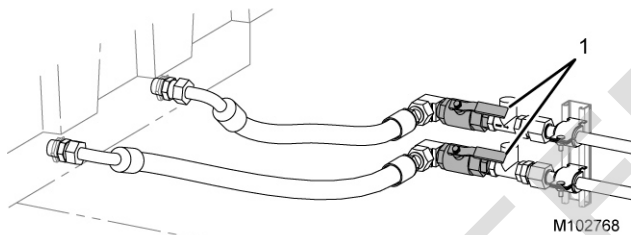
Item	Description
1a	CLOSE Shut-Off Valve
1b	OPEN Shut-Off Valve
2	Locking Pin (can be replaced with an owner furnished padlock)

Figure 3-11. Hydraulic Tank Shut-Off Valves

5. For Cummins engine only, make sure the fuel system shut-off valves (1, [Figure 3-12](#)) are open as shown.



View at Engine



View at Fuel Tank

Item	Description
1	Fuel System Shut-Off Valve (4) Shown Opened

Figure 3-12. Fuel System Shut-Off Valves

- If necessary in cold weather, or at elevations of 1676 m (5500 ft) above sea level or higher, disengage the engine clutch as shown in [Figure 3-13](#). This step will disconnect the pumps from the engine and aid in cold weather startup or high elevation.

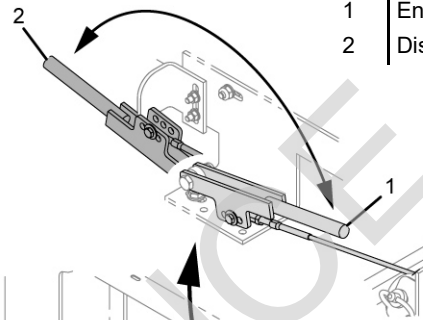
CAUTION

Avoid Engine Clutch Damage!

Observe the following precautions for engine clutch:

- **Decrease engine speed to idle** before engaging or disengaging clutch.
- Do not run engine longer than twenty minutes with clutch disengaged.
- Disengage and engage clutch several times monthly with engine running.

Through Access Cover on Top of Engine



Item	Description
1	Engage
2	Disengage

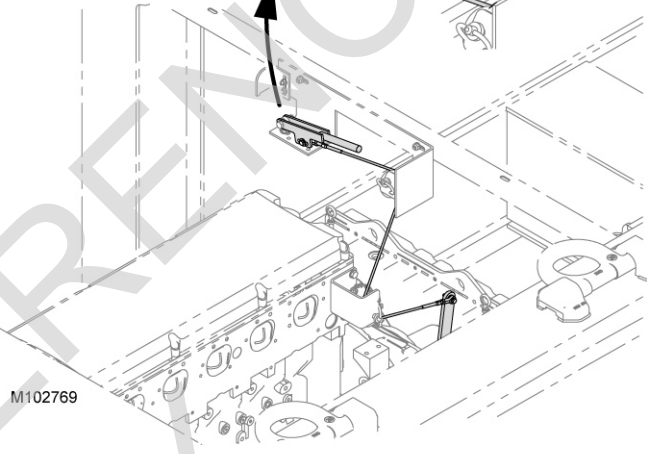


Figure 3-13. Engine Clutch Lever

- Turn the ignition switch to the RUN position.
 - All indicator lights, the operating limit buzzer, and the system fault beeper should come on for 2 to 3 seconds when the ignition switch is in RUN position. If not, correct the fault as soon as possible.
 - For a Cummins engine only, the *WAIT TO START* icon will appear in the Main Display indicating that the pre-heater is warming the engine's air intake.



The length of time the wait to start icon remains on depends on ambient temperature. The lower the ambient temperature, the longer the icon will stay on.

- When the *WAIT TO START* icon turns off, turn the ignition switch to the START position.

CAUTION

Avoid Starter Damage

If the engine does not start after 30 seconds of cranking, wait a few minutes before starting again so the starter motor cools.

- Once the engine starts, increase engine speed as necessary to keep the engine running.

10. If the engine clutch is disengaged, decrease engine speed to low idle and engage the clutch within 20 minutes after starting the engine.

11. After the engine is started, the Working Screen shown in [Figure 3-14](#) will appear in the Main Display.

See the Main Display Operation Manual for detailed instructions on what is displayed in the Working Screen.

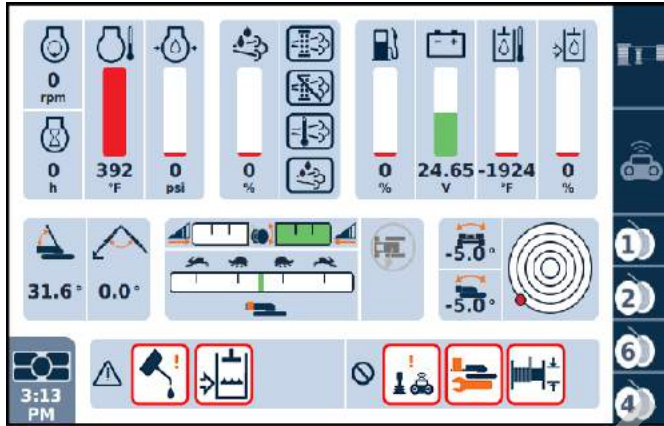


Figure 3-14. Working Screen

When the engine is started, it is normal for faults to appear in the alerts bar of the Main Display Working Screen. The faults should go away as soon as the engine oil pressure and hydraulic oil temperature rise to normal.

NOTE For fault identification, see the MLC650 Main Display Operation Manual.

CAUTION

Machinery Damage

Do not operate the crane when faults exist. If the faults do not go away soon after the engine is started, or if any come on during operation, immediately proceed as follows:

- Determine the fault in the Main Display Working Screen.
- Land the loads, if possible, and park all functions.
- Move all the control handles to off.
- Stop the engine.
- Correct cause of the fault.

NOTE You will not be able to increase engine speed until the hydraulic oil temperature is warmed to at least 17°C (63°F).

The hydraulic temperature fault will remain on until the hydraulic oil temperature is 17°C (63°F). **There will be no throttle response until this fault is cleared.**



12. Configure the crane and select the appropriate capacity chart in the RCL/RCI Display. See the MLC650 RCL/RCI Operation Manual.

NOTE The last capacity chart used will be the current capacity chart.

13. Inspect the self-erect cylinder at the start of each shift to make sure it is fully retracted. Retract it if necessary.

CAUTION

Unintended Cylinder Movement

The self-erect cylinder can creep due to thermal expansion/contraction. Inspect the self-erect cylinder before any operation when the live mast is pivoted forward past 90° to verify that the cylinder is fully retracted and engaged with the retention bracket.

If the self-erect cylinder comes free of the retention bracket, it will swing freely, which could result in death or serious injury.

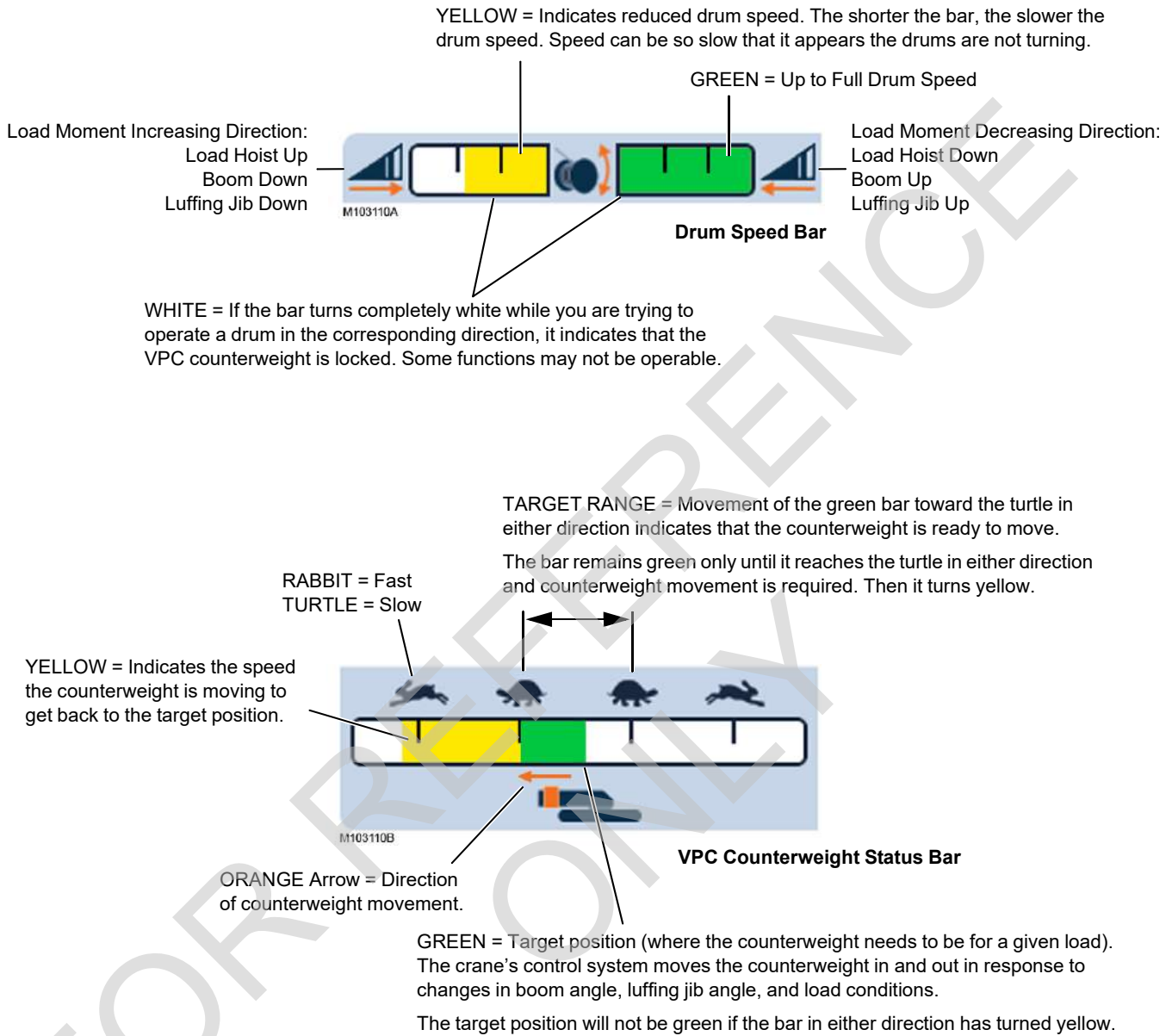


Figure 3-15. Drum Speed and VPC Status Screen

OPERATING PROCEDURES

VPC Operation

The **V**ariable **P**osition **C**ounterweight system automatically moves the crane counterweight in and out in response to changes in boom angle, luffing jib angle, and load conditions.

The amber strobe lights on the counterweight tray flash and an alarm sounds intermittently when the counterweight is moving.

During counterweight movement, it is normal for the control system to temporarily reduce the speed of the following functions:

- Boom hoist
- Luffing hoist
- Load drums

The control system continuously monitors counterweight inputs to determine the location of the counterweight. If the control system cannot move the counterweight to the target position quickly enough, the system will reduce the speed of the function causing the change in load moment. For example, if the counterweight needs to move toward the rear

of the crane, operations increasing load moment — hoisting up, booming down, or luffing down — will be limited.

Drum speed and VPC movement can be monitored in the Crane Operation Status Bar of the Main Display Working Screen. See [Figure 3-15](#).

For travel on grade, the VPC Lockout Key Switch ([page 3-22](#)) must be in the LOCK position. See [step 4 on page 3-73](#).

Current production cranes are equipped with a Capacity Chart Information Screen in the RCL/RCI Display. The Capacity Chart Information Screen allows the operator to:

- view crane capacities (published or modified) and
- in the VPC configuration only, to move the counterweight to a desired locked position and handle loads from a modified capacity chart.

The counterweight can be locked when the crane is in the VPC-MAX configuration, but a modified chart is not provided.

For Capacity Chart Information Screen instructions, refer to the following publications located at the end of this section:

- RCL/RCI Operation Manual
- Locked VPC Operation Manual

Boom Hoist Operation

The location of the boom control handle varies depending on the crane's configuration. Refer to [Drum and Control Handle Identification on page 3-56](#).

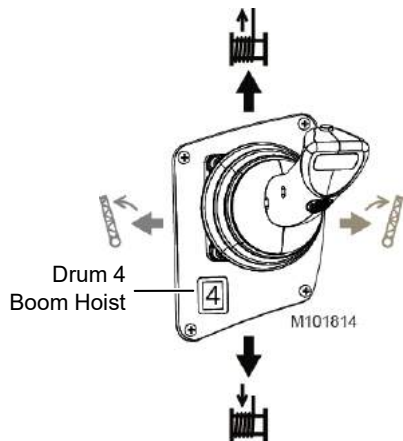


Figure 3-16. Boom and Swing Control Handle

CAUTION

Avoid Rigging Damage

Check that the boom hoist wire rope is reeved through all sheaves and spooled properly onto the drum before raising the boom from the ground.

- For wire rope and reeving specifications, see the Boom Assembly Drawing in Section 4 of the MLC650 Operator Manual.
- For instructions on attaching the wire rope to boom hoist drum, see the Wire Rope Installation topic in Section 4 of the MLC650 Operator Manual.

1. Select the correct capacity chart and crane configuration using the RCL/RCI Display. For detailed instructions, see the MLC650 RCL/RCI Operation Manual.
2. Boom hoist speed can be adjusted between 25% and 100% to meet operator needs. See the Speed and Limits Screen topic in the Main Display Operation Manual for detailed instructions.
3. Make sure the automatic boom stop is set at the proper angle. For detailed instructions, see the Automatic Boom Stop Adjustment topic in Section 4 of the MLC650 Service Manual.
4. If not previously done, perform the crane Startup Procedure on [page 3-61](#).
5. Turn off the boom hoist park switch. It may be necessary to raise the boom slightly to disengage the boom hoist pawl.

CAUTION

Avoid Boom or Luffing Jib Damage

Do not turn on the drum park switch while raising or lowering the boom. The brake will bring the boom to an abrupt stop. This action could cause shock load damage to the boom and the jib. Bring the boom to a smooth stop with the control handle and then turn on the drum park switch.

6. Increase the engine speed to the desired RPM with the hand throttle. Press the foot throttle to momentarily increase the engine speed when more power is required.

NOTE The VPC setup mode must be ON anytime the boom is suspended and operated out of the capacity chart. The VPC Setup Required fault will come and you will not be able to operate the boom hoist until this step is taken.

The VPC setup mode must be OFF anytime the boom is suspended and operated within the capacity chart. The VPC Setup Prohibited fault will come and you will not be able to operate the boom hoist until this step is taken.

7. Pull the boom control handle BACK from off to RAISE the boom.
8. Push the boom control handle FORWARD from off to LOWER the boom.



WARNING

Avoid Two-Blocking Hazard

Pay out the load lines while lowering the boom. The load may contact the boom point sheaves or the jib point sheaves if this step is not taken. The wire rope or other parts could break, allowing the load to fall.

9. As the boom nears the desired angle, slowly move the boom control handle toward off to decrease speed.

Then, move the control handle to off to stop the boom when it reaches the desired angle. The boom hoist brake will apply to hold the boom in position.

NOTE Besides the boom maximum up limit, a physical boom stop is provided. The physical boom stop cushions boom raising between approximately 78° and the maximum boom angle. The boom stop also provides a physical stop at 88°.

10. To hold the boom in position for long periods, turn on the boom park switch. The boom hoist pawl will engage.

Luffing Hoist Operation

The location of the boom and luffing jib control handles varies depending on the crane's configuration. Refer to [Drum and Control Handle Identification on page 3-56](#).

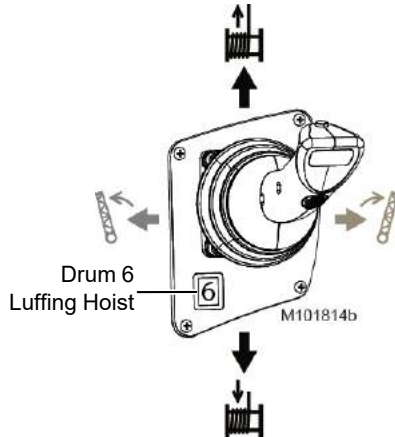


Figure 3-17. Luffing Jib Control Handle

1. Select the correct capacity chart and crane configuration using the RCL/RCI Display. For detailed instructions, see the MLC650 RCL/RCI Operation Manual.
2. Luffing hoist speed can be adjusted between 25% and 100% to meet operator needs. See the Speed and Limits Screen topic in the Main Display Operation Manual for detailed instructions.
3. Make sure the automatic boom stop is set at the proper angle. For detailed instructions, see the Automatic Boom Stop Adjustment topic in Section 4 of MLC650 Service Manual.
4. Make sure the automatic jib stops are set at the proper angles. For detailed instructions, see the Automatic Jib Stop Adjustment topic in the MLC650 Luffing Jib Operator Manual.
5. If not previously done, perform the crane Startup Procedure on [page 3-61](#).
6. Turn off the luffing hoist park switch. It may be necessary to raise the luffing jib slightly to disengage the luffing hoist pawl.



WARNING

Avoid Death or Serious Injury

Read and understand the instructions in the Luffing Jib Operator Manual and the Luffing Jib Raising Procedure chart in the Luffing Jib Capacity Chart Manual before attempting to raise or lower the luffing jib from or to the ground.

Use extreme care when operating the luffing hoist and the boom hoist at the same time. The maximum or minimum operating radius will be reached quickly when operating both hoists at the same time.

CAUTION

Avoid Rigging Damage

Check that the luffing hoist wire rope is reeved through all sheaves and spooled properly onto the luffing hoist drum before raising the boom and luffing jib from the ground.

- For wire rope and reeving specifications, see the Luffing Jib Assembly Drawing in the MLC650 Luffing Jib Operator Manual.
- For instructions on attaching wire rope to the luffing hoist drum, see the Wire Rope Installation topic in Section 4 of MLC650 Operator Manual.

CAUTION

Avoid Boom or Luffing Jib Damage

Do not turn on the luffing hoist park switch while raising or lowering the luffing jib. The brake will bring the luffing jib to an abrupt stop. This action could cause shock load damage to the boom and jib. Bring the luffing jib to a smooth stop with the control handle and then turn on the park switch.

7. Increase the engine speed to the desired RPM with the hand throttle. Press the foot throttle to momentarily increase the engine speed when more power is required.
8. Pull the luffing jib control handle BACK from off to RAISE the luffing jib.

Push the luffing jib control handle FORWARD from off to LOWER the luffing jib.



WARNING

Avoid Two-Blocking Hazard

Pay out the load lines while lowering the luffing jib. The load may contact the jib point sheaves if this step is not taken. The wire rope or other parts could break allowing load to fall.

Continued on next page

- As the luffing jib nears the desired angle, slowly move the luffing jib control handle toward off to decrease speed.

Then, move the control handle to off to stop the luffing jib when it reaches the desired angle. The luffing hoist brake will apply to hold the boom in position.

NOTE Besides the automatic luffing jib stops, a physical luffing jib stop starts to cushion luffing jib raising at a boom-to-luffing jib angle of 160° and provides a physical stop at a boom-to-luffing jib angle of 173°.

- To hold the luffing jib in position for long periods, turn on the luffing jib park switch. The luffing hoist pawl will engage.

Swing Operation

! WARNING Tipping Hazard

To prevent the crane from tipping, adhere to any swing limitations given in the capacity chart.

! DANGER Moving Crane Hazard

The counterweights can strike personnel in the area of the swing path! Warn personnel to stay clear of the swing path. Sound the horn prior to swinging.

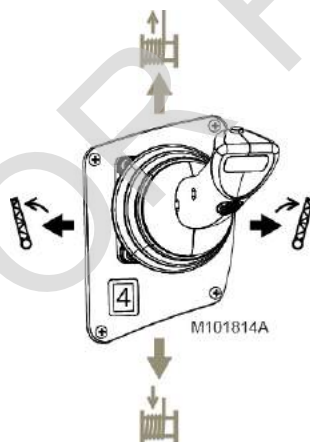


Figure 3-18. Swing Control Handle

- Select the correct capacity chart and crane configuration using the RCL/RCI Display. For detailed instructions, see the MLC650 RCL/RCI Operation Manual.
- Swing speed and torque can be adjusted between 25% and 100% to meet operator needs. See the Speed and Limits Screen topic in the Main Display Operation Manual for detailed instructions.
- The swing angle can be adjusted between 0° and 100° to meet job site restrictions. See the Swing Angle Screen topic in the Main Display Operation Manual for detailed instructions.
- If not previously done, perform the crane Startup Procedure. See [page 3-61](#).
- Turn off the swing park switch.

CAUTION

Avoid Boom/Swing Drive Damage

Do not apply the swing holding brake or turn on the swing park switch while swinging. The brake will bring the rotating bed to an abrupt stop. This action could cause damage to the boom and the luffing jib from side loading or damage to the swing drive from shock loading. Bring the rotating bed to a smooth stop with the swing control handle and then apply the swing holding brake or turn on the swing park switch.

- Increase the engine speed to the desired RPM with the hand throttle. Press the foot throttle to momentarily increase the engine speed when more power is required.
- Move the swing control handle to the LEFT from off to SWING LEFT.
Move the swing control handle to the RIGHT from off to SWING RIGHT.
- Start the swing motion with a smooth acceleration. Continue control handle motion to swing at the desired speed.
- Stop swinging by releasing the swing control handle to OFF. Swing speed will decrease to off and the rotating bed will coast to a stop.
If a faster stop is desired, move the swing control handle past OFF to the opposite swing direction.
- Once the rotating bed stops, depress the button on the control handle to apply the swing holding brake and hold the rotating bed in position for short periods during the operating cycle.
- To hold the rotating bed in position for long periods, turn on the swing park switch.

FOR REFERENCE ONLY

THIS PAGE INTENTIONALLY LEFT BLANK

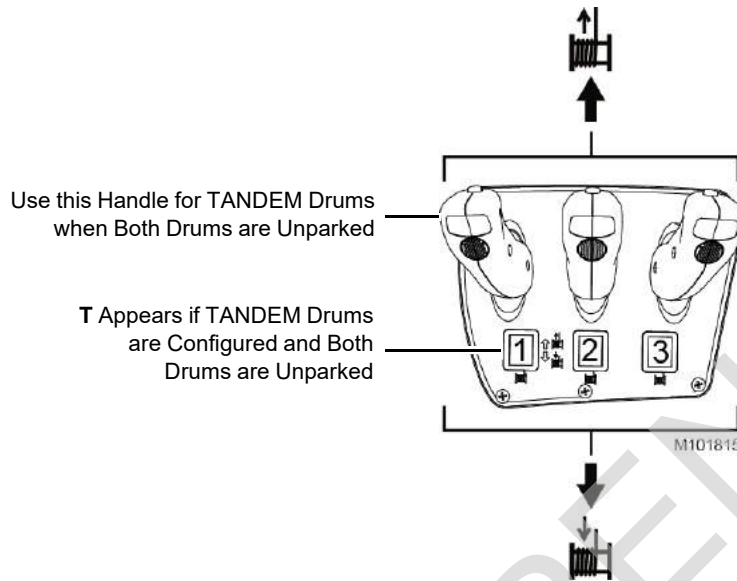


Figure 3-19. Load Drum Control Handles

Item	Description
1	Lower Boom Point Sheaves
2	Load Block Sheaves
3	To Drum Configured for Left Side Boom Point Sheaves
4	Left Side Boom Point Sheaves
5	To Drum Configured for Right Side Boom Point Sheaves
6	Right Side Boom Point Sheaves

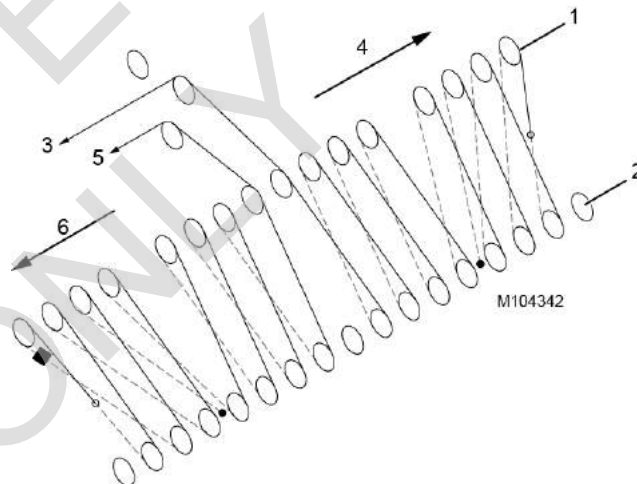


Figure 3-20. Example of Boom Point Reeving for Tandem Drums

Load Drum Operation

The location of the load drum handles varies depending on the crane's configuration. Refer to [Drum and Control Handle Identification on page 3-56](#).



WARNING Falling Load Hazard

Prevent load on unused drums from falling. Turn on drum park switch for drums not in use.

1. Select the correct capacity chart and crane configuration using the RCL/RCI Display. For detailed instructions, see the MLC650 RCL/RCI Operation Manual.
2. Load drum speed can be adjusted between 25% and 100% to meet operator needs. See the Speed and Limits Screen topic in the Main Display Operation Manual for detailed instructions.
3. If not previously done, perform the crane Startup Procedure. See [page 3-61](#).
4. Turn off the drum park switch for the drum to be operated.

For TANDEM drum operation turn off the drum park switch for both drums.

CAUTION

Avoid Boom or Luffing Jib Damage

Do not turn on the drum park switch while raising or lowering the load. The brake will bring the load to an abrupt stop. This action could cause shock load damage to boom, luffing jib, and load line. Bring the load to a smooth stop with the drum control handle and then turn on the drum park switch.

NOTE In the TANDEM drum configuration:

- With both tandem drums unparked, the left handle on the right console ([Figure 3-19](#)) controls both drums simultaneously and automatically adjusts speed to keep the load block level. A **T** appears in the drum identifier.
- With both tandem drums unparked, the middle handle on the right console controls the drum that is configured for the right side boom point sheaves ([Figure 3-20](#)) independently if needed. Doing this will activate a fast beeping signal in the cab. The drum identifier will indicate the number of the drum that is configured for the right side boom point sheaves.
- If the drum that is configured for the right side boom point sheaves is parked, the left handle on the right console controls the drum for the left side boom point sheaves ([Figure 3-20](#)) independently if needed. The drum identifier will indicate the number of the drum that is configured for the left side boom point sheaves.

5. Increase the engine speed to the desired RPM with the hand throttle. Press the foot throttle to momentarily increase the engine speed when more power is required.

6. Pull the drum control handle BACK from OFF to RAISE the load.

Push the drum control handle FORWARD from OFF to LOWER the load.

7. As the load nears the desired position, slowly move the drum control handle toward OFF to slow down the load.
8. Then release the control handle to OFF to stop the load when it reaches the desired position. The drum brake will apply to hold the load in position.
9. To hold the load in position for long periods, turn on the drum park switch.

Travel Operation



WARNING

Tipping Hazard

The travel surface must be firm and uniformly supporting. Refer to the Maximum Allowable Travel Specifications chart in the Capacity Chart Manual for:

- Travel specifications with load
- Travel specifications without load

Failure to comply with the Maximum Allowable Travel Specifications can result in tipping.

Moving Crane Hazard

Know the position of the rotating bed with relation to the front of the carbody before traveling. An accident can result if the crane travels opposite of the intended direction.

- The boom is at the front of the upperworks.
- A yellow arrow and dot on the left top and left front sides of the carbody indicate the FRONT of the carbody.

Flying Object Hazard

Excessive dirt build-up at the tumbler and the front roller ends of crawlers can result in excessive tension in tread connectors. The tread connectors can break if over tensioned, causing the treads to fly apart unexpectedly with dangerous force.

CAUTION

Accelerated Crawler Wear

To reduce the wear and tear of the crawler components (treads, rollers, frames), try not to allow dirt to pile up at the tumbler and the front roller ends of the crawlers.

Dirt can pile up when turning on soft surfaces. To avoid this:

- Bring crawlers to a complete stop before changing direction of travel.
- Turn a few degrees. Then slowly travel forward or reverse so dirt falls away from the crawlers. Continue this procedure until the desired turn has been made.
- Avoid sharp turns if possible.
- Make gradual turns or counter-rotate whenever possible so both crawlers are always powered.
- Clean the crawlers often.

Keep the crawler treads properly adjusted.

CAUTION

Boom Damage

Abrupt travel operation could result in shock loading the boom and rigging. To avoid this, perform all travel functions—starting, turning, stopping—slowly and smoothly.

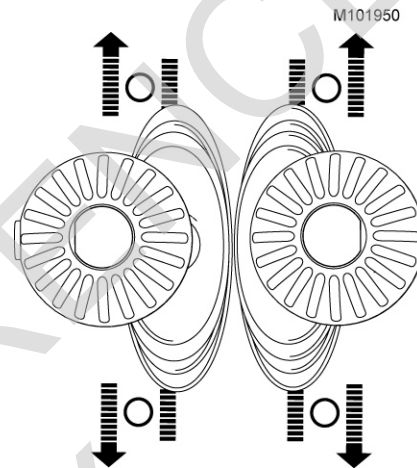


Figure 3-21. Crawler Handles

1. Before traveling:

- Check for travel restrictions. See the Maximum Allowable Travel Specifications chart in the Capacity Chart Manual.
- Plan the travel route. It must be firm, level, and free of obstructions. Do not exceed the grades specified in the Maximum Allowable Travel Specifications chart.
- Check the crawlers for proper adjustment.
- Warn personnel to stand clear of the travel area. **Do not travel without a signal person.** Turn off the travel park switch.

2. For **travel with load**, position the boom within the applicable capacity chart. Carry the load as close to the ground as possible. Stabilize the load with taglines.

3. For **travel without load**, carry the load block and the weight ball low enough that they cannot swing into the boom or jib. If desired, tie off the load block at the front of the rotating bed.

4. For **travel on grade**, the VPC Lockout Key Switch (page 3-22) must be in the LOCK position (not applicable to VPC-MAX).



WARNING

Tipping Crane Hazard




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

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

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

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

For cranes without VPC-MAX:

- The **Travel on Grade Permitted** icon will appear in the Information/Notifications Bar of the RCL/RCI display when the VPC is locked and positioned for travel on a grade that corresponds to the current boom/jib angle. See Maximum Allowable Travel Specification chart for details. 
- The **Travel on Grade Prohibited** icon will appear in the Information Bar of the RCL/RCI display if the VPC is locked and positioned such that travel on grade is not permitted. See Maximum Allowable Travel Specification chart for details. 
- The **Travel on Grade with VPC Unlocked** fault will come on in the main display and travel will stop if the crane is traveled onto a grade greater than 7% with the VPC unlocked. 

5. Increase the engine speed to the desired RPM with the hand throttle. When more power is needed, depress the foot throttle to momentarily increase the engine speed.
6. Travel speed can be adjusted between 25% and 100% to meet operator needs. See the Speed and Limits Screen topic in the Main Display Operation Manual for detailed instructions.
7. Select the desired travel speed—low or high.

NOTE The following directions of travel are with the front of the rotating bed and the front of carbody facing the same direction.

If the front of the rotating bed and the front of the carbody face in opposite directions, the crane will travel in the direction opposite of control handle movement.

Travel cruise can be turned on once the crane is being traveled in the desired direction (see [Crawler Handles on page 3-23](#)).

8. To TRAVEL STRAIGHT (Figure 3-22), move both of the crawler handles the same amount in the desired direction from the neutral position.

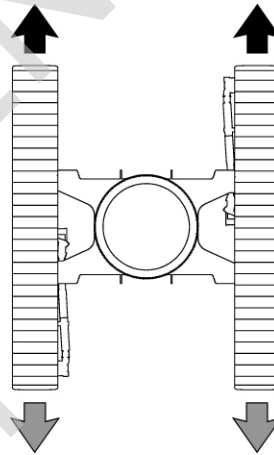


Figure 3-22. Travel Straight

9. To make a SHARP LEFT TURN (Figure 3-23), move the right crawler control handle forward from the neutral position and leave the left crawler control handle in the neutral position. The crane will pivot about the left crawler.

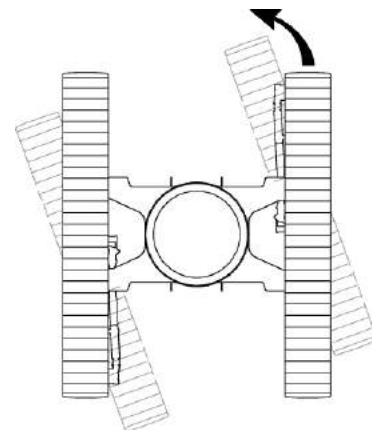


Figure 3-23. Travel Left (sharp turn)

10. To make a SHARP RIGHT TURN, reverse step 7.
11. To make a GRADUAL LEFT TURN (Figure 3-24), move both crawler handles to front from the neutral position. Move the right crawler control handle farther to the front than the left crawler handle. The right crawler will turn faster than left crawler.

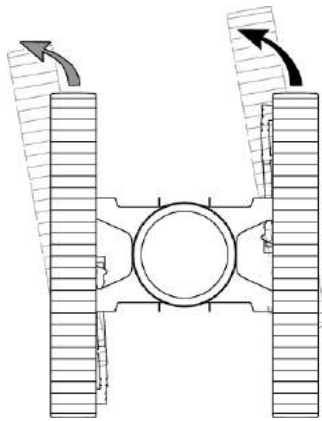


Figure 3-24. Travel Left (gradual turn)

12. To make a GRADUAL RIGHT TURN, reverse step 9.
13. To COUNTER-ROTATE LEFT (Figure 3-25), move the right crawler control handle forward from the neutral position and move left crawler control handle back from the neutral position.

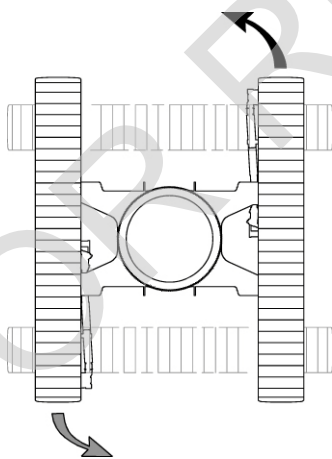


Figure 3-25. Counter-rotate Left

14. To COUNTER-ROTATE RIGHT, reverse step 11.
15. Slowly move both crawler handles to the neutral position to stop traveling and to hold the crane in position.

16. When finished traveling, turn on the travel park switch.

SHUTDOWN PROCEDURE OR LEAVING THE CRANE UNATTENDED



WARNING

Moving Load/Tipping Crane Hazard

The operator shall not leave the operator cab until the crane, loads, and boom have been secured against movement.

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.

1. Travel the crane onto a level surface. **Do not leave the crane unattended on a grade.**
2. Turn on the travel park switch.
3. Swing the rotating bed to the desired position. Then turn on the swing park switch.
4. Lower all loads to the ground.
5. Turn on the drum park switch for each load drum.
6. If possible, lower the boom (and luffing jib, if equipped) onto blocking at ground level.

If the boom and luffing jib cannot be lowered, as determined by a qualified designated person, they must be securely fastened from movement by the wind or other outside forces.

Refer to the wind conditions in the Wind Conditions chart for operating restrictions under various wind conditions.

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

7. Check that all control handles are in the center position.
8. Decrease engine speed to idle. Allow the engine to idle for three to five minutes so it cools evenly.
9. Stop the engine.
10. Remove all keys from the cab to prevent unauthorized operation.
11. Lock the operator cab windows and door to prevent unauthorized entry.

CHANGING COUNTERWEIGHT WITH BOOM/ JIB IN AIR

VPC

For crane only (without fixed mast), proceed as follows:

1. Raise the boom and luffing jib (if equipped) to the maximum operating angle and wait for the counterweight to reposition itself.

The suspended load under the boom and jib points must be as small as permitted by the capacity chart.

2. Make sure the current boom length, luffing jib length (if equipped), and radius are valid for both the current series capacity chart and the desired series capacity chart.
3. Lock the counterweight using the lockout switch on the right console (item 13, [page 3-22](#)).
4. Select the appropriate capacity chart in the RCL/RCI for the desired series counterweight. See the RCL/RCI Operator Manual for detailed instructions.

If you are changing counterweight from Series 1 to Series 3, or vice versa, select the Series 2 capacity chart and perform the remaining steps. Then select the Series 1 or 3 capacity chart and repeat the remaining steps.

5. Start installing/removing counterweight boxes following the procedures in Section 4 of this manual.

Do not add or remove more than one series of counterweight before allowing the counterweight to reposition itself.

If any system fault is activated during this procedure, stop the procedure and correct the cause of the fault before continuing. A system fault could prevent the counterweight from repositioning itself.

6. Unlock the counterweight (use item 13, [page 3-22](#)), allowing the counterweight to reposition itself as necessary.
7. Repeat [step 3](#) through [step 6](#) until the desired counterweight is installed.
8. Make sure the counterweight is unlocked and continue with normal operation within the selected capacity chart.

VPC-MAX

For crane with fixed mast, proceed as follows:

1. Raise the boom (and luffing jib if equipped) to an angle that causes the VPC-MAX actuator and beam to move to the minimum position along on the rotating bed. Preferably, the counterweight tray will also be positioned at the minimum possible distance along the VPC-MAX beam.

The suspended load under the boom and jib points must be as small as permitted by the capacity chart.

2. Make sure the current boom length, luffing jib length (if equipped), and radius are valid for both the current series capacity chart and the desired series capacity chart.
3. Lower the load blocks so there is adequate clearance between the load blocks and the boom (or luffing jib) in case the mast stop relief pressure is exceeded during this procedure.
4. Lock the counterweight using the lockout switch on the right console (item 13, [page 3-22](#)).
5. Select the appropriate capacity chart in the RCL/RCI for the desired series counterweight. See the RCL/RCI Operator Manual for detailed instructions.

If you are changing counterweight from Series 1 to Series 3, or vice versa, select the Series 2 capacity chart and perform the remaining steps. Then select the Series 1 or 3 capacity chart and repeat the remaining steps.

CAUTION

Unanticipated Motion Hazard

Beware that when adding counterweight in some configurations, it is possible to exceed the mast stop relief pressure. Unanticipated motion of the fixed mast can occur, causing the machine to rock, the boom to sway, and the load blocks to swing.

6. Start installing/removing counterweight boxes following the procedures in Section 4 of this manual.

Do not add or remove more than one series of counterweight before allowing the counterweight to reposition itself.

If any system fault is activated during this procedure, stop the procedure and correct the cause of the fault before continuing. A system fault could prevent the counterweight from repositioning itself.

7. Unlock the counterweight (item 13, [page 3-22](#)), allowing the counterweight to reposition itself as necessary.
8. Repeat [step 4](#) through [step 7](#) until the desired counterweight is installed or removed.

If at any point the VPC-MAX actuator and beam move from the minimum position, reposition the boom (and/or luffing jib) to make sure the actuator and beam are at the minimum position.

9. Make sure the counterweight is unlocked and continue with normal operation within the selected capacity chart.

THIS PAGE INTENTIONALLY LEFT BLANK

COLD WEATHER OPERATION

Also see [Cold Weather Heater Package on page 3-79](#).

Crane Limitations

The static load-carrying limitations of the steels used in Manitowoc cranes are not affected by cold weather. Manitowoc's capacity charts are acceptable for use in cold weather.

However, dynamic loads (impact and shock) can affect the steels used in Manitowoc cranes when operating in cold weather. Dynamic loads are created by traveling, sudden application and release of load, and duty-cycle operations.



DANGER

Injury and Equipment Failure Hazard

At low ambient temperatures, dynamic loads (impact and shock) can result in structural failure leading to serious injury or death.

When operating in ambient temperatures of:

-20 to -30°C (-5 to -22°F):

- Avoid impact or shock-loading of the crane and any attachment.
- Conduct operations with regard to potential failure of hydraulic components.

-31 to -40°C (-23 to -40°F):

- De-rate crane by 40% for all lift operations. Halting all lifts should be considered.
- Duty-cycle operation is prohibited.

below -40°C (-40°F):

- All operation (lift and duty-cycle) is prohibited except in extreme emergencies, and then only with approval from a competent engineer who has de-rated crane accordingly.

CAUTION

Avoid Hydraulic Component Damage

Heat the hydraulic oil to at least 0°C (32°F) prior to start-up. Tank heaters are available from Manitowoc.

Before operating any hydraulic components, always allow the hydraulic system to warm up to 16°C (60°F).

Do not activate any lower accessory functions until the hydraulic system has obtained the minimum operating temperature of 16°C (60°F).

Wire Rope

Wire rope manufacturers state that wire rope will not become brittle in temperatures down to -34°C (-30°F). However, lubrication may be a problem during extremely cold weather because normal wire rope lubricants may harden and chip off, leaving rope without lubrication.

Consult your wire rope supplier for recommended cold-weather lubricants.

Cooling System

The cooling system must be kept full and be protected from freezing at the lowest expected ambient temperature. See engine manual for antifreeze recommendations.

A mixture of 40% antifreeze and 60% water provides freeze protection to -37°C (-35°F). A mixture of 60% antifreeze and 40% water provides freeze protection to approximately -51°C (-60°F). 100% antifreeze will freeze at -23°C (-10°F).

Batteries

To provide maximum cranking power and to prevent the batteries from freezing, they must be kept fully charged (resting voltage 12.4V–13.2V) and warm when crane is idle during cold weather.

It is recommended that batteries be stored indoors or heated with a battery heater when crane is idle. Be aware that:

- A battery with a 50% charge freezes at -27°C (-16°F). A battery with a 100% charge freezes at -57°C (-70°F).
- A battery with a 100% charge retains only 40% of its cranking power at -18°C (-0°F). At -29°C (-20°F), the same battery retains only 18% of its cranking power.

Engine Oil, Gear Oil, and Hydraulic Oil

For extreme cold, refer to Approved Lubricants for Operation in Arctic Climate in the MLC650 Lubrication Guide.

See the Legend on [page 3-79](#).

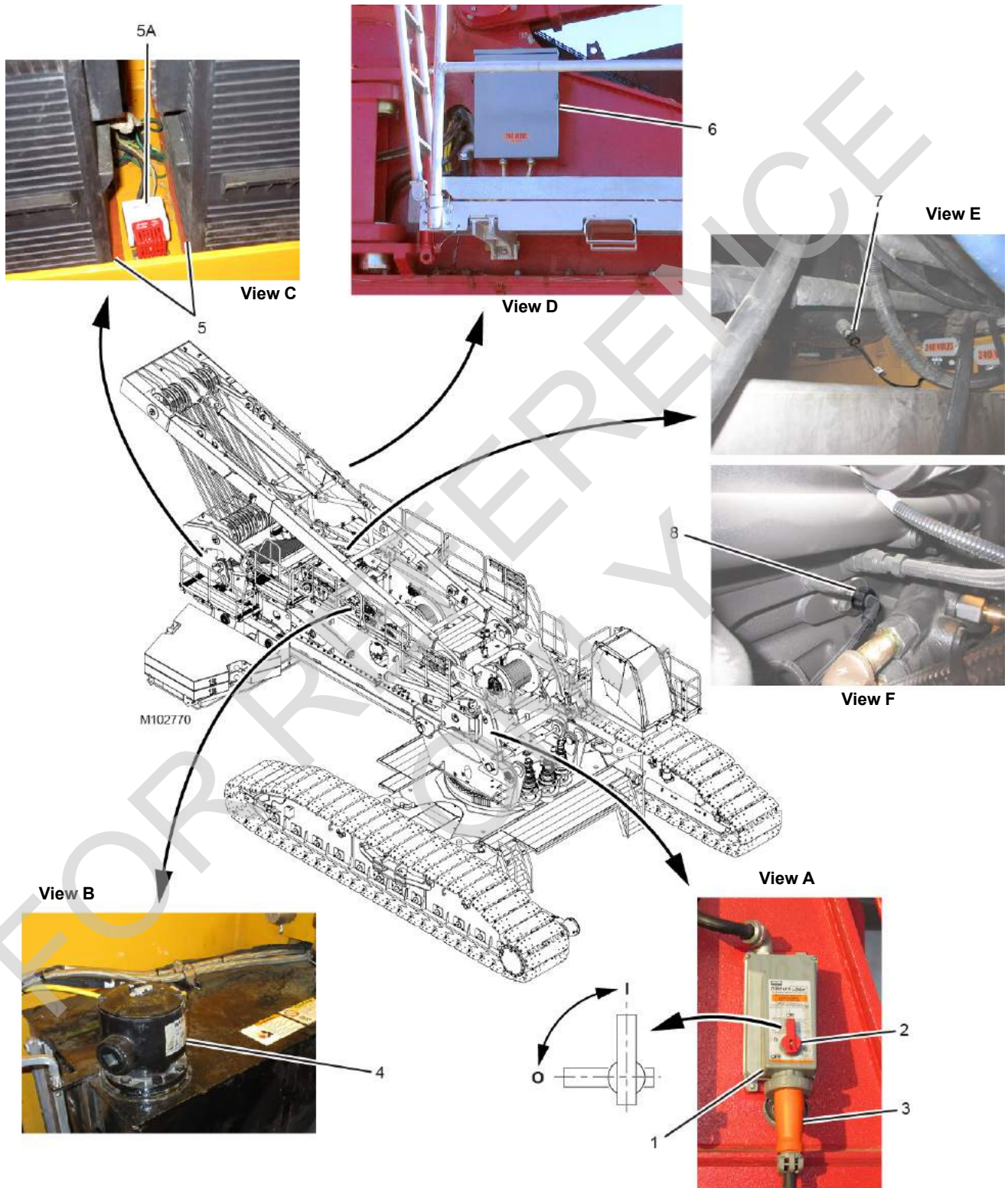


Figure 3-26. Cold Weather Heaters

Legend for [Figure 3-26](#)

Item	Description
1	Receptacle, 125/150VAC, 60A
2	Interlock Switch
3	Power Supply Cable
4	Hydraulic Tank Heater
5	Battery Pad Heater (2)
5A	Battery Pad Thermostat
6	Load Center
7	Engine Oil Heater
8	Engine Coolant Heater

COLD WEATHER HEATER PACKAGE

To preheat critical components and lubricant sumps during a cold weather shutdown, an optional Cold Weather Heater Package is available. The package contains the following 240VAC heaters:

See [Figure 3-26](#)

- Hydraulic tank heater (4, View B): 2,000 watt.

The hydraulic tank heater is designed to keep the hydraulic oil temperature 16°C (30°F) warmer than the ambient air temperature.

A thermostat, located under the heater cover, is factory set to turn the heater ON at 16°C (60°F) and OFF at 27°C (80°F).

- Battery pad heaters (5, View C): two, 75 watts each. The battery pad thermostat (5A, View C) turns the heaters ON at 5°C (41°F) and OFF at 15°C (59°F).
- Engine oil heater (7, View E): 300 watt.
- Engine coolant heater (8, View E): 1,500 watt.

CAUTION

Avoid Machinery Damage

When the ambient temperature is above -1°C (30°F) or when the engine is running, do not turn on the engine oil or coolant heaters. Doing so may result in overheating because they are not supplied with thermostats.

NOTE When operating below -34°C (-30°F), the heater package may not provide adequate protection.

Contact your Manitowoc dealer for recommendations.

The heater package is powered by 125/250VAC, 60A electricity supplied by either of the following:

- Owner furnished generator
- Manitowoc furnished APU (see [Figure 3-27 on page 3-80](#)).

Turning Heaters ON

- Make sure the generator (APU) engine is OFF.
- Turn OFF the circuit breakers in the load center (6, View D).
- Make sure the interlock switch (2, View A) is OFF at the receptacle (1) on the crane and at the receptacle on the generator (APU).
- Connect the power supply cable (3, View A) to the receptacle (1) on the crane and to the receptacle on the generator (APU).
- Start the generator (APU) engine. The Manitowoc supplied APU can be started from inside the operator's cab.
- Turn ON the interlock switch at the generator (APU).
- Turn ON the interlock switch (2, View A) at the receptacle (1) on the crane.
- Turn ON the circuit breakers in the load center (6, View D).

Turning Heaters OFF

- Turn OFF the circuit breakers in the load center (6, View D).
- Turn OFF the interlock switch (2, View A) at the receptacle (1) on the crane.
- Turn OFF the interlock switch at the generator (APU).
- Stop the generator (APU) engine. The Manitowoc supplied APU can be stopped from inside the operator's cab.
- If necessary, disconnect the power supply cable (3, View A) from the receptacle (1) on the crane. Store the cable on the generator (APU).

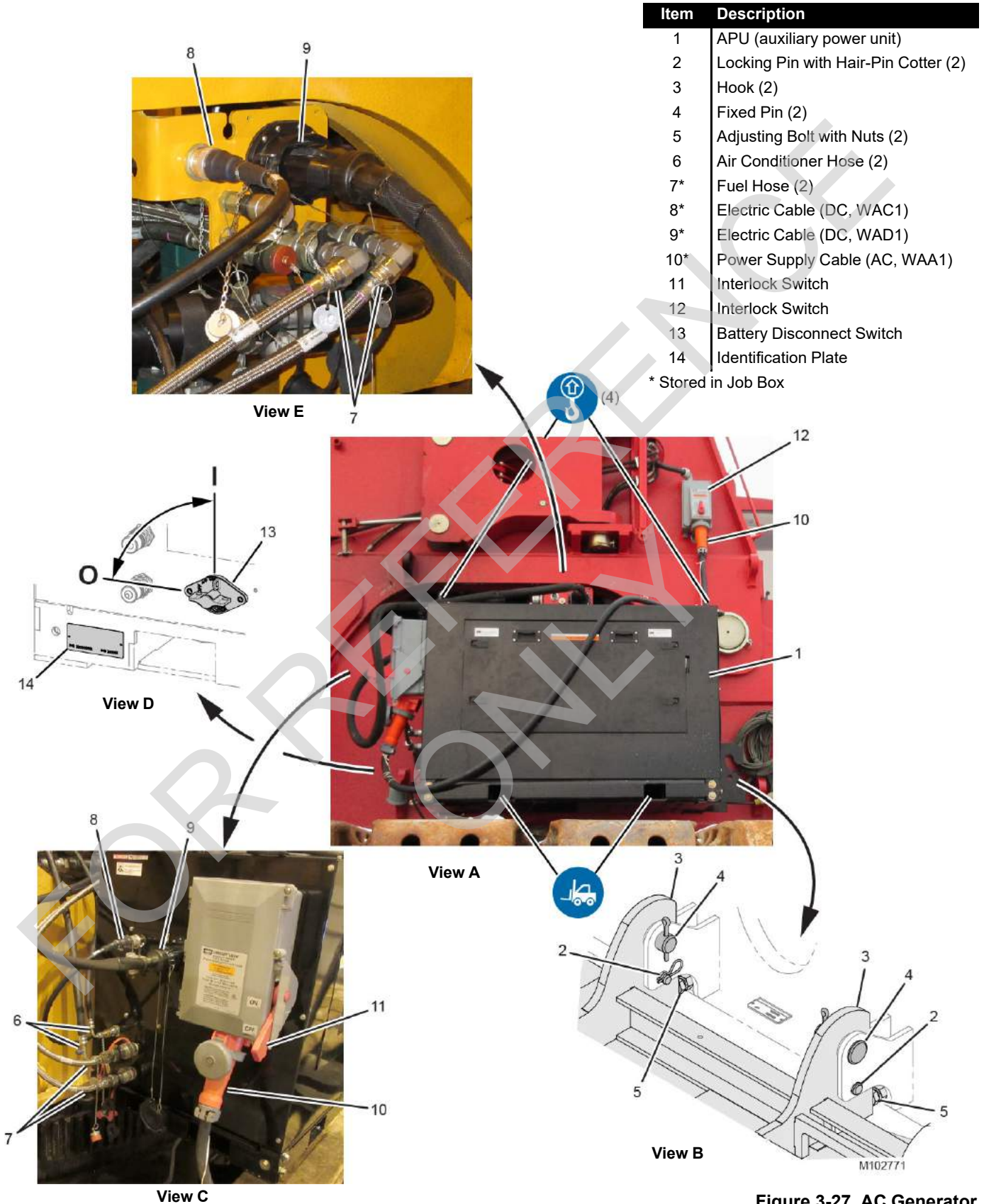


Figure 3-27. AC Generator

AC OPERATION

See [Figure 3-27](#) for the following procedure.

An optional APU equipped with a 10 KW, continuous duty, 60 HZ AC generator and a DC charging system is available from Manitowoc to power the following operations when the crane engine is off:

- Cab heater and air conditioner
- Crane batteries (charging)
- Optional cold weather heaters
- Any AC lighting the crane is equipped with

Refer to the APU manufacturer's manual for operation and maintenance instructions.

The APU can be started with the switch in the crane operator's cab. See [APU Ignition Switch on page 3-20](#).

The APU prep package includes an external heater which heats the water used to heat the operator cab. The heater is controlled using screens in the Main Display. See the MLC650 Main Display Operation Manual for heater instructions.

The APU has an identification plate (14, View D) which contains the units part number and serial number. Please provide these numbers when discussing APU service and parts inquiries with your Manitowoc dealer.

Installing APU

NOTE The fuel hoses (7) and the electric cables (8, 9, and 10) are stored for shipping in the job boxes provided with your crane by Manitowoc.

1. Stop the crane engine.
2. Using a forklift or an assist crane, lift the APU (1, View A) into position on the right side of the crane.
3. Remove the locking pins (2, View B) from the mounting brackets on the rotating bed.
4. Position the APU (1) so the hooks (3, View B) engage the fixed pins (4) on the rotating bed,
5. Install the locking pins (2, View B).
6. Remove the forklift or the assist crane.
7. Adjust bolts (5, View B), as needed, to level the APU.
8. Connect two air conditioner hoses (6, View C) from the crane to the quick couplers on the APU.

Match the identification numbers on the hoses with the identification numbers on the quick couplers for proper connection.

9. Connect two fuel hoses (7, View C) to the quick-couplers on the APU and to the quick couplers on the right side of the rotating bed (View E).

Match the identification numbers on the hoses with the identification numbers on the quick couplers for proper connection.

10. Connect the electric cable (8, View C) to the receptacle on the APU and to the receptacle on the rotating bed (View E).
11. Connect the electric cable (9, View C) to the receptacle on the APU and to the receptacle on the rotating bed (View E).
12. Connect the power supply cable (10, View C) to the interlock switch (11) on the APU and to the interlock switch (12, View A) on the rotating bed.
13. Turn on (I) the battery disconnect switch (13, View D). The switch can be locked in this position with an owner supplied padlock.

Turning ON AC Powered Components

NOTE The following instructions assume that the electric cables are connected between the APU and the crane. It is only necessary to disconnect the electric cables when the APU is removed from the crane.

1. Stop the crane engine and turn the ignition switch to off.
2. Start the APU engine using the switch in the operator's cab or on the APU.

NOTE If the switch in the cab is used, the main engine ignition switch must be in the RUN position.

The APU will not start if the APU doors are removed.

3. Turn ON the interlock switch (11) at the APU and the interlock switch (12) on the rotating bed.

This step is required only at installation. Thereafter, the interlock switches can remain on except when servicing the APU or removing it.

4. Turn ON the circuit breakers in the load center (see item 6 in [Figure 3-26 on page 3-78](#)).
5. The AC and DC powered components can now be turned on in the operator's cab (heater and air conditioner, work lights, and other such components).

Turning OFF AC Powered Components

1. Turn OFF the circuit breakers in the load center.
2. Stop the APU engine using the switch in the operator's cab or on the APU.

NOTE Turning OFF the interlock switch (11) at the APU and the interlock switch (12) on the rotating bed is required only when servicing the APU or removing it.

Removing APU

1. If the air conditioner hoses (6, View C) are connected, proceed as follows to prevent the air conditioner from losing its charge:

Continued on next page.

- a. Leave the air conditioner hoses connected and stop the APU.
 - b. Start the crane engine and run the air conditioner in the cab using the crane engine for at least two minutes.
 - c. Turn off the air conditioner in the cab and stop the crane engine.
 - d. Disconnect the air conditioner hoses (6, View C) from the APU and coil the hoses on the crane for storage.
2. Turn off all AC power components and stop the APU engine.
 3. If equipped, turn off (O) the battery disconnect switch (13, View D). The switch can be locked in the off position with an owner supplied padlock.
 4. Disconnect the power supply cable (10, View C) from the interlock switch (11) on the APU and from the interlock switch (12, View A) on the rotating bed. Store the cable in the job box.
 5. Disconnect the electric cable (9, View C) from the receptacle on the APU and from the receptacle on the rotating bed (View E). Store the cable in the job box.
 6. Disconnect the electric cable (8, View C) from the receptacle on the APU and from the receptacle on the rotating bed (View E). Store the cable in the job box.
 7. Disconnect two fuel hoses (7, View C) from the quick-couplers on the APU and from the quick couplers on the right side of the rotating bed (View E). Store the hoses in the job box.
 8. Support the APU (1, View A) with the forks from a forklift or with slings from an assist crane.
 9. Remove the locking pins (2, View B) from the mounting brackets on the rotating bed.
 10. Lift the APU (1, View B) clear of the fixed pins (4) on the rotating bed.
 11. Reinstall the locking pins (2, View B) in the rotating bed holes.
 12. Secure the APU to a trailer for shipping or store it on the job site.
 13. Remove the forklift or assist crane.

SECTION 4

SET-UP AND INSTALLATION

TABLE OF CONTENTS

Boom and Jib Assembly Drawings	4-1
Liftcrane Mast Handling Capacities	4-1
Optional Attachments	4-1
General Safety	4-1
Crane Orientation	4-1
Assembly and Disassembly Notes	4-1
Assembly And Disassembly Area	4-2
Accessing Parts	4-2
Retaining Connecting Pins	4-2
Crane Weights and Shipping Data	4-2
Personal Fall-Protection	4-3
Handling Components	4-3
Crane Assembly Components	4-5
Parts Box	4-5
Swing Limits	4-8
Hydraulic Hose Identification	4-10
Connecting/Disconnecting Hydraulic Hoses and Electric Cables	4-10
Hose and Cable Cleanliness	4-10
Pin and Connecting Hole Cleanliness	4-10
Tightening Hydraulic Couplers	4-10
Remote Control	4-12
Activating the Remote Control	4-13
Starting Engine with Remote Control	4-13
Rotating Bed Jacking Cylinders Function	4-13
Setup Mode	4-13
Identification and Location of Components	4-14
Crane Assembly	4-15
Remove Cab Window Covers	4-15
Perform Pre-Start Checks	4-17
Electric System	4-17
Hydraulic System	4-17
Gear Boxes	4-17
Deploy Operator Cab Platforms	4-19
Start Engine	4-19
Remove Rotating Bed from Trailer	4-23
Install Alignment Pendants	4-23
Deploy Rotating Bed Jacking Cylinders	4-23
Install Operator Cab Rear Platform	4-24
Install Operator Cab Ladder	4-25
Overview of Rotating Bed Platforms and Handrails	4-27
Deploy Rotating Bed Platforms	4-29
Install Platforms, Ladders and Handrails	4-31
Install Drum 3	4-33
Activate Auxiliary Hydraulic System	4-34
Connect Hand-Held Pin Puller	4-37
Install the Live Mast	4-38
Secure the Backhitch/Gantry Assemblies	4-41
Secure the Live Mast Hoist Drum	4-43
Disconnect the Live Mast Straps	4-43
Connect the Live Mast Hydraulic and Electrical	4-45
Activate Setup Mode	4-46

Raise Live Mast to Operating Position	4-46
Deploy the Self-Erect Cylinder	4-49
Use the Mast as a Boom	4-49
Connect Rotating Bed to Carbody	4-51
Installing Rotating Bed to Adapter Pins	4-53
Lower Crane onto Carbody Pedestals	4-54
Install Carbody Platforms	4-55
Install Carbody Ladders and Handrails	4-56
Store Front Rotating Bed Jacking Cylinders	4-58
Install Hydraulic Connections	4-59
Deploy Operator Cab (Working Position)	4-61
Install Platforms, Ladders, and Handrails	4-62
Install Crawlers	4-63
Install Crawlers (continued)	4-67
Store Rear Rotating Bed Jacking Cylinders	4-71
Install Drive Shafts	4-73
Install Counterweight Tray	4-75
Install the Hydraulic Hoses	4-79
Align the Counterweight Tray to the Pinions	4-79
Remove Counterweight Boxes from Trailer	4-81
Assemble Boom and Jib	4-81
Install Counterweight Boxes	4-81
Boom And Jib Rigging—General	4-86
Assist Crane Requirements	4-86
Blocked Crawlers	4-87
Boom Handling with Mast	4-87
Assembly Drawings	4-87
Identifying Boom and Jib Components	4-87
Handling Boom and Jib Sections	4-89
Boom Ladders	4-91
General	4-91
Removing Ladders from Insert	4-91
Installing Ladders on Boom Inserts	4-91
Storing Ladders in Insert	4-91
Boom Assembly	4-93
Assemble Boom Inserts and Top	4-93
Raise Boom Top Wire Rope Guide	4-103
Install/Remove Lower Boom Point	4-105
Install Position Light and Wind Speed Indicator	4-107
Connect Boom Straps	4-109
Install Upper Boom Point	4-111
Connect Terminator/Shorting Plugs at Boom Top	4-111
Prepare 4M Insert	4-115
Raise Wire Rope	4-115
Connect 4M Insert to Boom Butt	4-117
Lower Carbody Platform	4-117
Connect Boom Butt to Crane	4-119
Lower Boom Butt and 4M Insert	4-121
Raise Carbody Platform	4-121
Connect Hydraulic Hoses from Crane to Boom Butt	4-123
Connect Electric Cables from Boom Butt to Crane	4-123
Connect 4M to Boom	4-125
Connect Mast Straps to Boom Straps	4-127
Deactivate Setup Mode	4-127
Connect Camera and Electric Cables	4-129
Install the Boom Load Lines	4-131
Install the Boom Block-Up Limit Components	4-131

Prepare Intermediate Suspension Pendants	4-133
Raise Boom	4-134
Pre-Raising Checks	4-134
Boom Raising Procedure	4-134
Shipping Crane Components	4-135
Crane Disassembly	4-136
Preparing Crane	4-136
Lowering Boom	4-136
Removing Block-Up Limit Components	4-136
Storing the Load Lines	4-136
Removing Boom Top Cameras	4-136
Disconnecting Boom Butt Electric Cables	4-136
Disconnecting Boom Butt Hydraulic Hoses	4-136
Activating Setup Mode	4-139
Disconnecting Mast Straps from Boom Straps	4-139
Lowering Carbody Platform	4-139
Disconnecting Boom from 4M Insert	4-141
Deploying Self-Erect Cylinder	4-141
Removing Boom Butt and 4M	4-142
Separating 4M Insert from Boom Butt	4-145
Lowering the Wire Rope Guide	4-145
Loading Boom Butt	4-146
Raising Carbody Platform	4-146
Disassembling Boom	4-147
Removing Counterweight Boxes	4-148
Preparing Counterweight Tray for Removal	4-150
Disconnecting Counterweight Tray Hydraulics and Electrical Wiring	4-151
Removing Counterweight Tray	4-153
Removing Carbody Platforms	4-155
Disconnecting and Storing Drive Shafts	4-157
Deploying Rear Rotating Bed Jacking Cylinders	4-159
Removing First Crawler (continued)	4-163
Removing Second Crawler	4-165
Disconnecting Carbody from Rotating Bed	4-167
Disconnecting Hydraulic Hoses	4-168
Storing Self-Erect Cylinder	4-171
Securing Live Mast, Gantry, and Backhitch	4-173
Removing Drum 3	4-175
Disconnecting Live Mast Hydraulics and Electrical Connectors	4-177
Removing Live Mast	4-177
Removing Rotating Bed Handrails and Rear Platform	4-181
Removing Front Platform and Ladders From Rotating Bed and Cab	4-182
Storing Rotating Bed Platforms	4-184
Moving Operator Cab (Shipping Position)	4-186
Removing Operator Cab Ladder	4-187
Removing Operator Cab Rear Platform	4-188
Storing Operator Cab Front Platform	4-189
Securing Operator Cab	4-190
Extending Rotating Bed Jacking Cylinders	4-191
Lowering Rotating Bed Jacking Cylinders	4-193
Installing Cab Window Covers (If Equipped)	4-194
Wire Rope Installation	4-195
Wire Rope Specifications	4-195
Wire Rope Storage	4-195
Seizing and Cutting Wire Rope	4-195
Anchoring Wire Rope to Drum	4-196
Winding Rope onto Drum	4-196

Anchoring Wire Rope to Wedge Socket	4-199
Anchoring Wire Rope to Button Socket	4-199
Pad Eye Usage for Wire Rope Reeving	4-201
Breaking in Wire Rope	4-201
Rigging Winch Operation	4-202
Selecting Rigging Winch Mode	4-202
Operating Rigging Winch	4-203
Load Line Reeving	4-205
Guide Sheaves and Drums	4-205
Load Block Identification	4-205
Duplex Hook	4-205
Wire Rope Specifications	4-206
Load Block Reeving	4-206
Dead End Locations	4-206

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 and VPC-MAX) 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 cab looking forward.

- The operator cab is at the front of the upperworks.
- 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 Cotter
- Safety Pins
- 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.

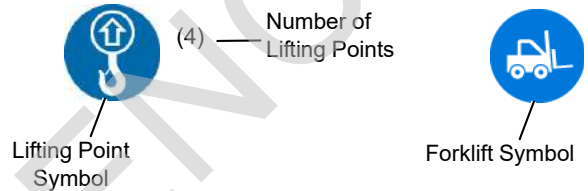


FIGURE 4-3

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.



M102313

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.

Item	Description
1	Live Mast
2	Live Mast Links/Straps
3	Self-Erect Cylinder
4	Cylinder Rod End
5	Shackle (2)
6	Synthetic Lifting Sling (not shown)
7	Operator Cab
8	Crawler (2)
9	Carbody Pedestals (4)
10	Carbody
11	Outrigger Pads (4)
12	Rotating Bed Jacking Cylinders (4)
13	Rotating Bed
14	Gantry
15	Boom Hoist Rope
16	Live Mast Hoist (Drum 4)
17	Mast-Assist Cylinders (2)

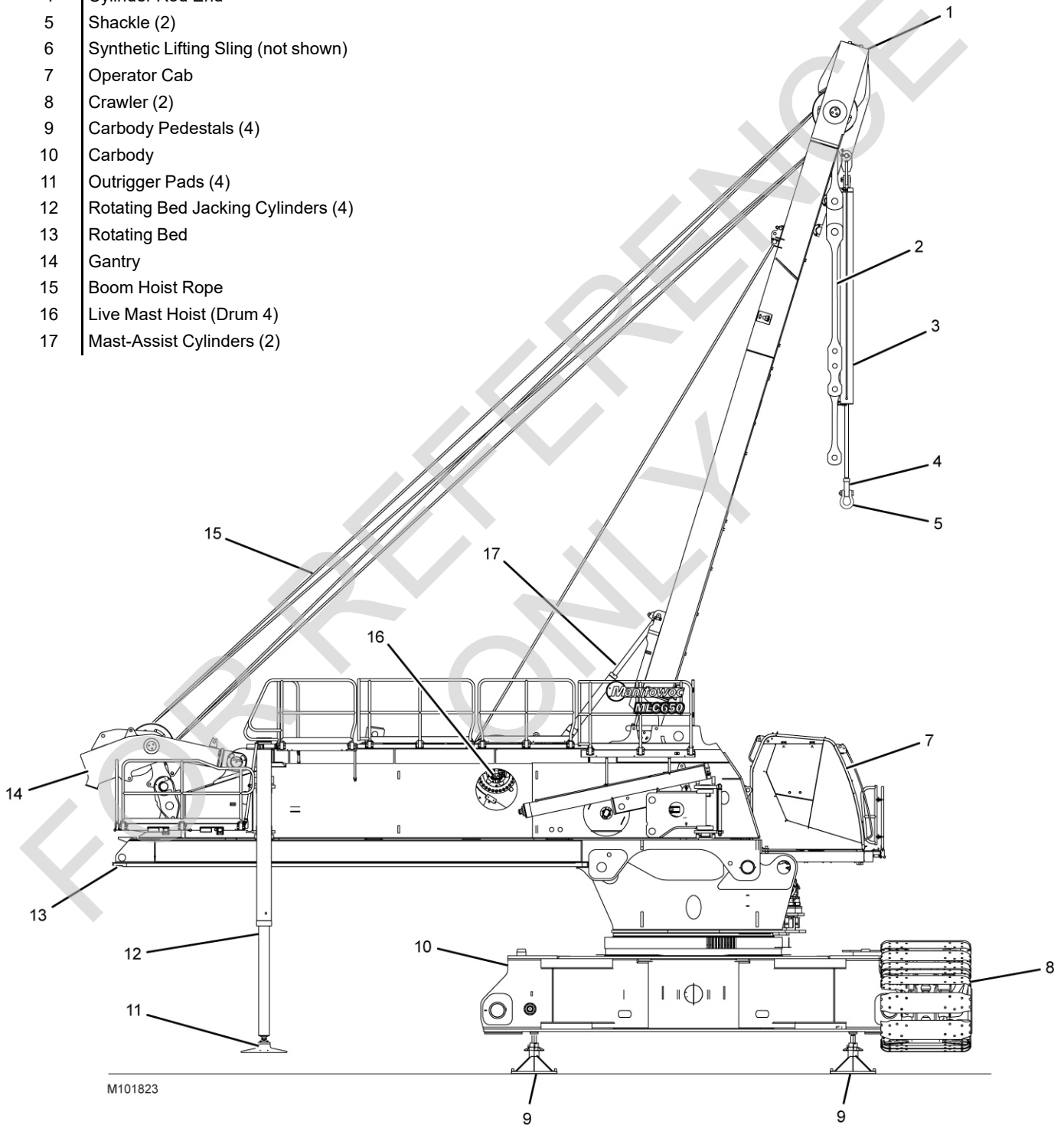


FIGURE 4-5

CRANE ASSEMBLY COMPONENTS

The MLC650 crane can be equipped with the following self-erect components, as shown in [Figure 4-5](#).

- Self-erect cylinder (3) for lifting major parts. The cylinder is attached to the top of the live mast (1).
- Shackles (5) which attach to the cylinder rod end (4) (various sizes, see [Figure 4-7 on page 4-6](#) for a list of shackles)
- Synthetic slings (various sizes, see [Figure 4-7 on page 4-6](#) for a list of slings)
- Rotating bed jacking cylinders (12) with outrigger pads (11) for lifting the crane onto and off of trailer
- Hydraulically actuated pins (not shown) for connecting and disconnecting the crawlers to and from the carbody
- Hydraulically actuated mast-assist cylinders (17) for assisting the mast to the operating position and to the transport position
- Hand-held cylinder used to connect the boom butt to the adapter frame
- Remote control for operating the above components (see [Figure 4-12](#))
- Pins (installed and removed using hydraulics, not shown) for connecting and disconnecting the rotating bed to the adapter frame

An assist crane will be required for handling and installing the following components:

- Installation of the live mast to the rotating bed
- Counterweight tray and counterweights



M102312

FIGURE 4-6

PARTS BOX

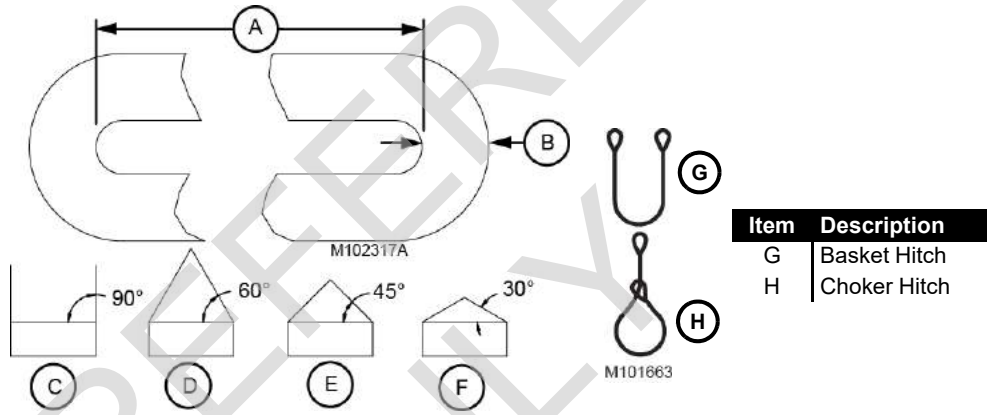
Manitowoc provides a parts box ([Figure 4-6](#)).

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

- 1 - link assembly dead end
- 10 - Shackles (various sizes, see [Figure 4-7 on page 4-6](#))
- 14 - Lifting slings (various sizes, see [Figure 4-7 on page 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 - open end wrenches (Stucchi - 16, 20, and 24) OR a strap wrench

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)



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)

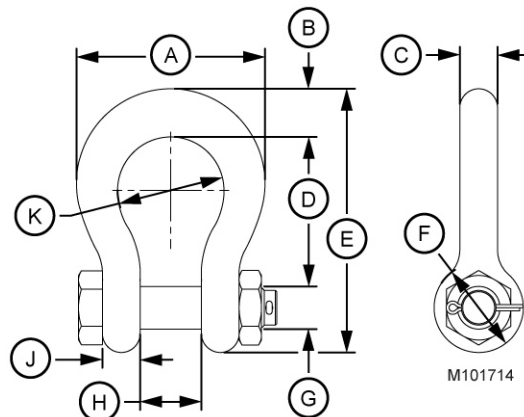
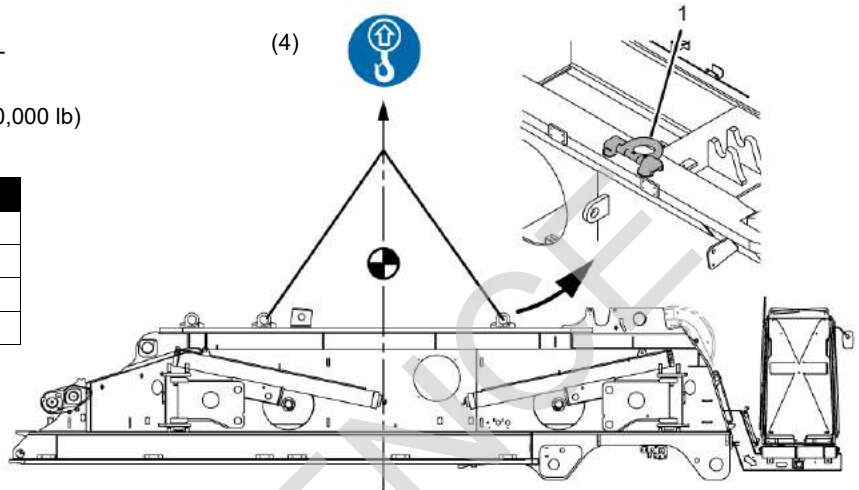


FIGURE 4-7

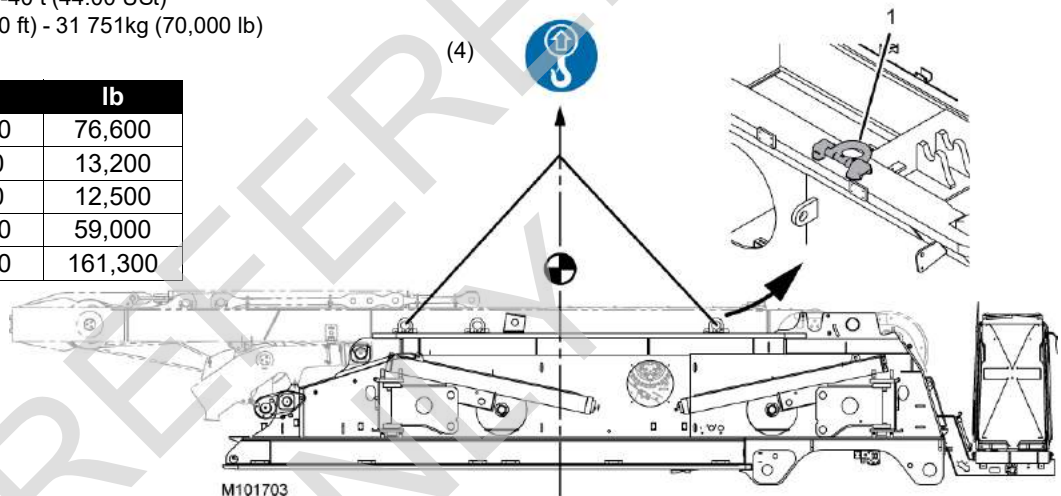
LIFTING POINTS WITHOUT LIVE MAST
 4- SH 3-SHACKLES-40 t (44.00 USt)
 4- SL 6-SLINGS-5,00 m (16.40 ft) - 31 751kg (70,000 lb)

Item	kg	lb
Rotating Bed	43 800	76,600
Jacks	6 000	13,200
Drum	5 700	12,500
Total	46 500	102,300



LIFTING POINTS WITH LIVE MAST
 4- SH 3-SHACKLES-40 t (44.00 USt)
 4- SL 6-SLINGS-5,00 m (16.40 ft) - 31 751kg (70,000 lb)

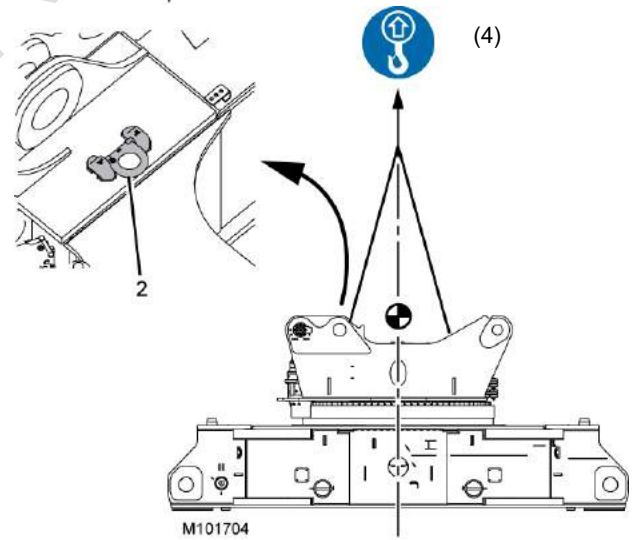
Item	kg	lb
Rotating Bed	43 800	76,600
Jacks	6 000	13,200
Drum	5 700	12,500
Live Mast	26 800	59,000
Total	73 300	161,300



M101703

LOWER WORKS LIFTING POINTS
 42 200 kg (93,000 lb)
 4- SH 3-SHACKLES-40 t (44 USt)
 4- SL 6-SLINGS-5,00 m (16.40 ft) - 31 751kg (70,000 lb)

Item	Description
1	Upperworks Lifting Points
2	Lowerworks Lifting Points



M101704

4

FIGURE 4-8

SWING LIMITS

Reference [Table 4-2](#) and [Table 4-3](#) for swing data during crane assembly and disassembly.

Table 4-2 Crane Configurations on Pedestals

Crane Configuration	Swing	Max Capacity	Max Radius
<ul style="list-style-type: none"> Crane on pedestals (rotating bed, adapter frame, and carbody) Live mast in operating range (110°-158°) No crawlers No counterweight 	30° Either Side of Center See Figure 4-9		
<ul style="list-style-type: none"> Crane on pedestals (rotating bed, adapter frame, and carbody) Live mast in operating range (110°-158°) No crawlers installed (handling 1st crawler) No counterweight 	30° Either Side of Center See Figure 4-9	54 430 kg 120, 000 lb	8,5 m (29 ft)
<ul style="list-style-type: none"> Crane on pedestals (rotating bed, adapter frame, and carbody) Live mast in operating range (145°-158°) First crawler installed No counterweight 	360°		
<ul style="list-style-type: none"> *Crane on pedestals (rotating bed, adapter frame, and carbody) Live mast in operating range (110°-158°) First crawler installed and resting on the ground. No counterweight <p>*See note for this section</p>	360°	54 430 kg 120, 000 lb	8,5 m (29 ft)
<ul style="list-style-type: none"> Crane on crawlers Counterweight installed (fully retracted) or removed Handling loads with live mast. 	360°		

NOTE: *Pedestals installed only on the side of the carbody opposite the 1st crawler.

NOTE: Mast hoist (drum 4) operation is not permitted at radii greater than 8,5 m (29 ft).

Refer to the Liftcrane Mast Capacities Chart at the end of this section for detailed lifting capacities with the mast and self-erect cylinder.

Swing Limited to 30° (1) for Handling the First Crawler Over Side of Crane on Carbody Pedestals

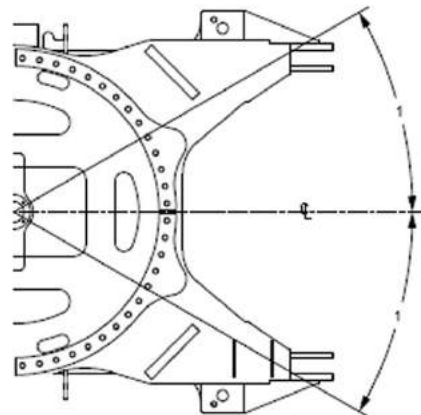


FIGURE 4-9



WARNING

Crane Tipping Hazard!

To avoid serious or fatal crushing injury, do not exceed operating radii and capacities given in the Liftcrane Mast Handling Capacities Chart. Structural failure or crane tipping will occur.

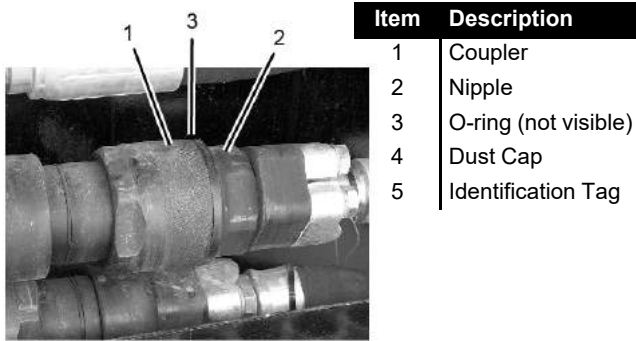
Table 4-3 Crane Configurations on Carbody Jacks

Crane Configuration	Swing	Max Capacity	Max Radius
<ul style="list-style-type: none"> Crane on four carbody jacks (rotating bed, adapter frame, and carbody) Live mast in operating range (110°-158°) No crawlers No counterweight 	360°	54 430 kg 120, 000 lb	7,5 m (26ft) when handling loads
		8,5 m (29 ft) when handling slings and shackles	
<ul style="list-style-type: none"> Crane on four carbody jacks (rotating bed, adapter frame, and carbody) Live mast in operating range (110°-158°) First crawler installed No counterweight 	30° Refer to Figure 4-9	54 430 kg 120, 000 lb	7,5 m (26ft) when handling loads
		8,5 m (29 ft) when handling slings and shackles	
<ul style="list-style-type: none"> Crane on two carbody jacks (rotating bed, adapter frame, and carbody) Live mast in operating range (110°-158°) First crawler installed and resting on the ground No counterweight 	360°	54 430 kg 120, 000 lb	7,5 m (26ft) when handling loads
		8,5 m (29 ft) when handling slings and shackles	

NOTE: Mast hoist (drum 4) operation is not permitted at radii greater than 8,5 m (29 ft).

HYDRAULIC HOSE IDENTIFICATION

Where necessary, the hydraulic hoses and corresponding couplers have identification tags (5) as shown in [Figure 4-10](#). Match the number on the hose with the number on the decal or the corresponding coupler to ensure proper connection.



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

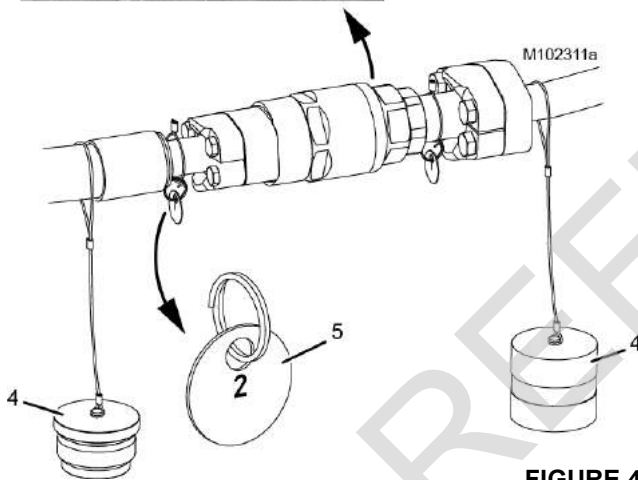


FIGURE 4-10

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 (6, [Figure 4-12 on page 4-12](#)) 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.

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 4-10](#)), as follows:

1. Lubricate coupler internal threads (1), nipple threads (2), and nipple O-ring (3) with LPS-2 Aerosol Lubricant.
2. Hand tighten coupler (1) onto nipple (2).
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 (3) 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 4-16 on page 4-17](#)) is open.
 5. Check for leaks after the crane has been operated and the hydraulic oil is at operating temperature. Retighten the couplers if necessary.

6. 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:

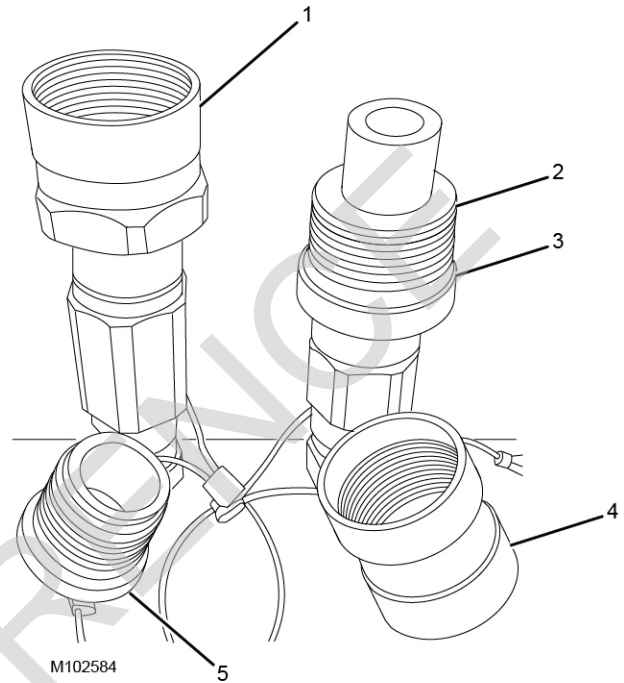
- Hanging lanyards
- Storage brackets
- Job box

7. 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 with LPS-2 Aerosol Lubricant during crane assembly and disassembly (see [Figure 4-11](#)):

- 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.



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

FIGURE 4-11

Item	Description
1	Remote Control
2	Electric Cable: 20 m (66 ft)
3	Transceiver
4	Receptacle (2)
5	Battery Charger
6	External Engine Switch
7	DC Load Center

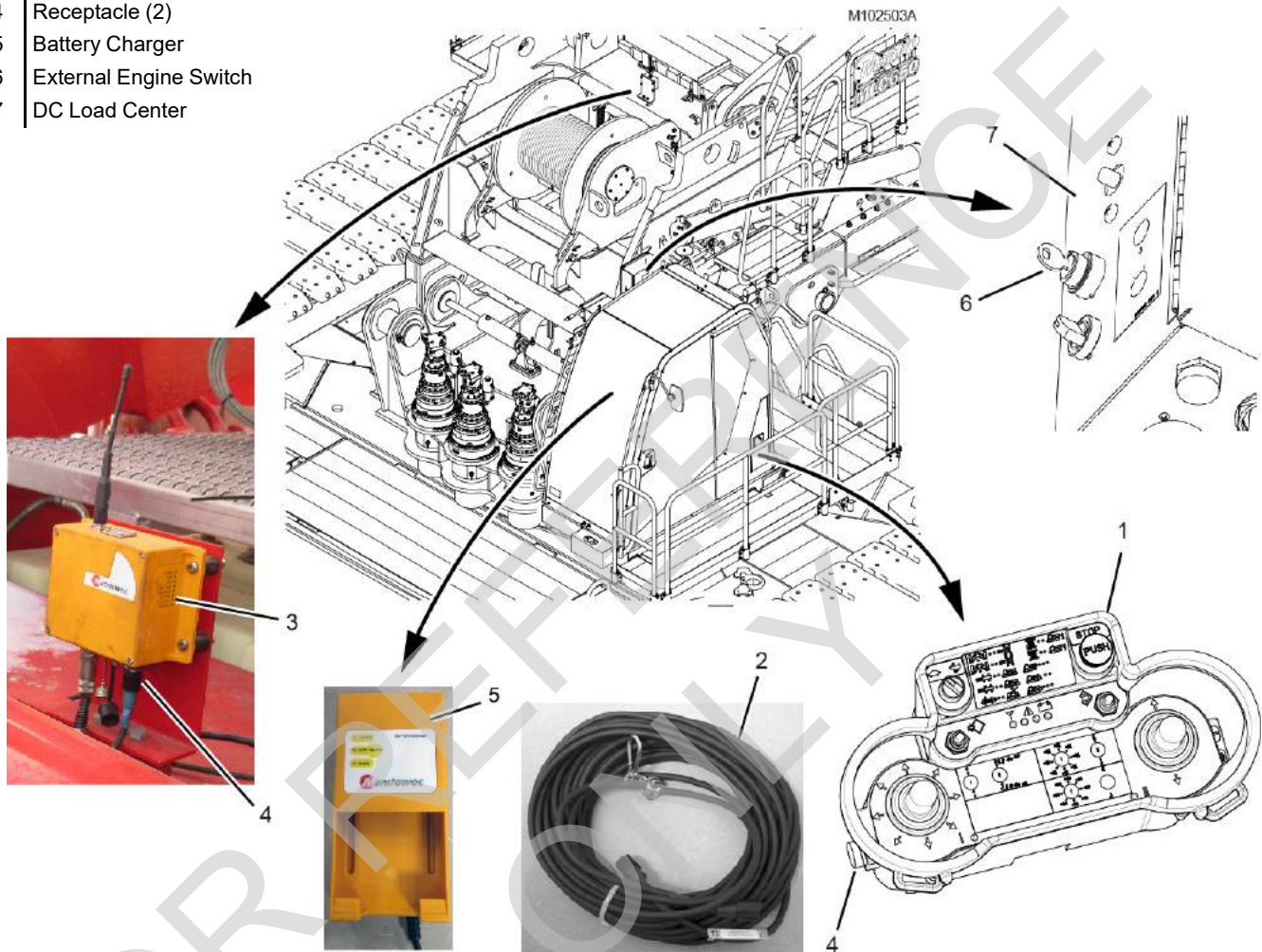


FIGURE 4-12

REMOTE CONTROL

For identification and operation of the self-erect controls provided on the remote control, refer to Section 3 of this manual.

Do not operate self-erect controls without first reading Section 3 of this manual and the applicable procedures in this section.

NOTE: The speed of all self-erect functions depends on engine speed: the faster the engine speed, the faster the self-erect functions (and vice versa).

The remote control can be operated without the electric cable (2)(wireless) if the job site conditions allow a wireless signal.

If a wireless signal is not obtainable, connect the electric cable (2) from the receptacle (4) on the remote control (1) to the receptacle (4) on the transceiver (3).

Controls for the following functions are provided on the remote control:

- Engine start, stop, and speed
- Rotating bed pins
- 4- Upperworks jacks (optional)

- 4- Lowerworks jacks (optional)
- Rigging winch
- Counterweight (tray) travel in and out
- VPC-MAX (beam) travel in and out
- 4- Upperworks jack stowage
- 2- VPC-MAX pins
- 4- Crawler pins
- 4- VPC-MAX beam to auxiliary member pins
- Horn

Activating the Remote Control

To activate the remote control upon arriving at the job site, proceed as follows (see [Figure 4-12](#)):

1. Remove the remote control (1) from the storage compartment on the side of the operator cab.
2. Using the key provided, turn the external engine switch (6) CLOCKWISE to the RUN position.
3. Turn the power switch on the side of the remote control CLOCKWISE to the ON (I) position. The communication light on the remote will flash green.
4. Press the communication switch on the side of the remote control for approximately one second and release it. The function light on the remote control for the last function used will glow green.

The remote control will remain active until the external engine switch (6) is turned COUNTERCLOCKWISE to the STOP position or the remote control is deactivated in the Remote Control Selection Screen in the Main Display (see MLC650 Main Display Operation Manual).

The remote control will “go to sleep” after 10 minutes of non-use. If this happens, press the communication switch on the side of the remote control for approximately one second and release it to re-establish communication.

NOTE The remote control can also be activated in the Remote Control Selection Screen in the Main Display (see Main Display Operation Manual).

Starting Engine with Remote Control

To start the engine using the remote control:

1. Activate the remote control as instructed in activating the remote control.
2. Read the Startup Procedures in Section 3 of this manual.

3. Turn the engine ignition switch on the remote control CLOCKWISE to the START position to start the engine.
4. Release the power switch to the ON (I) position as soon as the engine starts.

NOTE: To stop the engine when using the remote control, turn the external engine switch (6) COUNTERCLOCKWISE to the STOP position.

Rotating Bed Jacking Cylinders Function

When the ALL jacking cylinders function is selected, all of the rotating bed jacking cylinders will extend or retract at the same time. The cranes programmable controller will automatically adjust the jacks to keep the rotating bed in the same relative position that it starts out in. If the rotating bed is level, the jacks will adjust to keep it level.

The ALL jacking cylinders function is disabled and an error indicator light on the remote (AMBER LED) will illuminate if:

- The controller senses the roll (left/right) is out of level by 4.5 degrees.
- The pitch (front/rear) is out of level by 3.0 degrees.

Use the INDIVIDUAL jacking cylinders function to bring the crane back to level or to level the crane in the event of a faulty level sensor.

SETUP MODE

To operate in the setup mode during crane assembly and disassembly, perform the following steps:

- Select the live mast configuration in the RCL/RCI Display. See the RCL/RCI Display Operation Manual for instructions.

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

- For current production cranes (CCM-10 software version 0.022 and newer), activate the self-erect cylinder in the Mode Selection Group of the Main Display. See the Main Display Operation Manual for instructions.
- Activate the remote control in the Mode Selection Group of the Main Display. See the Main Display Operation Manual for instructions.

NOTE All of these steps are performed automatically when the remote control is turned on using the procedure under the topic [Activating the Remote Control](#).

IDENTIFICATION AND LOCATION OF COMPONENTS

Item	Description	Item	Description
1	Live Mast Sheaves	12	Boom Hinge Pin
2	Self-Erect Cylinder (optional)	13	Swing Drive
3	Live Mast Links/Straps	14	Adapter Frame/Rot Bed Pin Puller
4	Live Mast Hoist (Drum 4)	15	Crawler Drive
5	Mast Assist Cylinder	16	Crawler Shoe
6	Fuel Tank	17	Intermediate Roller
7	Whip Hoist (Drum 3)	18	Turntable Bearing
8	Boom Stop Switch	19	Adapter Frame
9	Operator Cab	20	Crawler Tensioning Assembly
10	Front Roller	21	Adapter Frame/Rot Bed Pin
11	Carbody/Crawler Pin	22	Rotating Bed Jacking Cylinders (optional)
		23	Outrigger Pad (optional)
		24	Counterweight Tray
		25	Counterweight Box
		26	Counterweight Tray Drive
		27	Counterweight Tray Roller
		28	Backhitch
		29	Gantry
		30	Live Mast

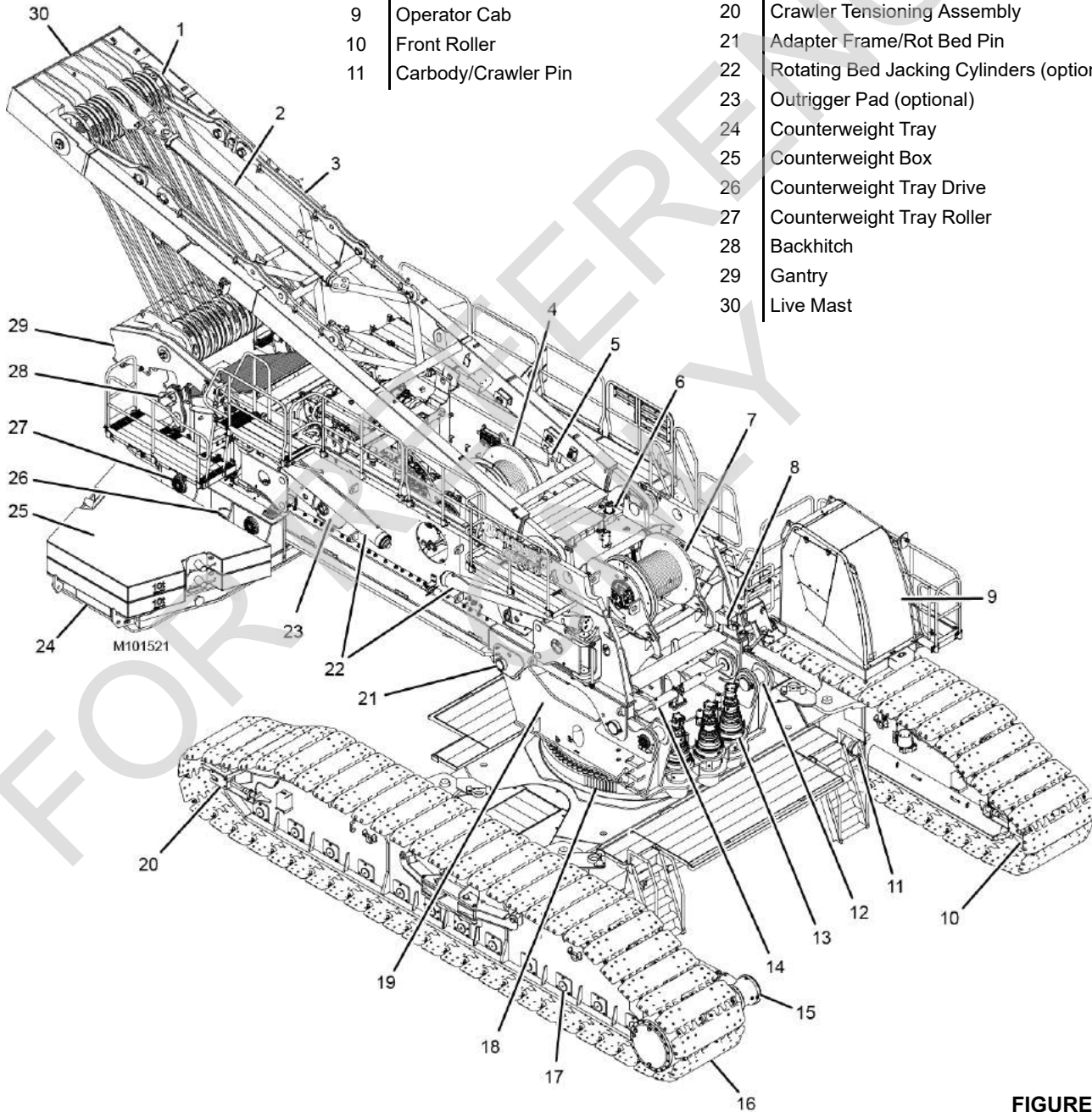


FIGURE 4-13

CRANE ASSEMBLY

Remove Cab Window Covers

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

If equipped, remove and store the cab window covers. The cab covers are secured with hair-pin cotters attached to the covers with lanyards. Remove hair-pin cotters to remove covers.

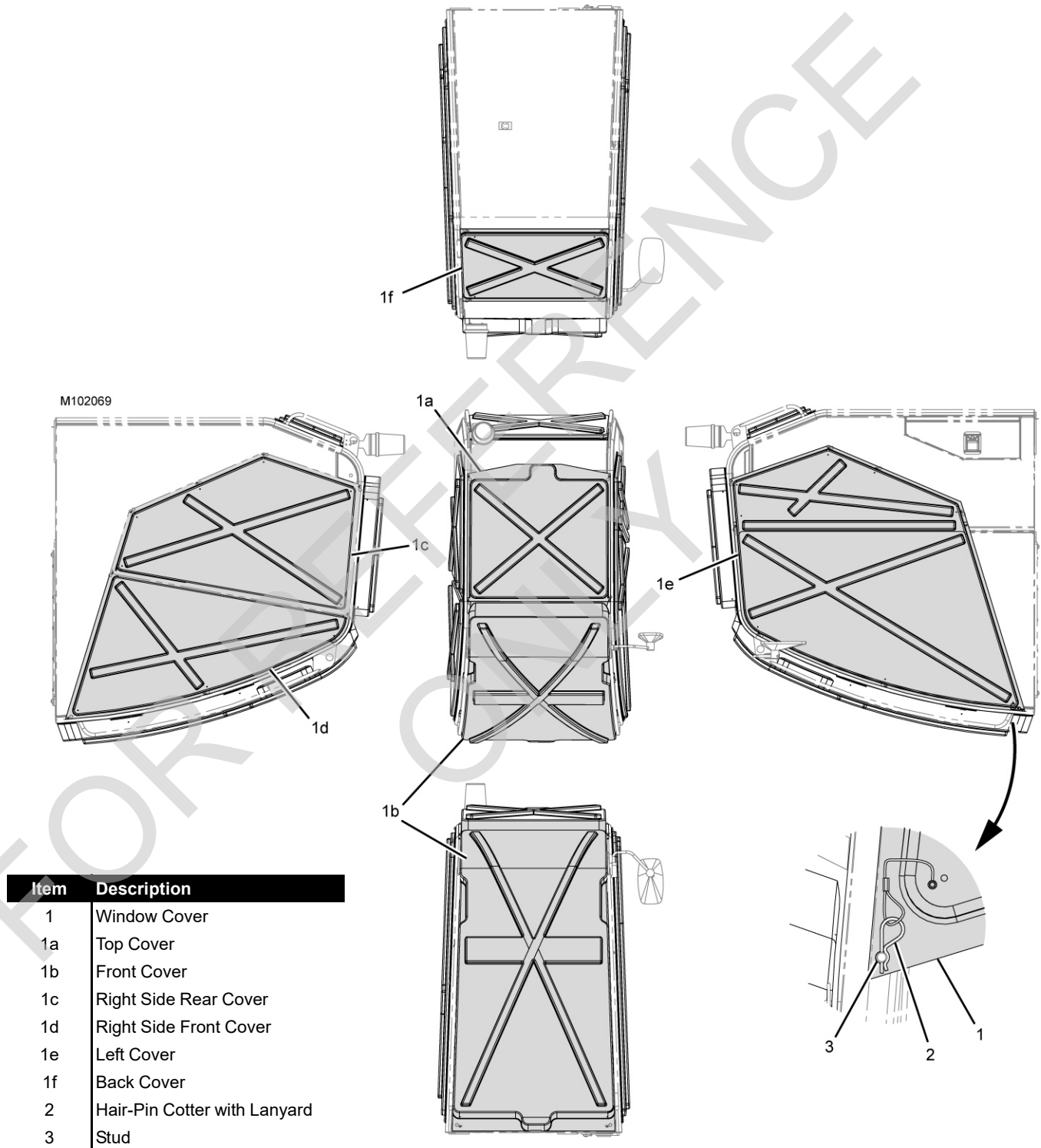
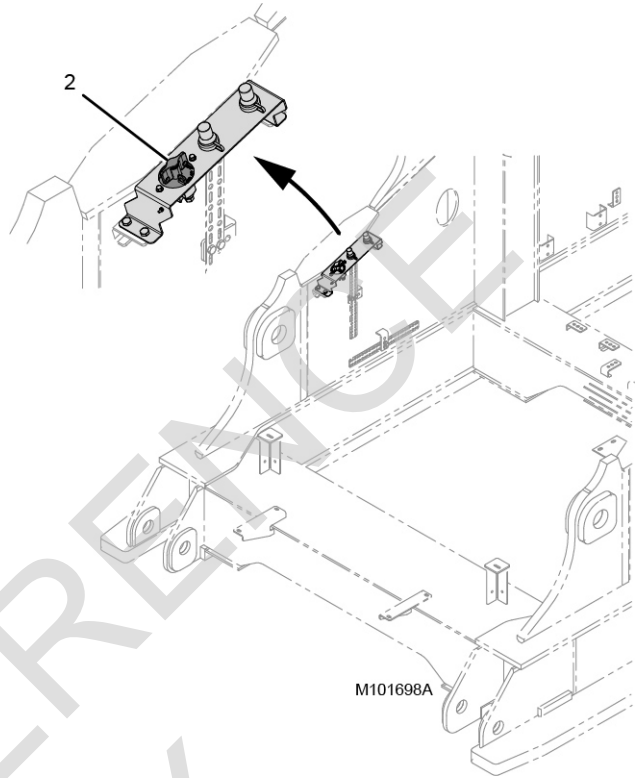
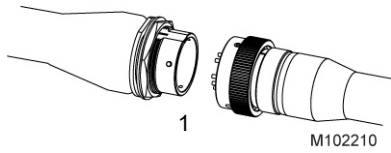
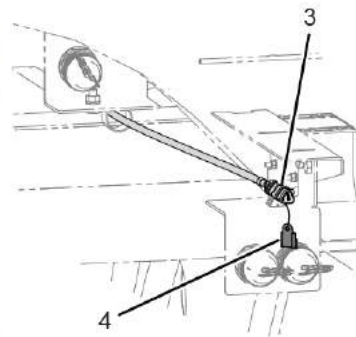
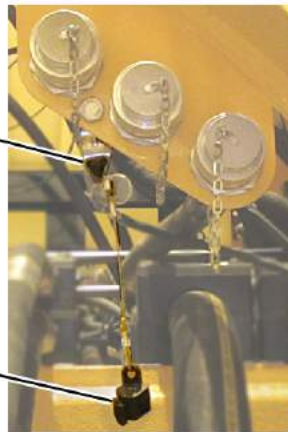
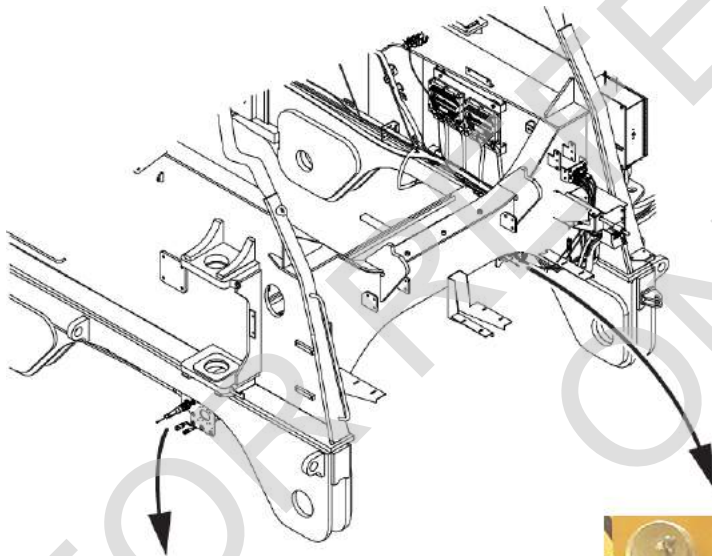


FIGURE 4-14



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 4-15

Perform Pre-Start Checks

Make the following checks before proceeding to assemble the crane or starting the engine. See Section 3 for starting instructions.

Electric System

1. Check that all electrical terminators (shorting plugs 3-6 as shown in [Figure 4-15](#)) are connected. The engine may not start and faults will be activated if the plugs are not connected.
2. Locate and turn on the electrical system disconnect switch (2, [Figure 4-15](#)).

Hydraulic System

1. Check for leaks.
2. Check level.
3. Repair or refill as required.

Gear Boxes

Perform required lubrication services and maintenance checks. See the Lubrication Guide and the Maintenance Checklist supplied with the crane.

1. Check for leaks.
2. Check levels.
3. Repair or refill as required.
4. Check that the hydraulic shut-off valve is in the open position (1b, [Figure 4-16](#)) and the locking pin is installed.

Item	Description
1a	Hydraulic Tank Shut-Off Valve (closed)
1b	Hydraulic Tank Shut-Off Valve (open)
2	Locking Pin (can be replaced with an owner furnished padlock)

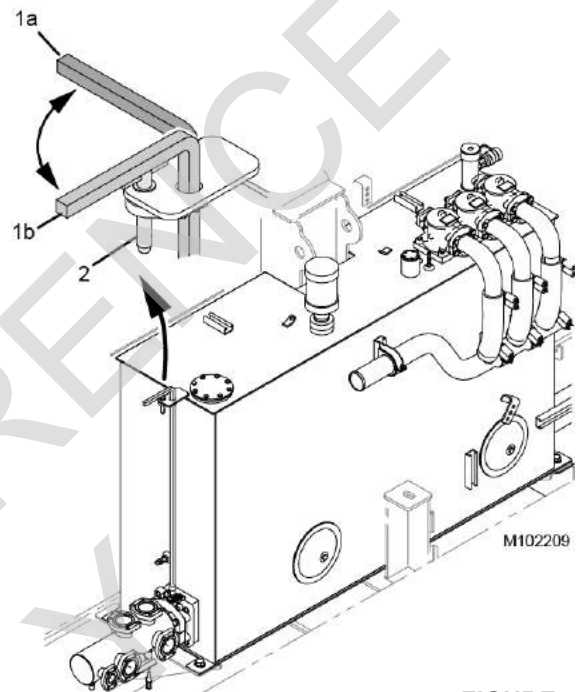
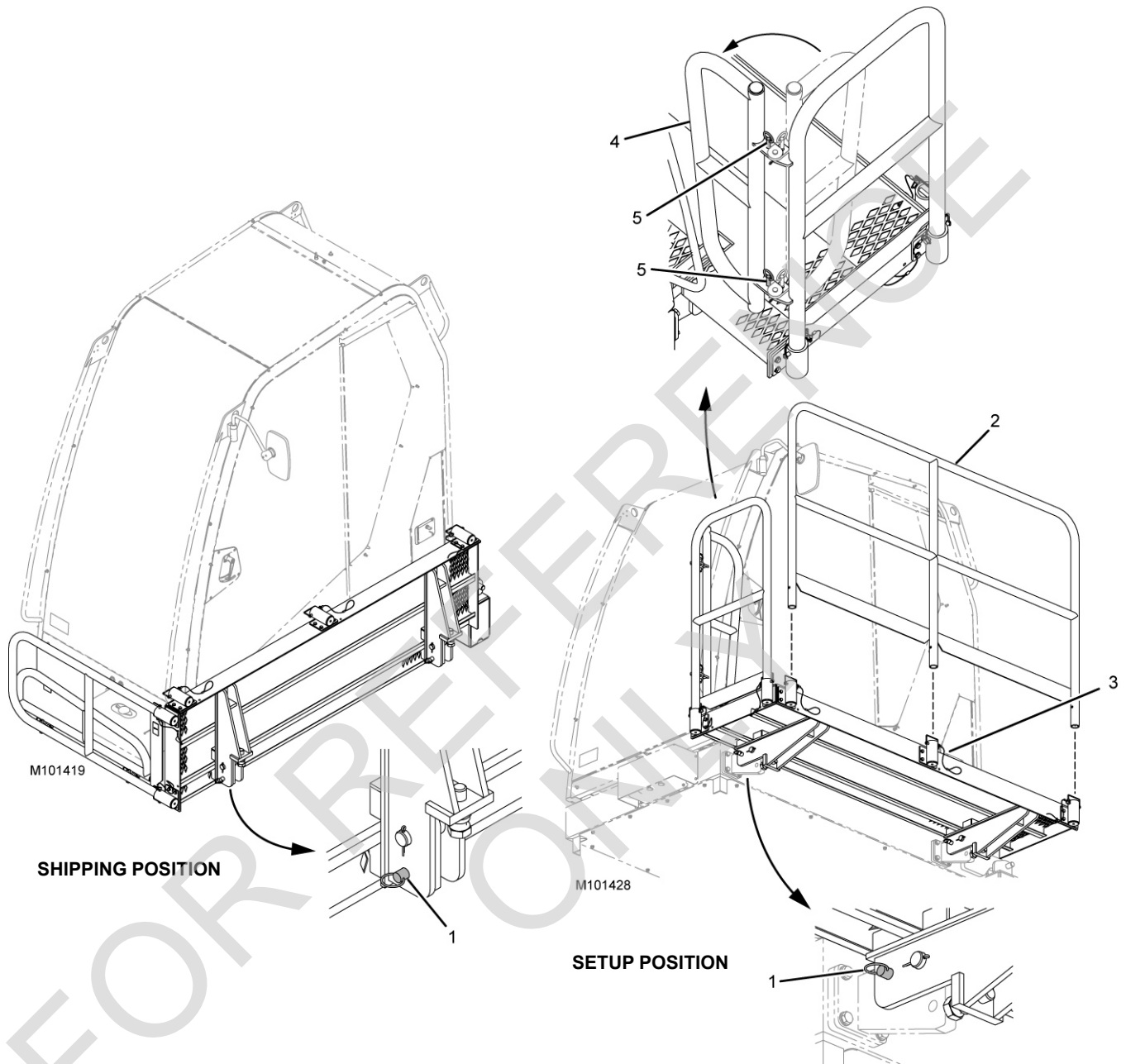


FIGURE 4-16



Item	Description
1	Safety Pin
2	Handrail
3	Lanyard Pin
4	Cab Handrail
5	Quick Release Pin

FIGURE 4-17

Deploy Operator Cab Platforms

NOTE: Identification labels are provided on the handrails and platforms for ease of installation.

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

1. Remove the safety pins (1) from the platform bracket. Lower the platform into the setup position and insert safety pins.
2. Remove the lanyard pins (3), install the handrail (2), and install the lanyard pins.
3. Remove the quick release pins (5), rotate the cab handrail (4), and install the quick release pins.

Start Engine

NOTE: It is normal for the system fault alert and operating limit alert to come on when the engine is started.

The system fault alert should go off as engine oil pressure and hydraulic oil temperature rise to normal. If alert does not go off soon after start-up, determine fault, stop engine, and correct cause of fault (see Main Display Operation).

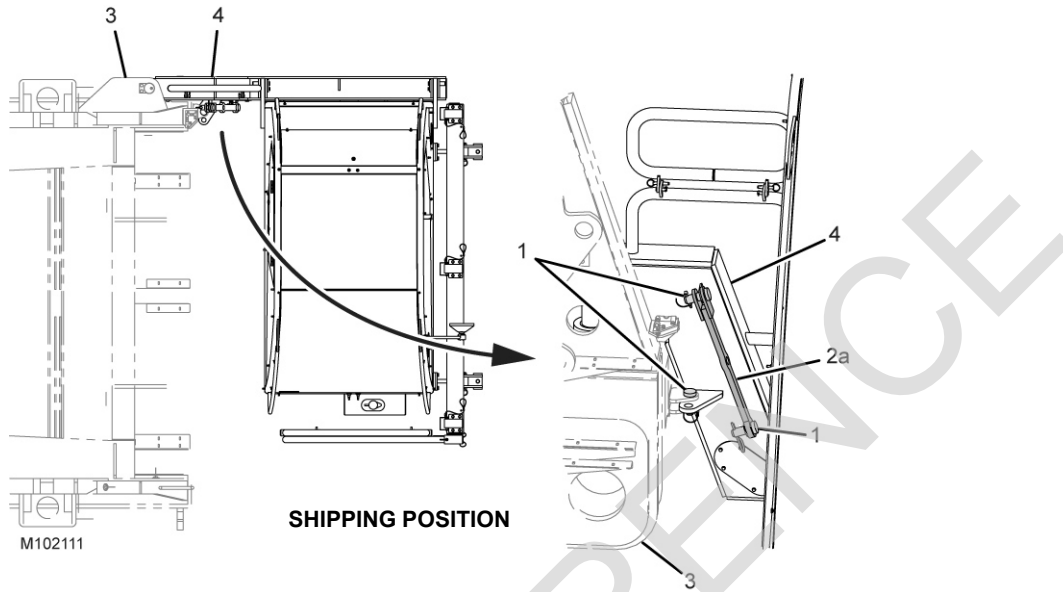
Reference the Start Up Procedure found in Section 3 of this manual.

1. Perform the pre-start checks given on [page 4-17](#).
2. Remove the remote control from the storage compartment on the left side of the operator cab (see [Figure 4-12 on page 4-12](#)).
3. Activate the remote control. See "[Activating the Remote Control](#)" on [page 4-13](#).
4. Start the crane engine with the start switch on the remote control. "[Starting Engine with Remote Control](#)" on [page 4-13](#)

NOTE: You will not be able to increase the engine speed until the hydraulic oil temperature is warmed to at least 17°C (63°F).

The hydraulic temperature fault will remain on until the hydraulic oil temperature is 17°C (63°F). **There will be no throttle response until this fault is cleared.**





Item	Description
1	Pins and Safety Pins
2a	Strut (shipping position)
2b	Strut (set up position)
2c	Strut (working position)
3	Rotating Bed
4	Operator Cab Support

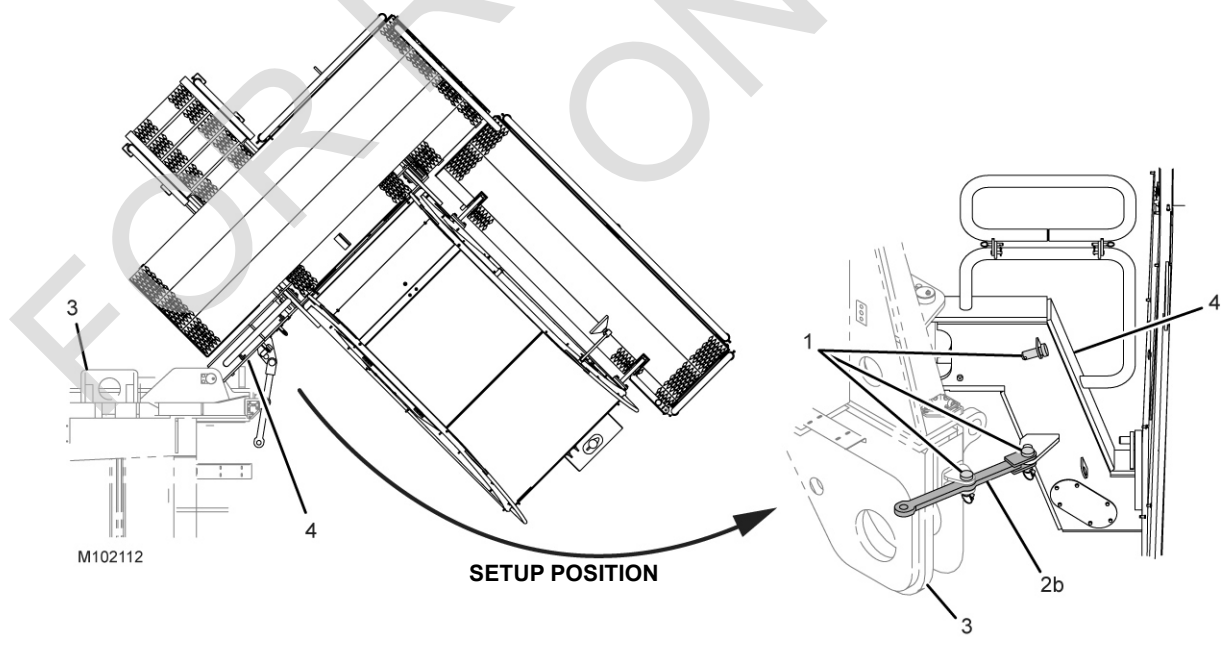


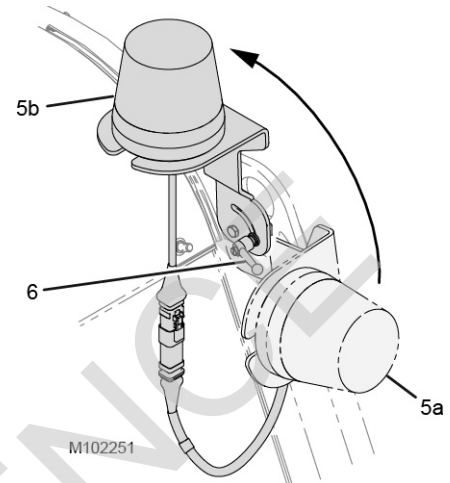
FIGURE 4-18

Deploy Operator Cab

See [Figure 4-18](#) for the following procedure.

1. Remove the strut (2a) from the shipping position.
2. Remove the pins and safety pins (1) from the shipping position that secure the operator cab support (4) to the rotating bed (3).
3. Rotate the operator cab to the setup position.
4. Install the strut (2b) using the pins and safety pins (1) to secure the operator cab in the setup position.
5. Loosen the clamping handle on the RCL light (5a), rotate the light up into the working position (5b), tighten the clamping handle.

Securing the operator cab in the setup position allows cab access and the set up of the cab platforms and handrails when the front rotating bed jacking cylinders are deployed.



Item	Description
5a	RCL Light (shipping position)
5b	RCL Light (working position)

FIGURE 4-18 continued

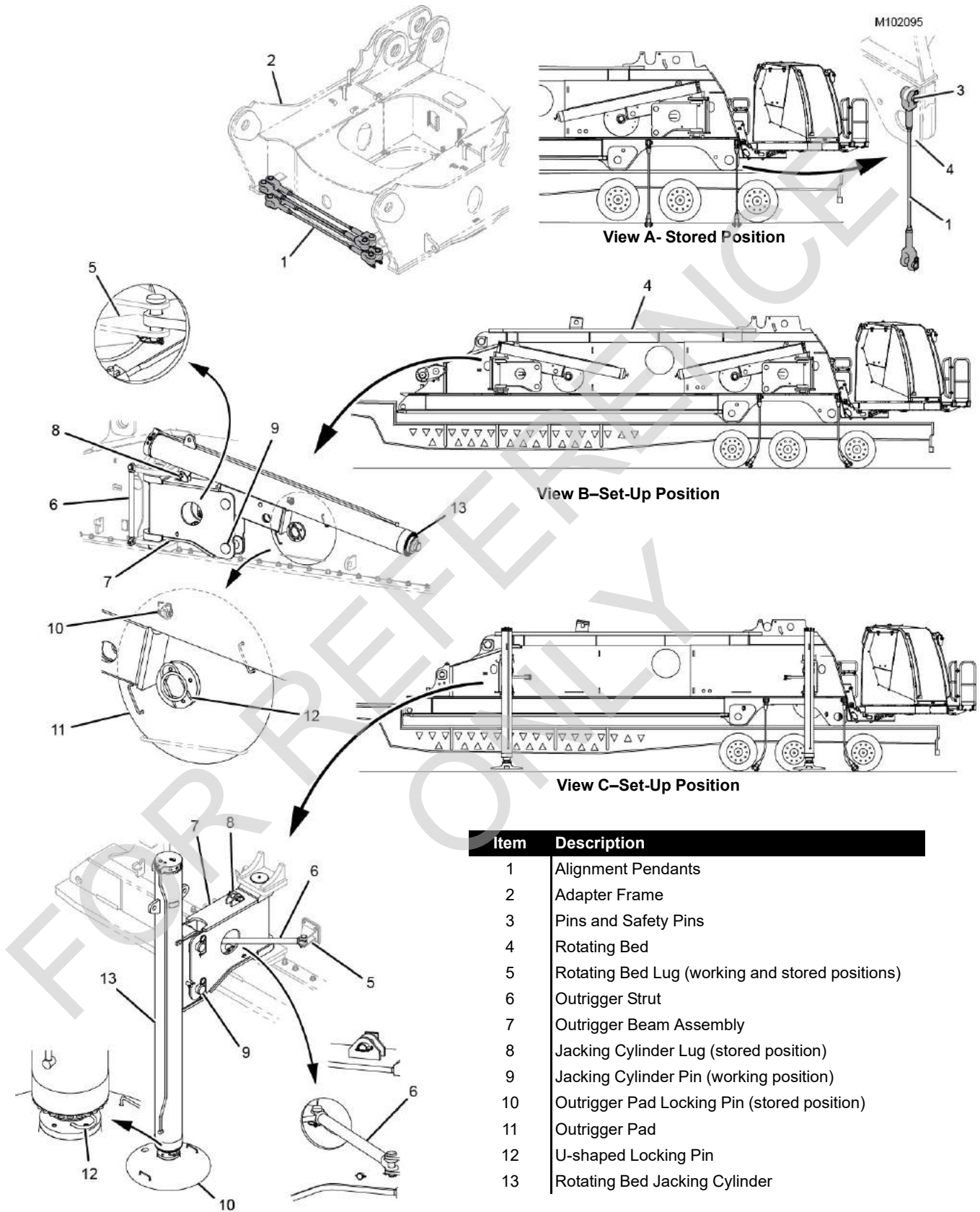


FIGURE 4-19

Remove Rotating Bed from Trailer

See [Figure 4-19](#) for the following procedures.

1. Position the trailer (View A) carrying the rotating bed module at the desired location at the assembly site.
2. Remove all chains and straps used to secure the rotating bed to the trailer.

Install Alignment Pendants

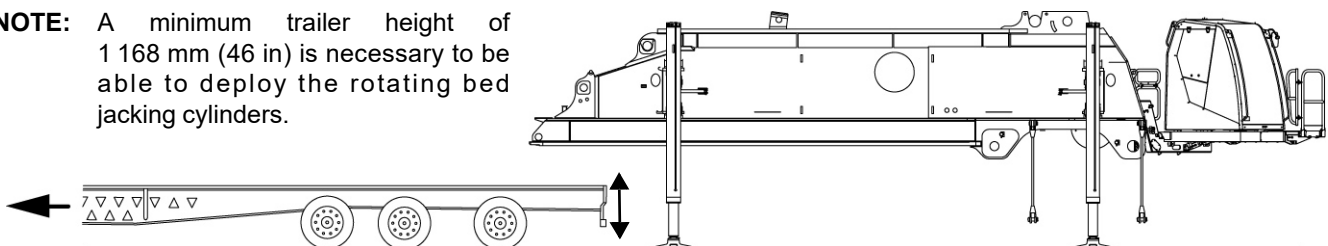
NOTE: The operator cab must be in the position (View B) to install the alignment pendant behind the operator cab frame.

1. Locate the adapter frame (2) and the alignment pendants (1).
2. Remove the pins and safety pins (3) securing the alignment pendants in the stored position on the adapter frame.
3. Align each of the four pendants to the lugs on the rotating bed (4, View A).
4. Install the pins and safety pins securing the pendants to the rotating bed (View A).

Deploy Rotating Bed Jacking Cylinders

1. Unfasten the outrigger strut (6) from the stored position.
2. Remove the connecting pin from the rotating bed lug (5, View B).
3. Swing the outrigger beam assembly (7, View B) from the stored position to the working position.
4. Install the pins and safety pins to connect the outrigger strut (6) from the rotating bed lug (5) to the outrigger beam assembly (7, View C).
5. Remove the jacking cylinder wire locking pin and pin (9) from the outrigger beam assembly.
6. Remove the wire locking pin and pin from the jacking cylinder lug (8, View B) which secures the rotating bed jacking cylinders in the stored position.
7. Use the remote control to lower the rotating bed jacking cylinder to the working position (View C).

NOTE: A minimum trailer height of 1 168 mm (46 in) is necessary to be able to deploy the rotating bed jacking cylinders.



M102931

FIGURE 4-20

8. Install the pin and wire locking pin (9, View C) to secure the rotating bed jacking cylinder.
9. Repeat steps 1-8 for each rotating bed jack assembly.
10. Remove the outrigger pad locking pins (10, view B) and remove the outrigger pads (11, View B) from the stored position.
11. Install the outrigger pad locking pins (10) in the lugs on the rotating bed (stored position).
12. Place the outrigger pads on the ground below the jacking cylinders and remove the U-shaped locking pins (12, View B) from the outrigger pads.
13. Using the remote control, extend the rotating bed jacking cylinders (13, View C) until the end of the cylinders align with the outrigger pads. Adjust pads to align with cylinders as required.
14. Install the U-shaped locking pins (12, View C).

WARNING Moving Part Hazard!

To avoid serious crushing injury — warn all personnel to stand clear of jacks.

15. Place unused pins into the stored position for later use.
16. Raise the rotating bed until it will clear the trailer and remove the trailer (see [Figure 4-20](#)).

NOTE: Attach tag lines to the pendants and hold the pendants away from the rotating bed as the trailer is removed.

WARNING Tipping Hazard!

Avoid tipping the crane over — keep the crane level while jacking.

Install Operator Cab Rear Platform

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

NOTE: The rear cab platform (1) must be installed using an assist crane or forklift.

1. Attach four lifting slings to the lifting lugs and raise the rear cab platform (1) into position until the platform hooks onto the fixed pins (2) and engages the hooked bracket (3).
2. Once lowered into position, secure the platform by inserting pins (4) into the hooked bracket.



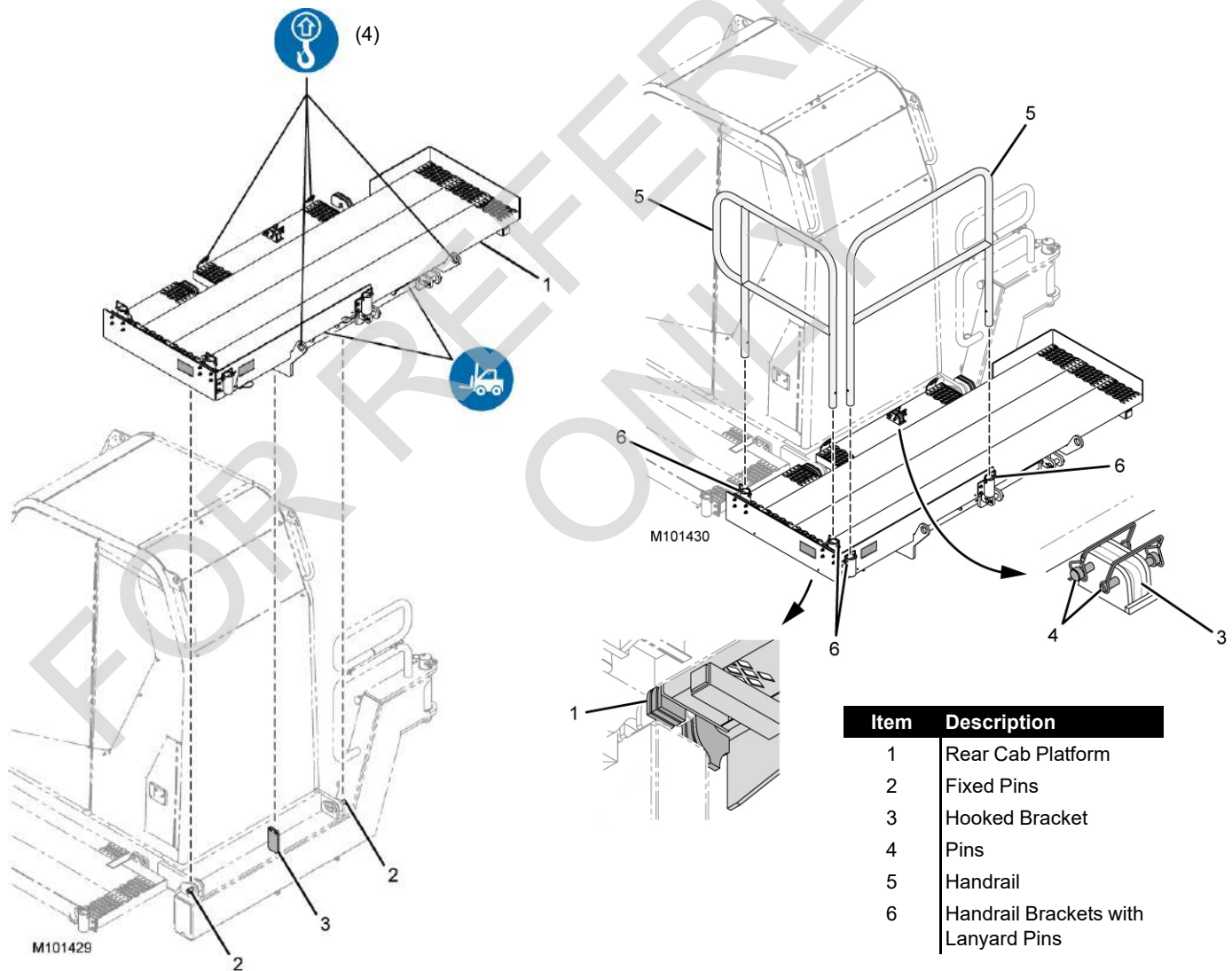
CAUTION

The pins (4) secure the platform to the crane and must be installed to avoid injury and /or property damage.

3. Once secured, remove the four lifting slings.
4. Insert the two handrails (5) into the handrail brackets and secure the handrails with the lanyard pins (6).

Each handrail weighs approximately 7 kg (15 lb).

NOTE: Identification labels are provided on the handrails and platforms for ease of installation.



Item	Description
1	Rear Cab Platform
2	Fixed Pins
3	Hooked Bracket
4	Pins
5	Handrail
6	Handrail Brackets with Lanyard Pins

FIGURE 4-21

Install Operator Cab Ladder

See [Figure 4-22](#) for the following procedure.

NOTE: Raise the rotating bed approximately 100 mm (4 in) by extending the jacking cylinders to provide ground clearance for the cab ladder installation.

1. Lift and hook the ladder (1), onto the ladder brackets (4).

NOTE: The ladder (1) (without handrails) weighs approximately 28 kg (62 lb).

Each handrail weighs approximately 7 kg (15 lb).

2. Remove pins and pivot the two struts (2) from the shipping position to the working position.
3. Install the pins into the strut brackets (3) to secure the ladder.
4. Remove the lanyard pins (6) from the handrail brackets.
5. Install the handrails (5) into handrail brackets.
6. Secure the handrails with lanyard pins.

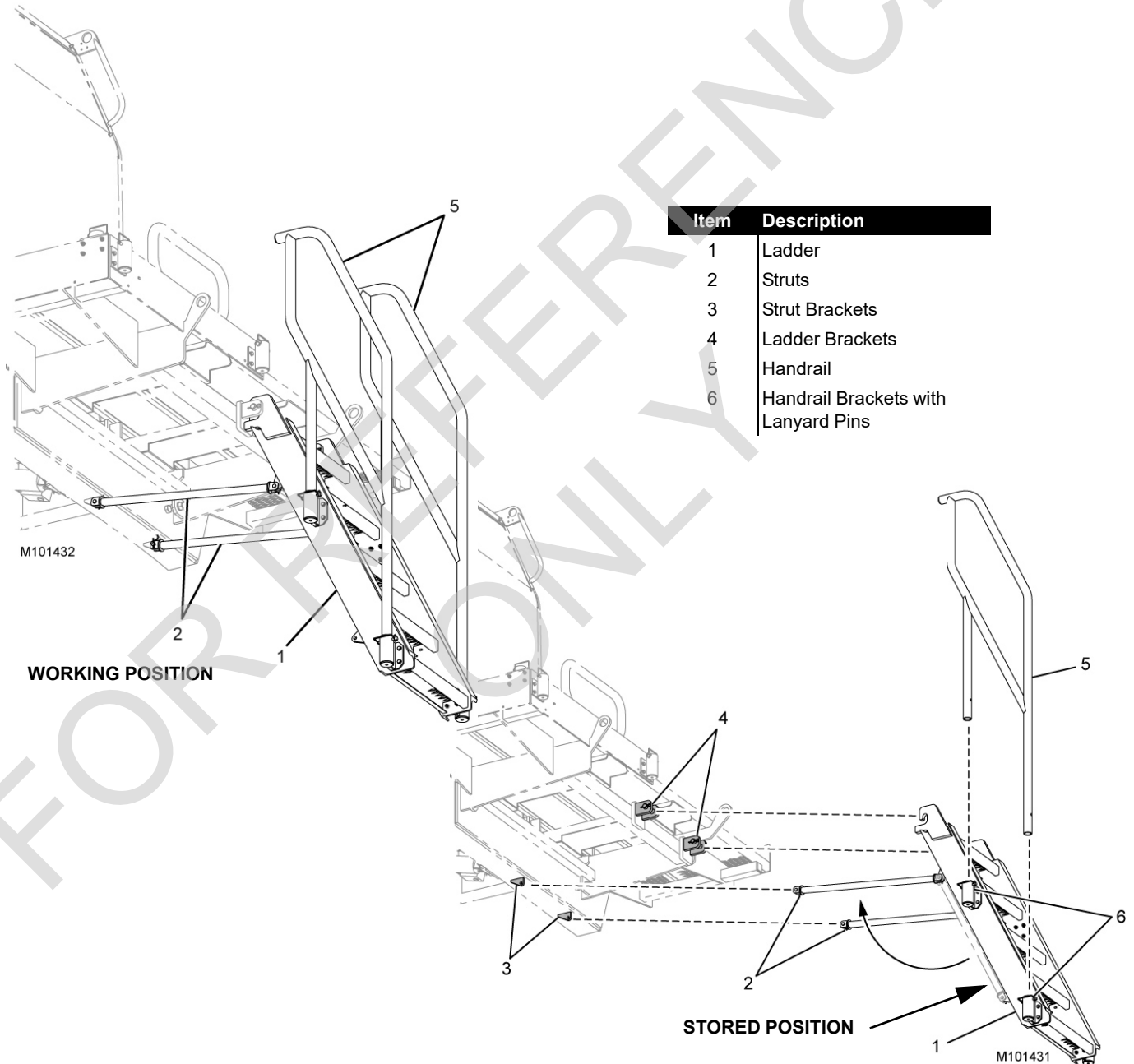
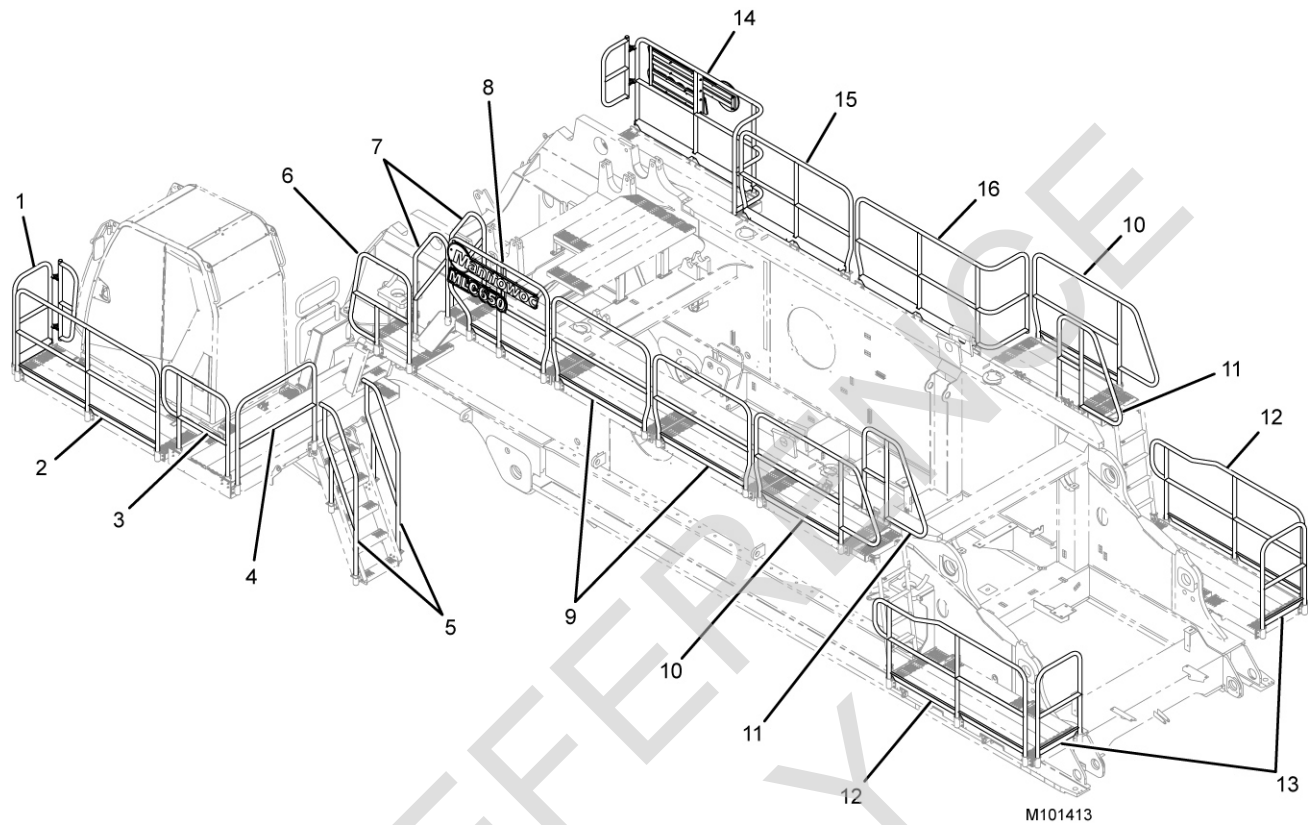


FIGURE 4-22

THIS PAGE INTENTIONALLY LEFT BLANK

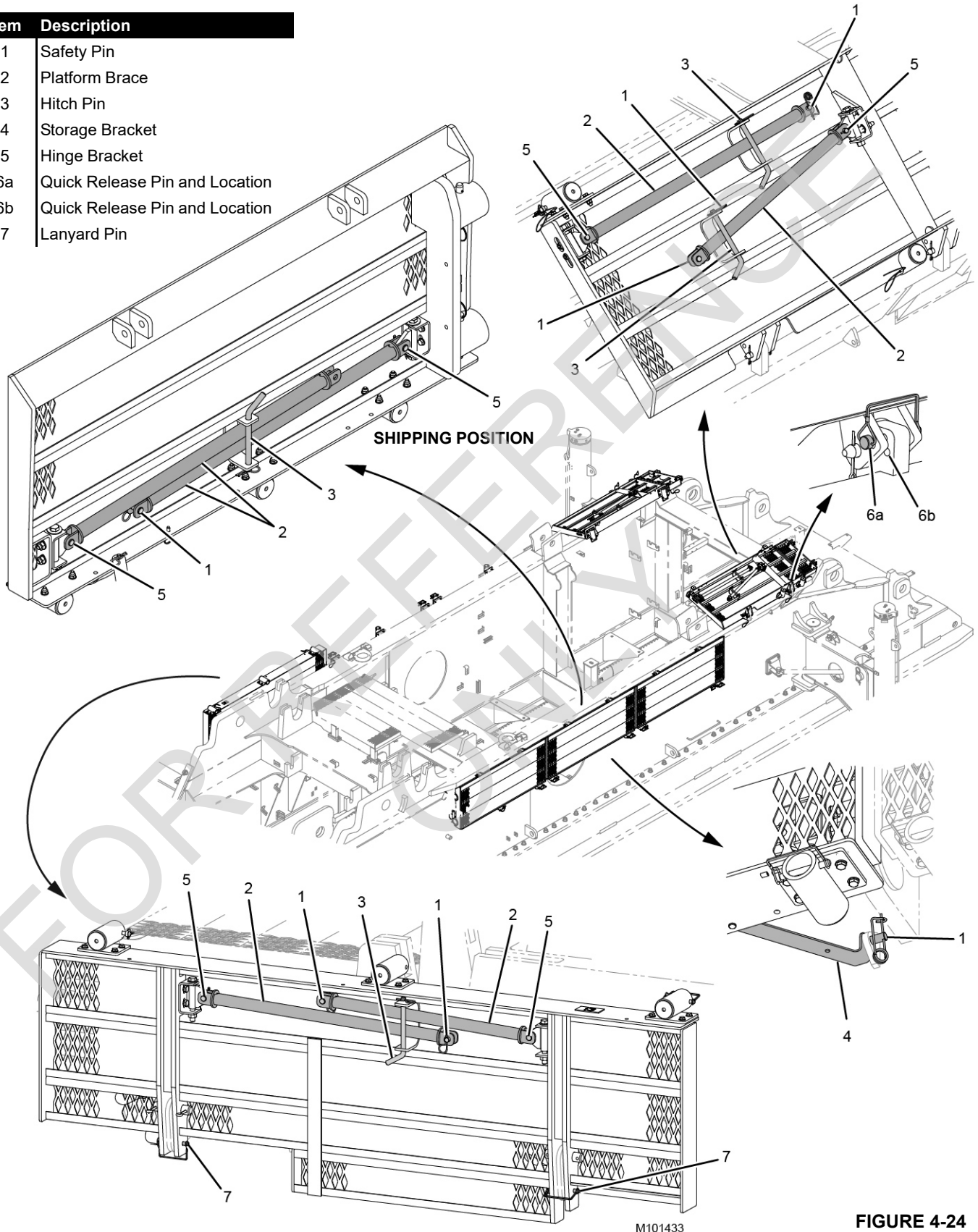
Overview of Rotating Bed Platforms and Handrails



Item	Description
1	Front Platform and Handrail - Operator Cab
2	Side Platform and Handrail - Operator Cab
3	Side/Rear Platform and Handrail - Operator Cab
4	Rear Handrail - Operator Cab
5	Ladder and Handrail - Operator Cab
6	Platform, Handrail, Ladder - Lower Front of Rotating Bed
7	Handrail, Ladder - Upper Front of Rotating Bed
8	Upper Platform and Handrail - Front Left Side of Rotating Bed
9	Upper Platform and Handrail - Mid-Left Side of Rotating Bed
10	Upper Platform and Handrail - Rear Upper of Rotating Bed
11	Platform and Handrail - Rear Upper of Rotating Bed
12	Handrail and Ladder - Rear Lower of Rotating Bed
13	Platform and Handrail - Rear Lower of Rotating Bed
14	Upper Platform and Handrail - Front Right Side of Rotating Bed
15	Upper Handrail - Front Right Side of Rotating Bed
16	Upper Handrail - Rear Right Side of Rotating Bed

FIGURE 4-23

Item	Description
1	Safety Pin
2	Platform Brace
3	Hitch Pin
4	Storage Bracket
5	Hinge Bracket
6a	Quick Release Pin and Location
6b	Quick Release Pin and Location
7	Lanyard Pin



M101433

FIGURE 4-24

Deploy Rotating Bed Platforms

The rotating bed platforms are attached to the rotating bed and must be flipped up or down to the working position. Each platform includes hinged platform braces for quick assembly.

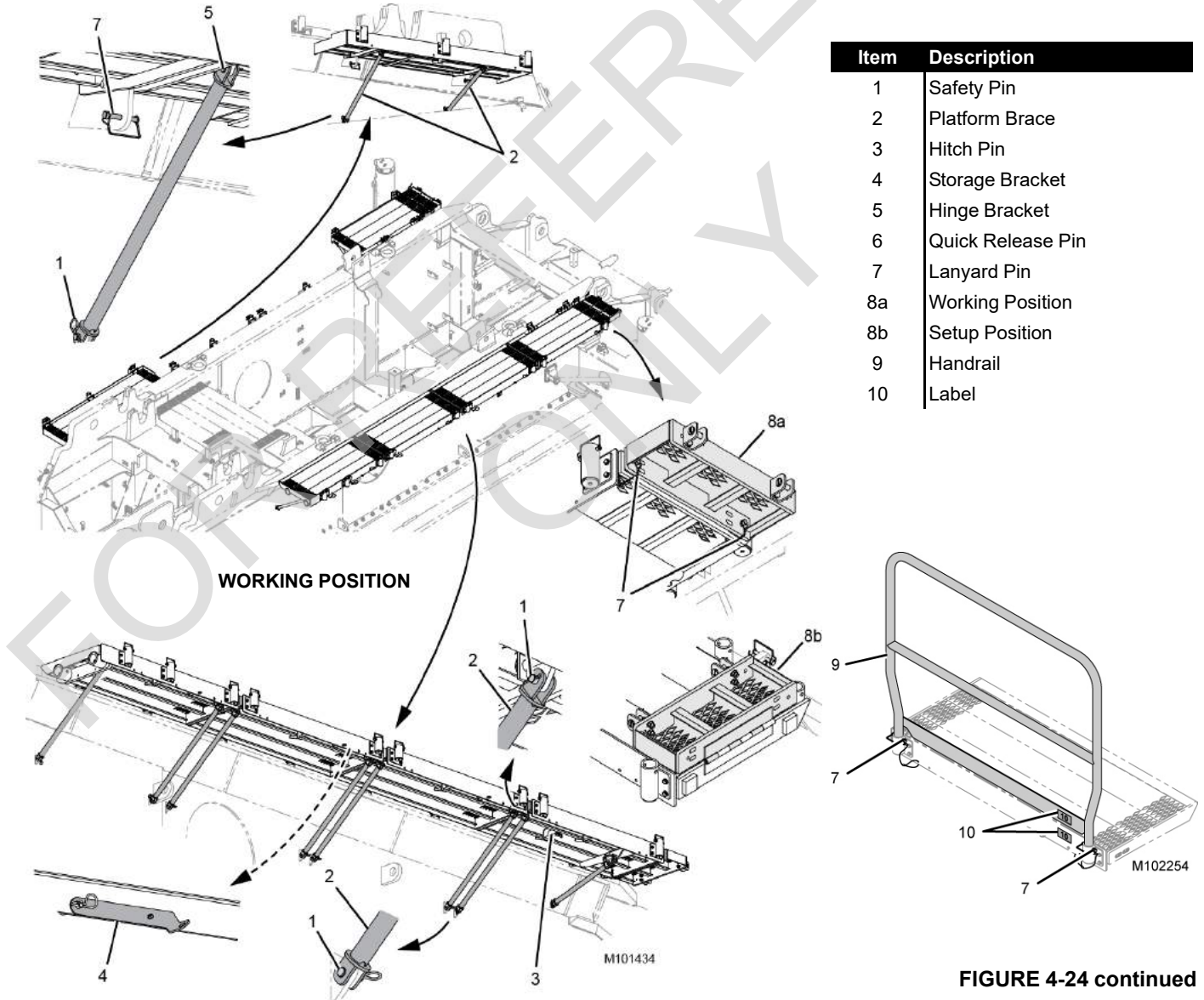
NOTE: Install the handrails when available, if they are not available use the anchors (Figure 4-2) supplied to attach safety harnesses.

The upper rear platforms include an area which must be flipped up when the rotating bed jacking cylinders are to be placed into the stored position.

The upper rear platforms have two positions for shipping. Pin position 6a is used for shipping with a live mast and pin position 6b is used for shipping without a live mast.

See Figure 4-24 for the following procedure.

1. Remove safety pin (1) from the storage bracket (4).
2. Swing platform up (upper rear platforms swing down).
3. Remove the safety pin (1) from the hitch pin (3) and remove the hitch pin.
4. Swing platform brace(s) (2) out from the platform.
5. Store hitch pin (3) using safety pin (1).
6. Lower platform into position and align platform brace(s) with rotating bed brackets.
7. Install pin and secure using safety pin (1).
8. Install handrails (9) along both sides of the rotating bed according to labels (10) and secure the handrails with lanyard pins (7).
9. Repeat the procedure for each platform section.



Item	Description
1	Safety Pin
2	Platform Brace
3	Hitch Pin
4	Storage Bracket
5	Hinge Bracket
6	Quick Release Pin
7	Lanyard Pin
8a	Working Position
8b	Setup Position
9	Handrail
10	Label

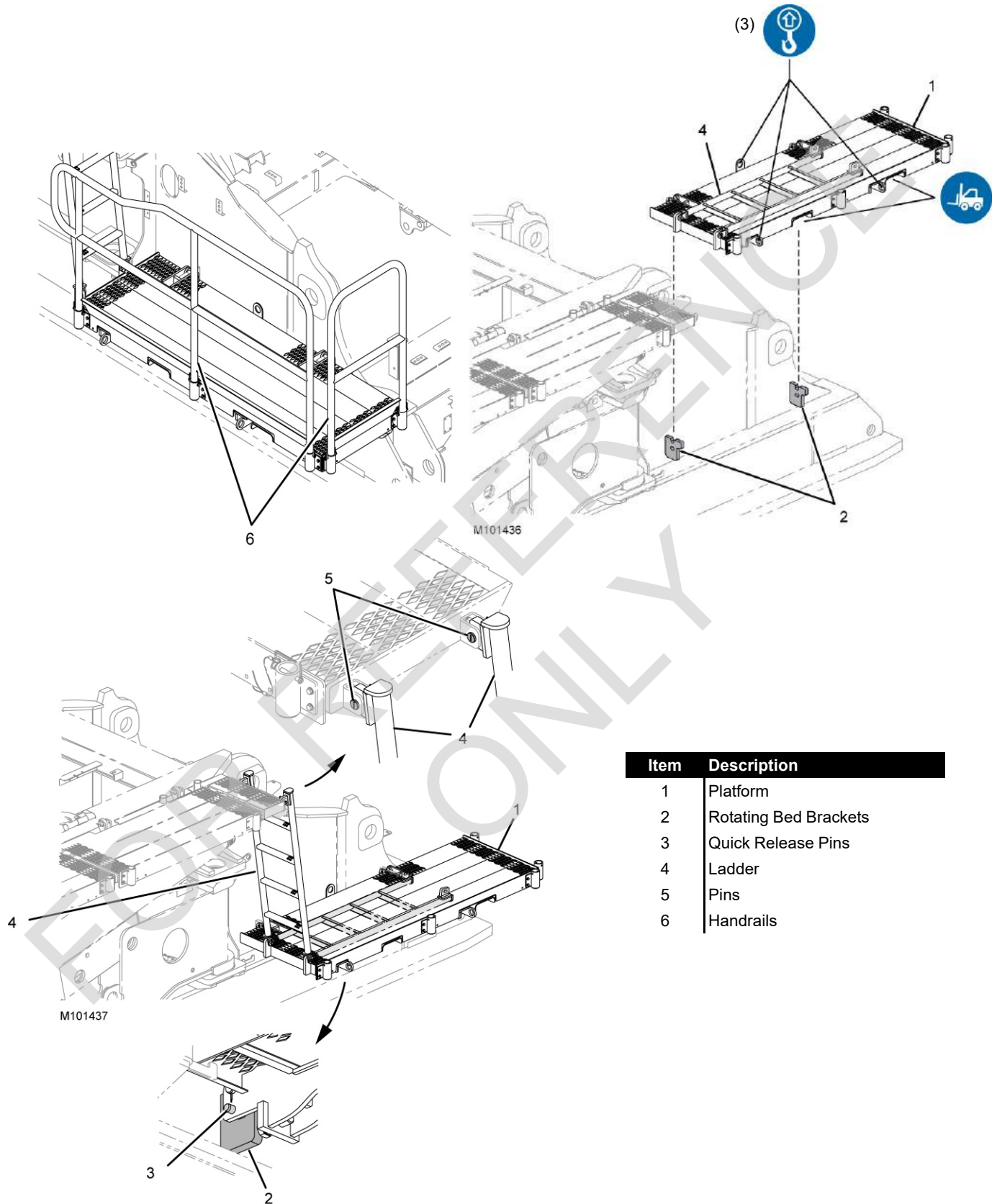


FIGURE 4-25

Install Platforms, Ladders and Handrails

NOTE: Identification labels are provided on platforms and handrails for ease of installation.

The rear platforms, ladders, and handrails on the left and right side of the rotating bed (shown in [Figure 4-25](#)) are the same and are installed in the same manner.

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

1. Remove the two pins and quick release pins (3) from the platform mounting brackets.
2. Using an assist crane or a forklift, raise the platform (1) into position, align with the mounting holes in the rotating

bed brackets (2), and secure with pins and quick release pins(3).

Platform and ladder combined weight is approximately 60 kg (133 lb).

3. Raise ladder (4) from the shipping position and attach to the upper platform using pins (5) supplied with the upper platform.
4. Install handrails (6) into handrail brackets and secure with lanyard pins.

The rear handrail weighs approximately 6 kg (15 lb) and the side handrail weighs approximately 15 kg (35 lb).

FOR REFERENCE ONLY

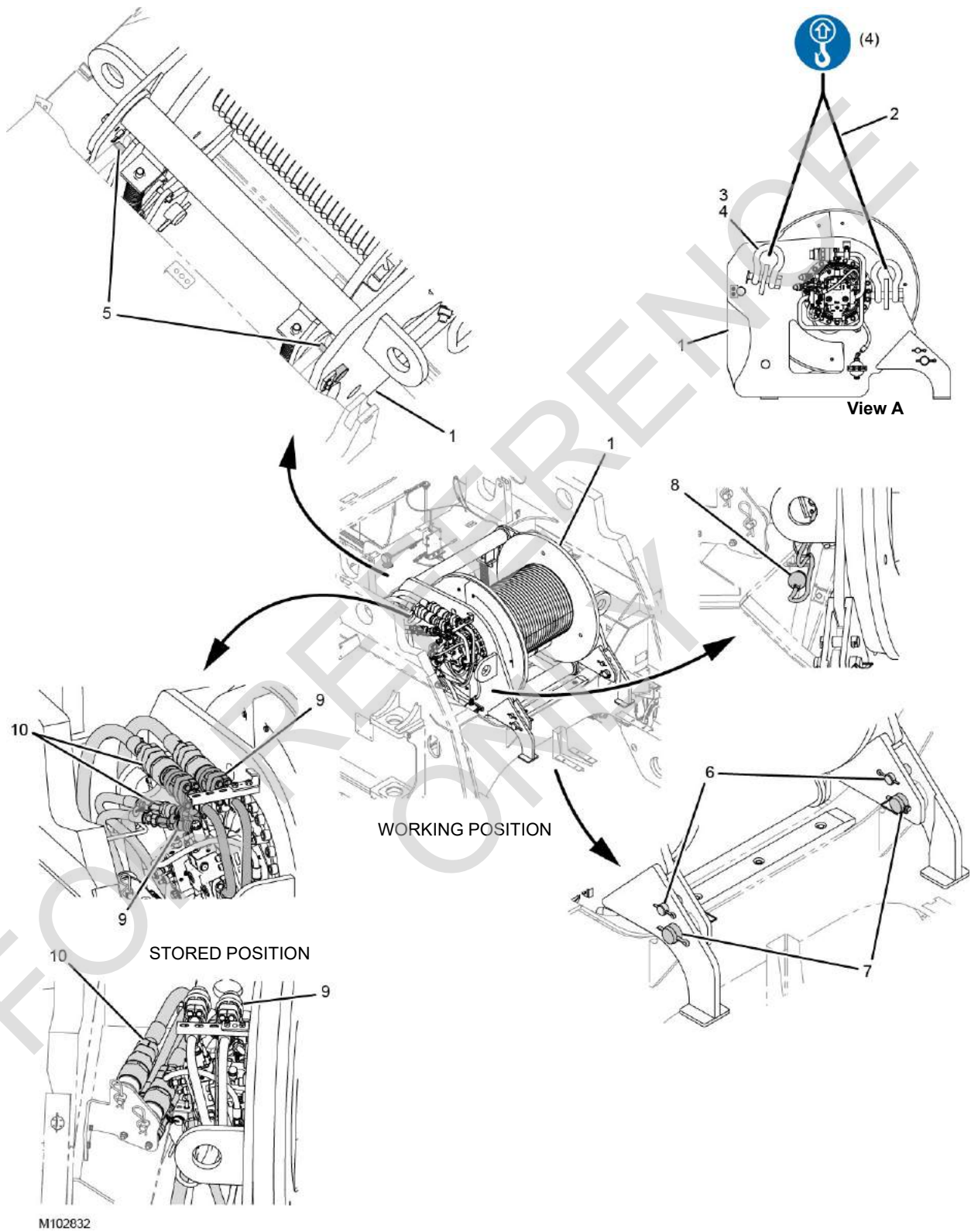


FIGURE 4-26

Legend for [Figure 4-26](#)

Item	Description
1	Drum 3 Assembly
2	4-SL 4 - Slings - 3,80 m (12.5 ft) - 11 340 kg (25,000 lb)
3	Lifting Lug (4)
4	4-SH 2 - Shackles - 17 t (18.70 USt)
5	Rear Pins
6	Front Pins
7	Pins with Safety Pins (2)
8	Electric Cable (WRF1-P1)
9	Hydraulic Couplers (4)
10	Hydraulic Hoses (4)

Install Drum 3

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

An assist crane is required to lift the drum into position in the rotating bed.

The assist crane must be capable of lifting 6 000kg (13,200 lb) to a height of approximately 6 m (20 ft) above the ground.

Reference Section 1 of this manual for the weights of components.

- Position the trailer carrying the drum in the assembly area.
- Attach the Manitowoc supplied lifting slings (2, View A) to the hook of the assist crane.
- Connect the other end of the lifting slings (2, View A) to the lifting lugs (3) on the drum assembly (1) with the Manitowoc supplied shackles (4).
- Remove the tie downs and blocking securing the drum assembly to the trailer.
- Lift the drum assembly off the trailer and remove the trailer.
- Remove the safety pins and pins (7) and set aside.
- Lift the drum into position over the rotating bed.
- Lower the drum into the rotating bed, aligning the rear pins (5) and the front pins (6) of the drum assembly over the rotating bed slots. Continue to lower the drum into the rotating bed slots.
- Align the front holes of the drum assembly with the rotating bed holes and insert the pins and safety pins (7).
- Disconnect the shackles and the lifting slings (2 and 4, View A) from the lifting lugs (3) on the drum assembly.
- Disconnect the four hydraulic hoses (10, stored position) from the rotating bed and connect them to the four hydraulic couplers (9, working position) on the drum assembly (1).

Match the identification numbers on the hoses with the identification numbers on the couplers for proper connection.
- Connect the electric cable (8) from the drum assembly (1) to the electric receptacle on the rotating bed.

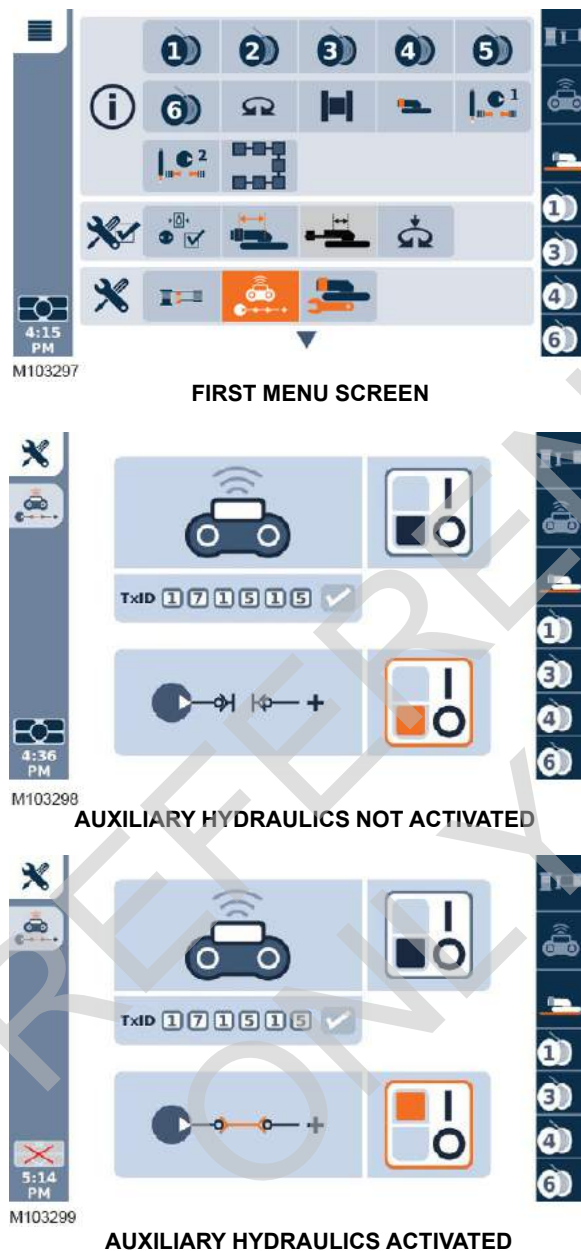


FIGURE 4-27

Activate 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.

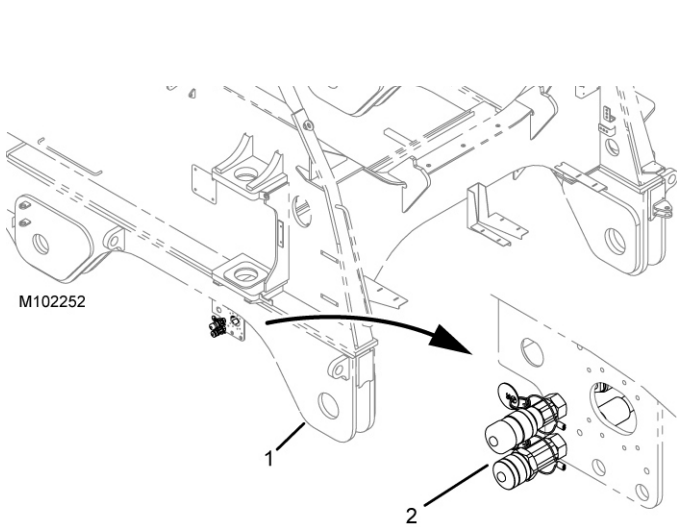
See [Figure 4-27](#) for the following procedure.

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.

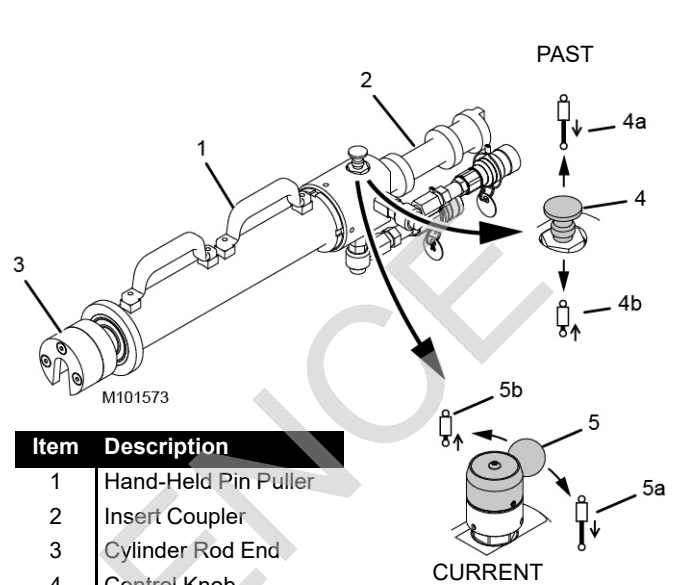
FOR REFERENCE ONLY

THIS PAGE INTENTIONALLY LEFT BLANK



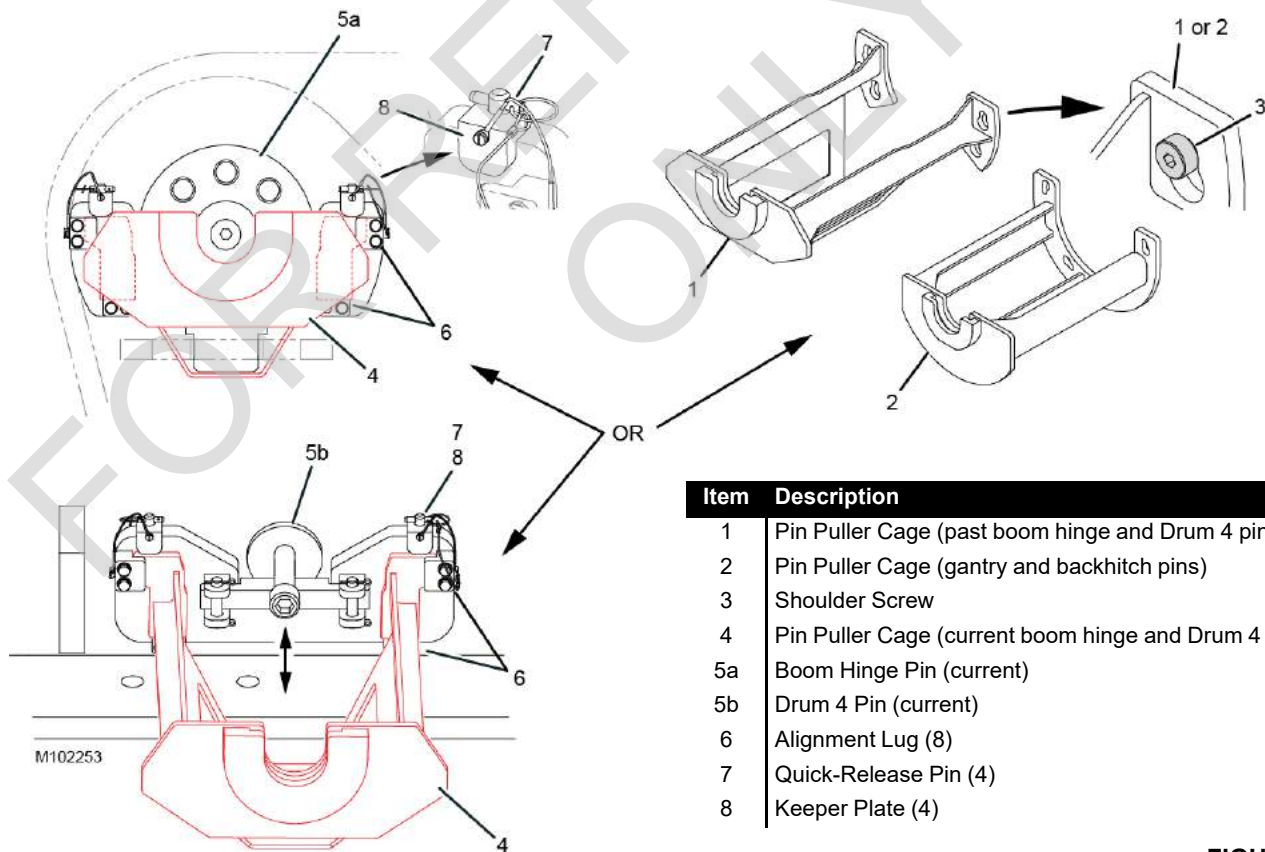
Item	Description
1	Rotating Bed
2	Hydraulic Connections

FIGURE 4-28



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
5	Control Knob
5a	Right to Extend
5b	Left to Retract

FIGURE 4-29



Item	Description
1	Pin Puller Cage (past boom hinge and Drum 4 pins)
2	Pin Puller Cage (gantry and backhitch pins)
3	Shoulder Screw
4	Pin Puller Cage (current boom hinge and Drum 4 pins)
5a	Boom Hinge Pin (current)
5b	Drum 4 Pin (current)
6	Alignment Lug (8)
7	Quick-Release Pin (4)
8	Keeper Plate (4)

FIGURE 4-30

Connect 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 4-28](#) 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.

2. Connect the two hydraulic hose connections to the connections on the hand-held pin puller (1, [Figure 4-29](#)).
 - a. With the hand-held pin puller in position, operate the control knob (4 or 5) to extend and retract 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.
3. Install pin puller cage (1, View A, [Figure 4-30](#)) to install/remove the boom hinge pins (past) and the live mast hoist (drum 4) pins.

4. Install pin puller cage (2, View A, [Figure 4-30](#)) to install/remove the gantry pins and the backhitch pins.

NOTE: Both cages (1 and 2) are designed to slip over shoulder the screws (3) mounted on the crane.

5. Install pin puller cage (4, View B, [Figure 4-30](#)) to install/remove the boom hinge pins (current):
 - a. Remove quick-release pins (7) and keeper plates (8).
 - b. Install the pin puller cage (4) by engaging it with the alignment lugs (6).
 - c. Install the keeper plates (8) and the quick-release pins (7).

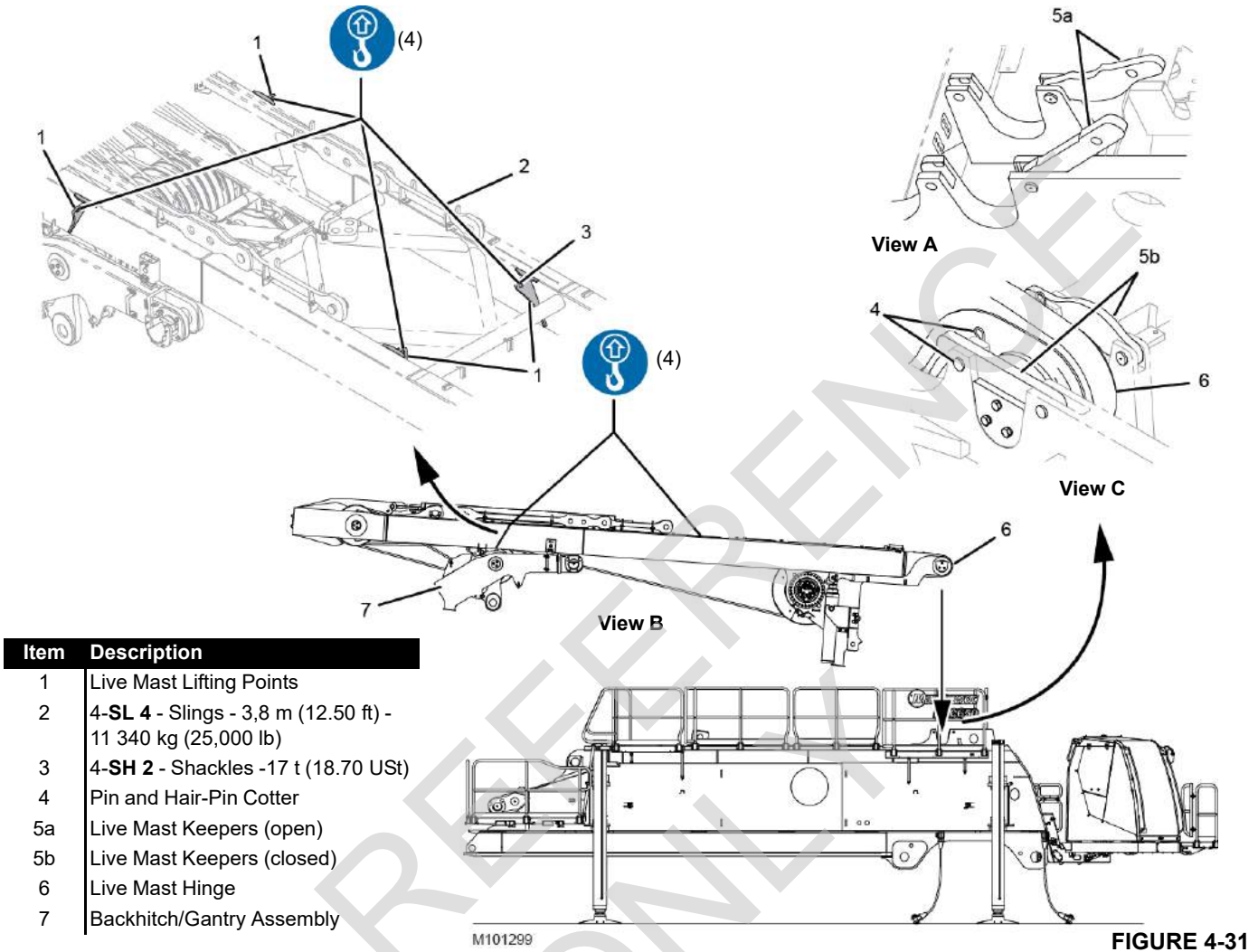


FIGURE 4-31

Install the Live Mast

See [Figure 4-31](#) for the following procedure.

1. Position the trailer carrying the live mast at the desired location at the assembly site.
2. Remove all chains and straps used to secure the live mast to the trailer.
3. Using an assist crane, attach 4 - SL 6 lifting slings (2) to the live mast lift points (1) using 4 - SH 2 shackles (3), lift the live mast from the trailer and remove the trailer.

NOTE: As the mast assembly is lifted, it will tilt forward approximately 4° (View B).

4. Open the live mast hinge keepers (5a, View A) on the rotating bed to allow the live mast hinge pin (6) to engage the rotating bed pockets.
5. Move the four backhitch/gantry operating pins (8, [Figure 4-32](#)) into the handling positions.

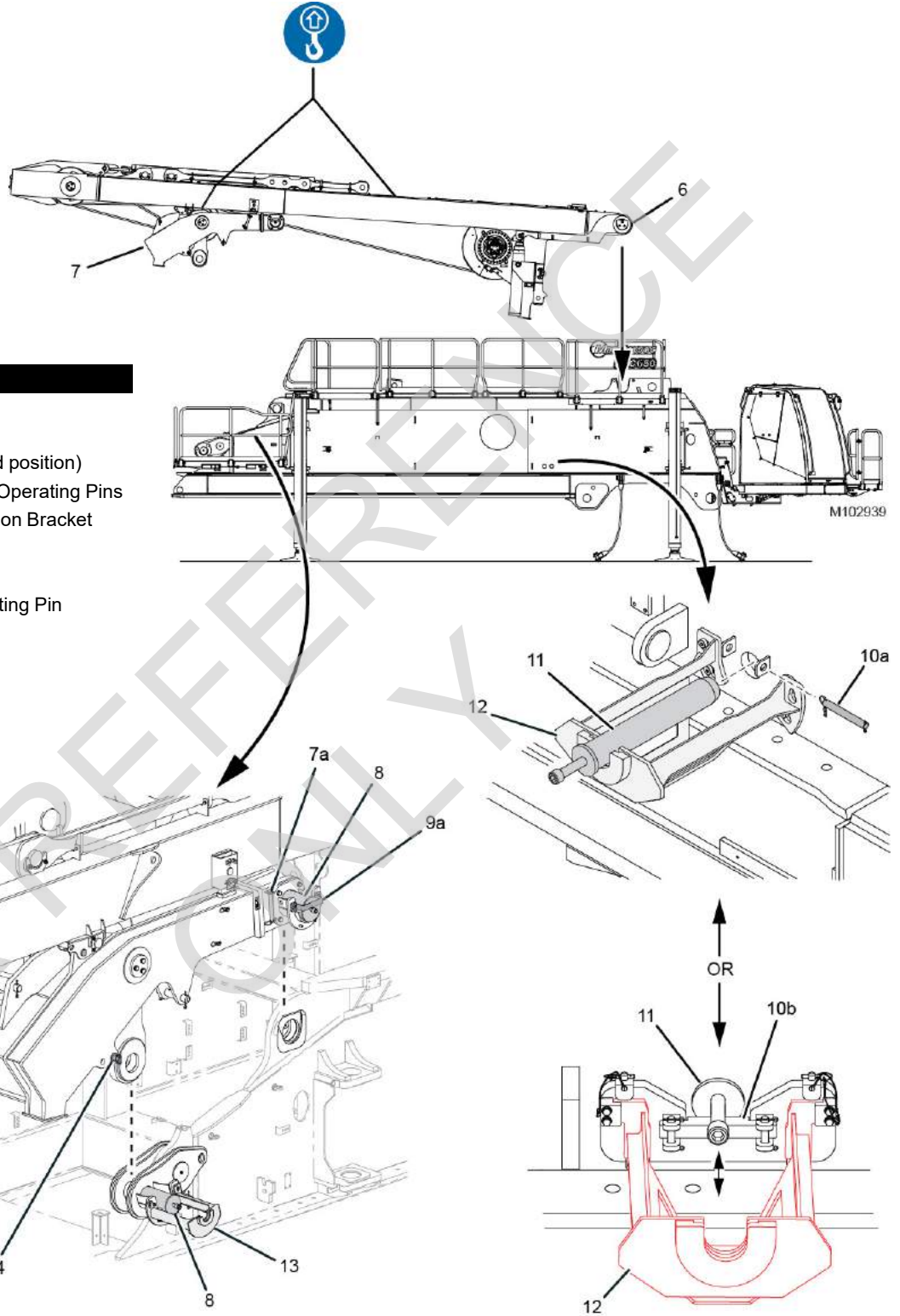
NOTE: Ensure that the gantry pin retention bracket (9a, [Figure 4-32](#)) is assembled in the mast assembly position prior to lifting the mast to prevent the operating pin (8, [Figure 4-33](#)) from falling.

6. Remove the two keeper pins or plates (10a or 10b, [Figure 4-32](#)).
7. Install the pin puller cage (12, [Figure 4-32](#)) and disengage the two hoist drum operating pins (11) using the hand-held pin puller.

See "[Connect Hand-Held Pin Puller](#)" on page 4-37 for information on using the pin puller.

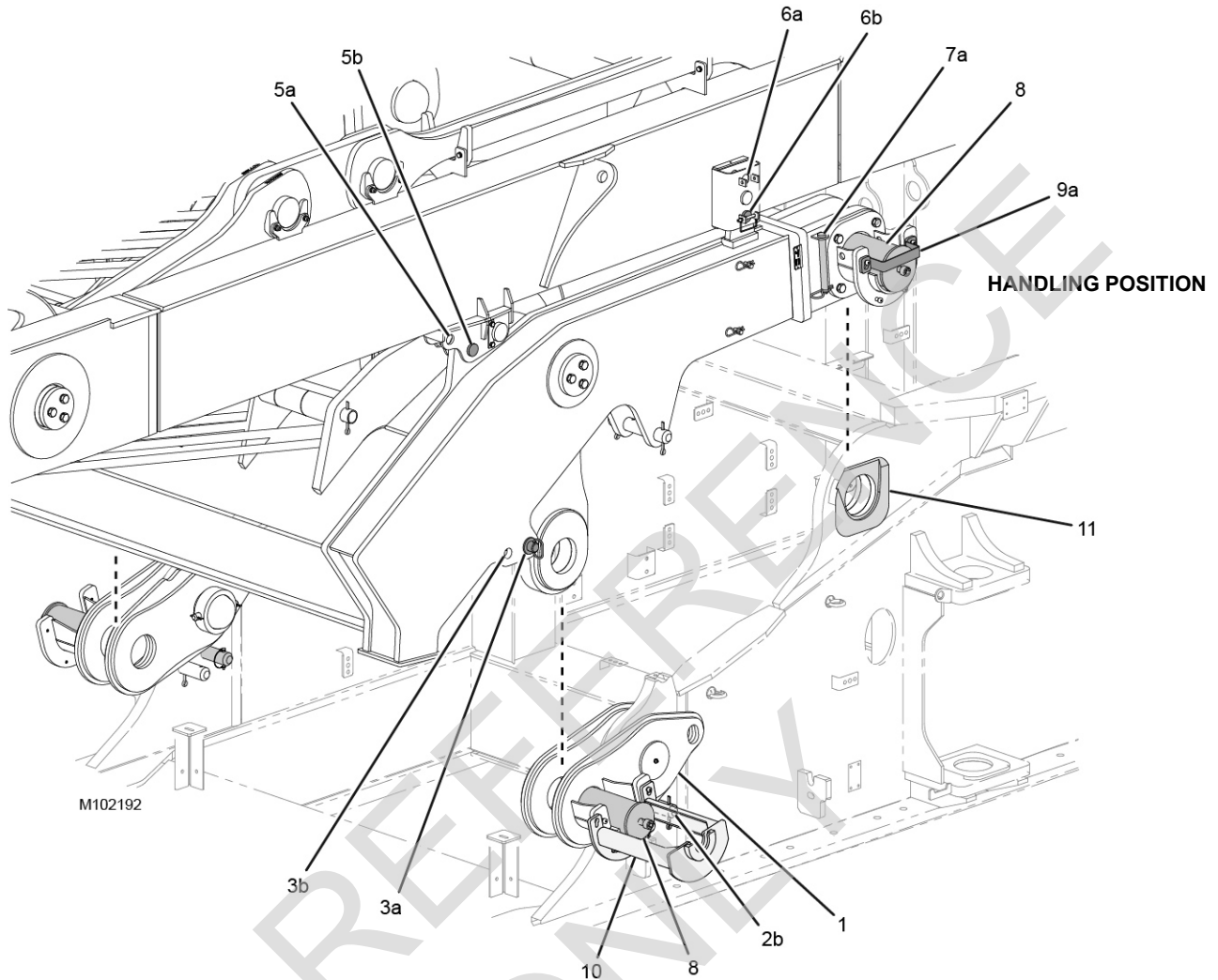
8. Lower the mast into position onto the rotating bed.
The live mast hinge will align first.
9. Once the live mast hinge is engaged in the rotating bed pockets, secure the mast to the rotating bed by closing the live mast keepers (5b, View C [Figure 4-31](#)) and inserting the pins and hair-pin cotter (4, View C [Figure 4-31](#)).

Item	Description
1-5	Not Used
6	Live Mast Hinge
7a	Keeper Pin (stored position)
8	Backhitch/Gantry Operating Pins
9a	Gantry Pin Retention Bracket
10a	Keeper Pin
10b	Keeper Plate
11	Hoist Drum Operating Pin
12	Pin Puller Cage
13	Pin Puller Cage
14	Backhitch Link Pin



4

FIGURE 4-32



Item	Description
1	Backhitch Assembly
2a	Backhitch Link Pin (working position)
2b	Backhitch Link Pin (shipping position)
3a	Pin (shipping position)
3b	Pin (stored position)
4	Gantry Assembly
5a	Pin (stored position)
5b	Pin (shipping position)
6a	Shipping Pin (stored position)
6b	Shipping Pin (shipping position)
7a	Keeper Pin (stored position)
7b	Keeper Pin (working position)
8	Operating Pins
9a	Gantry Pin Retention Bracket (handling position)
9b	Gantry Pin Retention Bracket (stored position)
10	Pin Puller Cage
11	Rotating Bed Pockets

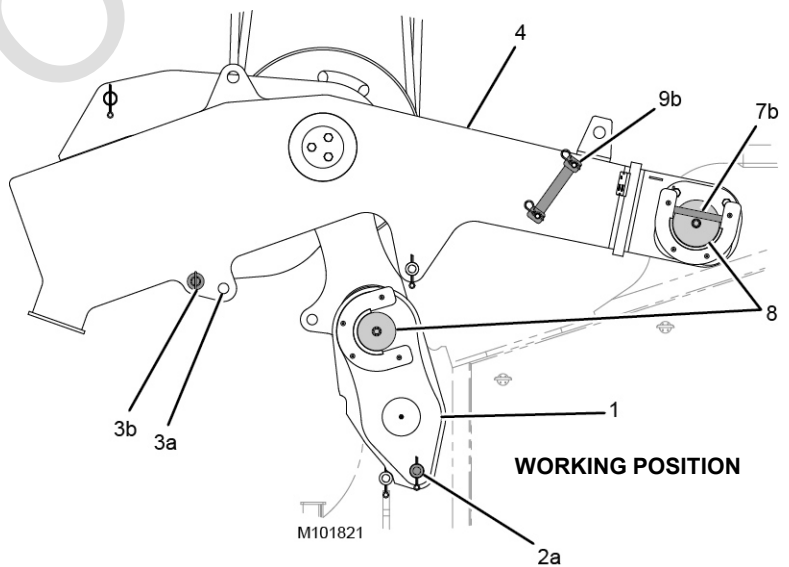


FIGURE 4-33

Secure the Backhitch/Gantry Assemblies

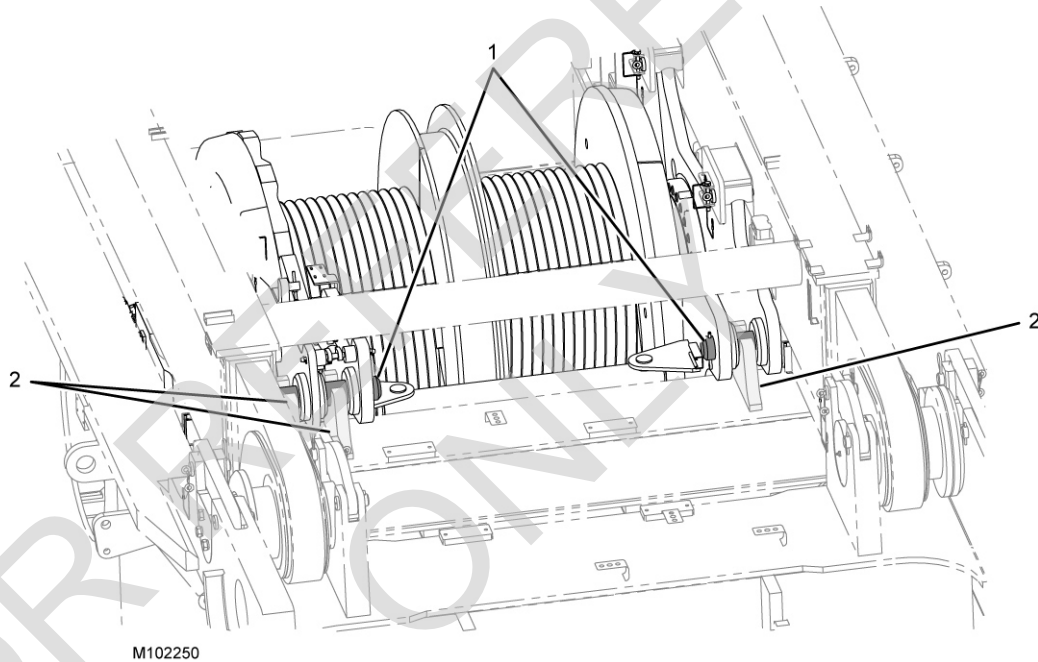
With the assist crane still attached to the live mast assembly, slowly lower the mast assembly to the rotating bed until the live mast hoist drum pins (1, [Figure 4-34](#)) engage the hooks (2, [Figure 4-34](#)) on the rotating bed.

Ensure that the gantry is fully engaged with the rotating bed pockets (11, [Figure 4-33](#)).

When installing the backhitch/gantry assemblies reference [Figure 4-33](#) for the following procedure.

1. Remove the gantry pin retention brackets (9a) and place them in the stored position (9b).
2. Install the operating pins (8) to the working position using the pin puller cage (10) and the hand-held pin puller:
See ["Connect Hand-Held Pin Puller" on page 4-37](#) for information on using the pin puller.
3. Secure the operating pins (8) with keeper pins (7b) and hitch pins.
4. Remove pins 3, 5, and 6 from the shipping position and place them into the stored position.
5. Remove the backhitch link pin (2b) from the shipping position before raising the mast.

The backhitch link pin will be inserted into the working position but will require lifting the backhitch assembly to align the holes (see [Figure 4-37 on page 4-46](#)).



Item	Description
1	Hoist Drum Pins
2	Hooks

FIGURE 4-34

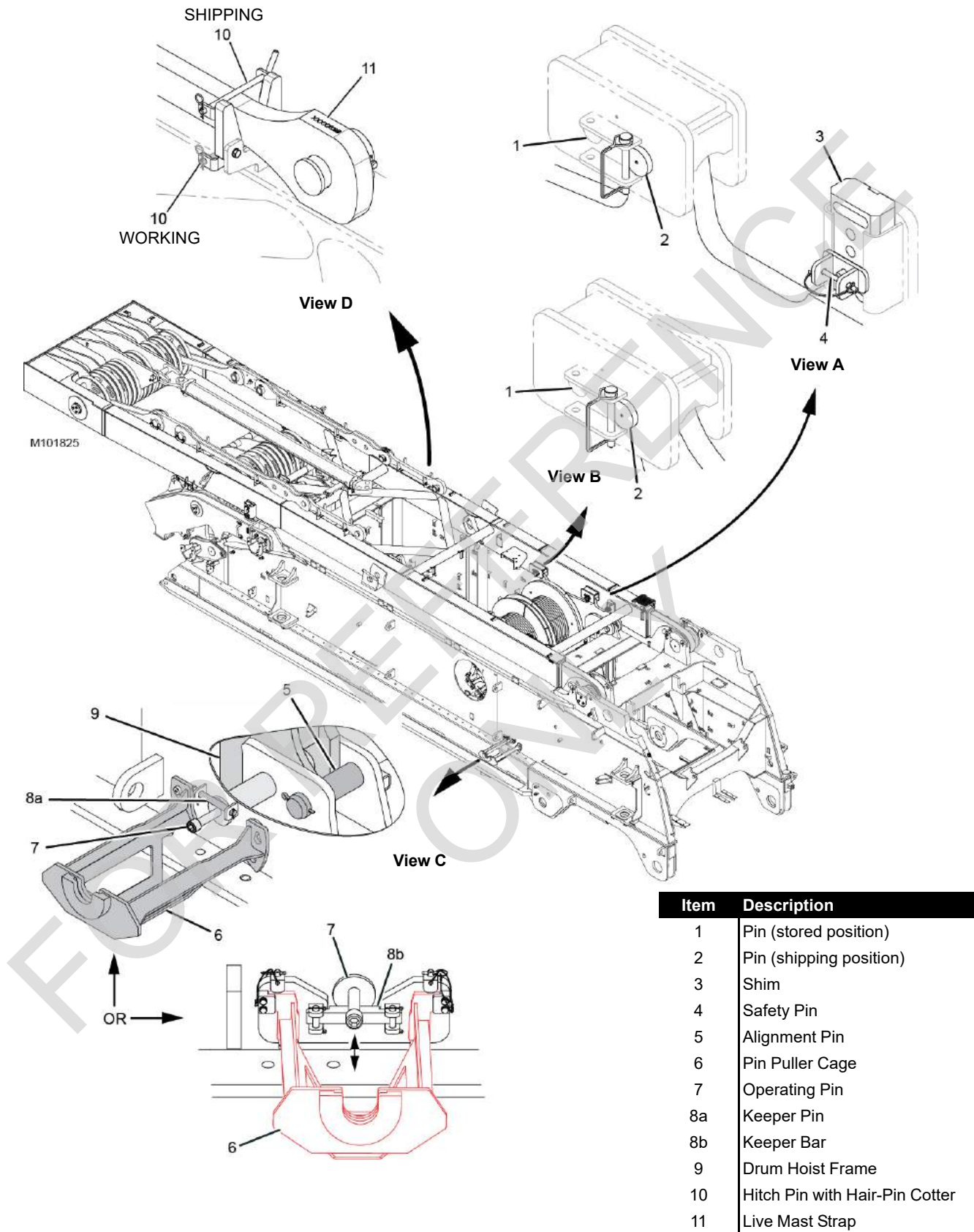


FIGURE 4-35

Secure the Live Mast Hoist Drum

CAUTION

Equipment Damage!

Damage will occur if the hoist drum remains attached to the shipping brackets.

With the live mast lowered to the horizontal position see [Figure 4-35](#) for the following procedure.

NOTE: The platforms and handrails have been removed from the following graphics for clarity.

1. Remove the shipping pins from the shipping position (2, Views A and B).
2. Place shipping pins into the stored position (1, Views A and B).
3. Remove the pins (4, View A) and move the shims (3) up to the highest hole in the shim and install the pins.

NOTE: This shim reduces the amount the mast can shift relative to the drum assembly during shipping and is not used during crane operation.

4. Install the operating pins (7, View C) using the pin puller cage (6) with the hand-held pin puller unit and secure them with the keeper pins or bars (8a or 8b).

NOTE: Use the pin puller cage and the hydraulic hand-held pin puller to assist in the installation of the operating pins.

See "[Connect Hand-Held Pin Puller](#)" on page 4-37 for information on using the pin puller.

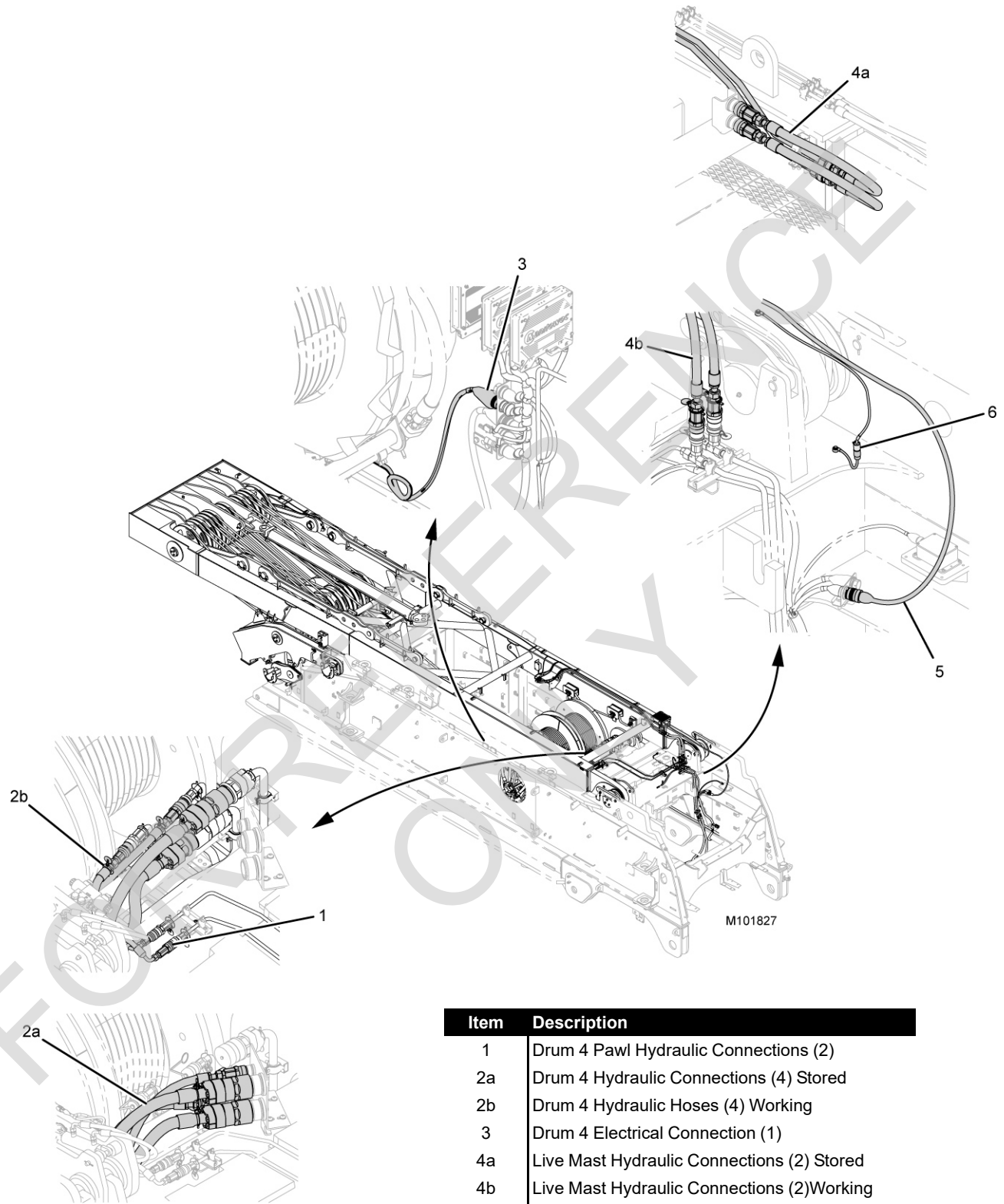
5. Remove and store the pin puller cages (6) and the hand-held pin pullers.

Disconnect the Live Mast Straps

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

Perform the following steps on both sides of the live mast.

1. Remove the hitch pin (10) from the shipping position.
2. Install the hitch pin (10) in the working position.



M101827

Item	Description
1	Drum 4 Pawl Hydraulic Connections (2)
2a	Drum 4 Hydraulic Connections (4) Stored
2b	Drum 4 Hydraulic Hoses (4) Working
3	Drum 4 Electrical Connection (1)
4a	Live Mast Hydraulic Connections (2) Stored
4b	Live Mast Hydraulic Connections (2) Working
5	Live Mast Electrical Connection (WRM-P1)
6	Live Mast Grounding Wire

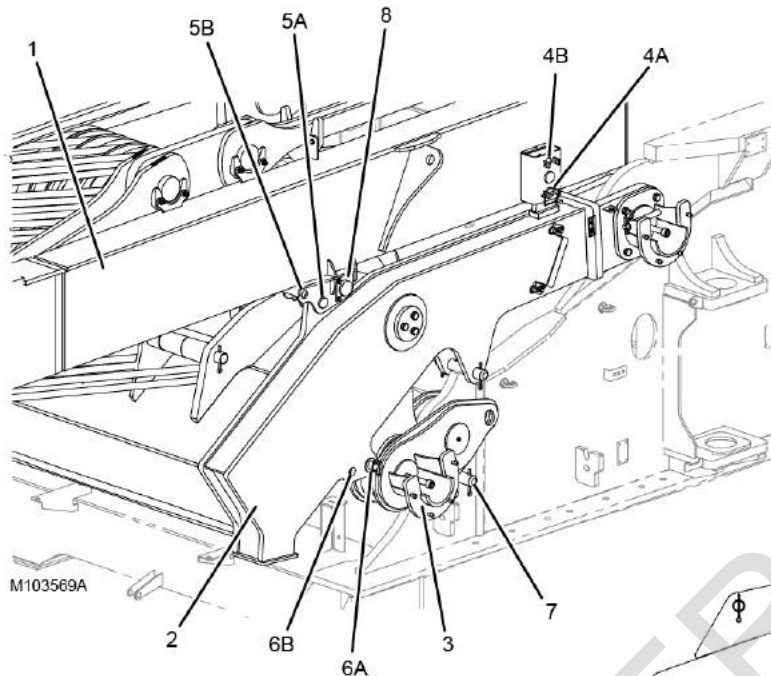
FIGURE 4-36

Connect the Live Mast Hydraulic and Electrical

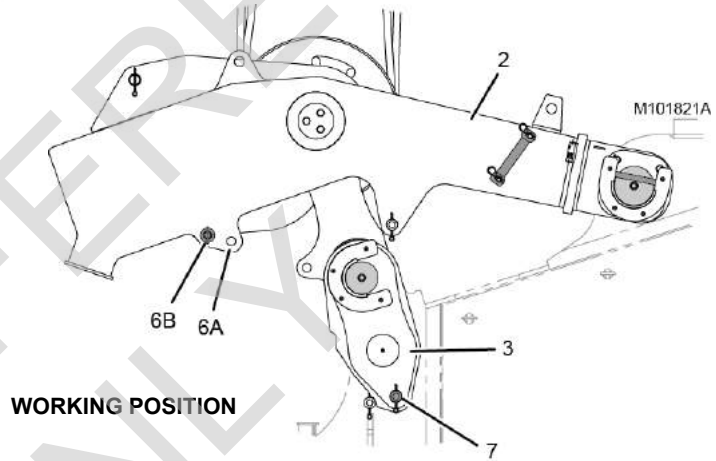
See [Figure 4-36](#) for the following procedure.

1. Connect the two drum 4 pawl hydraulic connections (1).
2. Remove the four drum 4 hydraulic connections (2a) from the stored position.
3. Connect the four drum 4 hydraulic connections (2b) to the working position.
4. Connect the drum 4 electrical connector (3) to the second plug connector from the top of the receptacle bracket.
5. Remove the two hydraulic connections (4a) from the stored position.
6. Connect the two hydraulic connections (4b) on the left side for the live mast assist cylinders.
7. Connect the live mast electrical plug (5).
8. Connect the live mast grounding wire (6) to the rotating bed.

FOR REFERENCE ONLY



STORED POSITION



WORKING POSITION

Item	Description
1	Live Mast
2	Gantry
3	Backhitch
4A	Pin - Stored Position
4B	Pin - Working Position
5A	Pin - Stored Position
5B	Pin - Working Position
6A	Pin - Stored Position
6B	Pin - Working Position
7	Backhitch Pin
8	Mast Roller

FIGURE 4-37

Activate Setup Mode

Perform the steps under [Setup Mode on page 4-13](#).

Raise Live Mast to Operating Position

The following controls are used to raise and lower the live mast. See the Operating Controls in Section 3 for identification and operation of these controls.

- RCL/RCI Display to monitor the live mast working screen. See the MLC650 RCL/RCI Operation Manual for instructions.
- Main Display to monitor the live mast angle and to view operating faults. See the MLC650 Main Display Operation Manual for instructions.
- MAST-ASSIST ARMS SWITCH to raise and lower the mast arms independently of the mast. The control is mounted on the right side control console in the cab and on the remote control.

- BOOM HOIST CONTROL to raise and lower the mast while using it as a boom for crane assembly and disassembly.
 - RIGHT CONTROL HANDLE (on right console) to extend and retract the self-erect cylinder.
1. Make sure pins (4, 5, and 6 [Figure 4-37](#)) have been moved from the storage holes A to the working holes B. **Damage will occur if this step is not performed before the mast is raised.**
 2. Remove pins (7, [Figure 4-37](#)). **Damage will occur if this step is not performed before the mast is raised.**
 3. Select the Liftcrane Mast Handling Capacities Chart in the RCL/RCI display.
 4. Turn on the setup remote control.
 5. Monitor the MAST ANGLE in the main display working screen during the raising procedure.

6. Check the boom hoist wire rope between the sheaves in the end of the live mast (1) and the gantry (2). If the wire rope is slack, proceed as follows:
 - a. Extend the live mast assist cylinders (9, [Figure 4-38](#)) with the switch on the remote control or on the right console in the cab.
 - b. Stop when the slack is out of the wire rope.
7. BOOM DOWN with the boom control handle to raise the live mast (1, [Figure 4-38](#)).
The live mast will rise while the live mast assist cylinders (9) extend automatically.
8. Stop raising the live mast when the holes in the backhitch (3, [Figure 4-37](#)) are aligned with the holes in the rotating bed (approximately 40°) and install the backhitch pins (7).

9. If the pin holes do not align, extend the live mast assist cylinders (7) to tighten the ropes and align the pin holes.
10. With the backhitch secured, continue to boom down to raise the live mast to the desired position.

NOTE: It is okay for the gantry to contact the mast roller (8, [Figure 4-37](#)).

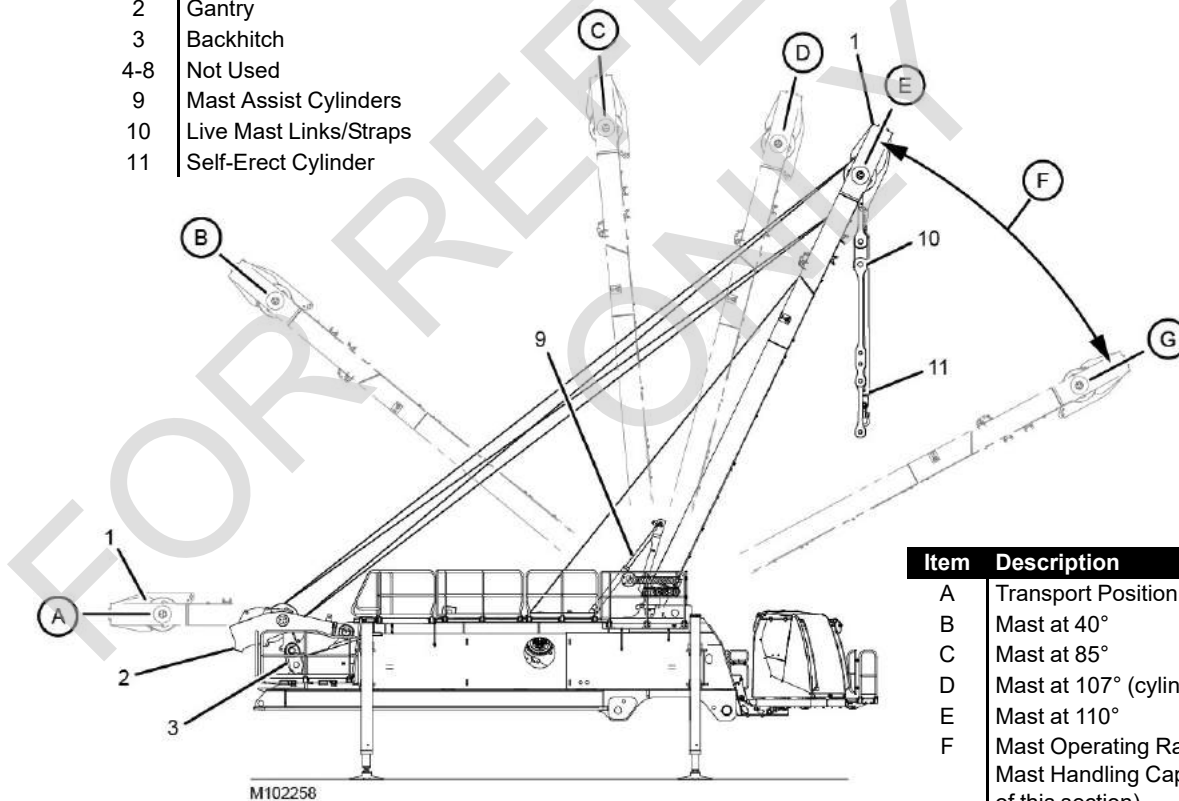
WARNING

Unintended Cylinder Movement

The self-erect cylinder can creep due to thermal expansion/contraction. Inspect the self-erect cylinder before any operation when the live mast is pivoted forward past 90° to verify that the cylinder is fully retracted and engaged with the retention bracket.

If the self-erect cylinder comes free of the retention bracket, it will swing freely, which could result in death or serious injury.

Item	Description
1	Live Mast
2	Gantry
3	Backhitch
4-8	Not Used
9	Mast Assist Cylinders
10	Live Mast Links/Straps
11	Self-Erect Cylinder



Item	Description
A	Transport Position (fully lowered)
B	Mast at 40°
C	Mast at 85°
D	Mast at 107° (cylinders fully extended)
E	Mast at 110°
F	Mast Operating Range (see Liftcrane Mast Handling Capacities Chart at end of this section)
G	Maximum Mast Angle at 158°

FIGURE 4-38

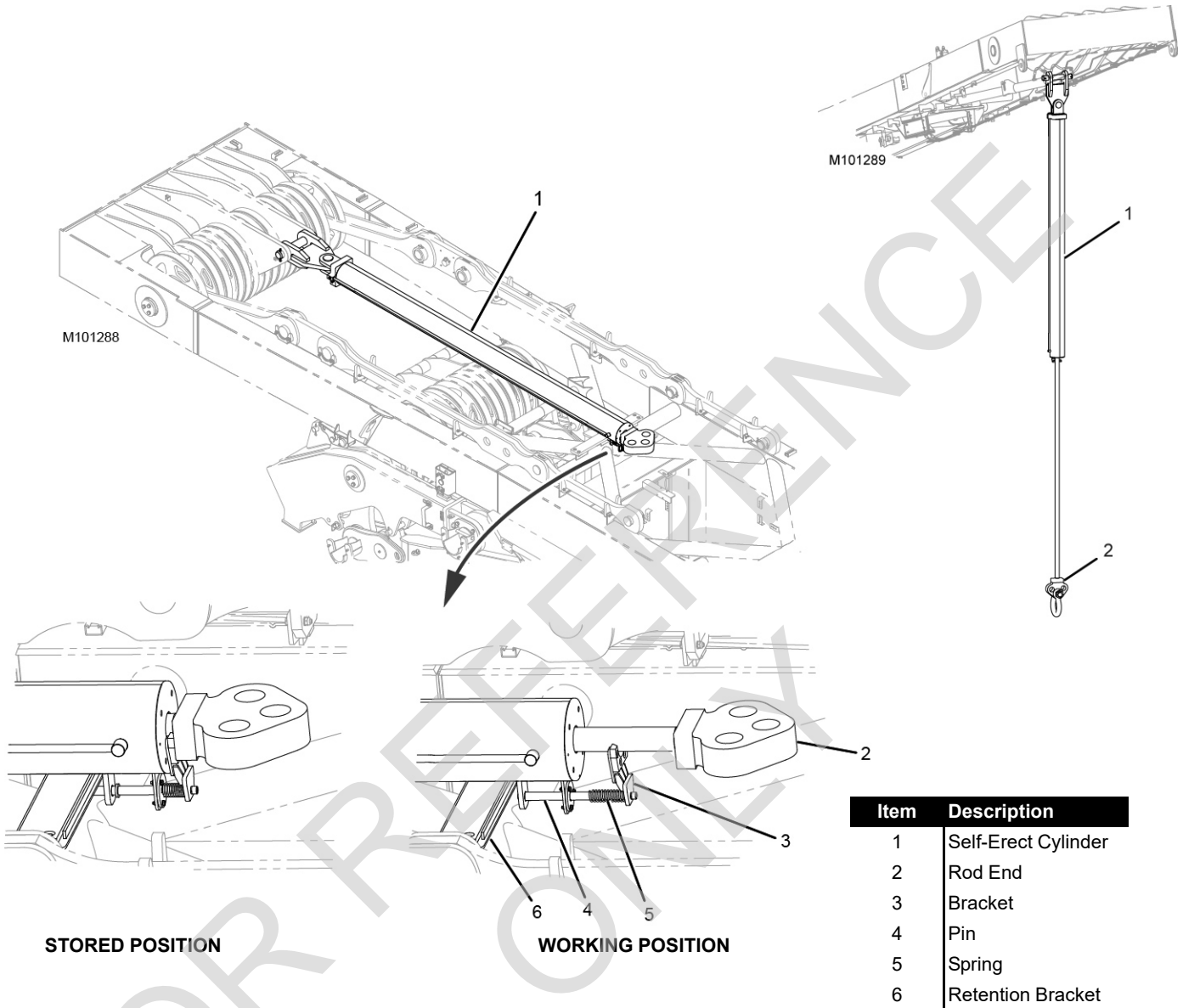


FIGURE 4-39

! WARNING
Falling Mast Hazard!

Prevent the mast from falling over backwards or forward:

- Read and thoroughly understand the mast raising instructions.
- Select the Liftcrane Mast Handling Capacities Chart in the RCL/RCI display before raising mast and using it as a boom. Mast operating limits remain off until this step is performed.

CAUTION
Mast Damage!

Make sure mast angle indicator is properly installed and adjusted prior to raising the mast (see Section 4 of MLC650 Service Manual).

The mast can be damaged if the angle indicator is not properly installed or adjusted.

Deploy the Self-Erect Cylinder

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

1. Raise the live mast to 85° (7).
2. Slightly extend the self-erect cylinder (1) enough to allow the pin (4) to disengage from the retention bracket (6) below the cylinder.

NOTE: As the mast passes 90°, the self-erect cylinder (1) will begin to sway away from the mast.

The mast straps will also sway away from the mast after the mast passes 90°.

3. Continue booming down and fully extend the self-erect cylinder (1) to attach the self-erect rigging or to connect the boom straps.

NOTE: The mast raising cylinders will automatically stop when they are fully extended.

Use the Mast as a Boom

Proceed to use the mast as a boom and the self-erect cylinder as a hoist for the remainder of the self-erect procedure.

See Liftcrane Mast Handling Capacities Chart at the end of this section for detailed lifting capacities.

NOTE: The following will occur if the mast is lowered to 158° (8):

- The mast will stop lowering.
- The hazard warning buzzer will come on.

- The hazard warning symbol and MAST TOO FAR FORWARD icon will appear in the system fault bar on the information screen.

MAST TOO FAR FORWARD ICON



DANGER

Falling Load Hazard!

Prevent structural failure of components or tipping:

- Do not exceed the lifting capacities given in the Liftcrane Mast Handling Capacities Chart at the end of this section.

Mast Damage Hazard!

Prevent mast damage:

- Do not use the limit bypass switch to lower the mast below 158° or mast damage will occur.

Falling Mast Hazard!

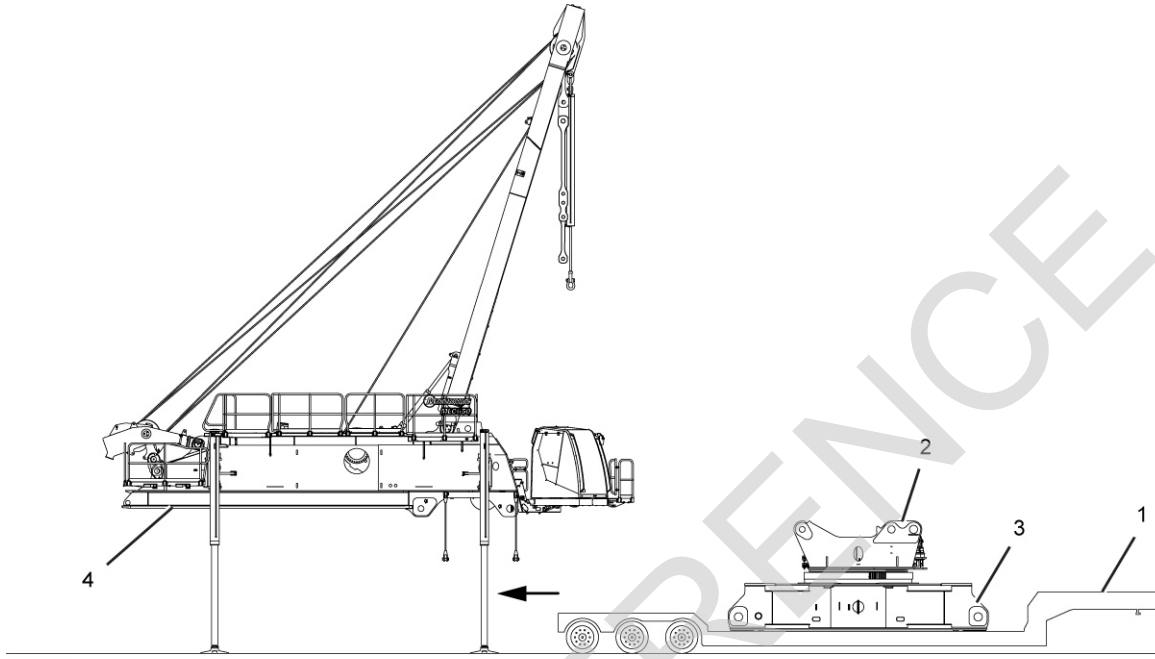
Prevent the mast from falling over backwards:

- Do not lower the mast-assist arms until after the mast links are connected to boom straps.

Self-Erect Cylinder Damage Hazard!

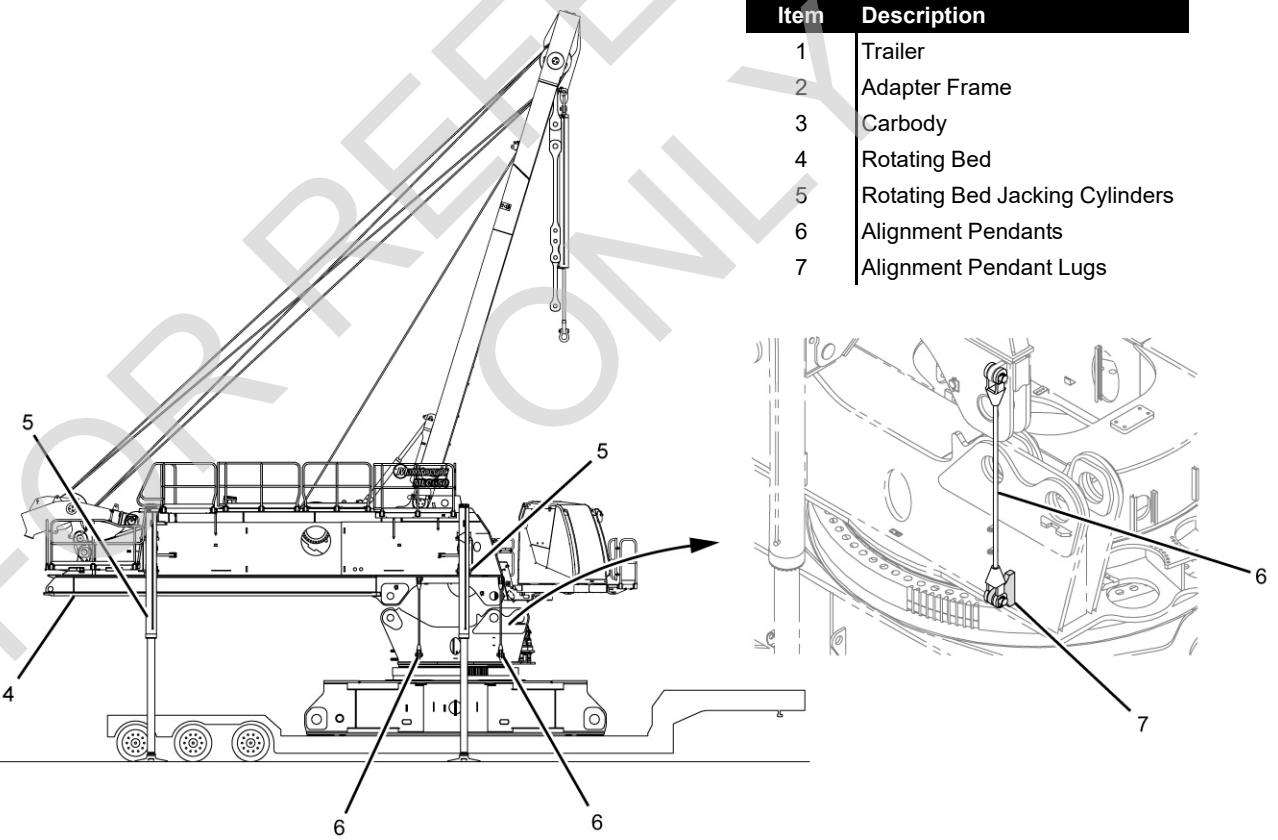
Prevent self-erect cylinder damage:

- Do not lower the rod end into the ground or cylinder damage will occur.



VIEW A

Item	Description
1	Trailer
2	Adapter Frame
3	Carbody
4	Rotating Bed
5	Rotating Bed Jacking Cylinders
6	Alignment Pendants
7	Alignment Pendant Lugs



VIEW B

FIGURE 4-40

Connect Rotating Bed to Carbody

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

1. Confirm that the live mast position is at a minimum of 110° to avoid tipping the crane.
2. Fully extend the rotating bed jacking cylinders (5) to raise the rotating bed to its highest position.
3. Position trailer (1, View A) carrying the adapter frame (2) and carbody (3) directly in front of the rotating bed (4).

CAUTION

Equipment Damage!

Use extreme care when backing the trailer into position:

- Do not hit the jacks with the trailer.
- Do not hit the rotating bed with the adapter frame.

Provide a signal person to give instructions to the truck driver.

4. Position the trailer so the alignment pendant lugs (7) on the carbody are directly under the alignment pendants (6, View B) hanging from the rotating bed.
5. Retract the rotating bed jacking cylinders only enough so the four alignment pendants can be pinned to the adapter frame. The rotating bed must not be more than 3° out of level when retracting the jacks (View B).

6. Remove all tie-downs securing adapter frame and carbody to trailer.
7. Slowly extend the rotating bed jacking cylinders to raise the rotating bed, adapter frame, and carbody just clear from the trailer to allow the adapter frame to self align to the rotating bed.
8. Slowly retract the rotating bed jacking cylinders to lower the adapter frame and carbody back onto the trailer, continuing to lower the jacks until the mounting holes in the adapter frame and rotating bed align ([Figure 4-42](#)).
9. Turn off power to the crane and stop the engine.

NOTE: Reference ["Connecting/Disconnecting Hydraulic Hoses and Electric Cables" on page 4-10](#) for more information.

10. Connect the electric cable (1, [Figure 4-41](#)) to the connector on the left side of the rotating bed.
11. Connect the two hydraulic hoses (2, [Figure 4-41](#)) on the right side (bottom or lower) from the adapter frame to the rotating bed to provide hydraulic power to the front pin puller cylinders.
12. Turn on crane power and start engine.

CAUTION

Equipment Damage!

Install the two hydraulic hoses and the electric cable before attempting to install the adapter frame to rotating bed pins.

Item	Description
1	Adapter Frame Electrical Cable (WFC1 connects to WRF2-J5)
2	Hydraulic Connections #3 and #4

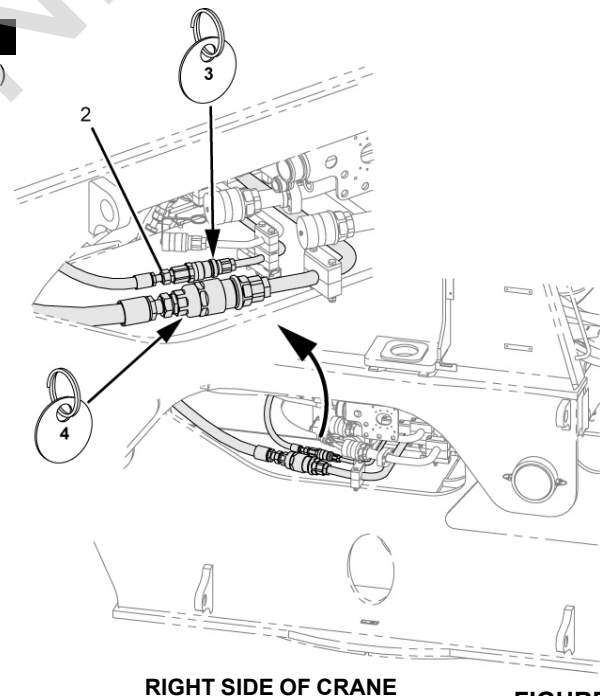
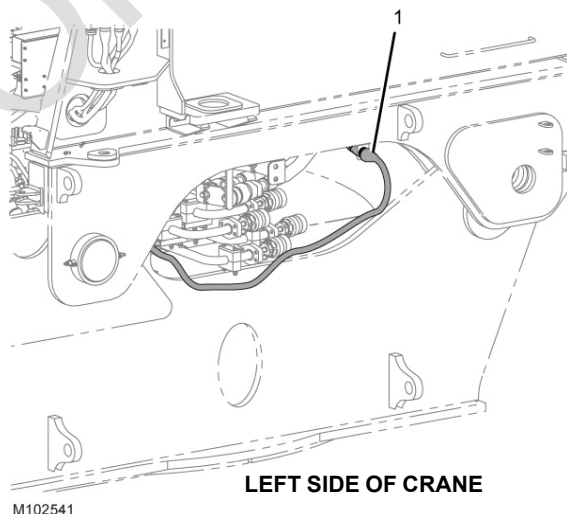


FIGURE 4-41

Item	Description
1a	Rotating Bed to Adapter Frame Pin (stored position)
1b	Rotating Bed to Adapter Frame Pin (working position)
2a	Collar (stored position)
2b	Collar (working position)
3a	Adapter Frame to Rotating Bed Pin (stored position)
3b	Adapter Frame to Rotating Bed Pin (working position)

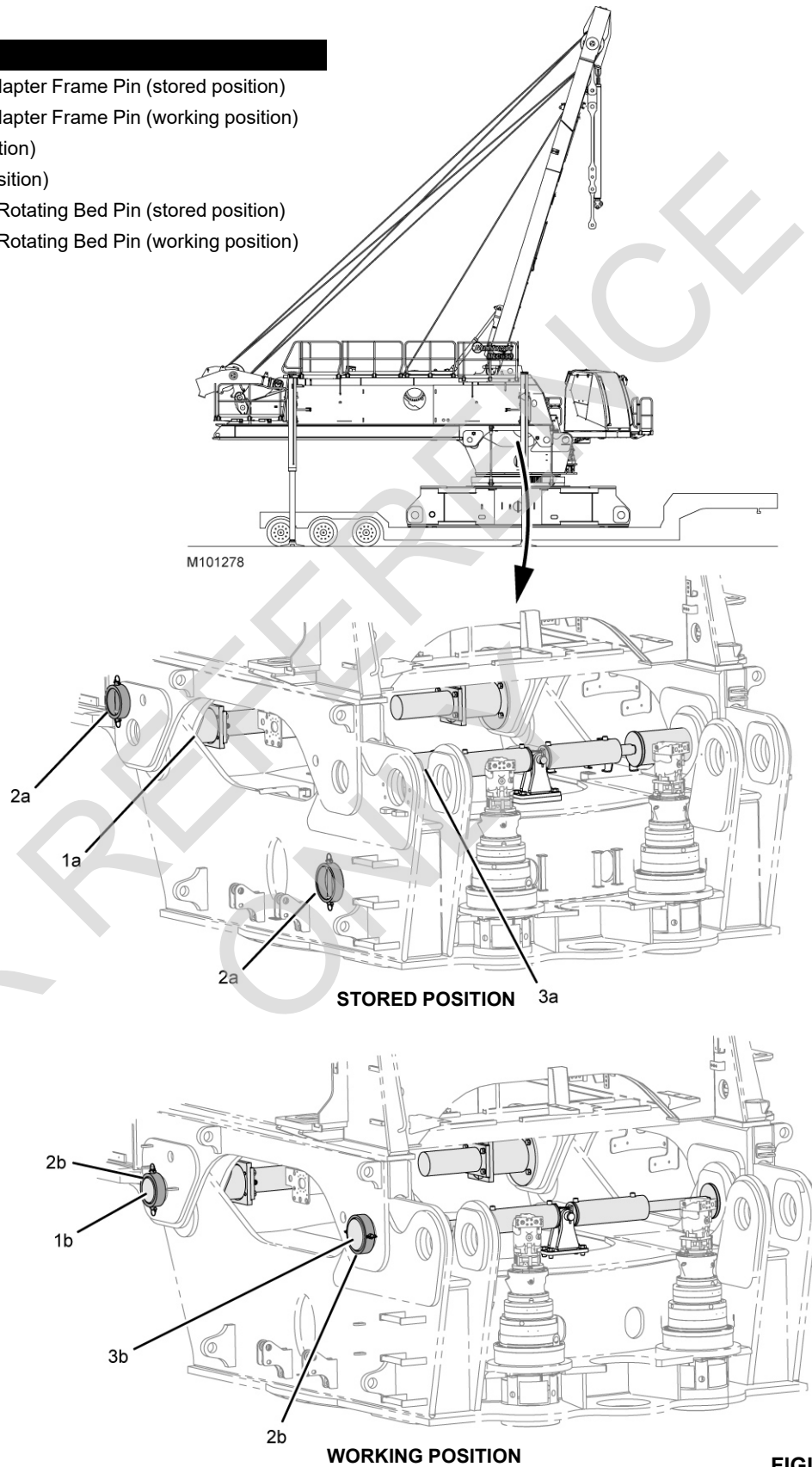


FIGURE 4-42

Installing Rotating Bed to Adapter Pins

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

CAUTION

Overweight Hazard!

Do not lower the entire weight of the rotating bed onto the adapter frame. Weight may exceed trailer capacity.

1. Confirm the alignment of the pin holes of the rotating bed and the adapter frame.
2. Engage the front adapter frame pins (3a) to the rotating bed.
3. Engage the rear rotating bed pins (1a) to the adapter frame.
4. Remove the hair-pin cotters, pins, and collars (2a) from the stored positions.
5. Install the hair-pin cotters, pins, and collars (2b) onto the adapter frame pins (3b) and rotating bed pins (1b).
6. Extend the rotating bed jacking cylinders to clear the carbody from the trailer ([Figure 4-43](#)).

7. Remove trailer using extreme care not to hit the rotating bed jacking cylinders with the trailer.

Provide a signal person to give instructions to the truck driver.

WARNING

Moving Part Hazard!

To avoid serious crushing injury — warn all personnel to stand clear of jacks.

Crane Tipping Hazard!

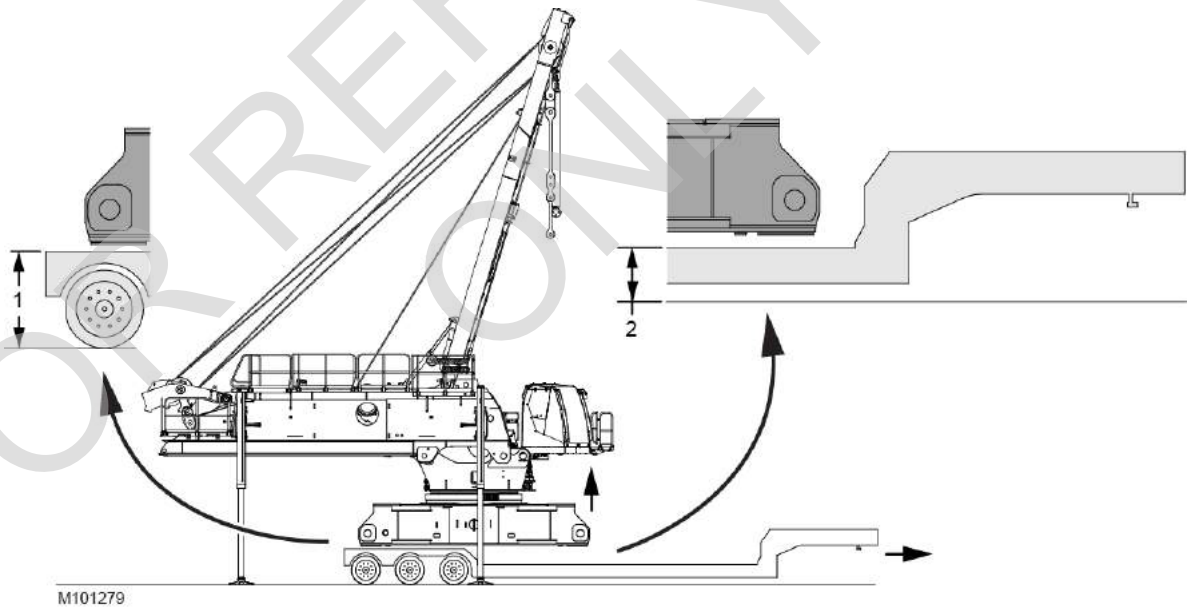
Keep the crane level while jacking.

CAUTION

Equipment Damage!

Use extreme care when removing the trailer:

- Do not hit the jacks with the trailer.
- Provide a signal person to give instructions to the truck driver.

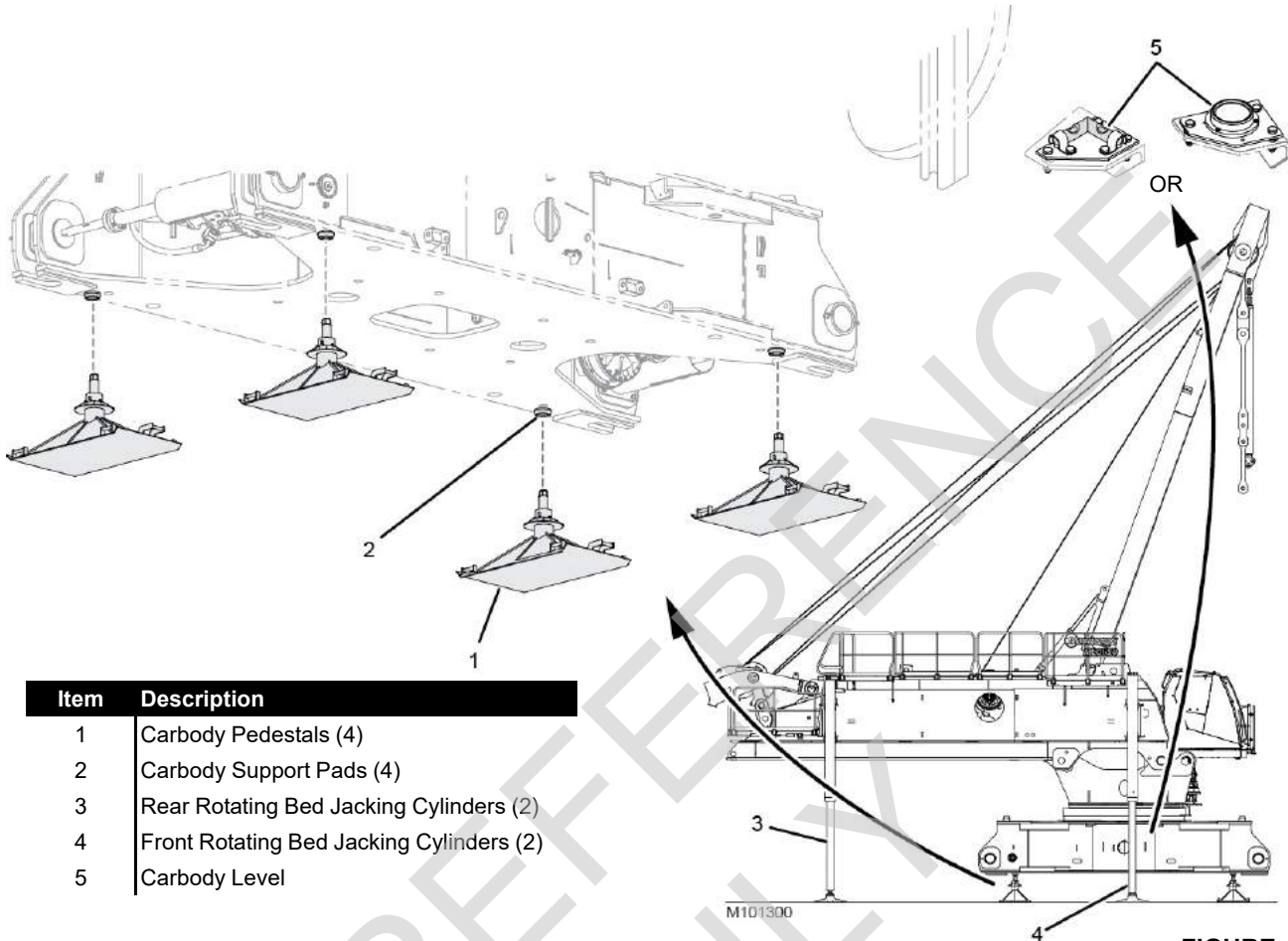


M101279

Item	Description
1	1168,4 mm (46 in)
2	609,6 mm (24 in)

NOTE: With no blocking under the outrigger pads and the carbody attached to the rotating bed, the jacking cylinders can lift the carbody to clear a maximum trailer height of 1 168 mm (46 in).

FIGURE 4-43



Item	Description
1	Carbody Pedestals (4)
2	Carbody Support Pads (4)
3	Rear Rotating Bed Jacking Cylinders (2)
4	Front Rotating Bed Jacking Cylinders (2)
5	Carbody Level

FIGURE 4-44

Lower Crane onto Carbody Pedestals

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

NOTE: Each carbody pedestal weighs approximately 214 kg (470 lb).

1. Remove the four carbody pedestals (1) from storage.
2. Place the pedestals under the carbody support pads (2) so that the short sides of the pedestals are parallel to the front and rear sides of the carbody.

NOTE: The orientation of the pedestals in step 2 is critical to allow clearance for the crawler installation. An arrow (6, [Figure 4-46 on page 4-56](#)) identifies the front of the crane and can be found on the left-front top surface of the carbody.

3. Adjust the carbody pedestals (1) up slightly from the lowest position and adjust the carbody pedestals (1), as required, to level the carbody.

Use the carbody level (5) as a guide while adjusting the pedestals until the carbody is as level as possible for crawler installation.

4. Retract the rotating bed jacking cylinders (3 and 4) to lower the carbody onto the four carbody pedestals.
5. Retract the rear rotating bed jacking cylinders (3) until they are clear from the ground for complete crane rotation.

See [Figure 4-48 on page 4-58](#) for the following:

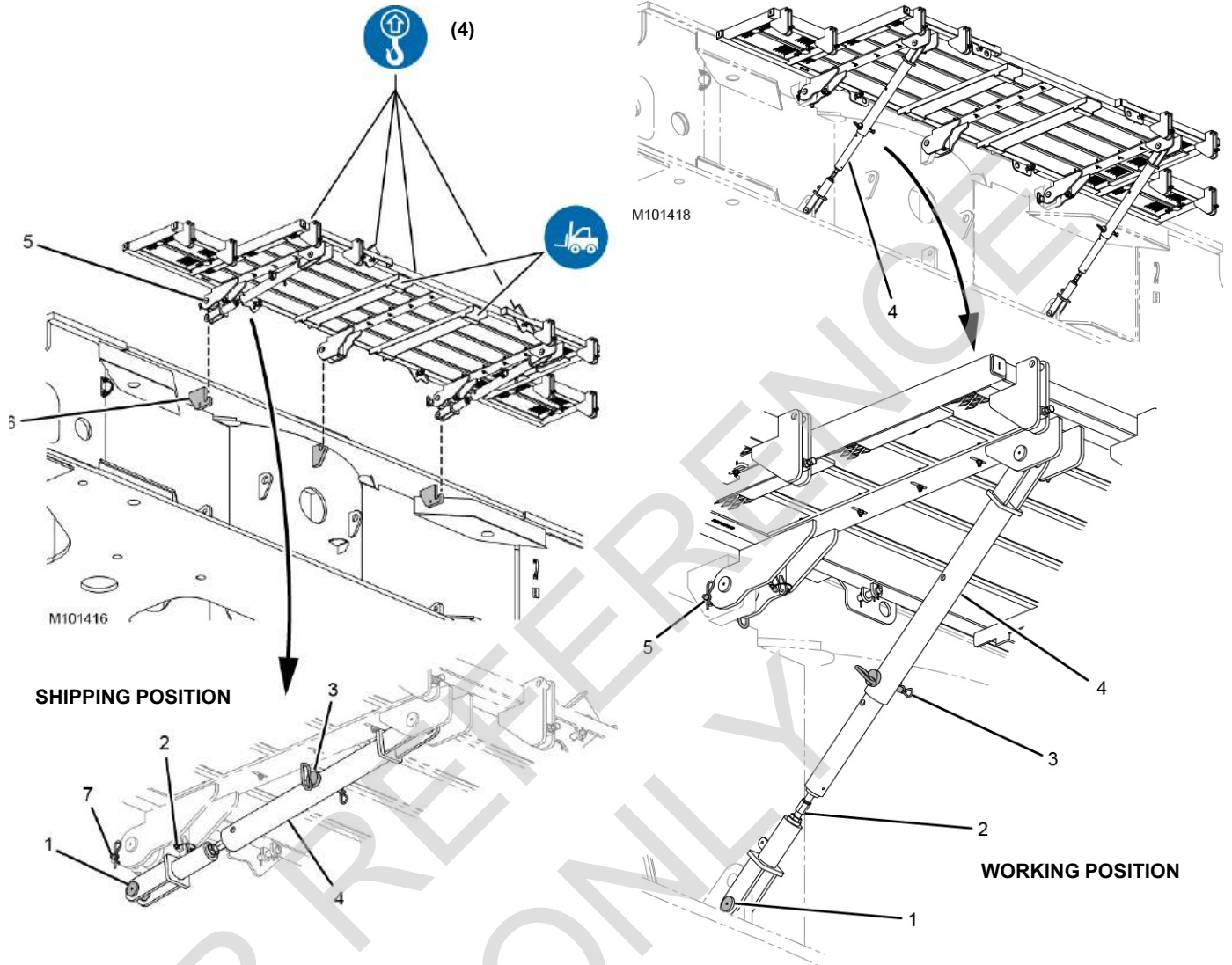
6. Remove u-shaped locking pin (1b) from the outrigger pad (3b).
7. Fully retract the front rotating bed jacking cylinders (4b).



WARNING

Crane Tipping Hazard!

The live mast must be between the range of 110° and 158° (8,5 m (29 ft) max. radius to avoid tipping the crane).



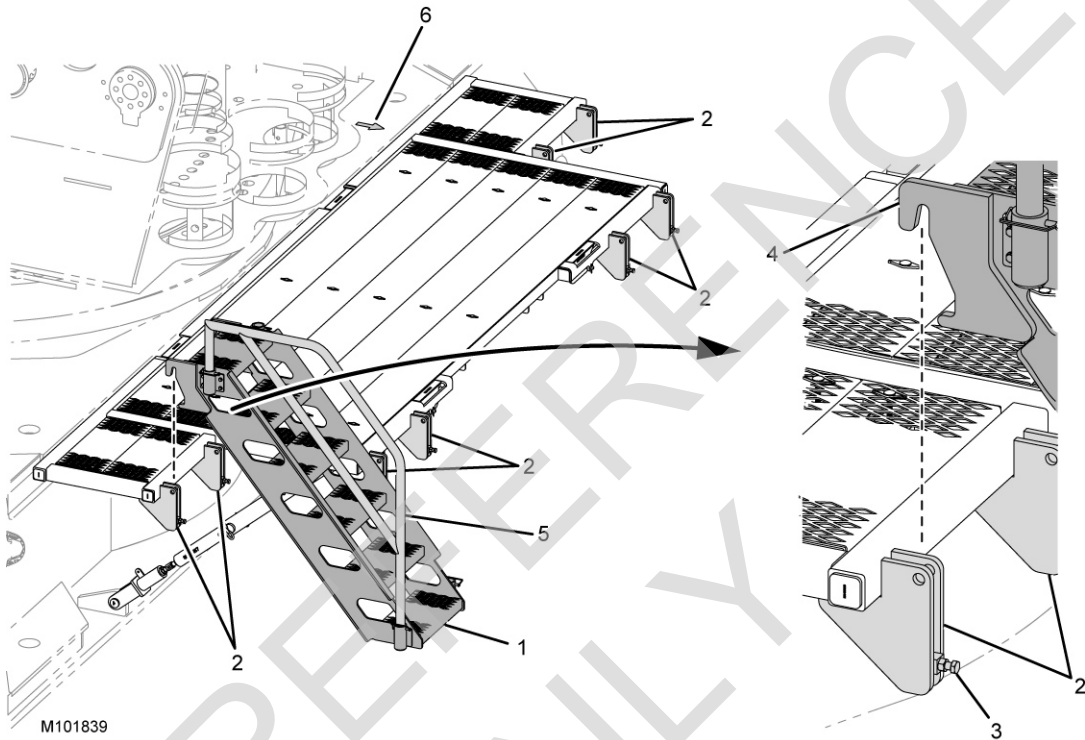
Item	Description	Item	Description
1	Wire Locking Pin	5	Platform Bracket
2	Safety Pin	6	Carbody Platform Bracket
3	Hitch Pin	7	Hitch Pin with Safety Pin
4	Strut	8	Adjuster

FIGURE 4-45

Install Carbody Platforms

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

1. Use an assist crane or forklift to lift the carbody platform.
2. Hold onto the strut (4), remove the safety pin (2) allowing the strut (4) to swing down, and store the safety pins (2).
3. Remove the two safety pins and hitch pins (7).
4. Move the platform to the carbody and hook the platform brackets (5) onto the carbody platform brackets (6).
5. Remove the hitch pin (3), extend the strut (4) to the working position, and insert the hitch pin (3).
6. Swing the two struts (4) toward the carbody, aligning the struts with the carbody brackets and insert the wire locking pins (1).
7. Install the two hitch pins and safety pins (7) to secure the platform to the carbody.
8. Use the adjusters (8) on the struts to level the platforms.



Item	Description
1	Ladder Assembly
2	Ladder Support
3	Adjustment Screw
4	Ladder Bracket
5	Handrail
6	Front of Carbody Arrow

FIGURE 4-46

Install Carbody Ladders and Handrails

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

1. Using an assist crane or forklift, install ladders by hooking the ladder assembly (1) onto the ladder support (2) on the carbody platform.
2. Use the adjustment screws (3) to level the ladder.

3. Install the handrail into the ladder assembly and secure with pins.

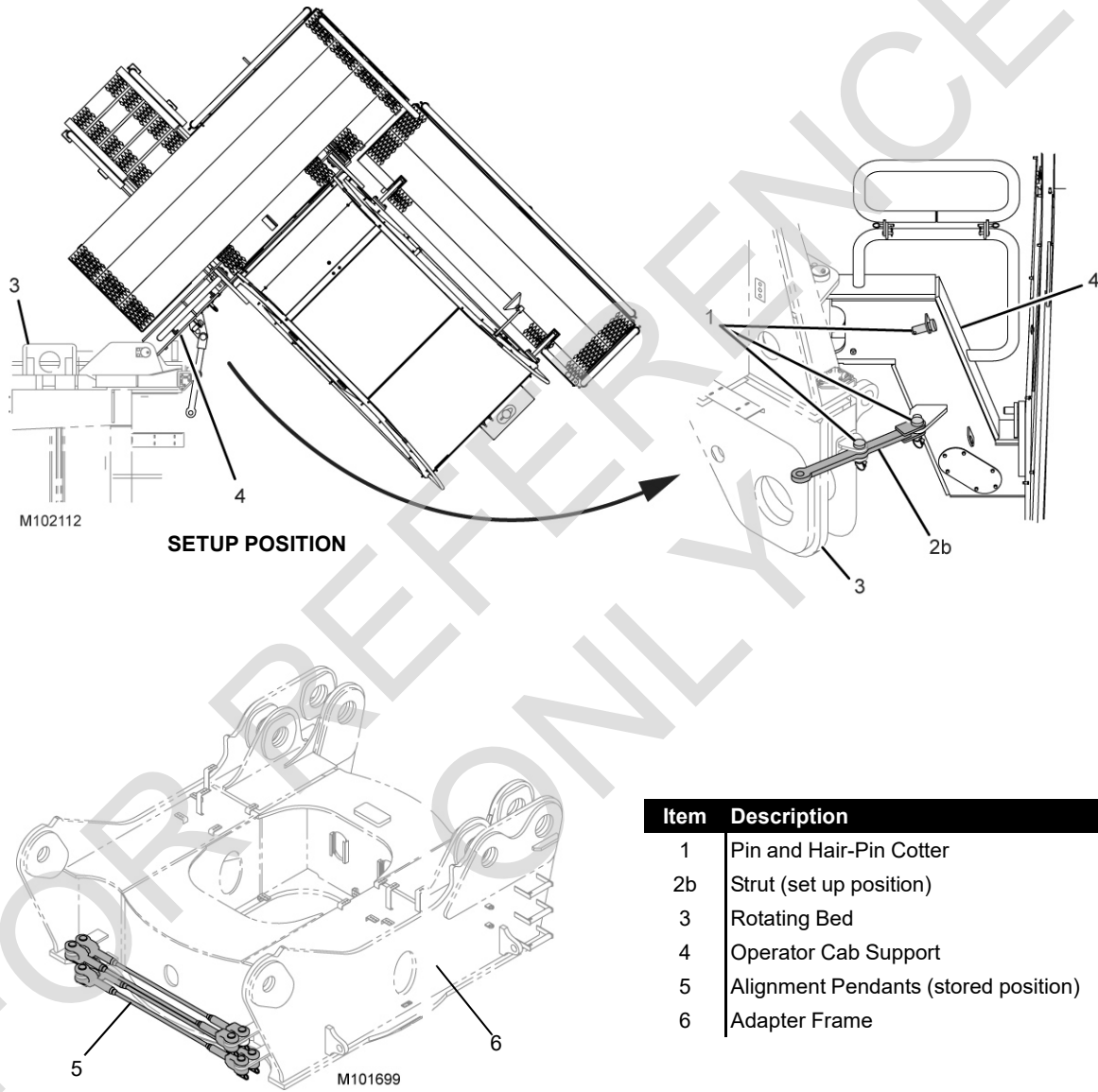
The ladder and handrail combined weigh approximately 53 kg (117 lb).

NOTE: Multiple locations are provided for the ladders. When the ladder assembly is installed the handrail must be installed on the crawler side of the platform.

Remove and Store Pendants

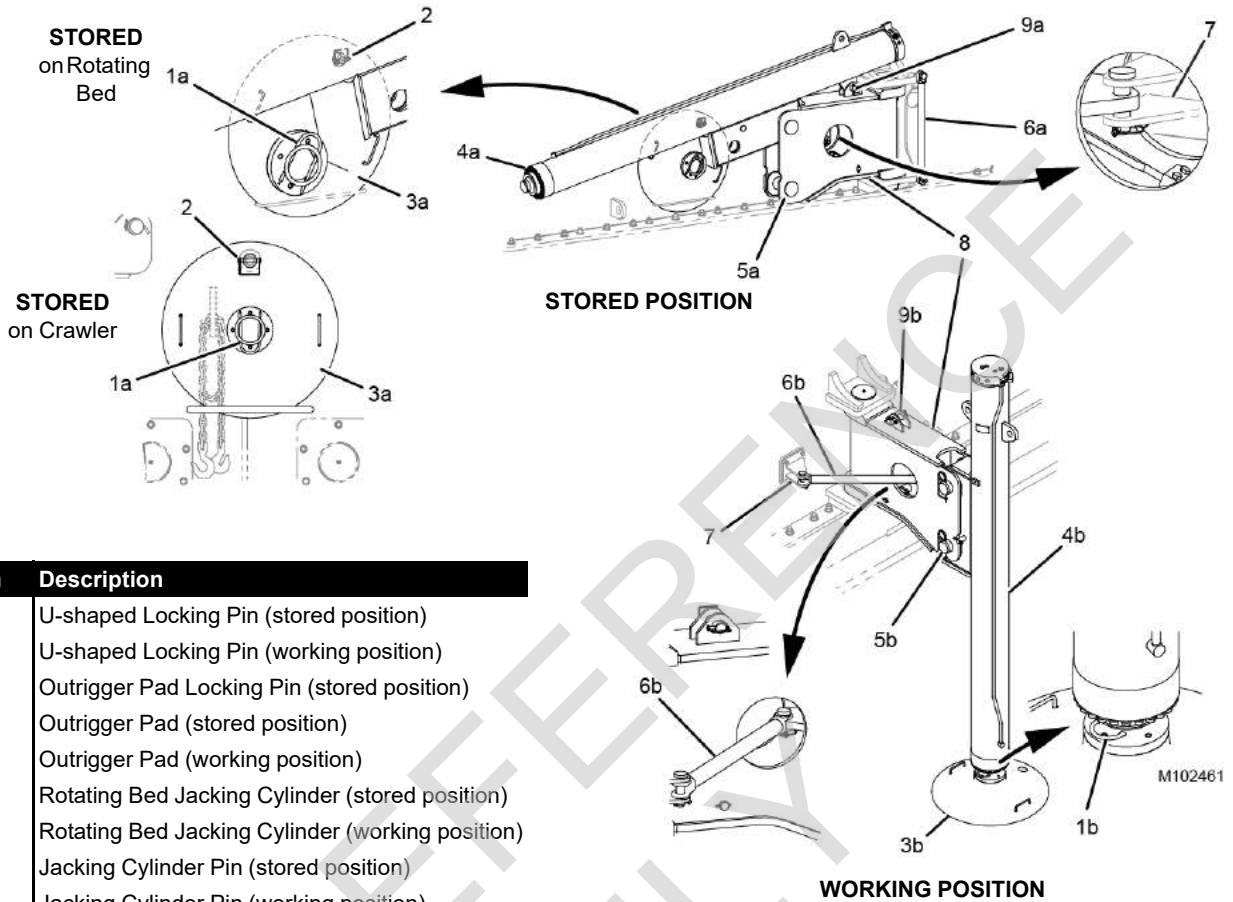
See [Figure 4-47](#) for the following procedure.

1. Remove the alignment pendants (5) and store them on the adapter frame.
2. Rotate the operator cab to the set up position and install the pin and hair-pin cotter (1).



Item	Description
1	Pin and Hair-Pin Cotter
2b	Strut (set up position)
3	Rotating Bed
4	Operator Cab Support
5	Alignment Pendants (stored position)
6	Adapter Frame

FIGURE 4-47



Item	Description
1a	U-shaped Locking Pin (stored position)
1b	U-shaped Locking Pin (working position)
2	Outrigger Pad Locking Pin (stored position)
3a	Outrigger Pad (stored position)
3b	Outrigger Pad (working position)
4a	Rotating Bed Jacking Cylinder (stored position)
4b	Rotating Bed Jacking Cylinder (working position)
5a	Jacking Cylinder Pin (stored position)
5b	Jacking Cylinder Pin (working position)
6a	Outrigger Strut (stored position)
6b	Outrigger Strut (working position)
7	Rotating Bed Lug (work and stored positions)
8	Outrigger Beam Assembly
9a	Jacking Cylinder Pin (stored position)
9b	Jacking Cylinder Lug (working position)

FIGURE 4-48

Store Front Rotating Bed Jacking Cylinders

See [Figure 4-48](#) for the following procedure.

1. Place the outrigger pads in the stored position (3a) on the rotating bed or on the crawlers (if equipped with lugs and brackets) and secure them with the outrigger pad locking pins (2). Place the U-shaped locking pins into the stored position (1a).
2. Remove the jacking cylinders pins (5b) and (9b) in the working position. Using the remote control, tilt the cylinders up and secure the jacking cylinders with pins (9a) in the stored position.

3. Remove the struts from the working position (6b) and secure the struts in the stored position (6a).
4. Remove the pins from the rotating bed lugs (7) and swing the jack assemblies toward the rotating bed.
5. Pin the outrigger beam assemblies to the rotating bed lugs (7) in the stored position.

! WARNING
Moving Part Hazard!

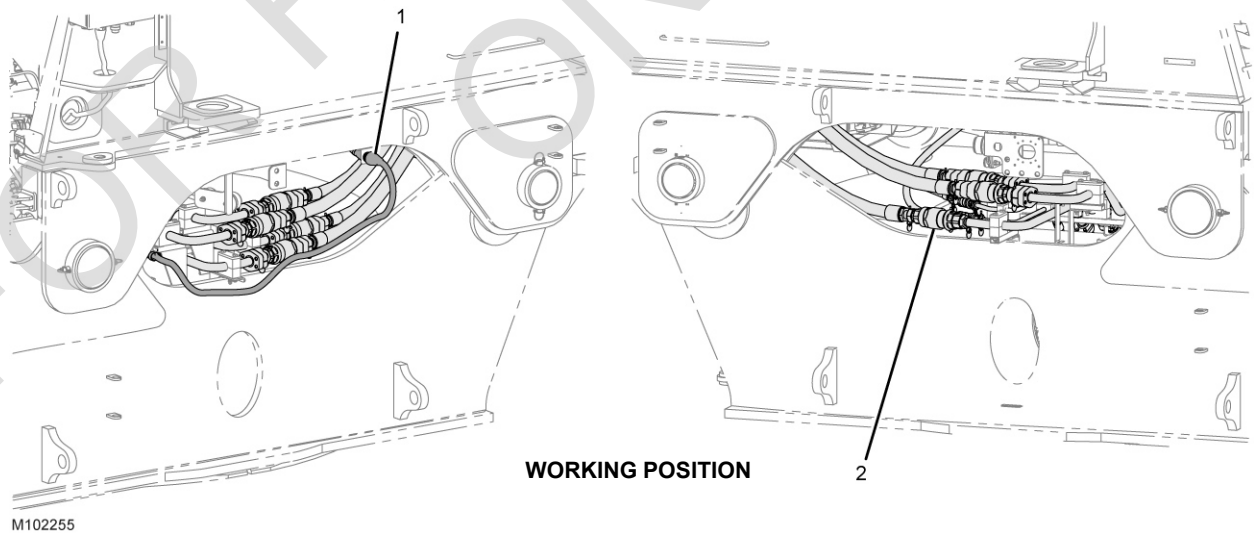
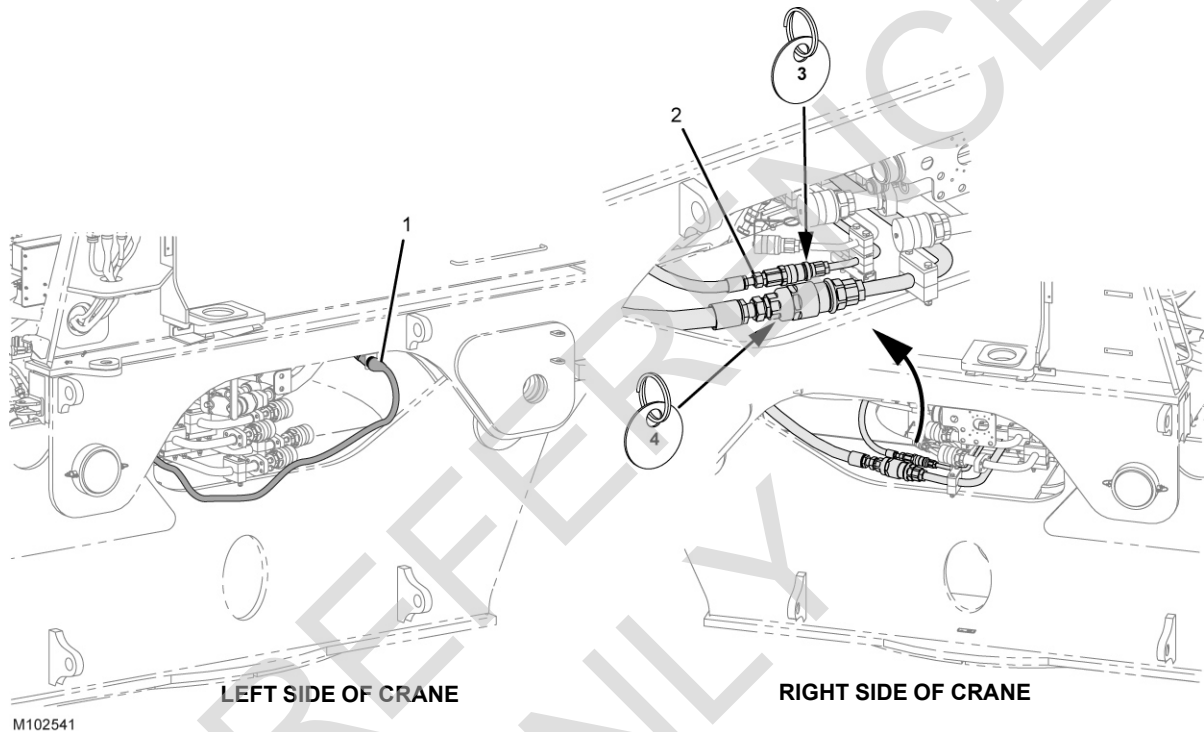
To avoid serious crushing injury — warn all personnel to stand clear of jacks.

Install Hydraulic Connections

See [Figure 4-49](#) for the following procedure.

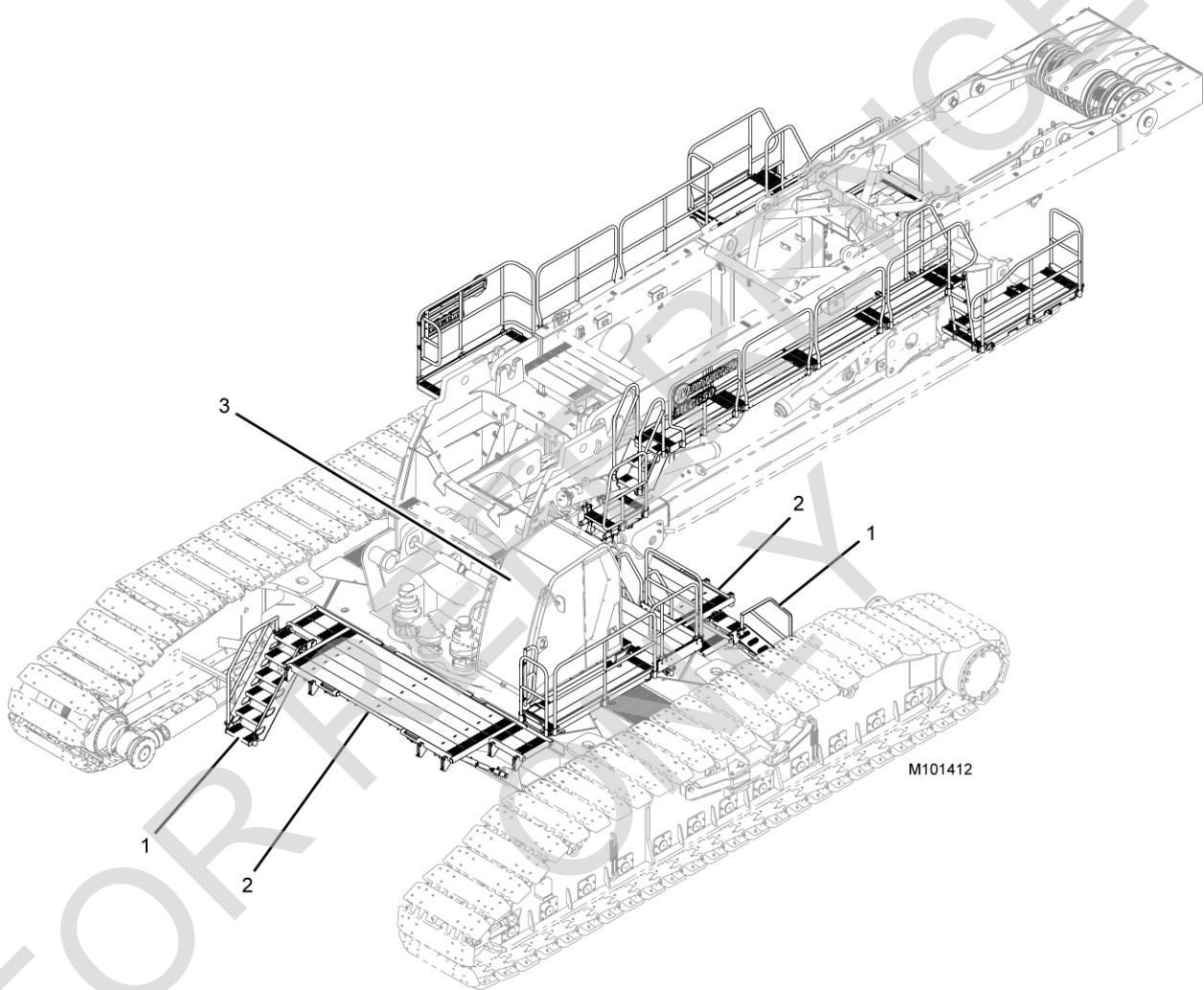
1. On the right and left side of the crane, remove the remaining hydraulic hoses from the stored position.
2. Connect remaining hydraulic hoses (2) to the working position.

NOTE: There are four hydraulic hose connections on the left side of the crane and five hydraulic hose connections on the right side of the crane.



Item	Description
1	Adapter Frame Electrical Cable (WFC1 connects to WRF2-J5)
2	Hydraulic Connections (5 connections)

FIGURE 4-49



Item	Description
1	Ladders and Handrails (2) - Carbody
2	Front and Rear Platforms - Carbody
3	Operator Cab - Working Position

FIGURE 4-50

Deploy Operator Cab (Working Position)

See [Figure 4-51](#) for the following procedure.

1. Remove the hair-pin cotter and pin (1) from the setup position that secures the operator cab support (4) to the rotating bed (3).
2. Rotate the operator cab to the working position.
3. Install the strut (2c) using the pin and safety pin (1) to secure the operator cab in the working position.

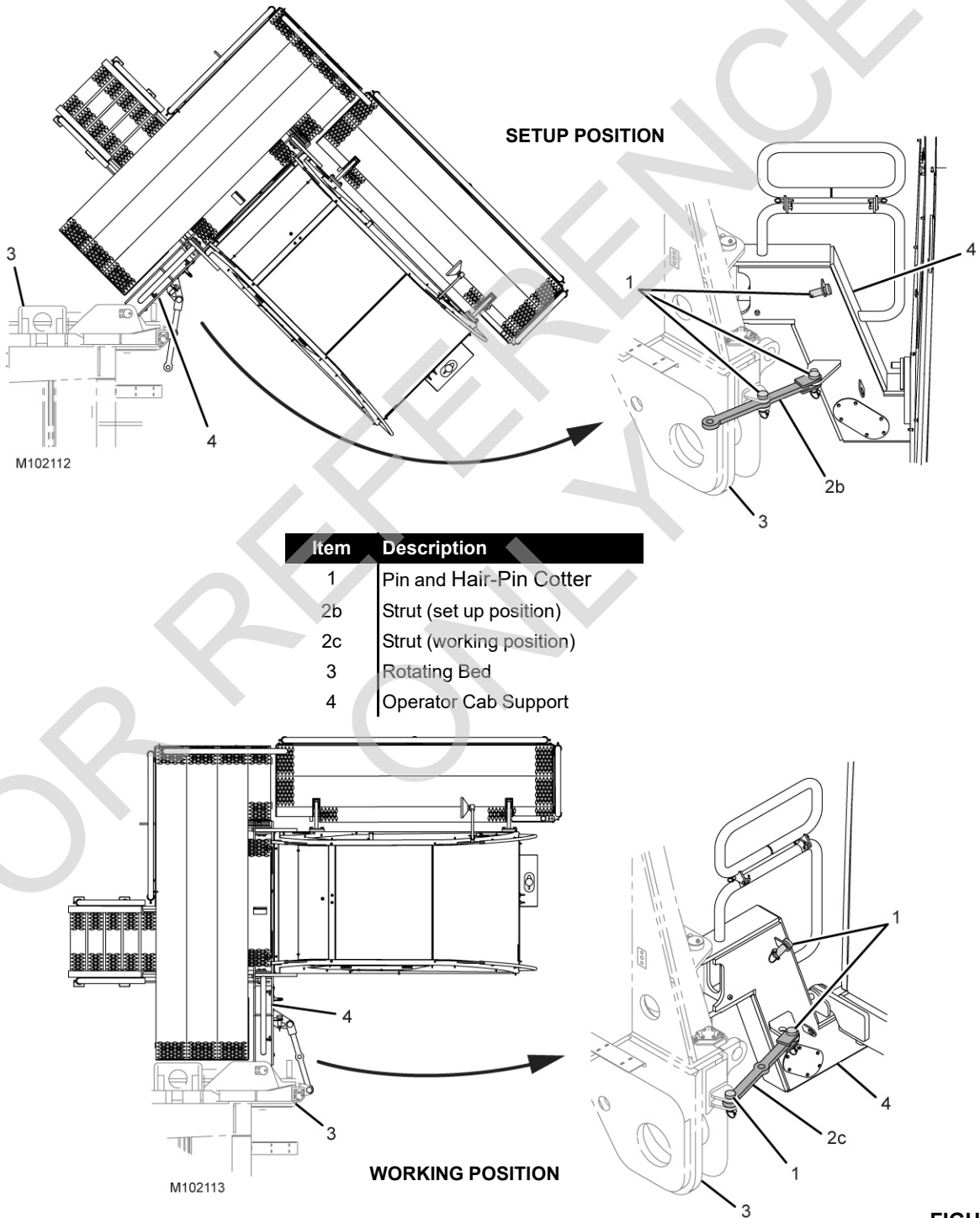


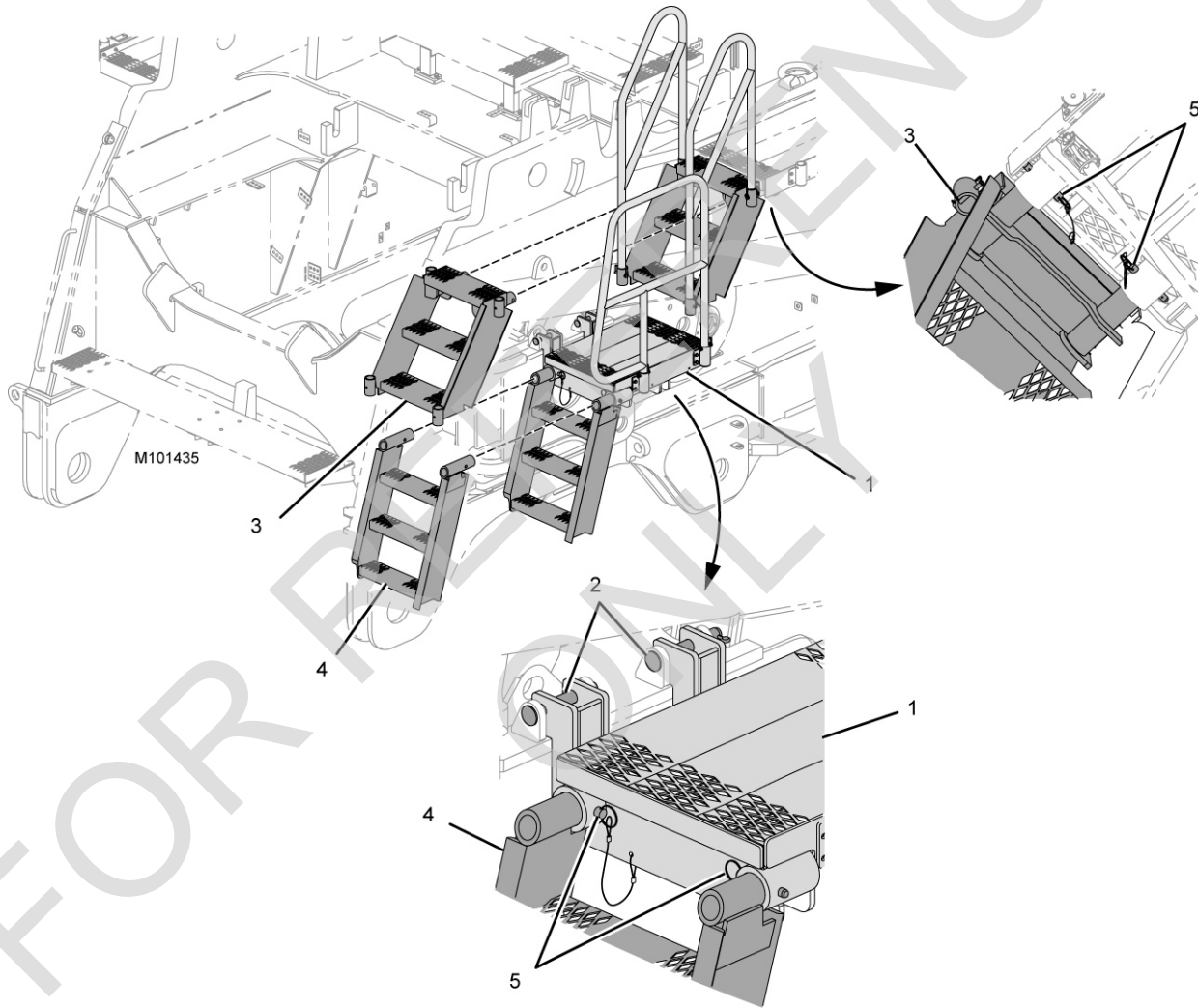
FIGURE 4-51

Install Platforms, Ladders, and Handrails

See [Figure 4-52](#) for the following procedure.

1. Install the platform (1) to the rotating bed using pins.
2. Install the lower cab to bed ladder (4) by sliding the tubes at the top of the ladder through sleeves on the underside of the platform (1).
3. Secure the ladder with the two quick-release pins (5).
The lower ladder weighs approximately 20 kg (45 lb).

4. Install the upper cab to bed ladder (3) by sliding the tubes at the top of the ladder through sleeves on the underside of the platform.
5. Secure the ladder with the two quick-release pins (5).
The upper ladder weighs approximately 20 kg (45 lb).
6. Install the dedicated handrails by inserting the handrail assembly into the handrail brackets and securing with lanyard pins.
Each handrail weighs approximately 8 kg (15 lb).



Item	Description
1	Platform
2	Quick- Release Pins
3	Upper Cab To Bed Ladder
4	Lower Cab To Bed Ladder
5	Quick-Release Pins

FIGURE 4-52

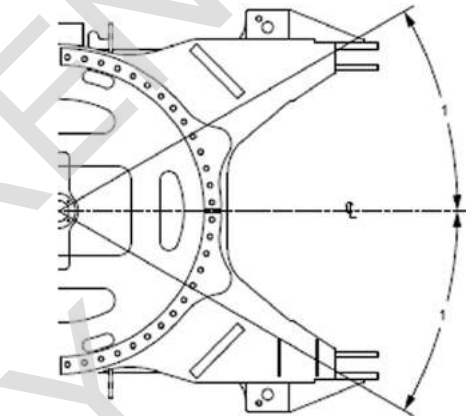
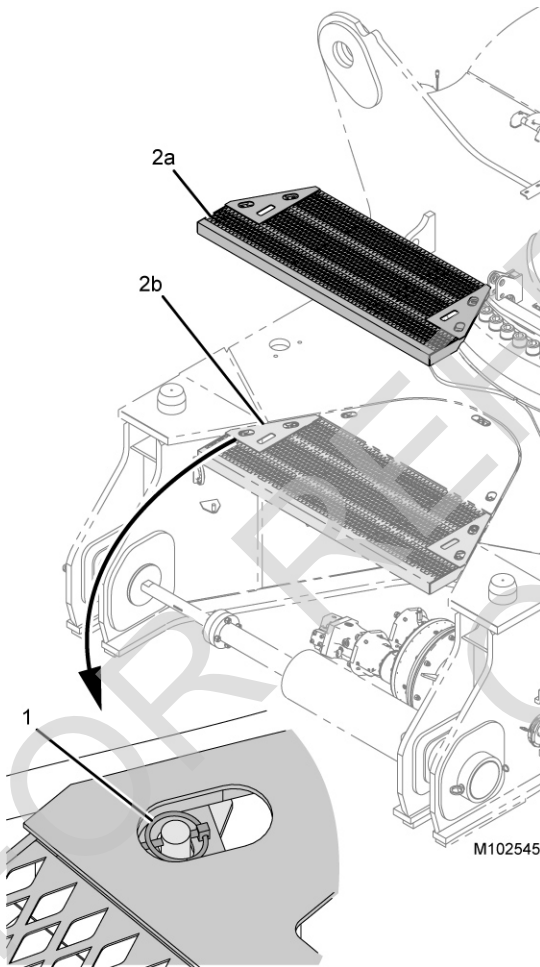
Install Crawlers

The crane must be in the following configuration to install the crawlers:

- Mast arms fully raised.
- Crane SETUP mode selected and confirmed.
- Swing limited to 30° when handling the first crawler.
- The live mast must be between the range of 110° and 158° (8,5 m (29 ft) max. radius to avoid tipping the crane while lifting the first crawler.
- Maximum capacity limited to 54 430 kg (120,000 lb).
- Crane is level (8) on carbody pedestals, (Figure 4-53).

! WARNING
Tipping Hazard!

- Do not exceed 54 430 kg (120,000 lb) capacity at 8,5 m (29 ft) radius when handling crawlers with the mast. The crane will tip forward.
- Crane must be level. Adjust the pedestals as required.
- Swing limited to 30° (1) when handling the first crawler



Swing Limited to 30° (1) for Handling First Crawler Over Side of Crane on Carbody Pedestals.

NOTE: Reference The Liftcrane Mast Handling Capacities document found at the end of this section for complete details.

CAUTION

Parts Damage!

Avoid hitting the carbody pedestals with the crawler.

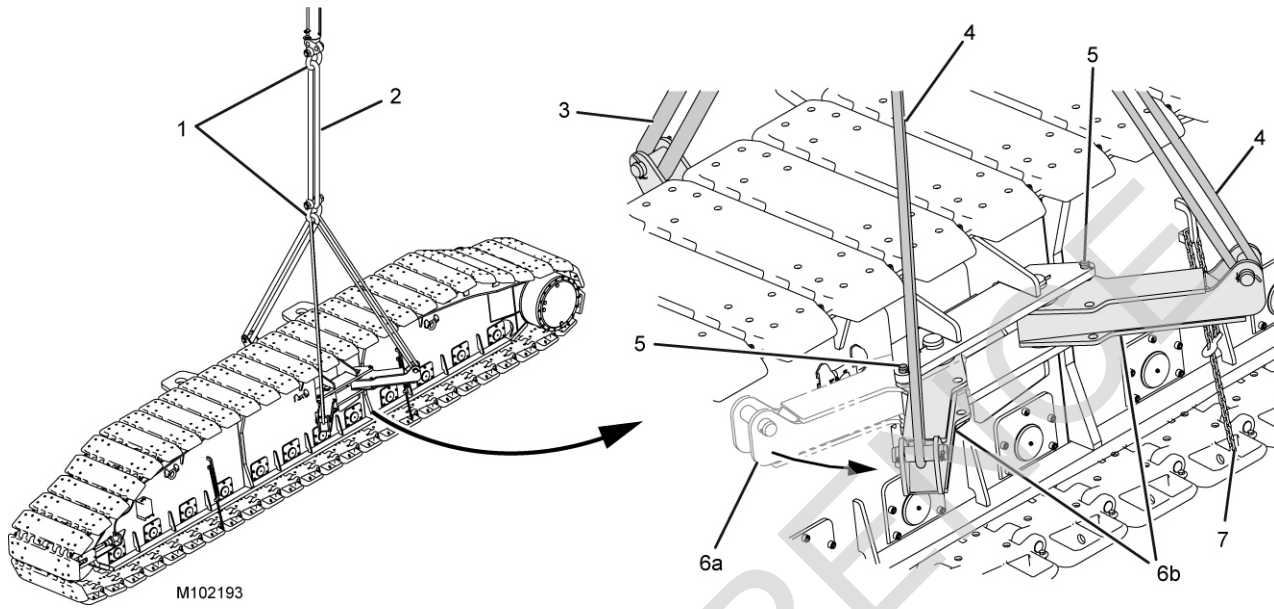
The carbody cavity platforms (2, Figure 4-53) must be removed before the crawlers can be installed or damage will occur.

See Figure 4-53 for the following procedure.

1. Remove the quick release pins (1).
2. Remove the carbody cavity platforms (from both sides) using hand holes in the platform to raise and set aside until after crawler installation is complete.

Item	Description
1	Quick Release Pins
2a	Carbody Cavity Platform (removed)
2b	Carbody cavity Platform (working position)

FIGURE 4-53



Item	Description
1	2-SH 1 - Shackle-55 t (60.60 USt)
2	1-SL 5 - Sling - 2,60 m (8.50 ft) - 56 700 kg (125,000 lb)
3	1-SL 1 - Sling - 3,30 m (10.83 ft) - 45 360 kg (100,000 lb)
4	2-SL 2 - Slings - 3,10 m (10.30 ft) - 18 144 kg (40,000 lb)
5	Pins and Safety Pins
6a	Crawler Lifting Brackets (stored position)
6b	Crawler Lifting Brackets (installation position)
7	Chain Slings
8	584 mm (23 in) - 685 mm (27 in)
9	Trailer

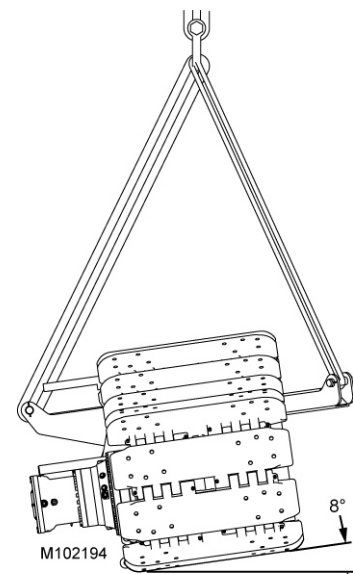
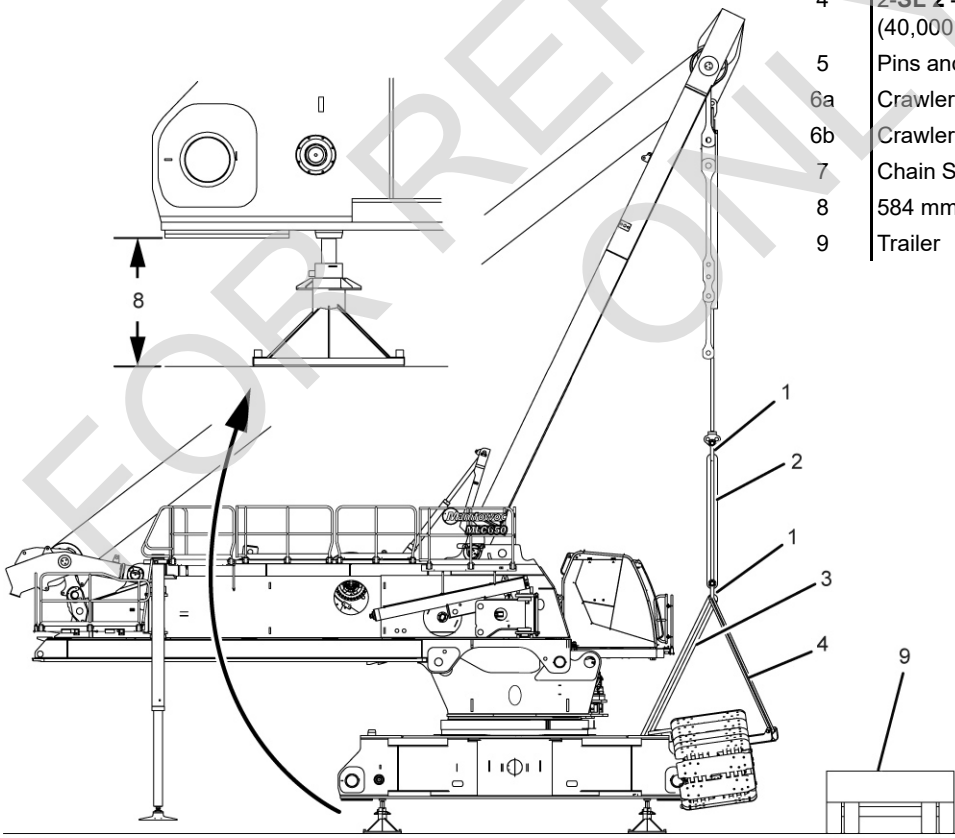


FIGURE 4-54

See [Figure 4-54](#) for the following procedure.

The crawlers may be installed using the live mast or an assist crane.

1. Position the trailer (9) carrying the crawler along the desired side of the crane.

The side of the crawler with one lifting link must face the crane.

2. Remove the tie downs and blocking securing the crawler to the trailer.
3. Attach one SL 1 and two SL 2 lifting slings to the **SL 5** synthetic sling (2) attached to the self erect cylinder rod end with an **SH 1** shackle (1).

NOTE: Reference the lifting sling and shackle chart found in [Figure 4-7 on page 4-6](#).

4. Swing the upperworks so the self-erect cylinder and the lifting slings are centered over the crawler.
5. Install four chain slings (7) from the crawler frames to the crawler shoes to prevent excessive crawler track sag. Some sag must be allowed to prevent interference between the carbody and crawler pads.
6. Remove safety pins and pins (5), rotate the crawler lifting brackets (6a) from the stored position to the installation position (6b), and install pins and safety pins.
7. Remove the hitch pins and pins from the outside crawler lifting brackets.
8. Attach two **SL 2** synthetic lifting slings (4) to the outside crawler lifting brackets and place the pins through each sling and bracket, and install the hitch pins.
9. Remove the hitch pin and pin from the inside crawler lifting bracket.
10. Insert one **SL 1** synthetic lifting sling (3) into the bracket, install the pin through the sling and bracket, and install the hitch pin.
11. Retract the self-erect cylinder to lift the crawler from the trailer: there will be approximately 8° of tilt toward the carbody.

12. Remove the trailer (9).

Lubricate Crawler-to-Carbody Machined Surfaces

Each time the crawlers are assembled to the carbody, thoroughly clean and grease all machined surfaces on the crawlers and the carbody—surfaces are marked with an asterisk (*) in [Figure 4-55](#).

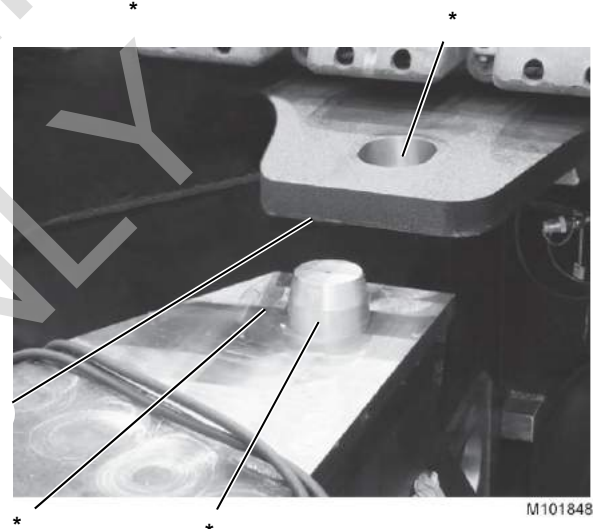
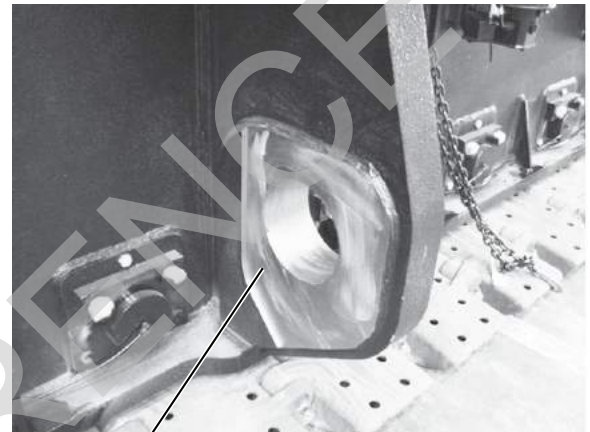
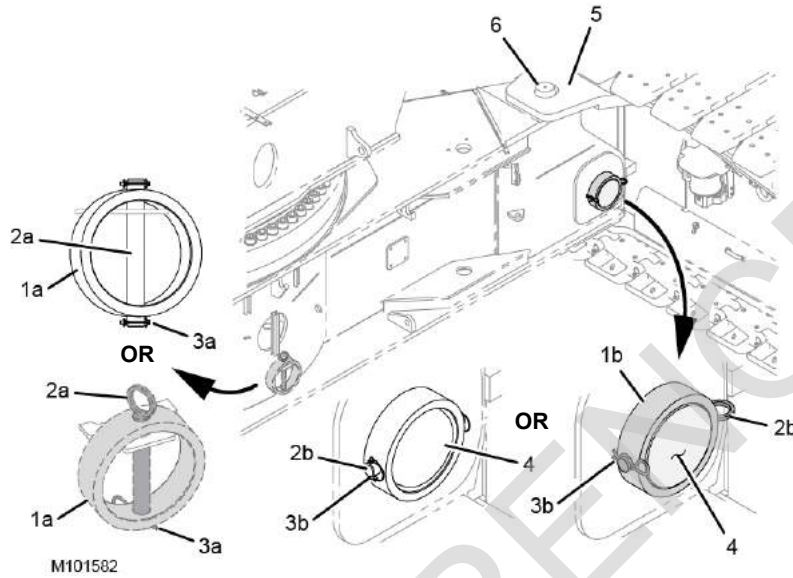
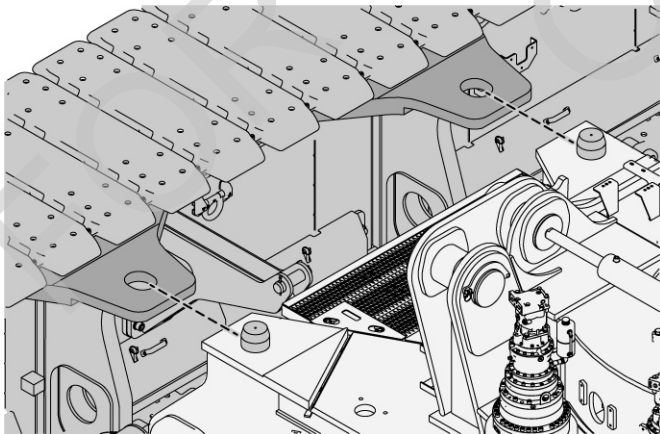


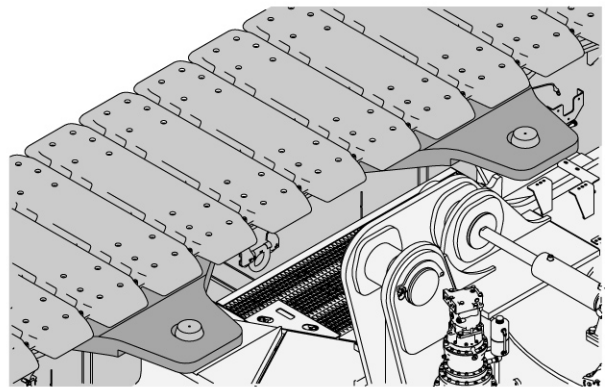
FIGURE 4-55



Item	Description
1a	Collar (stored position)
1b	Collar (working position)
2a	Retaining Pin (stored position)
2b	Retaining Pin (working position)
3a	Hair-Pin Cotter or Safety Pin (stored position)
3b	Hair-Pin Cotter or Safety Pin (working position)
4	Crawler Pin
5	Crawler Hooks
6	Carbody Pins



CRAWLER HOOKS/CARBODY PINS DISENGAGED



M102305

CRAWLER HOOKS/CARBODY PINS ENGAGED

FIGURE 4-56

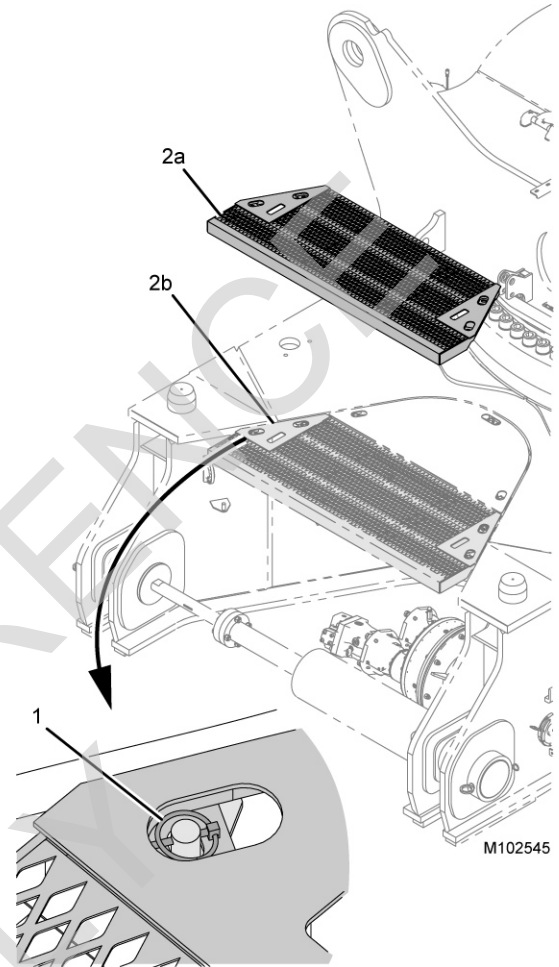
Install Crawlers (continued)

See [Figure 4-56](#) for the following procedure.

NOTE: The crawler pins (4) are shipped in the retracted position. This is required to meet shipping width requirements.

The collars (1) are stored on the carbody and are secured with retaining pins (2) and hair-pin cotter or safety pins (3).

13. Slowly lower the crawler, mast up, and swing to engage the crawler hooks (5) with the carbody pins (6).
14. Stop lowering when the crawler hooks are fully engaged with the carbody pins and when the connecting holes are aligned (handling slings slack).
15. Using the remote control, engage the crawler pins (4).
16. Install the collars, the retaining pins, and the cotter pins.
17. Connect the carbody electrical cable (1, [Figure 4-58](#)) to the crawler electrical cable (2, [Figure 4-58](#)).
18. Remove the synthetic slings (2-3, [Figure 4-53](#)) from the lifting brackets on the crawler frame.
19. Remove the pins from the crawler lifting brackets (6, [Figure 4-54 on page 4-64](#)), place the lifting brackets into the stored position and secure them with pins.
20. Install the carbody cavity platform (2b) to the working position and secure it with quick release pins (1, [Figure 4-57](#)).



Item	Description
1	Quick Release Pins
2a	Carbody Cavity Platform (removed)
2b	Carbody Cavity Platform (working position)

FIGURE 4-57

Item	Description
1	Carbody Electrical Cable (WLC1)
2	Crawler Electrical Cable (WLL1-P1)

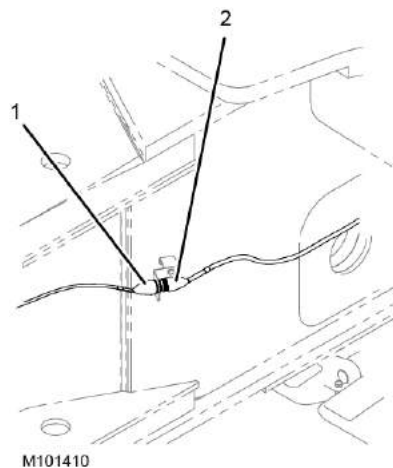


FIGURE 4-58

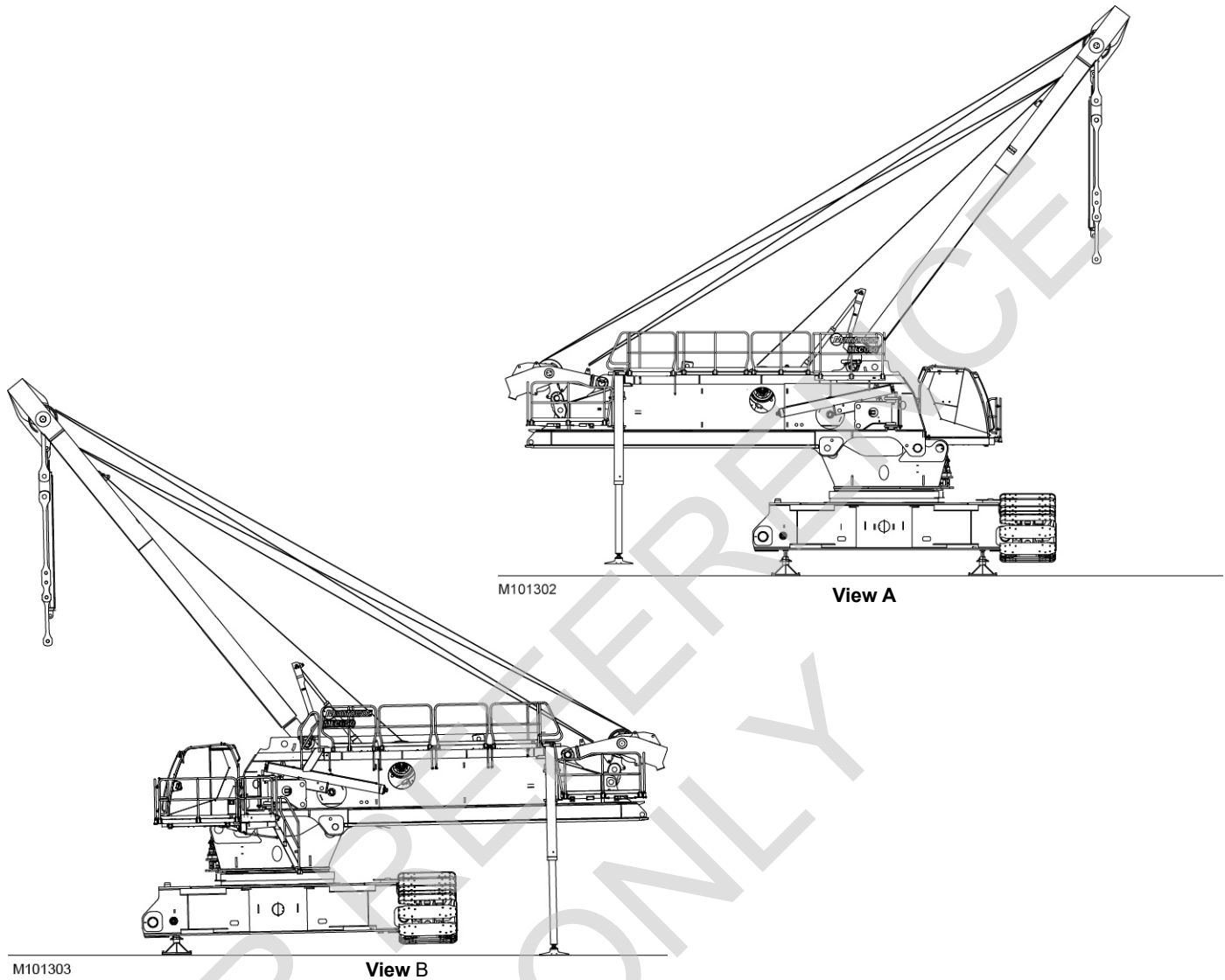


FIGURE 4-59

Install Second Crawler

See [Figure 4-59](#) for the following procedure.

3. Extend the rear rotating bed jacking cylinders until the carbody is lifted from the two carbody pedestals (View B) and remove the pedestals.

NOTE: The crane must not exceed 4° out of level during step 3.

! WARNING

Crane Tipping Hazard!

To avoid tipping the crane, position the mast at 145° prior to swinging the upperworks.

1. Position the mast at 145°-158° prior to swinging the upperworks.
2. Retract the rear rotating bed jacking cylinders (View A) and swing the upperworks 180° until the jacks are parallel to the installed crawler.

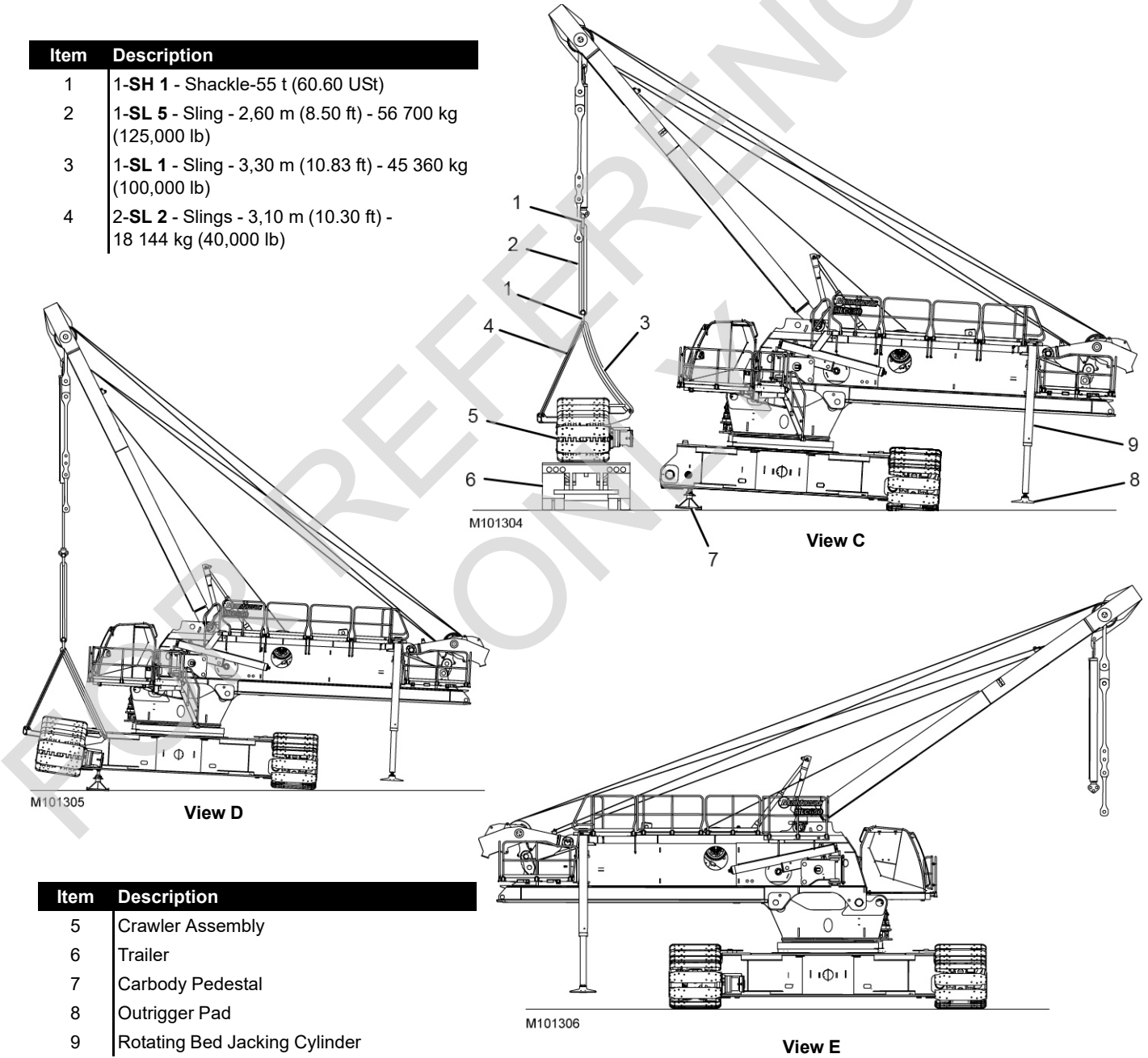
CAUTION

Parts Damage!

Avoid hitting crawlers and objects with the rotating bed jacking cylinders or outrigger pads while swinging the upperworks.

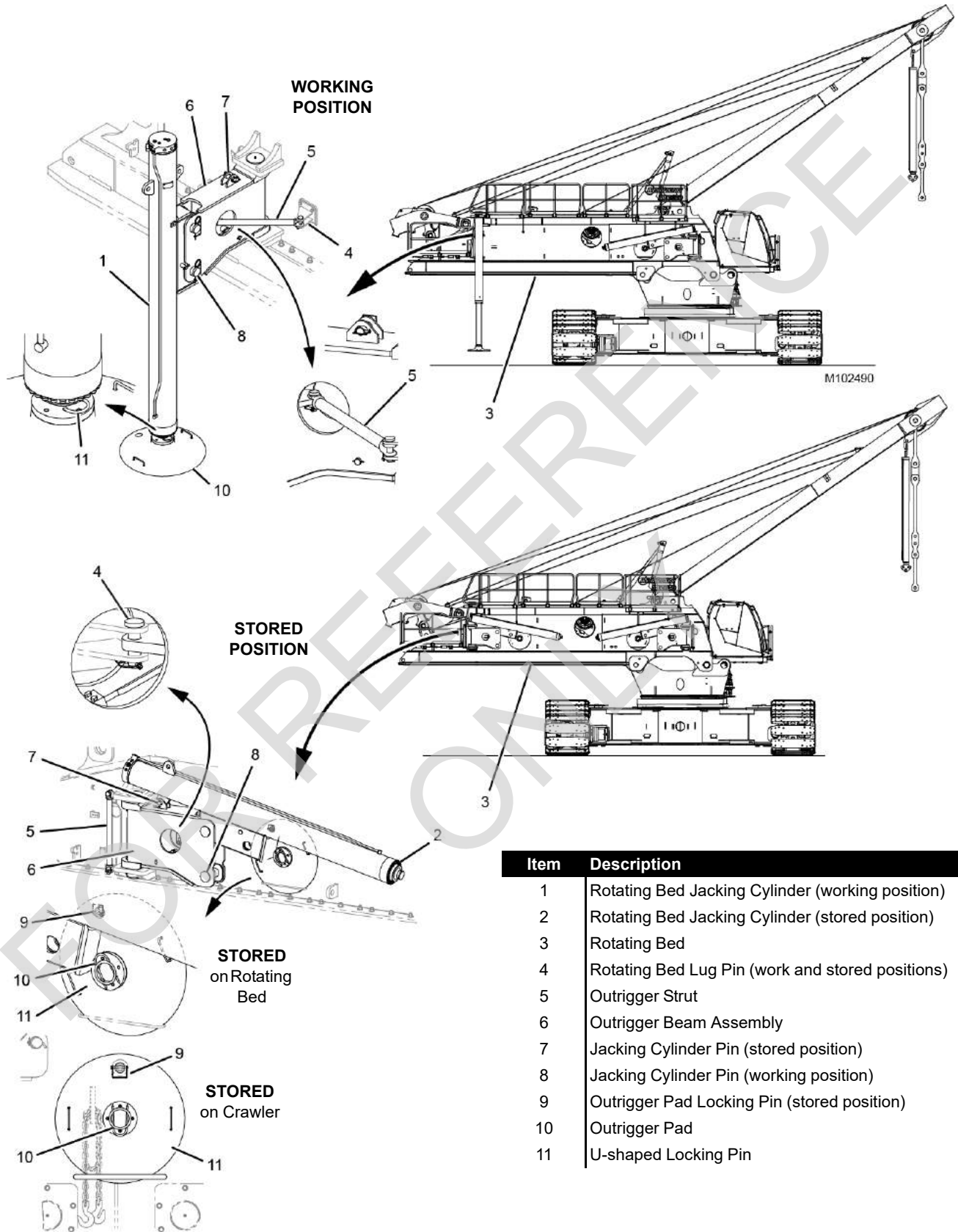
4. Retract the rear rotating bed cylinders (View C) until the installed crawler supports the weight of the crane and until the outrigger pads (8) are approximately 300 mm (12 in) above the ground and then rotate the upperworks 180°.
5. Reference ["Install Crawlers" on page 4-63](#) and follow the installation steps 1-2 and 1-20 for the second crawler installation (View D).
6. Extend the rear rotating bed jacking cylinders to lift the crane just slightly off of the two remaining carbody pedestals.
7. Remove the carbody pedestals and store them.
8. Retract the rotating bed jacking cylinders to lower the crane to the ground (View E).
9. Remove the chain slings from the crawler shoes and store on crawlers for future use.
10. Install the carbody cavity platform and secure it with pins (see [Figure 4-53 on page 4-63](#)).

Item	Description
1	1-SH 1 - Shackle-55 t (60.60 USt)
2	1-SL 5 - Sling - 2,60 m (8.50 ft) - 56 700 kg (125,000 lb)
3	1-SL 1 - Sling - 3,30 m (10.83 ft) - 45 360 kg (100,000 lb)
4	2-SL 2 - Slings - 3,10 m (10.30 ft) - 18 144 kg (40,000 lb)



Item	Description
5	Crawler Assembly
6	Trailer
7	Carbody Pedestal
8	Outrigger Pad
9	Rotating Bed Jacking Cylinder

FIGURE 4-59 continued



Item	Description
1	Rotating Bed Jacking Cylinder (working position)
2	Rotating Bed Jacking Cylinder (stored position)
3	Rotating Bed
4	Rotating Bed Lug Pin (work and stored positions)
5	Outrigger Strut
6	Outrigger Beam Assembly
7	Jacking Cylinder Pin (stored position)
8	Jacking Cylinder Pin (working position)
9	Outrigger Pad Locking Pin (stored position)
10	Outrigger Pad
11	U-shaped Locking Pin

FIGURE 4-60

Store Rear Rotating Bed Jacking Cylinders

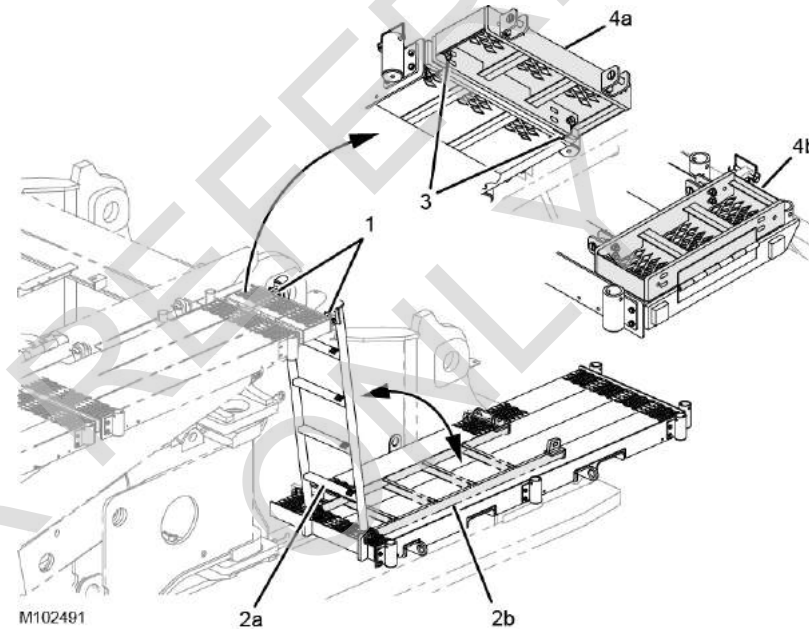
1. Remove the two pins (1, [Figure 4-61](#)) from the rear ladder (2a) and rotate ladder down (2b) onto the lower platform.
2. Remove upper platform lanyard pins (3, [Figure 4-61](#)) and flip upper rear platform from the working position (4a) up onto the upper platform (4b).

See [Figure 4-60](#) for the following:

3. Remove the u-shaped locking pins (11) from the outrigger pads (10).
4. Using the remote control, fully raise the rear rotating bed jacking cylinders (1) from the working position.
5. Store the outrigger pads (10) with u-shaped locking pins (11) on the rotating bed or on the crawler using the outrigger pad locking pins (9).

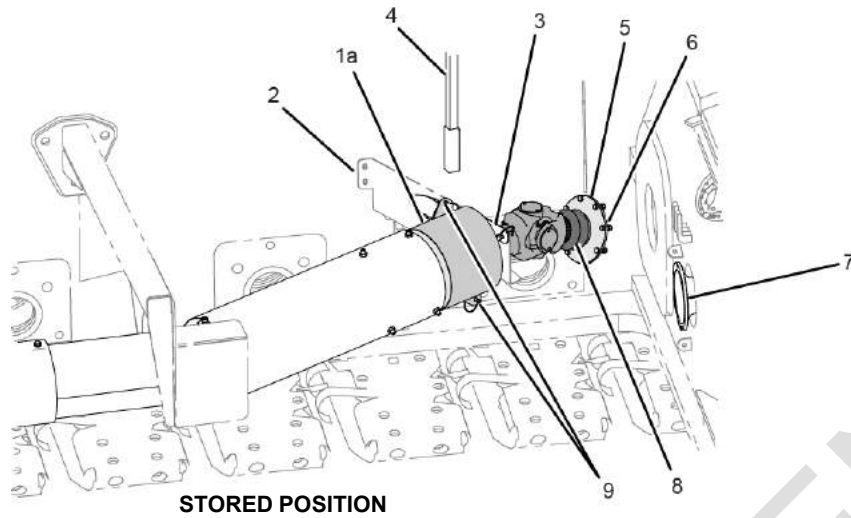
NOTE: The outrigger pad weighs approximately 30 kg (65 lb).

6. Remove the jacking cylinder pins (7 & 8) and use the remote to tilt the jacking cylinders up until pins (7) can be installed in the stored position. Store pins (8) in the outrigger beams (6).
7. Remove the outrigger struts (5) from the working position and place in the stored position.
8. Remove the rotating bed lug pins (4). Rotate the entire outrigger beam assemblies to the stored position (6b) and secure with pins in the rotating bed lug (4).
9. Flip upper platforms down (4a, [Figure 4-61](#)) and secure with lanyard pins.
10. Flip ladders (2a, [Figure 4-61](#)) to the working position and secure with pins.
11. Repeat steps for second rotating bed jacking cylinder and rear platform assembly.

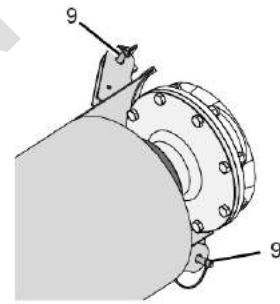


Item	Description
1	Pins
2a	Ladder (working position)
2b	Ladder (down position)
3	Lanyard Pins
4a	Platform (working position)
4b	Platform (flipped position)

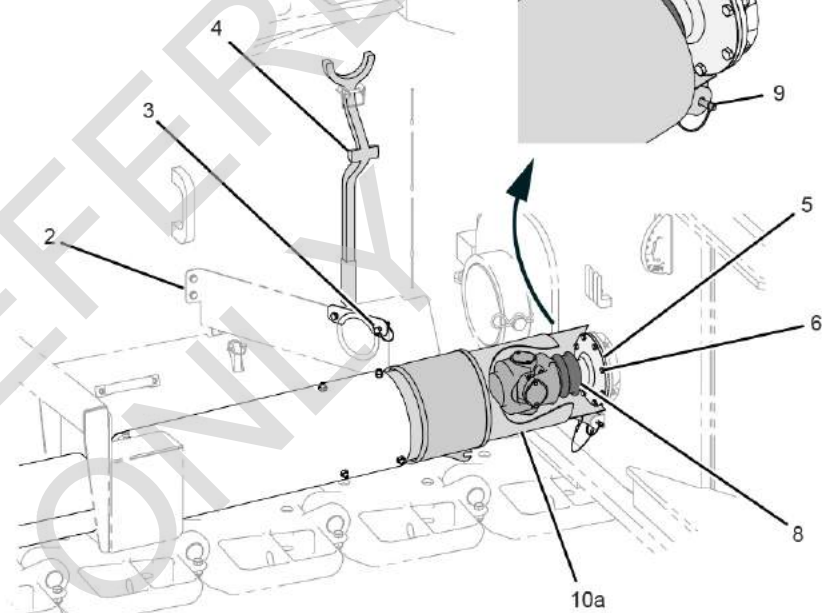
FIGURE 4-61



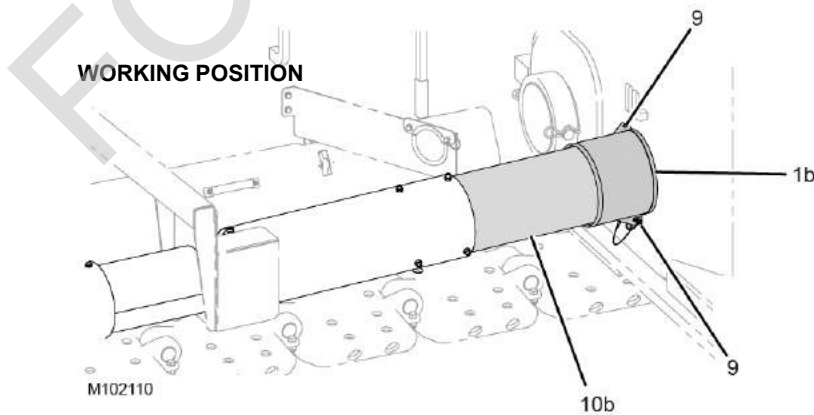
STORED POSITION



Item	Description
1a	Drive Shaft Guard (stored position)
1b	Drive Shaft Guard (working position)
2	Drive Shaft Storage Bracket
3	Storage Latch
4	Drive Shaft Lever
5	Drive Shaft Disconnect Flange
6	Flange Lock Nuts and Bolts
7	Companion Flange
8	Collar
9	Safety Pins
10a	Drive Shaft Guard (cut away view in the working position)
10b	Drive Shaft Guard (working position)



INSTALLATION VIEW



WORKING POSITION

M102110

FIGURE 4-62

Install Drive Shafts

See [Figure 4-62](#) for the following procedure.



WARNING

Rotating Drive Shaft Hazard!

The crawler drive shaft rotates at a high speed.

- Make sure the crawler drive shaft is securely attached at both ends.
- Make sure the collar is fully engaged with the splines.
- Make sure the guards are in place and securely attached at both ends during operation.
- Do not attempt to service the drive shaft until the crane has been parked and the engine stopped.

1. Remove drive shaft flange lock nuts and bolts (6) and set them aside.
2. Remove storage bracket latch pin, flip up the storage latch (3), and lift the crawler drive shaft from the storage bracket (2, stored position).
3. Extend the drive shaft and align the drive shaft disconnect flange holes (5) to the companion flange holes (7).

Check to be sure that the collar is fully engaged with the splines (see [Figure 4-63](#)).

4. Insert the flange bolts (6) and lock nuts. Torque the bolts to the lock nuts with 48 Nm (35 ft-lb) of force (installation view).
5. Close the storage latch (3) and insert the safety pin.
6. Remove the safety pins (9) from the drive shaft guard (1a), slide the drive shaft guard over the drive shaft and pin the guard (1b) into the working position using the safety pins.

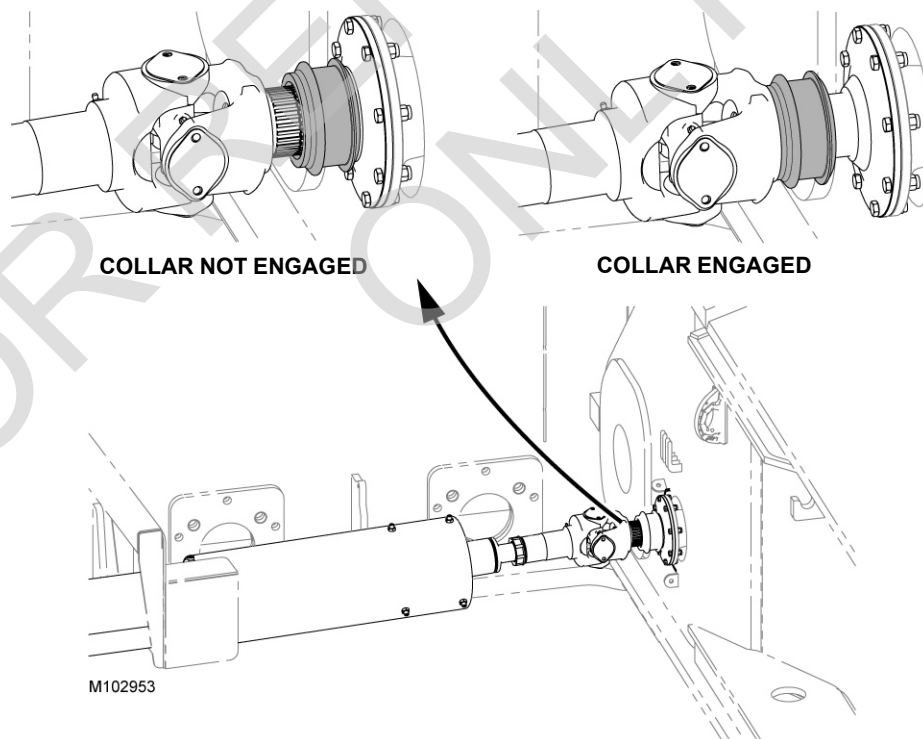
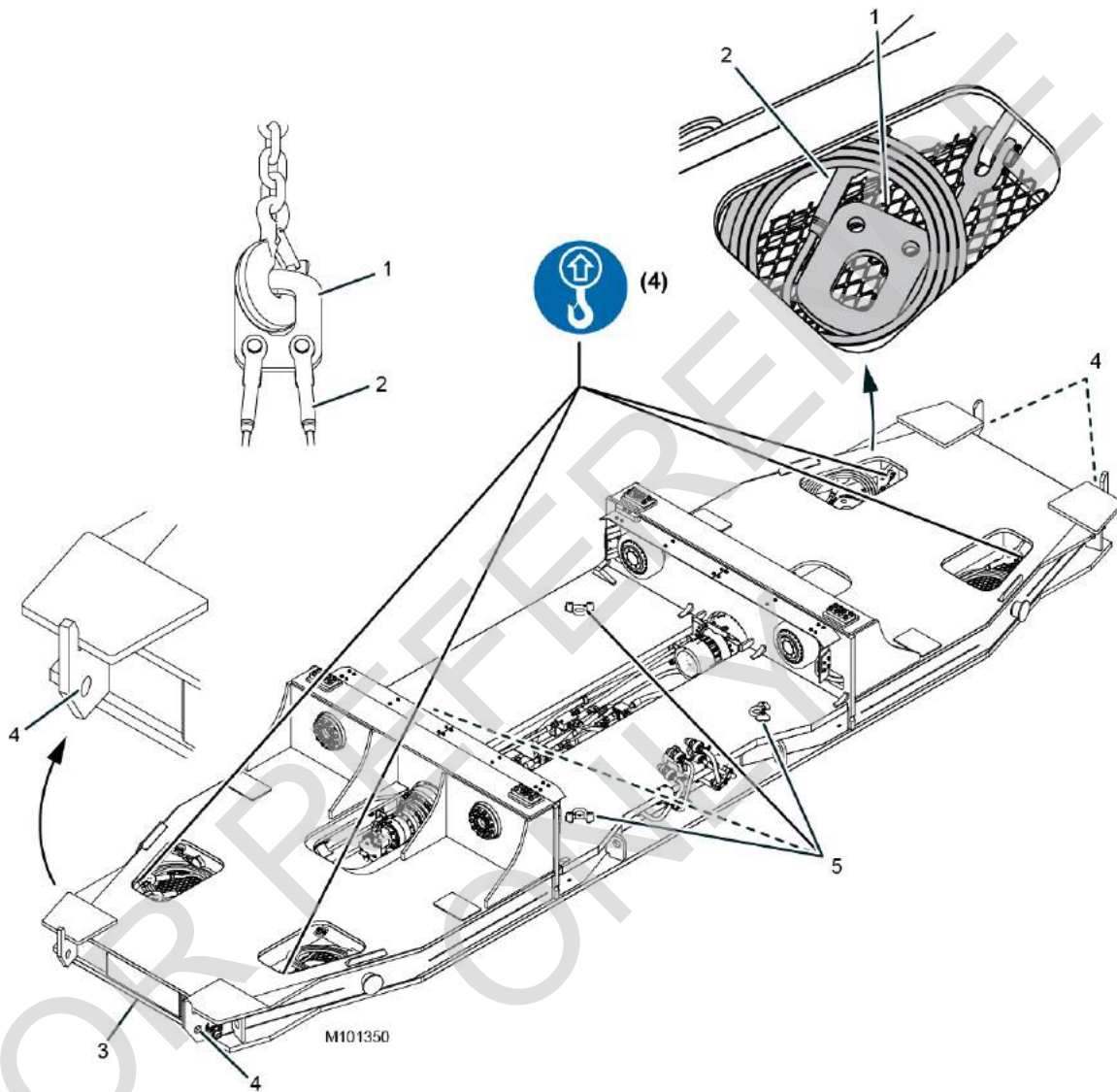


FIGURE 4-63



Item	Description
1	Plates
2	Pendants
3	Counterweight Tray
4	Tag Line Lugs
5	Lifting Ring

FIGURE 4-64

Install Counterweight Tray

See [Figure 4-64](#) for the following procedure.

NOTE: The counterweight tray must be installed 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 lbs). Use the appropriate equipment and techniques for lifting and transporting the counterweight tray, otherwise it could fall, causing possible injury.

At the time of the counterweight tray installation:

- The crane's rotating bed must be assembled to the carbody.
- The crane must be completely off the rotating bed lifting jacks and must be supported by the crawlers.
- Rotating bed jacking cylinders in the stored position
- The live mast and the backhitch may be in the installation position or in a raised position. If in a raised

position, then the live mast must be rotated to a 110° angle (minimum) from its shipping position.

For ease of counterweight tray handling and lifting, Manitowoc provides four pendants (2) and two plates (1). The pendants and plates are stored in the counterweight tray.

1. Position the trailer carrying the counterweight tray along the desired side of the crane.
2. Attach the pendants (2) to the plates (1) and onto the hook block.
3. Attach taglines to the supplied lugs for taglines (4) on opposite sides of the counterweight tray (3).

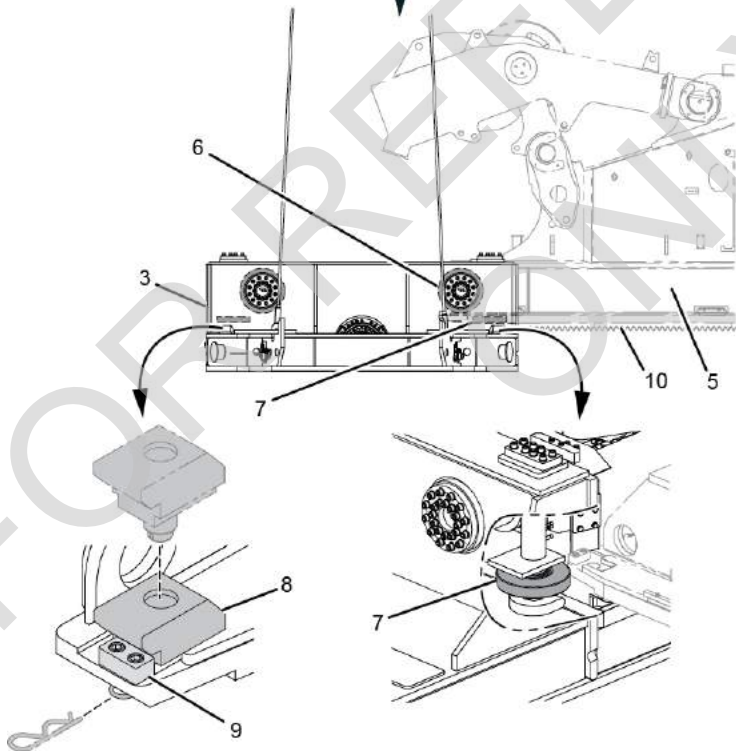
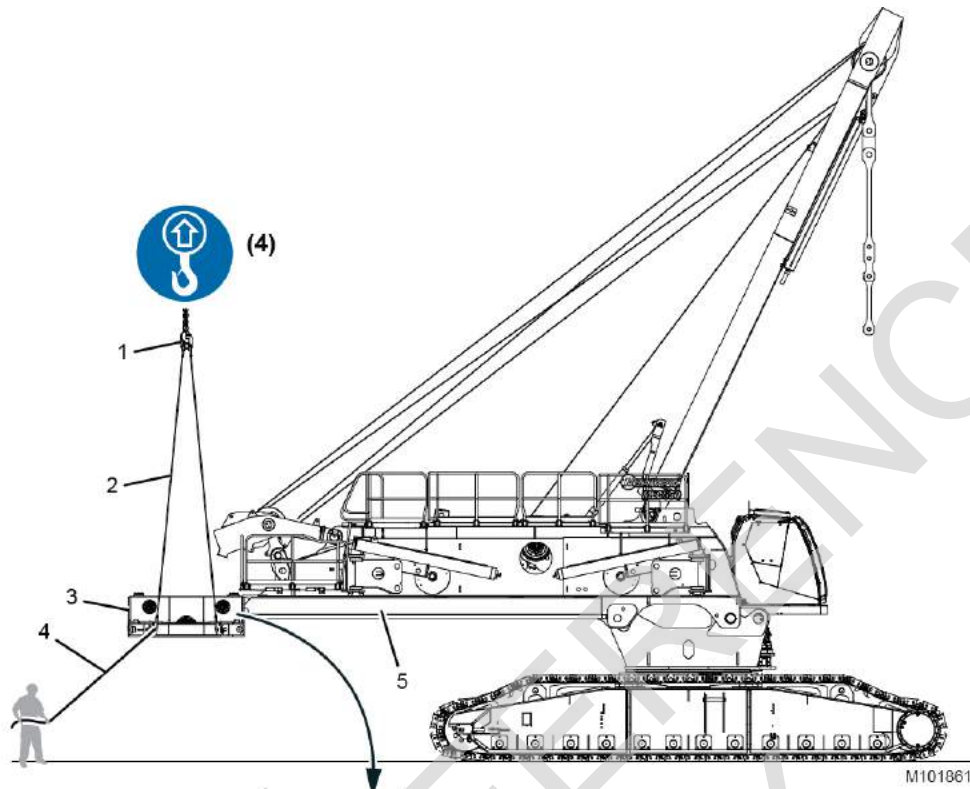
Assistants will use the tag lines to help control the movement of the counterweight tray and to help guide the tray onto the rotating bed.

4. Lift the counterweight tray (3) from the trailer and remove trailer.

CAUTION

Parts Damage!

The alternate lifting rings (5) must be laying flat before installing the counterweight tray onto the rotating bed or damage will occur.



Item	Description
1	Plates
2	Pendants
3	Counterweight Tray
4	Tag Line
5	Rotating Bed
6	Front Vertical Rollers
7	Front Horizontal Rollers
8	Large Stop Blocks (2)
9	Small Stop Blocks (2)
10	Rotating Bed Counterweight Tray Rack

FIGURE 4-65

Continued from the previous page.

See [Figure 4-65](#) for the following:

5. Remove the two large stop blocks (8) from the rotating bed by removing the safety pins from the stop blocks.

NOTE: Do not remove the small bolt-on stop blocks (9).

6. Use the tag lines (4), and the assist crane, to position the counterweight tray (3) at the back of the rotating bed (5) so that the front vertical rollers (6) are contacting the roller wear plates.

NOTE: While holding on to the tag lines, assistants shall walk with the tray to help maintain the position of the tray.

7. With the front vertical rollers (6) contacting the wear plates, lower the assist crane until the counterweight tray (3) is as horizontal as possible.

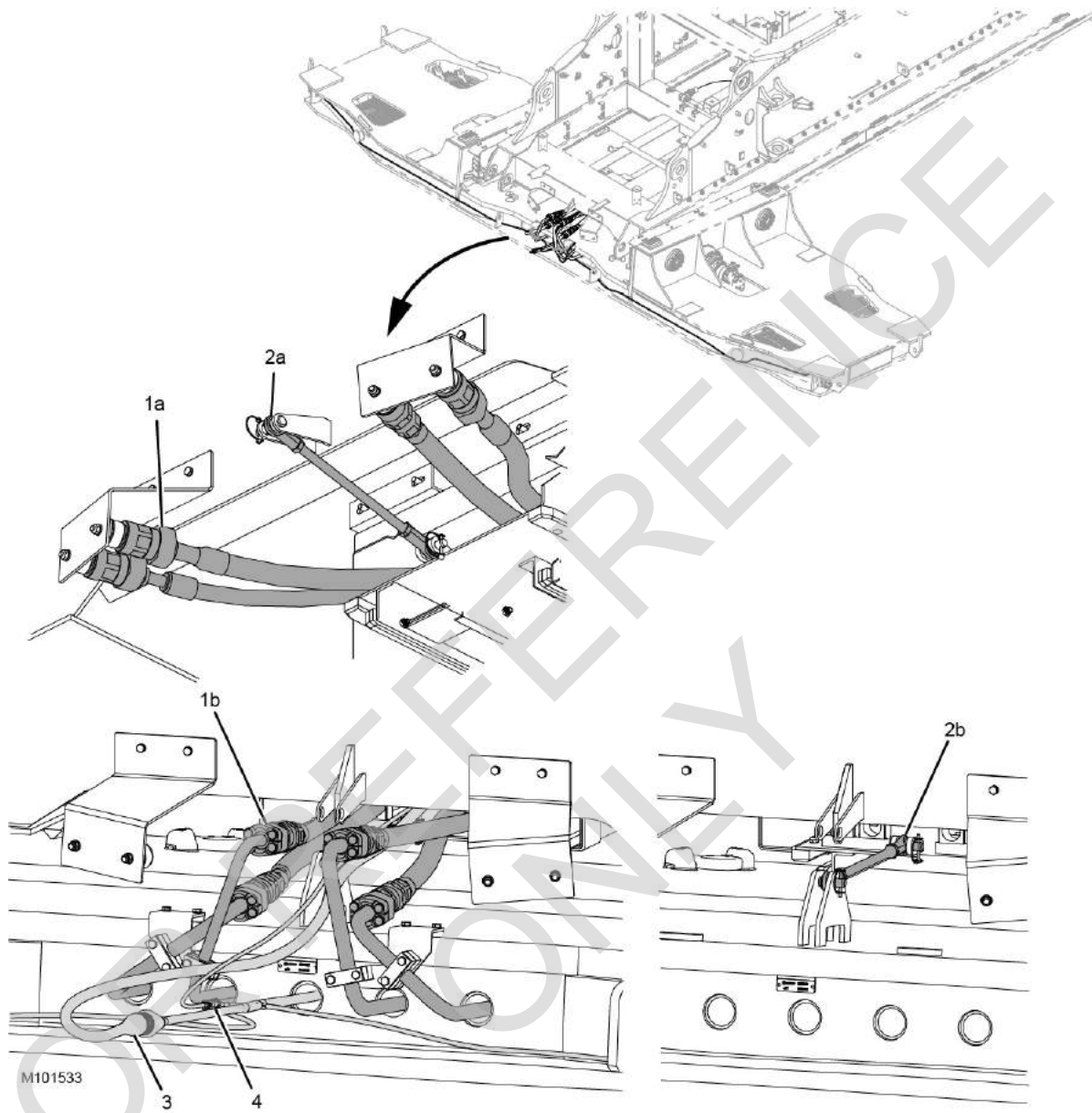
8. Slowly position the counterweight tray (3) using the assist crane toward the front of the crane and position the counterweight tray onto the rotating bed (5) to a point where the first set of front horizontal rollers (7) on the counterweight tray are contacting the sides (edge) of the rotating bed.

9. With the help of assistants, properly align the tray to the rotating bed.

Precise alignment is required to install the tray past the point where the side rollers first contact the rotating bed.

10. Using assistants, tag lines, and the assist crane, slowly draw the counterweight tray further onto the rotating bed until the rear (vertical) rollers are contacting the wear plates.

NOTE: During this process, the rear rollers should contact and roll over the small rear bolt-on stop blocks (9).



Item	Description
1a	Counterweight Tray Hydraulic Hoses (stored position)
1b	Counterweight Tray Hydraulic Hoses (working position)
2a	Connecting Link (stored position)
2b	Connecting Link (working position)
3	Rotating Bed Electrical Cable (WVB-1) connects to (WVT1-P1)
4	Rotating Bed Electrical Cable (WVB-2) connects to (WVT2-P1)

FIGURE 4-66

Install the Hydraulic Hoses

See [Figure 4-66](#) for the following procedure.

1. Activate the pinions using the remote control and confirm that the drive pinions rotate in the same and correct direction and then deactivate the pinions.

NOTE: Only one of the pinions may rotate, this is a normal condition. Confirm that at least one pinion rotates in the correct direction.

2. With the counterweight tray still attached to the assist crane, disconnect the four hydraulic hoses (1a) from the stored position and connect them to the working position (1b).

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

3. Connect the electrical connections (3 and 4) from the rotating bed to the counterweight tray.

Align the Counterweight Tray to the Pinions

See [Figure 4-67](#) for the following procedure.

1. Slowly pull the counterweight tray forward with assistants, taglines, and assist crane until the drive pinion teeth contact the first gear rack teeth.

With the tray still attached to the assist crane, relax the rigging just enough to be sure that the majority of the tray weight is supported by the rotating bed.

2. Using the remote control, activate the pinion drives (1) to slowly move the counterweight tray forward to be sure that the drive pinions are meshing properly with the rotating bed gear racks (2). Stop the counterweight tray movement when the connecting link aligns.
3. Move the connecting link from the stored position (2a, [Figure 4-66](#)) to the working position (2b, [Figure 4-66](#)) and install pins.

CAUTION

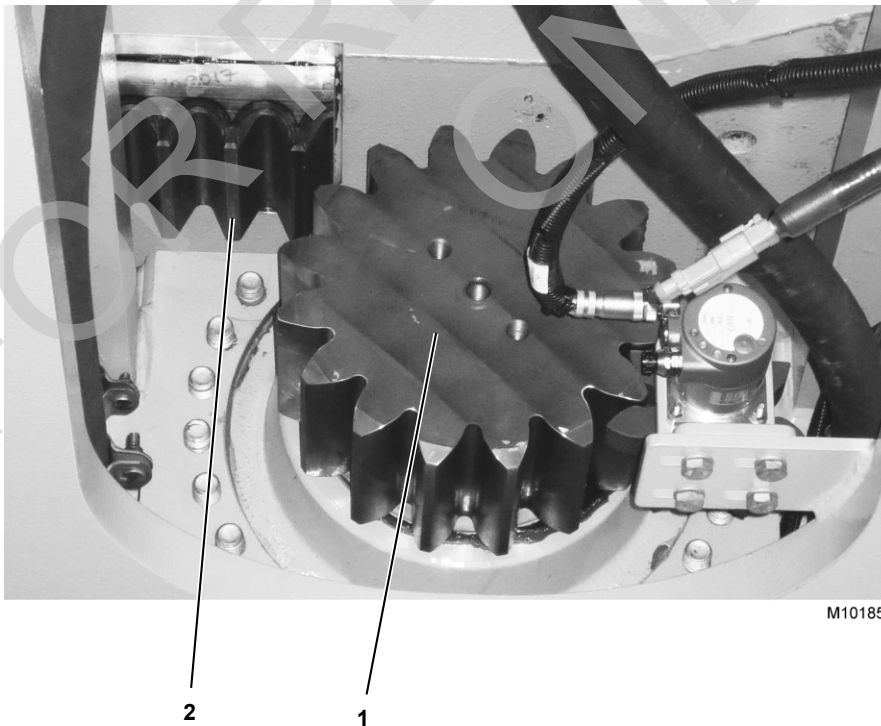
Parts Damage!

Connecting link must be installed before continuing or damage will occur.

4. Slowly drive the tray forward to a point where the large stop blocks (8, [Figure 4-65](#)) can be installed and install the blocks and pins.

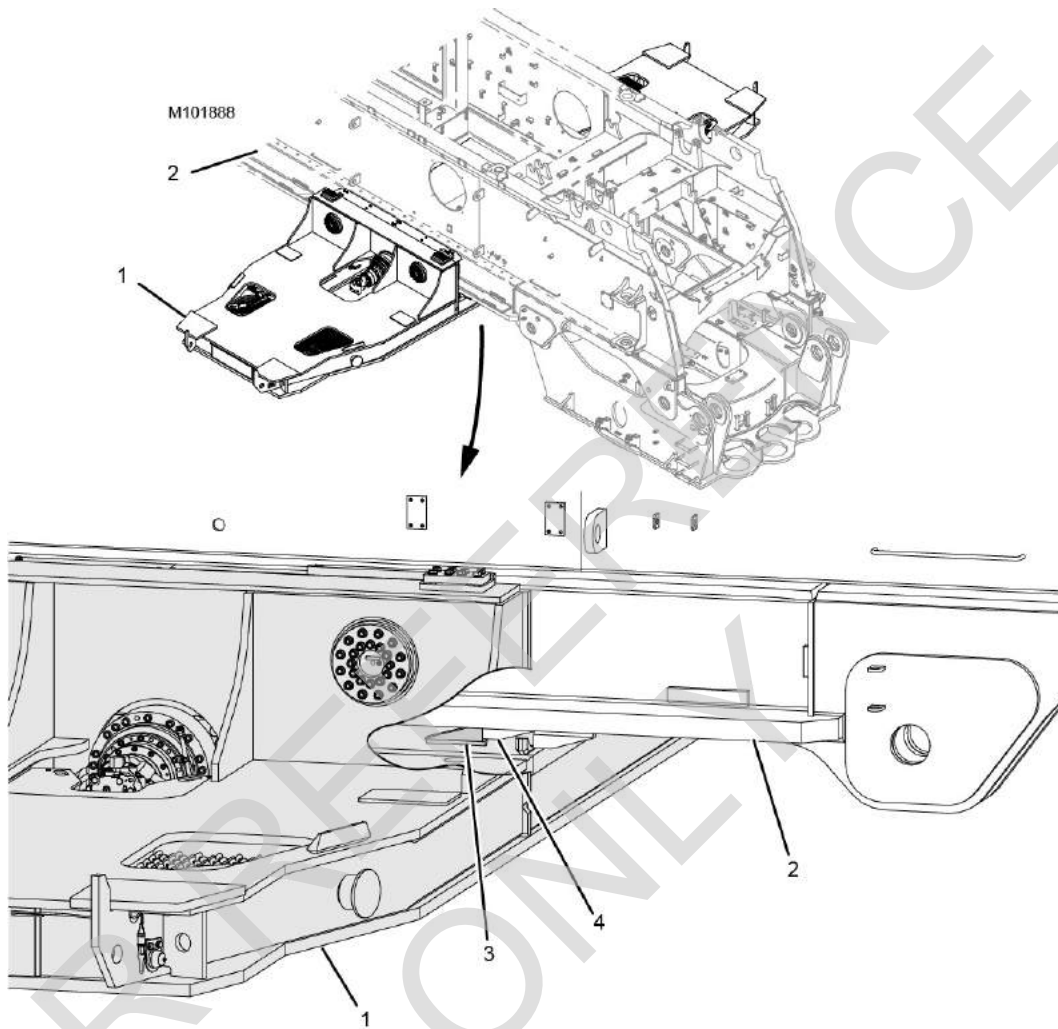
NOTE: Speed control is variable for the counterweight tray.

5. Disconnect the assist crane from the counterweight tray.
6. See the MLC650 Main Display Operation section of this manual for counterweight tray calibration instructions.



Item	Description
1	Drive Pinion
2	Gear Rack

FIGURE 4-67



Item	Description
1	Counterweight Tray
2	Rotating Bed
3	Physical Stop on Tray (1 each side)
4	Physical Stop on Bed (1 each side)

FIGURE 4-68

Remove Counterweight Boxes from Trailer

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



WARNING

Crush Hazard!

- Do not lift more than two boxes at a time. The lifting lugs may break resulting in the boxes falling.
1. Use lifting slings to remove the counterweight boxes from the trailers.
 2. Remove the tie downs and blocking securing the counterweight box to the trailer.
 3. Remove the counterweight box from the trailer.
 4. Remove the trailer.
 5. Place the counterweight in the assembly area for installation later.
 6. Disconnect the lifting slings from the counterweight box.
 7. Repeat the steps for all of the counterweight boxes.

Assemble Boom and Jib

The boom and jib can be assembled with the MLC650 mast and self-erect cylinder or with an assist crane. See ["Boom And Jib Rigging—General" on page 4-86](#) for instructions.

If the MLC650 will be used to assemble the boom and jib, install the counterweight boxes after the boom and jib are assembled. The MLC650 will be much easier to maneuver without the crane counterweight.

Install Counterweight Boxes

NOTE: The counterweight boxes must be removed from the trailers and installed using an assist crane.

See [Figure 4-68](#) for the following procedure.

Prior to stacking the counterweight boxes, position the counterweight tray (1) on the rotating bed (2) so that the

forward physical stop on the tray (3) contacts the forward physical stop on the rotating bed (4).



WARNING

Tipping Hazard!

Prior to stacking the counterweight boxes, position the counterweight tray all the way forward.

The counterweight tray weighs 20 000 kg (44,000 lb)

Each counterweight box weighs 10 000 kg (22,000 lb)

NOTE: Reference the Counterweight Tray Assembly Drawing at the end of this section and the Counterweight Arrangement Chart in the Capacity Chart Manual supplied with the crane for the allowable counterweight stacking arrangements.



WARNING

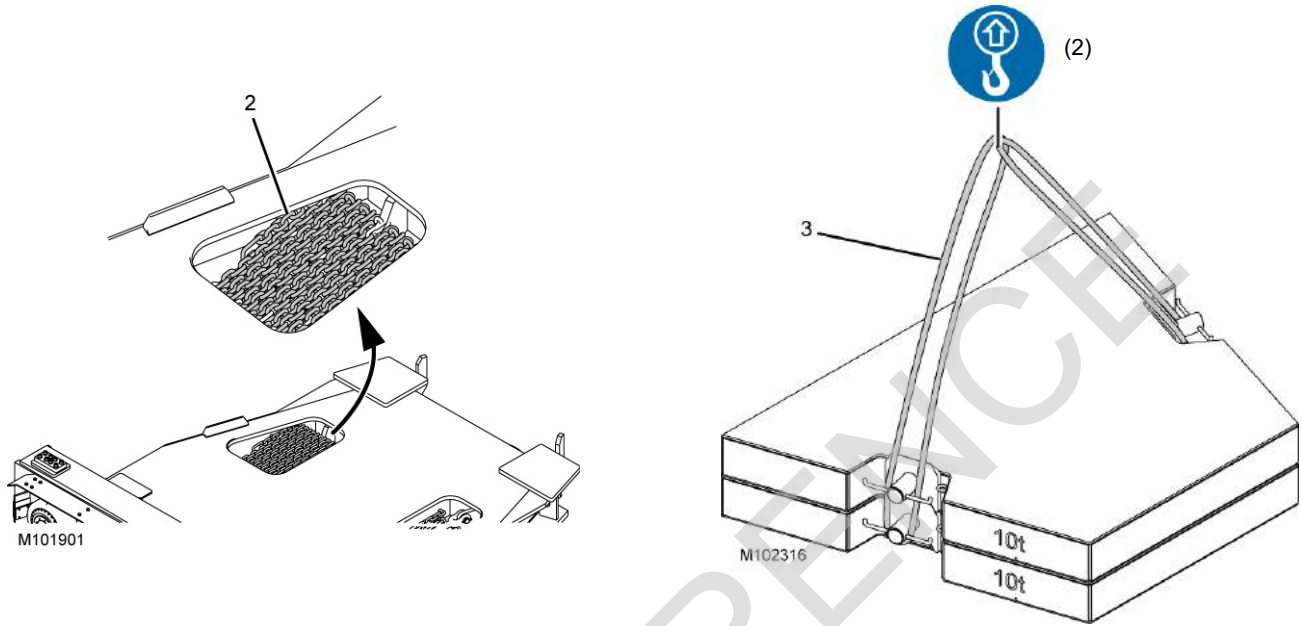
Crush Hazard!

To prevent the crane from tipping and the a counterweight boxes from falling off the tray during assembly/disassembly:

- Do not install (or remove) the counterweight boxes until the counterweight tray is traveled fully forward against the physical stops on the rotating bed. 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.
- Stack the counterweight boxes as follows: install one box on one side of the tray and then two boxes should be placed on the other side. Then alternate from side to side with two boxes; finally install one box to level the sides.



Item	Description
1	Tray at the minimum working position
2	Counterweight Chain Assembly
3	2-SL 4 Slings - 3,80 m (12.50 ft) - 11 340 kg (25,000 lb)
4	Counterweight Box Alignment Lug
5	Counterweight Tray Alignment Lug
6	Counterweight Tray Lug
7	Turnbuckle

FIGURE 4-69

See [Figure 4-69](#) for the following procedure.

1. Remove the counterweight chain assemblies (2) from the stored position in the counterweight tray.
2. Attach the lifting slings (3) around the lugs on one counterweight box.
3. Using an assist crane, lift the counterweight box. Boom, swing, and hoist as necessary to position the box on the desired side of the counterweight tray.
4. Lower the box so that the counterweight box alignment lugs (4) engage with the counterweight tray alignment lugs (5).

Each additional box must have the alignment lugs engage with the alignment lugs on the box below.

5. Remove the lifting slings.

6. Attach the lifting slings around the lifting lugs on two counterweight boxes.
7. Boom, swing, and hoist as necessary to position the box on the opposite side of the counterweight tray.
8. Lower the boxes so that the alignment lug in the lower box engages with alignment lug in the counterweight tray.
Each additional box must have the alignment lugs engage with the alignment lugs on the box below.
9. Remove the lifting slings.
10. Continue to install two counterweight boxes, alternating from side to side until the required number of boxes are installed.
11. Install the counterweight chain assemblies (2) threading the chain through each counterweight lifting lug and

around the counterweight tray lug (6). The counterweight chain assemblies (2) are designed to minimize counterweight movement during travel and operation permitted by Manitowoc's operating instructions.

12. Connect the counterweight chain assemblies to the turnbuckle hooks (7).

13. 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.

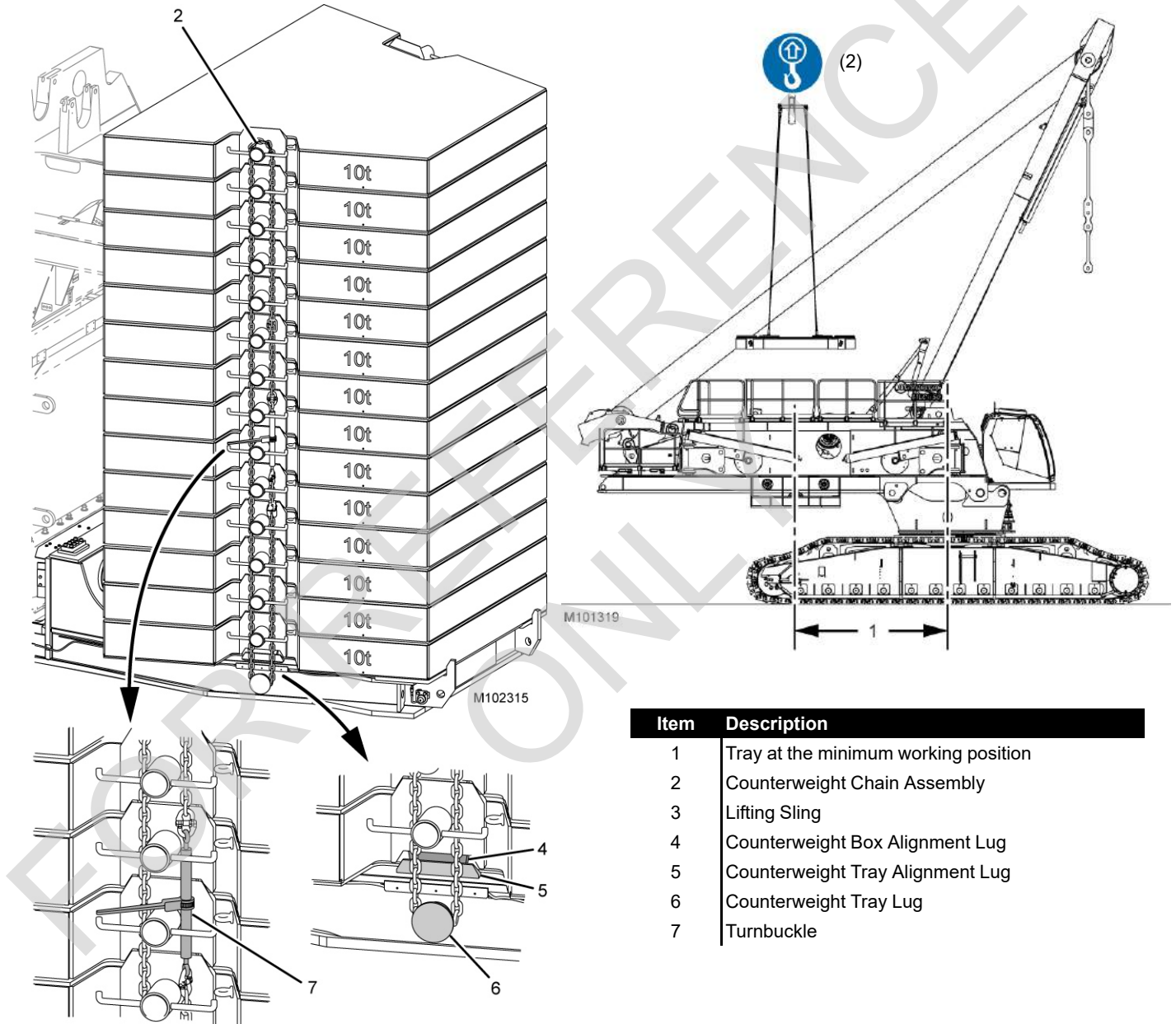


FIGURE 4-69 continued

Item	Description
------	-------------

- | | |
|----|---|
| 1 | Upper Boom Point |
| 2 | Lower Point Sheaves |
| 3 | Boom Top Assembly |
| 4 | Weight Ball |
| 5 | Block |
| 6 | Luffing Jib Wire Rope Guides |
| 7 | Insert w/Sheaves |
| 8 | Drum 2 Main Hoist (optional) |
| 9 | Drum 6 Luffing Hoist (optional) |
| 10 | Butt Assembly |
| 11 | Drum 0 Rigging Winch |
| 12 | Operator Cab |
| 13 | Swing Drives |
| 14 | Crawlers |
| 15 | Upperworks |
| 16 | Lowerworks |
| 17 | Adapter Frame |
| 18 | Rotating Bed Jacking Cylinders (optional) |
| 19 | Rotating Bed |
| 20 | Counterweight Tray |
| 21 | Counterweight Rail |
| 22 | Gantry |
| 23 | Boom Hoist Wire Rope |
| 24 | Live Mast |
| 25 | Self-Erect Cylinder |
| 26 | Counterweight Boxes |
| 27 | Drum Boom/Mast Hoist |
| 28 | Drum 3 Whip Hoist |
| 29 | Boom Stops |
| 30 | Drum 1 Main Hoist |
| 31 | Lifting Lug Wire Rope Guide |
| 32 | Wire Rope |
| 33 | Boom Straps |
| 34 | Luffing Jib Cable Guide |
| 35 | Wire Rope Guide |

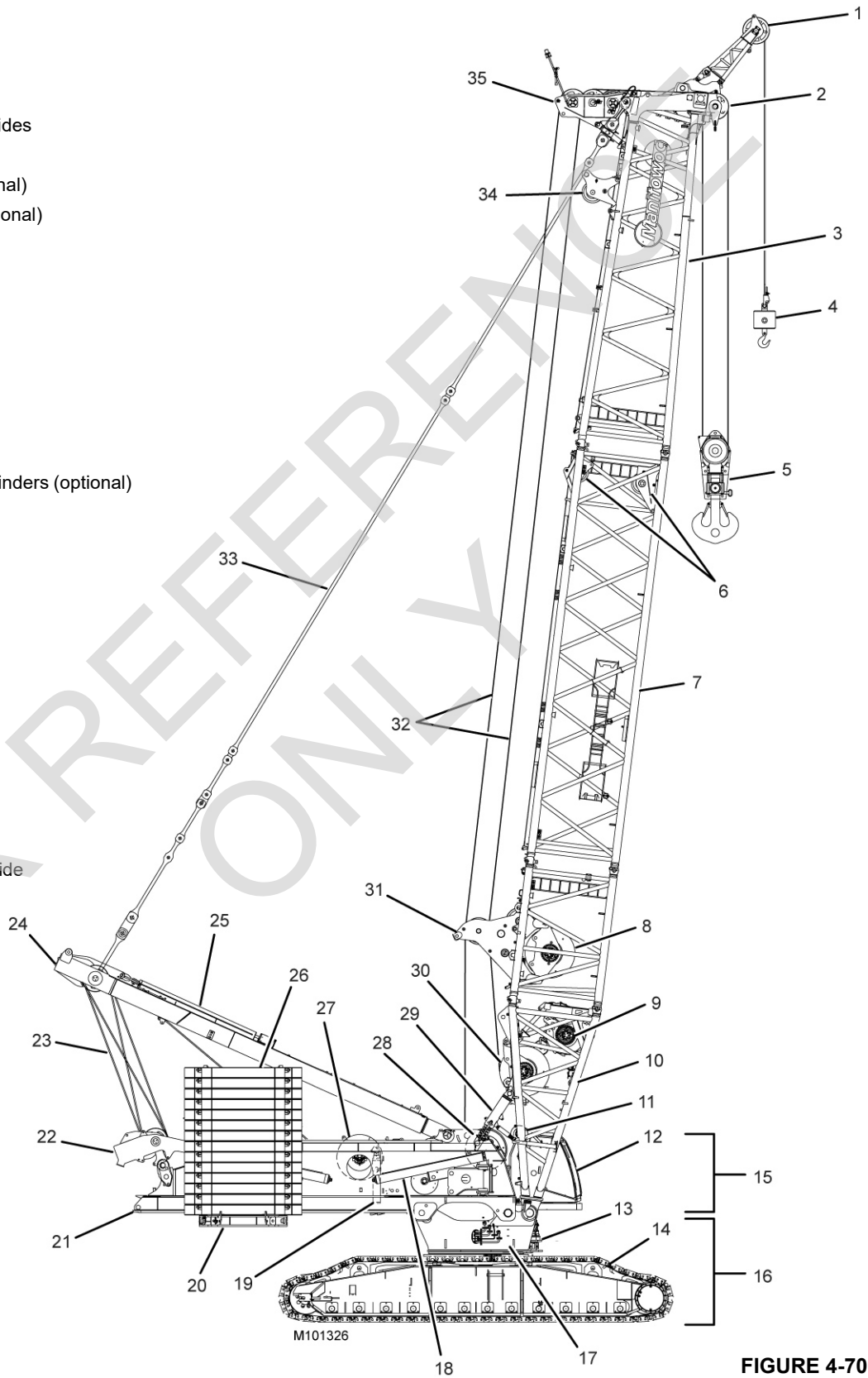
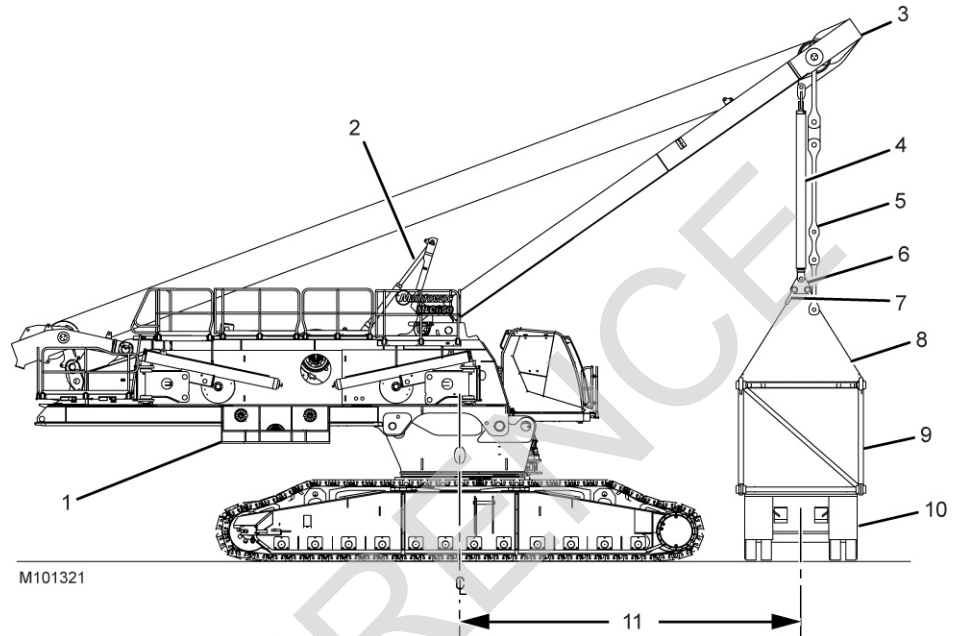


FIGURE 4-70

THIS PAGE INTENTIONALLY LEFT BLANK

FOR REFERENCE ONLY



M101321

Item	Description
1	Counterweight Tray Installed or Removed
2	Mast-Assist Arms
3	Mast in Operating Range
4	Self-Erect Cylinder
5	Live Mast Straps
6	Rod End
7	2-SH 1 Shackle - 55 t (60.60 USt)
8	4-SL 4 Slings - 3,80 m (12.50 ft) - 11 340 kg (25,000 lb)
9	Insert
10	Trailer
11	See Liftcrane Mast Handling Chart

FIGURE 4-71

BOOM AND JIB RIGGING—GENERAL

Assist Crane Requirements

The MLC650 can be used to handle, assemble, and disassemble the boom and jib components. See the Crane Weights in Section 1 of this manual for the weights of the boom and jib components.



DANGER

Falling Load Hazard!

Prevent structural failure of components:

- Do not exceed the lifting capacities given in the Liftcrane Mast Capacities Chart at the end of this section.

The MLC650 must be in the following configuration ([Figure 4-71](#)).

- Counterweight Tray and counterweight boxes NOT INSTALLED.
- Mast-assist arms (2) fully raised.
- Shackles (7) and lifting slings (8) attached to the self-erect cylinder rod end (6). Reference charts found in [Figure 4-7 on page 4-6](#).
- Liftcrane Mast Handling Capacities Chart (9) selected in configuration screen of the RCL/RCI display.
- Mast (3) operated between the fully extended mast-assist arms and the maximum allowable radius.
- Radius and capacity limited to that given in the Liftcrane Mast Handling Capacities Chart at the end of this section.

Blocked Crawlers

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

! DANGER
Tipping Hazard!

Do not attempt to raise or lower the boom or the boom and jib from or to the ground until the crawlers are blocked, if required. Otherwise, the crane will tip.

Boom Handling with Mast

Boom handling with the mast must be limited to the boom length given in the boom rigging Drawing at the end of this section.

! WARNING
Falling Boom Hazard!

Do not attempt to handle more boom with the mast than specified in the boom rigging Drawing. Structural failure of components can occur, allowing the boom to fall.

Assembly Drawings

Boom and jib components (top, inserts, butt, and straps) must be assembled in the proper sequence according to the applicable Boom and Jib Assembly Drawings at the end of this section.

Identifying Boom and Jib Components

The boom and jib sections are marked for proper identification as shown in View A, [Figure 4-72](#). An identification plate is located near the top end of all four chords.

The boom inserts also have two chord identification plates as shown in View B, [Figure 4-72](#). The plate is located on top end of the right-top chord and the butt end of the left-top chord.

The jib pendants are marked for proper identification as shown in View C, [Figure 4-72](#).

The boom straps and links are marked for proper identification as shown in View D, [Figure 4-72](#).

Item	Description
1	Boom or Jib Chord
2	Boom or Jib Number (680, 681, 682, or 685)
3	Manitowoc Part Number
4	Manitowoc Manufacturing Code
5	Chord Identification: H = Heavy XH = Extra Heavy M = Medium
6	Pendant
7	Diameter
8	Length
9	Manitowoc Purchase Order Number
10	Wire Rope Type
11	Set Number
12	Manufacturer's Number
13	Aluminum Tag (if equipped)
14	Boom or Jib Strap

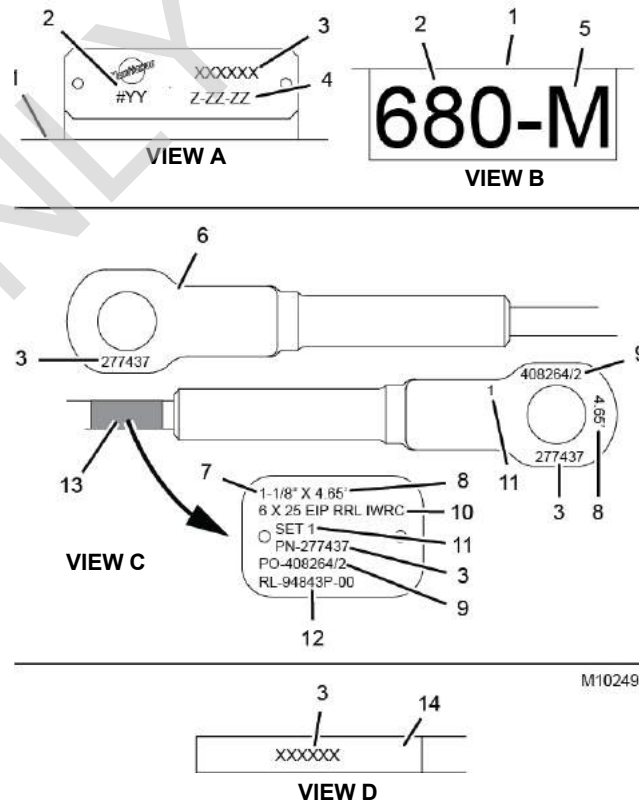
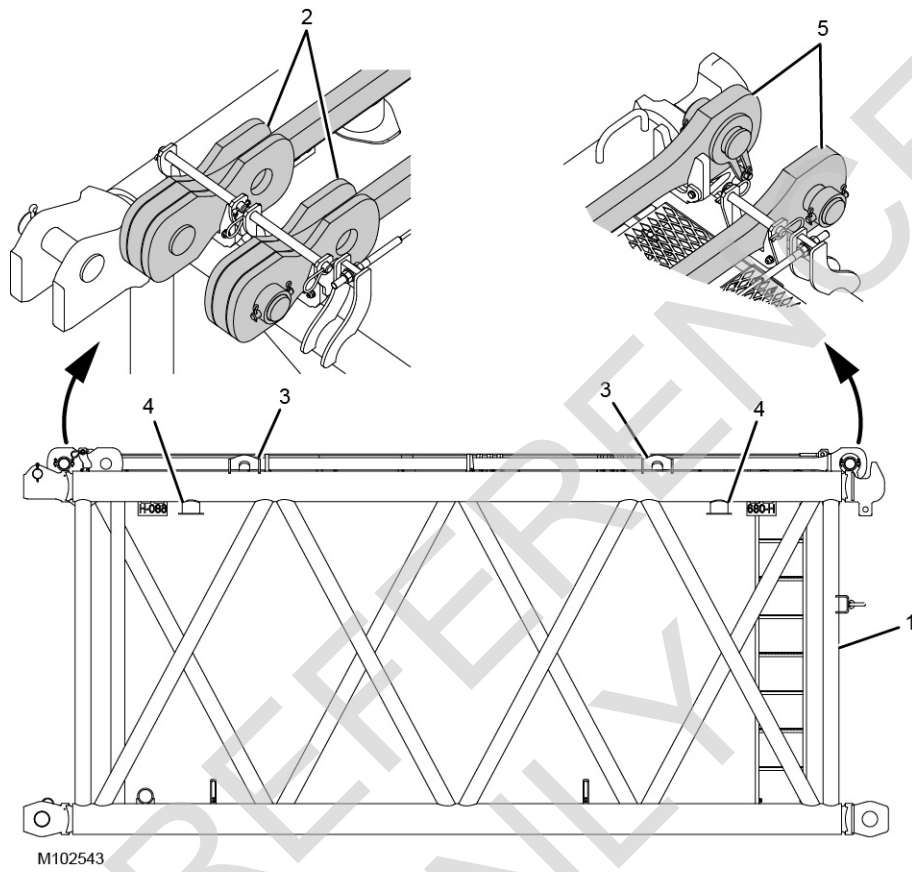


FIGURE 4-72



Item	Description
1	Boom Section (typical)
2	Boom links (stored)
3	Lifting Lug (4) (if equipped, for shackles of lifting sling hooks)
4	Lifting Lug (4) (synthetic lifting sling posts)
5	Boom Straps and Luffing Jib Backstay (stored)

FIGURE 4-73

Handling Boom and Jib Sections

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

All boom and jib sections have lifting lugs as shown in [Figure 4-73](#).



WARNING

Falling Load Hazard!

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

CAUTION

Lacing Damage

Ensure the boom straps and links ([Figure 4-73](#)) and the jib pendants are secured in the shipping position on the boom or jib inserts and top during handling and transportation unloading.

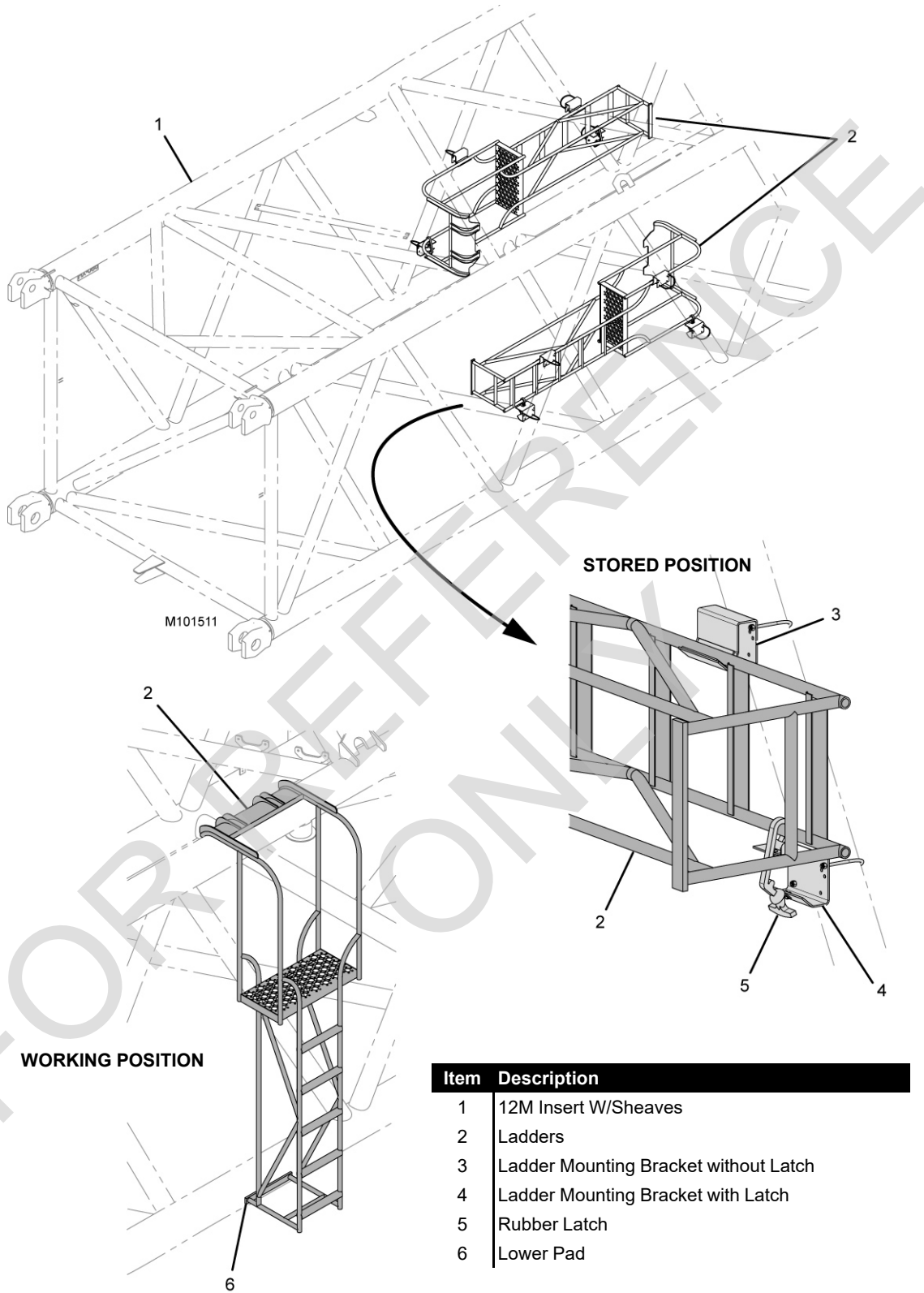


WARNING

Personal Injury or Property Damage!

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

NOTE: To lift inserts, use shackles and lifting slings attached to the self-erect cylinder rod end. Reference charts found in [Figure 4-7 on page 4-6](#).



Item	Description
1	12M Insert W/Sheaves
2	Ladders
3	Ladder Mounting Bracket without Latch
4	Ladder Mounting Bracket with Latch
5	Rubber Latch
6	Lower Pad

FIGURE 4-74

BOOM LADDERS



WARNING

To Prevent Serious Injury or Death:

- Limit load on ladder to 136 kg (300 lb).
- Avoid improper use. Ladder is intended for use only on Manitowoc #680 boom inserts. Any other use is prohibited.
- Use ladder for boom rigging/disassembly and maintenance only when boom is horizontal.
- Make sure ladder is properly secured to insert.
- Keep hands free of any objects while climbing ladder. Objects which cannot be carried in pockets or tool belts must be lifted into place onto ladder platform prior to climbing ladder.
- Stand only on platform. Do not stand on cross braces.

General

On past production cranes, two ladders (2) are stored inside the 12 m (40 ft) with sheaves insert (1) as shown in [Figure 4-74](#). The ladders are designed for use in assembly/disassembly and maintenance of #680 boom sections and components. Each ladder weighs approximately 15 kg (32 lb).

Removing Ladders from Insert

It is recommended that two people remove either ladder from the boom insert: one person inside the insert to unlatch and lift the ladder and another person outside the insert to help guide the ladder out of the insert.

See [Figure 4-74](#) for the following procedure.

1. Lower boom onto blocking at ground level. Boom sections must be horizontal.
2. Unhook rubber latches (5).
3. Lift ladder (2) up and out of ladder mounting brackets (3).
4. Guide ladder through lacings to outside of insert.

Installing Ladders on Boom Inserts

Lift ladder (2) to desired outside location on insert so ladder is securely hooked over backside of upper chord and lower pad (6) is firm against lower chord (see working position).

Ladder must hang vertically against boom insert when in use.

Storing Ladders in Insert

It is recommended that two people store either ladder in the insert: one person outside the insert to help guide the ladder into the insert and another person inside the insert to lift the ladder and latch it into position.



WARNING

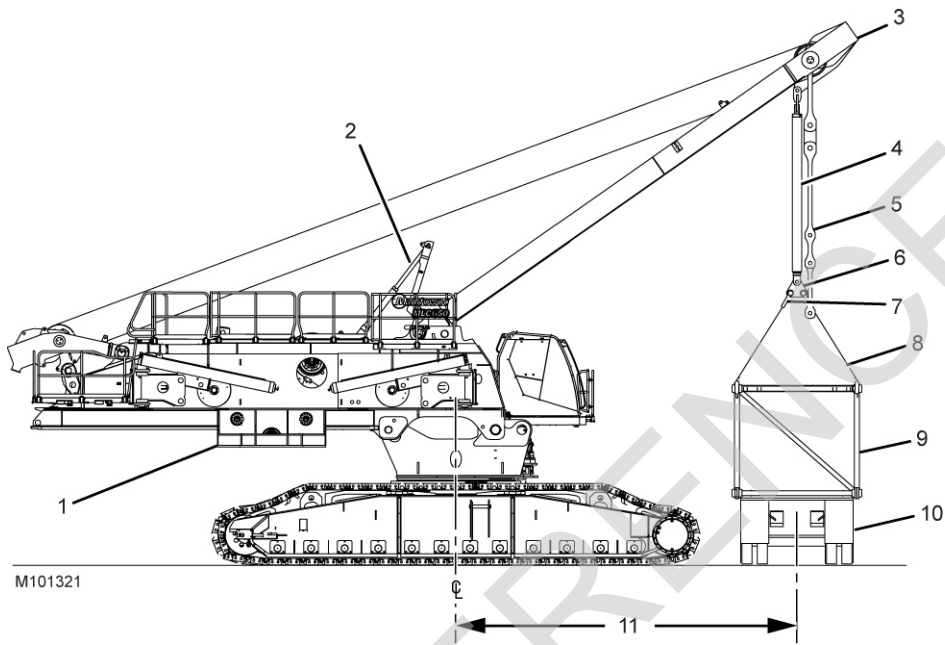
Falling Load Hazard!

Ladders must be properly stored to prevent them from falling out of insert when boom is raised.

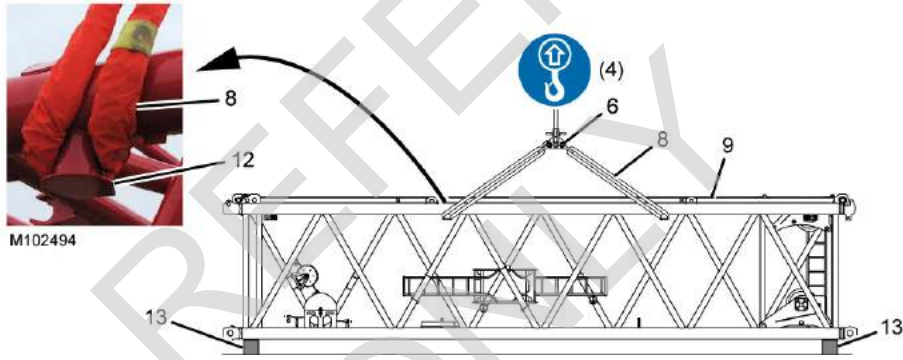
See [Figure 4-74](#) for the following procedure.

1. Hang ladder rails over ladder mounting brackets (3 and 4) inside insert.

Pull rubber latches (5) tightly over lower rails and latch in keepers on ladder mounting brackets.



M101321



M102494

Item	Description
1	Counterweight Tray Installed or Removed
2	Mast-Assist Arms
3	Mast in Operating Range
4	Self-Erect Cylinder
5	Live Mast Straps
6	Rod End
7	2-SH 1 Shackle - 55 t (60.60 USt)
8	4-SL 4 Slings - 3,80 m (12.50 ft) - 11 340 kg (25,000 lb)
9	Insert
10	Trailer
11	See Liftcrane Mast Handling Chart
12	Lifting Lug
13	Blocking (approximately 510 mm (20 in))

FIGURE 4-75

BOOM ASSEMBLY



WARNING

Crush Hazard!

For an unassisted raising, some boom lengths and boom + jib lengths require the crawlers to be blocked. Refer to the Liftcrane Boom Capacities charts for configurations that require crawler blocking.

Falling Load Hazard!

The luffing jib backstay straps can be stored on the boom sections for shipping.

Refer to the Capacity Chart for operating restrictions if the luffing jib backstay straps, links, and retaining hardware will be left on the boom sections during operation without a luffing jib.

Fall Hazard!

The boom sections are equipped with catwalks and ladders for accessing boom components during crane assembly and disassembly. Take every precaution to prevent falling off boom sections: use personal fall protection. See "[Personal Fall-Protection](#)" on [page 4-3](#).

The MLC650 has several boom options. All boom options are assembled in the same manner, as instructed in this section.

Assemble the desired boom in the exact sequence shown in the appropriate Boom Rigging Drawing at the end of this section.

If equipped with an Extended Upper Boom Point, supplemental assembly/disassembly instructions are

provided in a separate publication at the end of this section or at the end of Section 4 in the MLC650 VPC-MAX Operator Manual.

NOTE: To lift inserts, use shackles and lifting slings attached to the self-erect cylinder rod end. Reference charts found in [Figure 4-7 on page 4-6](#).

Assemble Boom Inserts and Top

See [Figure 4-75](#) for the following.

1. Rig the lifting slings (8) to the rod end (6) of the self-erect cylinder (4) using shackles (7). This rigging will be used for all inserts and the boom top.

2. Remove the insert (9) from the trailer(10):

- a. Position the trailer with the insert on the desired side of the crane at the specified radius.

NOTE: The first insert must be the 12 m (39.4 ft) insert with sheaves.

- b. Attach the lifting slings to the lifting lugs (12) on the insert.

- c. Lift the insert off of the trailer.

- d. Remove the trailer.

3. Place the insert on blocking (13) approximately 381 mm (15 in) high. This height will allow for installation of the boom top.

4. Adjust the blocking as needed so that the insert is level.

5. Disconnect the lifting slings.

6. Repeat [step 2](#) for the next insert (10).

Continued on [page 95](#).

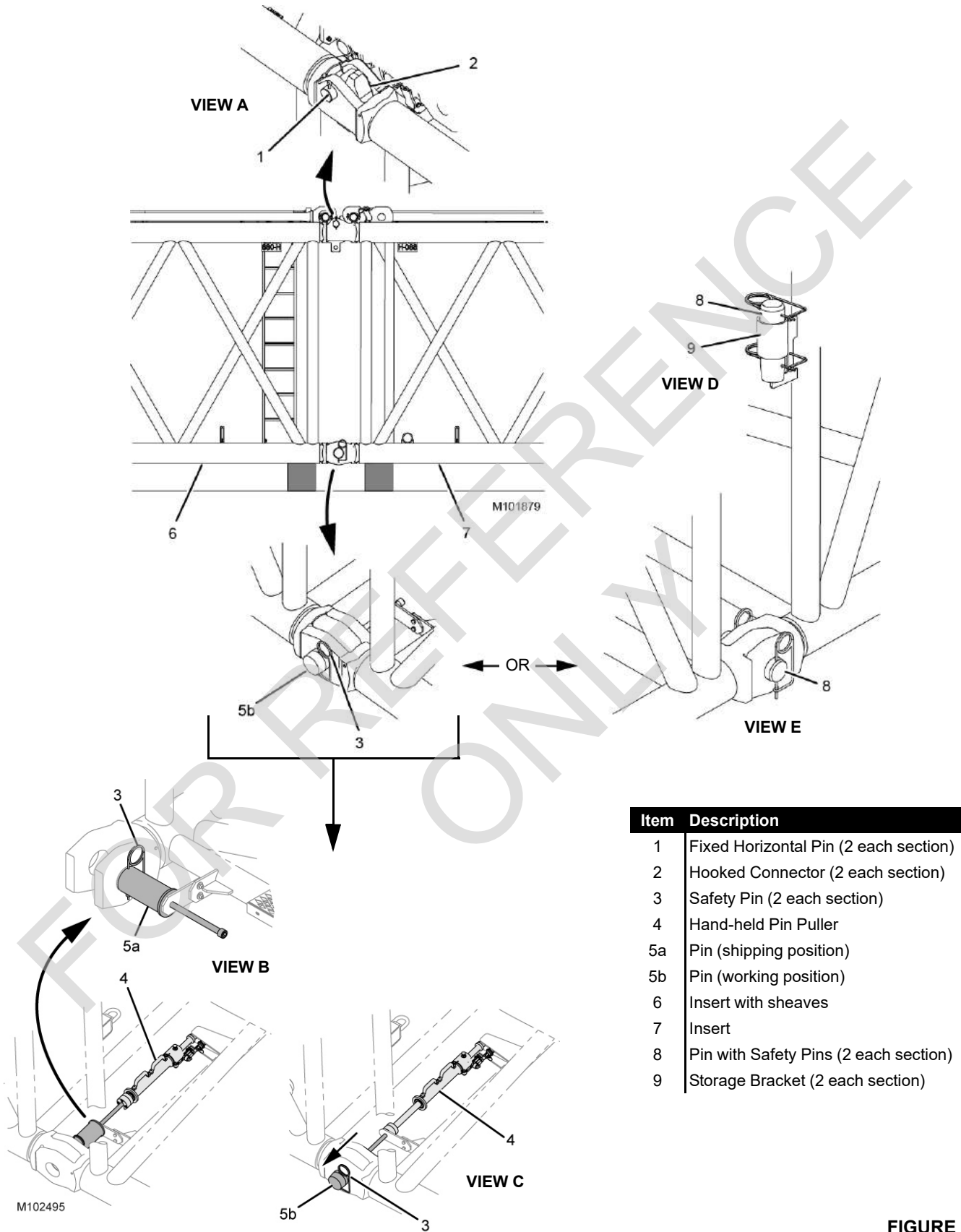


FIGURE 4-76

See [Figure 4-76](#), for the following steps.

7. Lift the next insert into position and engage the fixed horizontal pins (1, View A) with the hooked connectors (2) on the adjacent insert.
8. Lower the insert (7) until the bottom connector holes are aligned.
9. If equipped with hydraulically connected bottom pins:
 - a. Remove the safety pins (3, View B) from the shipping position in pins (5a).
 - b. Install the pins using the hand-held pin puller (4, View C). See ["Connect Hand-Held Pin Puller" on page 4-37](#).
 - c. Install the safety pins (3, View C), and remove the hand-held pin puller (4).
10. If equipped with manually connected bottom pins:
 - a. Remove the pins (8, View D) from the storage brackets (9) on the adjacent section.
 - b. Install the pins (8, View E) in the connecting holes between the sections.
11. Block under the top end of the insert. The blocking can be moved from the end of one insert to the end of the next insert.

If noted in the Boom Rigging Drawing, block under the boom sections at the specified locations to prevent damage caused by excessive sag in long boom combinations.

12. Disconnect the lifting slings.
13. If necessary per the Boom Rigging Drawing being used, perform the following steps as the boom inserts are assembled:
 - ["Deploy Luffing Jib Wire Rope Guide" on page 4-95](#)
 - ["Install Intermediate Wire Rope Guide" on page 4-97](#)
 - ["Install Drop-Down Suspension" on page 4-99](#)
 - Install Intermediate Suspension Insert at proper location (see ["Prepare Intermediate Suspension Pendants" on page 4-133](#))

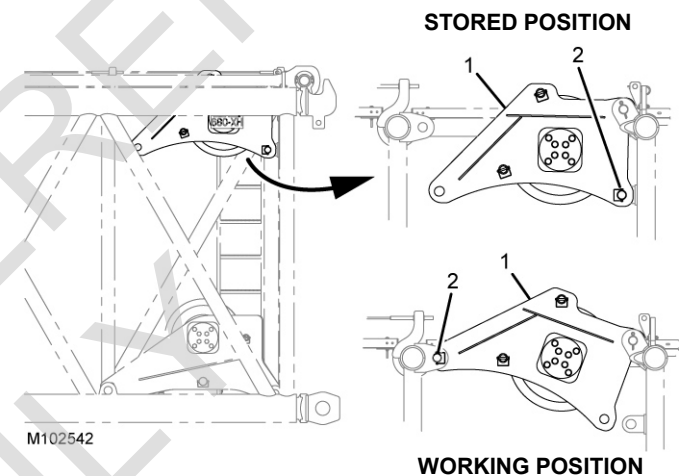
14. Repeat the above steps until all inserts are installed in the PROPER SEQUENCE.

Deploy Luffing Jib Wire Rope Guide

See [Figure 4-77](#) for the following.

If the crane will be rigged with a luffing jib, raise the luffing hoist wire rope guide as follows:

1. Attach a lifting sling to the wire rope guide (1).
2. Remove the safety pin and pin (2).
3. Raise the rope guide to the working position and install the pin (2) and safety pin.
4. Disconnect the lifting sling.



Item	Description
1	Wire Rope Guide
2	Pin and Safety Pin

FIGURE 4-77

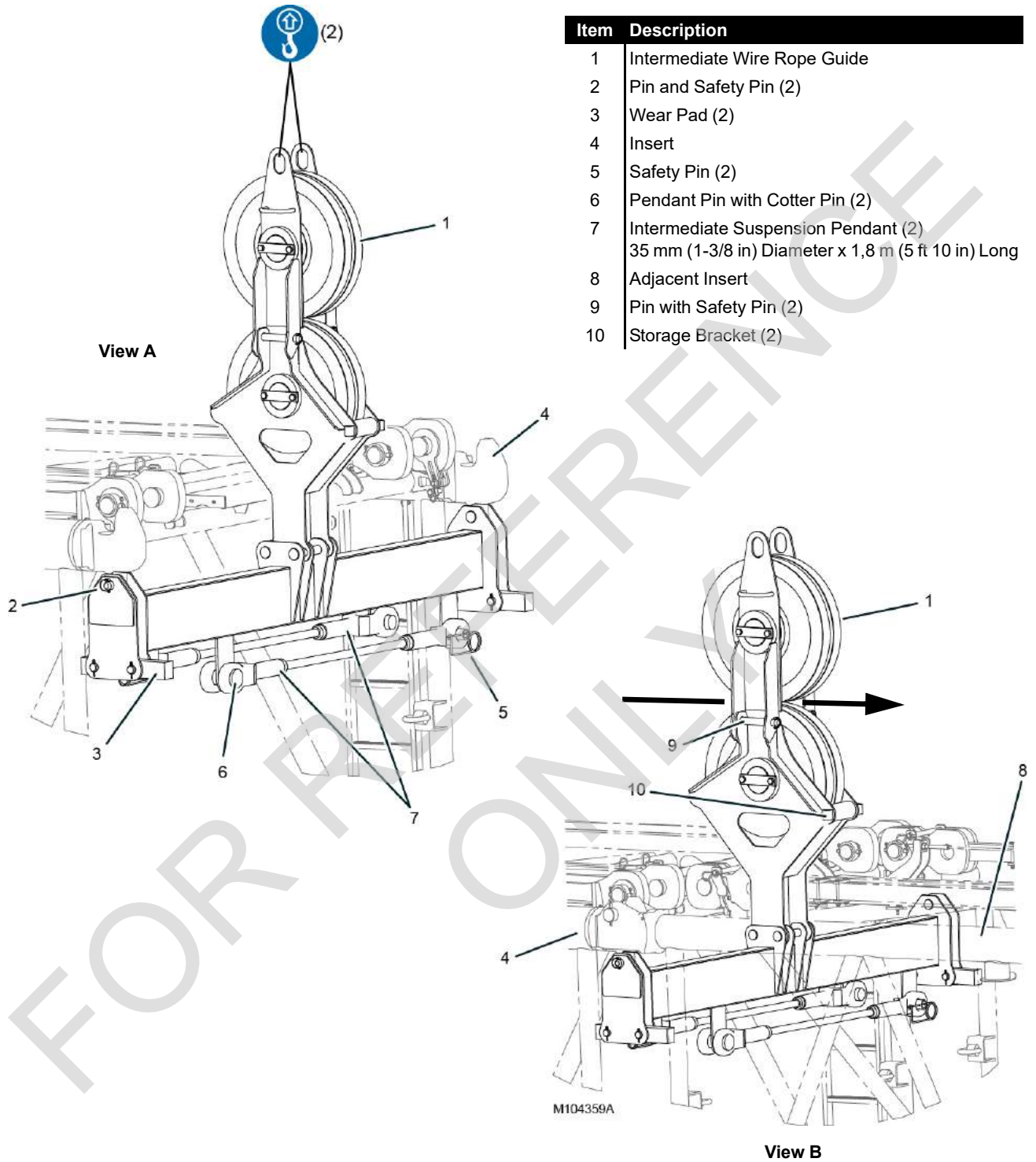


FIGURE 4-78

Install Intermediate Wire Rope Guide

If the intermediate wire rope guide is required per the Boom Rigging Drawing in use, install the wire rope guide as follows:

See [Figure 4-78](#), View A, for the following procedure.

1. Determine the insert (4) to which the intermediate wire rope guide (1) must be attached (see Boom Rigging Drawing).
2. Attach lifting slings from the assist crane to the lifting holes in the intermediate wire rope guide (1).
3. Lift the intermediate wire rope guide (1) into position at the end of the insert (4).
4. Make sure the long leg of the wear pads (3) is facing away from the insert.
5. Remove the pins (2).
6. Using the pins (2), pin the intermediate wire rope guide (1) to the lugs on the male connectors of the insert (4).
7. Disconnect the lifting slings.
8. If the intermediate suspension pendants (7) are required per the Boom Rigging Drawing in use (see **B**, [Figure 4-105 on page 4-133](#)), remove the pendants and place them to the side for use later.
9. Proceed to install the remaining boom inserts (8, View B).
10. The load lines must be routed through the sheaves as shown in View B:
 - a. Attach lifting slings from the assist crane to the lifting holes in the intermediate wire rope guide (1, View A).
 - b. Tighten the lifting slings and remove either pin (9, View B). Store the pin in the storage bracket (10).
 - c. Lower the upper sheave assembly in the required direction.
 - d. Pass the load lines over the top of the lower sheaves.
Refer to the rope routing diagrams in the Extended Upper Boom Point publication at the end of this section or at the end of Section 4 in the MLC650 VPC-MAX Operator Manual.
 - e. Raise the upper sheave assembly and install the pin (9, View B).

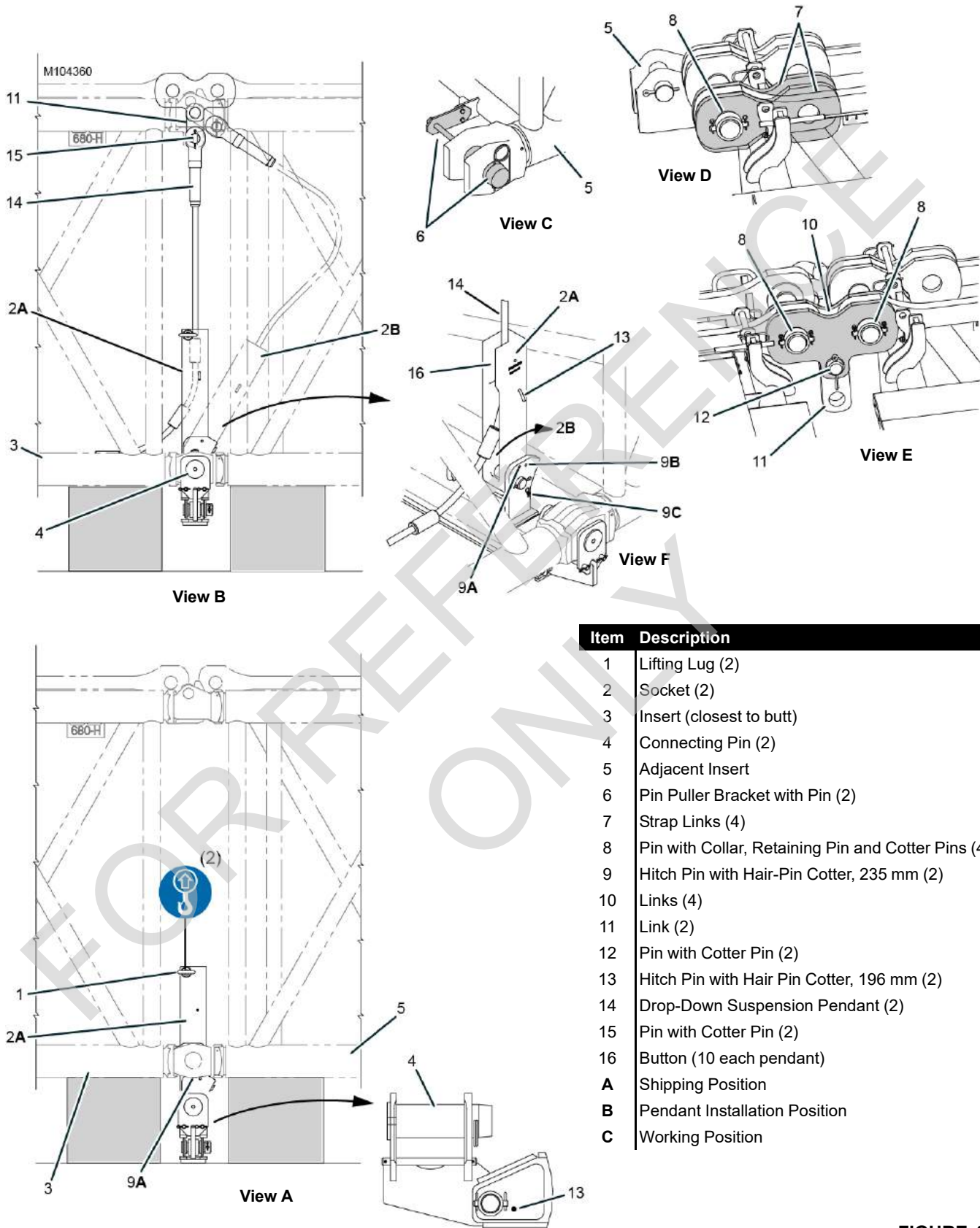


FIGURE 4-79

Install Drop-Down Suspension

If the drop-down suspension is required per the Boom Rigging Drawing in use, install it as follows:

- Refer to Boom Make-Up Table (see **A**, [Figure 4-80](#)) in the appropriate Boom Rigging Drawing at the end of this section to determine the following:
 - Whether or not the drop-down suspension is required and its location
 - Pendant button number that must be pinned to the sockets

The Boom Make-Up Table will vary from one Boom Rigging Drawing to another.

SUSPENSION			
INSERT SUSPENSION	INSERT SUSPENSION	INSERT SUSPENSION	INSERT SUSPENSION
SEE	SEE	SEE	SEE
SOLE	SOLE	SOLE	SOLE
SOLE	SOLE	SOLE	SOLE
7	2	-	-
9	-	-	-
7	2	-	-
7	3	-	-
9	-	-	-
4	2	-	-
4	-	-	B
4	-	-	H
4	-	-	B
4	-	-	B
4	-	-	B
4	-	-	B
9	-	-	B
4	-	-	10

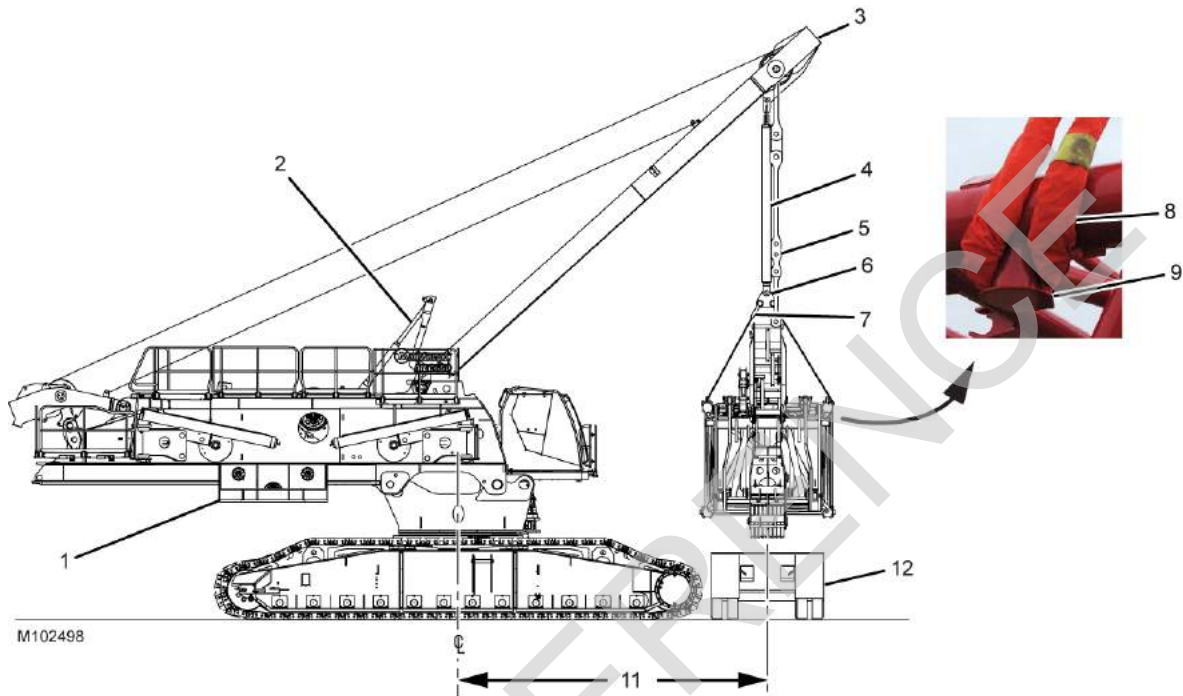
Example of Boom Make-Up Table in Boom Rigging Drawing

FIGURE 4-80

See [Figure 4-79](#) for the remaining steps.

- Make sure the drop-down suspension assembly is in the shipping position:
 - The sockets (2, View A) pinned in the shipping position (**A**) (vertical) with the hitch pins (9)
 - The hitch pins (13, View A) installed in the drop-down suspension beam
- Attach lifting slings from the assist crane to the lifting lugs (1, View A) on the button sockets (2).
The drop-down suspension assembly weighs 1 000 kg (2,205 lb).
- Lift the drop-down suspension assembly into position at the end of the proper insert (3, View A) so the connecting pins (4) are in line with the bottom connectors on the insert.
- Disconnect the lifting slings.
- Prepare the adjacent insert (5) as follows:
 - Remove both pin puller brackets and pins (6, View C) and store them in the parts box.

- Remove the strap links (7, View D) from both sides of the insert and store them in the parts box. Place the pins with collars (8) to the side for use later.
- Attach the adjacent insert (5, View A) to the insert (3).
 - Block the adjacent insert (5, View A) so the bottom connecting pin holes are aligned.
 - Remove the bottom connecting pins (4, View A).
 - Reattach lifting slings from the assist crane to the lifting lugs (1, View A) on the button sockets (2) and lift the drop-down suspension assembly into position so all of the connecting holes are aligned (View B).
 - Install the connecting pins (4, View B) so the pin heads face out and install the safety pins.
 - Remove the socket locking hitch pins (9, View F) from holes (**A**) and lower the sockets (2, View B) to the pendant installation position (**B**).
 - Install the socket locking hitch pins (9, View F) in holes (**B**).
 - Disconnect the lifting slings.
 - Install the drop-down suspension links (10, View E) with the pins (8). The pin heads must face out.
 - Attach the links (11, View E) to the links (10) with the pins (12). The pin heads must face out.
 - Lay the drop-down suspension pendants (14, View B) inside the insert (3) so the open socket ends are toward the boom top.
 - Pin the drop-down suspension pendants (14, View B) to the links (11) with the pendant pins (15).
 - Perform the remaining steps as the boom is raised:
 - As the boom straps rise during the boom raising procedure ([page 4-134](#)), guide the drop-down pendants through the opening between the boom inserts. **Take care not to damage lacings.**
 - Signal the crane operator to stop the boom raising procedure when the required pendant buttons (16) are near the sockets (2, View B).
 - Remove the socket locking hitch pins (13, View A) from the drop-down suspension beam.
 - Position the required pendant button into each socket (2, View F) and install the button retaining hitch pin (13).
 - Remove the socket locking hitch pins (9, View F) from the pendant installation position (**B**) and store the pins in the working position (**C**) to allow the sockets to pivot as the boom straps rise.
 - Continue with the boom raising procedure.



Item	Description
1	Counterweight Tray Installed or Removed
2	Mast-Assist Arms
3	Mast in Operating Range
4	Self-Erect Cylinder
5	Live Mast Straps
6	Rod End
7	2-SH 1 Shackles - 55 t (60.60 USt)
8	4-SL 4 Slings - 3,80 m (12.50 ft) - 11 340 kg (25,000 lb)
9	Lifting Lug
10	Boom Top
11	See Liftcrane Mast Handling Chart
12	Trailer
13	Fixed Horizontal Pin
14	Hooked Connector
15	Pin (2)
16	Safety Pin (2 or 4)

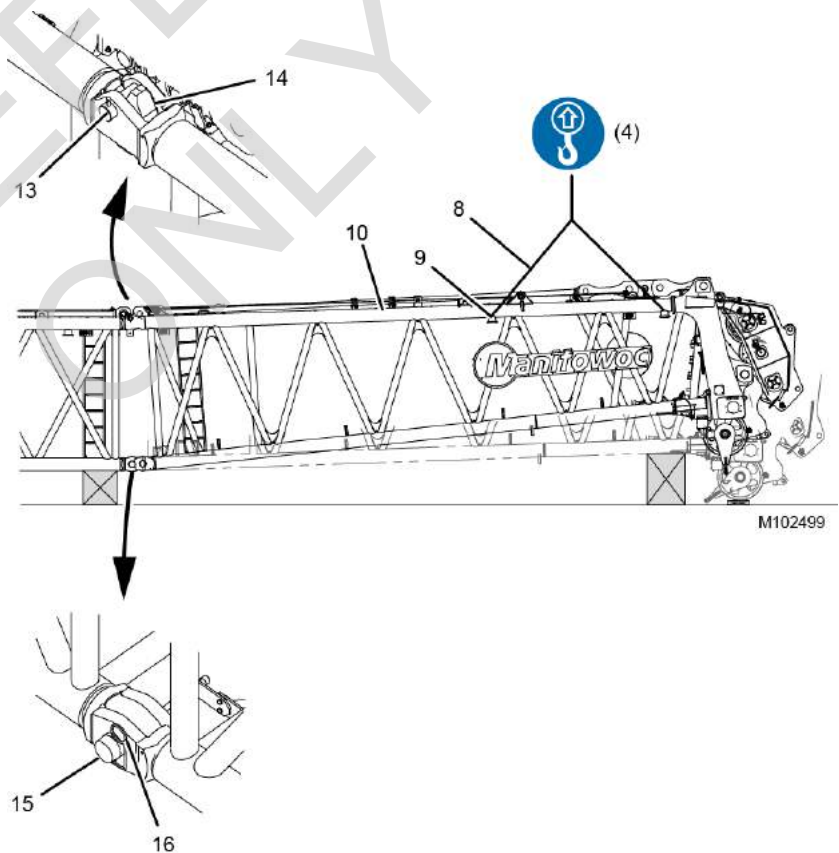


FIGURE 4-81

Assemble Top to Boom Inserts

The boom top can be shipped in either of the configurations shown in [Figure 4-82](#):

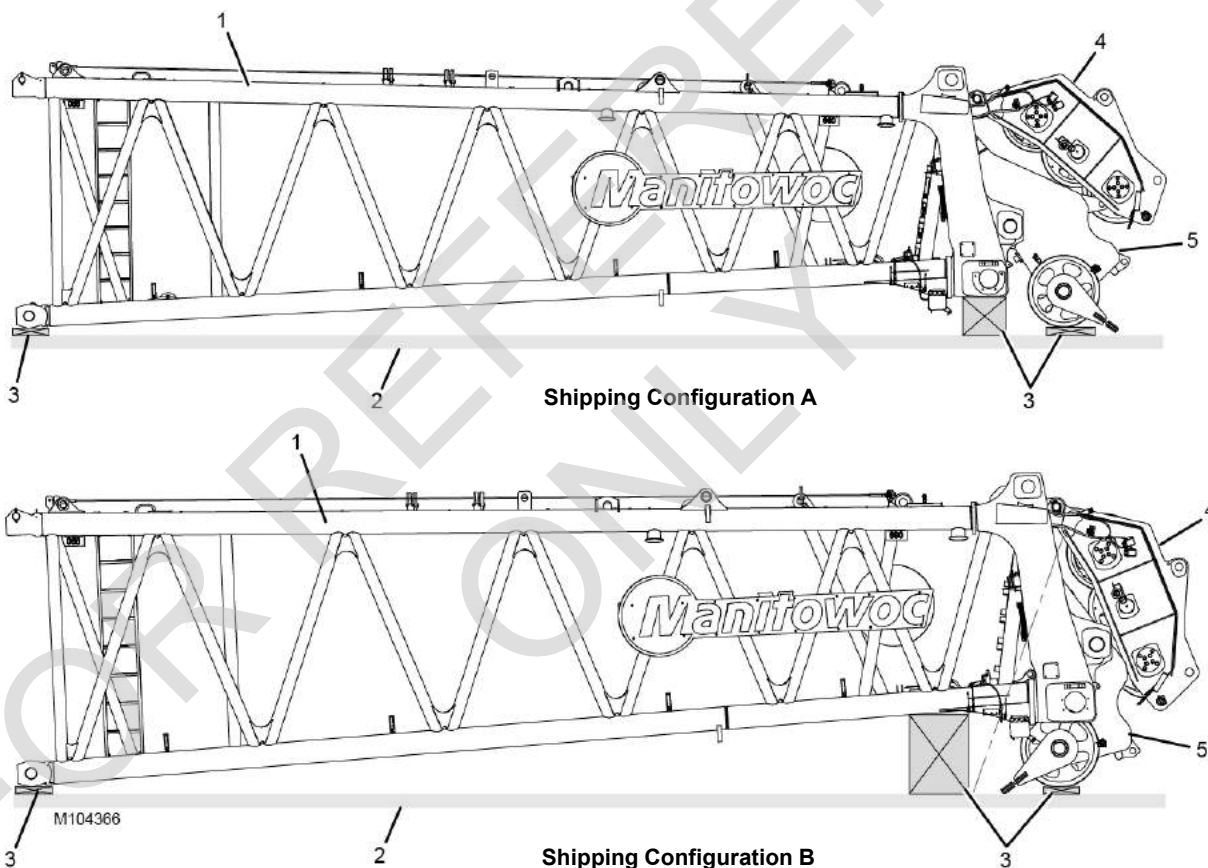
- Configuration A: the lower boom points are unpinned from the working position in the boom top. This configuration provides the lowest shipping height.
- Configuration B: the lower boom points are pinned to the working position in the boom top. This configuration can be used if there are no shipping height restrictions.

See [Figure 4-81](#), for the following steps.

1. Lift the boom top (10) off the trailer in the same manner the inserts were removed from the trailers.

If the boom top is in Shipping Configuration A, the lower boom points (and wire rope guide) will rotate down to the working position against the boom top bearing plates as the boom top is lifted.

2. Lift the boom top into position and engage the fixed horizontal pins (13) with the hooked connectors (14) on the insert.
3. Lower the boom top until the bottom connector holes are aligned.
4. Install the bottom pins (15) in the same manner the inserts were connected. See [step 9](#) or [step 10](#) on [page 95](#).
5. Block under the boom top as needed.
6. Disconnect the lifting slings.



Item	Description
1	Boom Top
2	Trailer
3	Blocking
4	Wire Rope Guide
5	Lower Boom Points (1, 2, or 3)

FIGURE 4-82

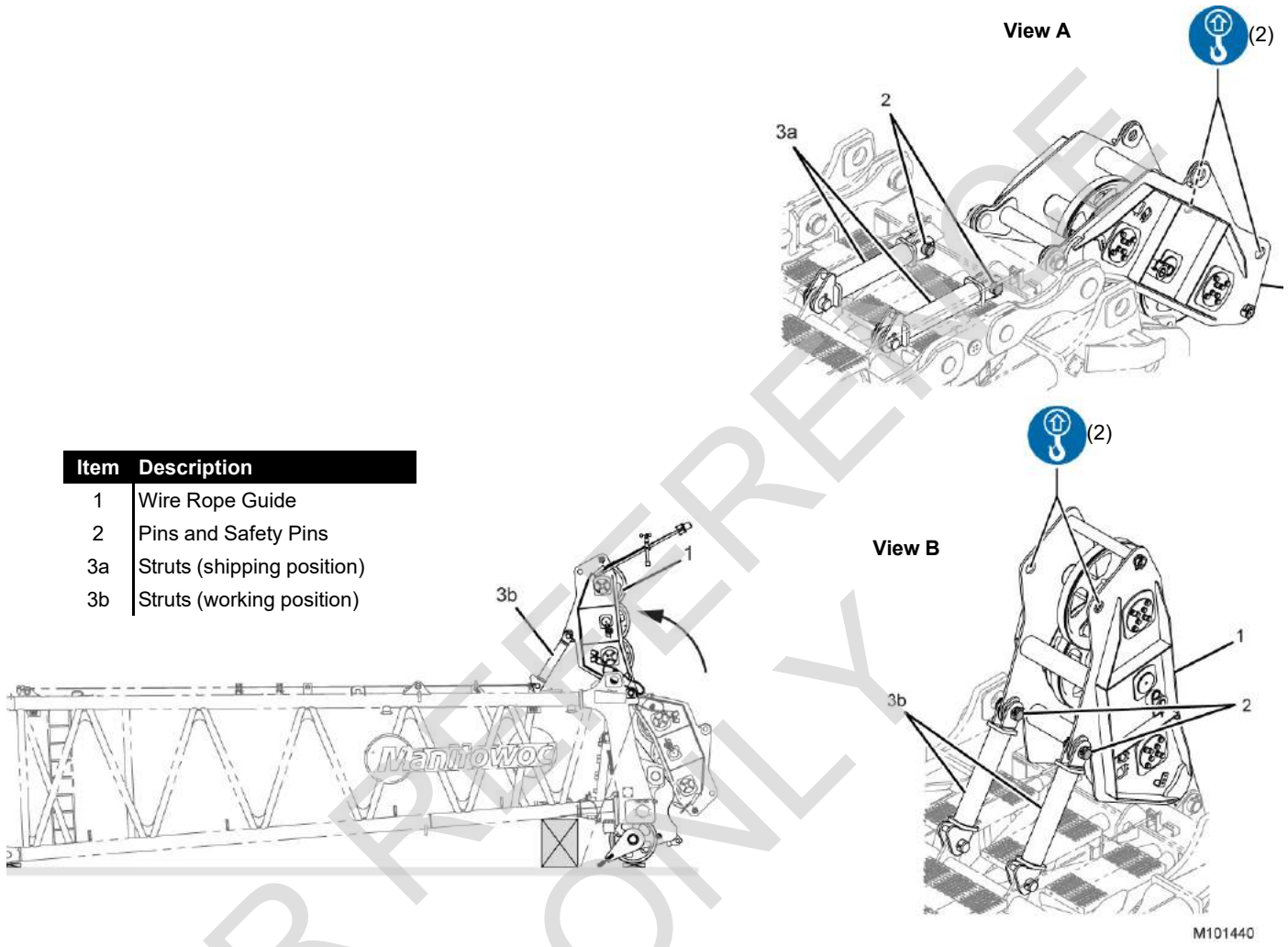


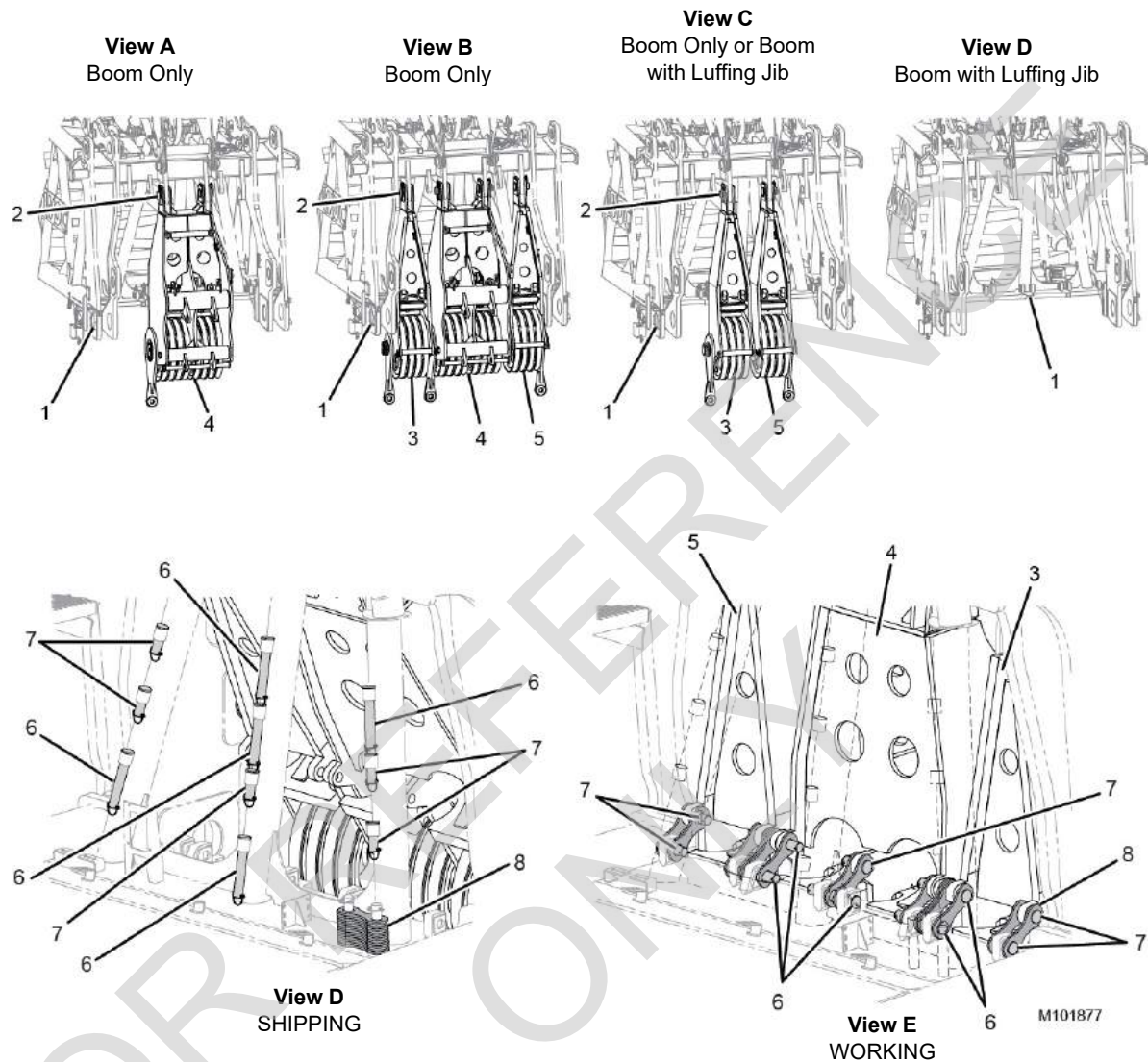
FIGURE 4-83

Raise Boom Top Wire Rope Guide

See [Figure 4-84](#), for the following procedure.

1. Rig two slings using shackles through the wire rope guide lifting holes (View A), and raise the wire rope guide. The assembly weighs approximately 1079 kg (2379 lb).
2. Unpin the struts (3a, View A) from the shipping position.
3. Raise the wire rope guide (1, View B) to the working position.
4. Raise the struts (3b, View B) and pin them to the wire rope guide.
5. Disconnect the lifting slings.

FOR REFERENCE ONLY



Item	Description
1	Boom Top
2	Connecting Pin with Safety Pin (2-4)
3	Lower Boom Point (4 sheave right side)
4	Lower Boom Point (8 sheave center)
5	Lower Boom Point (4 sheave left side)
6	Long Pin (5)
7	Short Pin (5)
8	Links (14)
9	Lifting Lug (2)
10	Lifting Link (2)

FIGURE 4-84

! WARNING

Crane Tipping Hazard!

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

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

Install/Remove Lower Boom Point

See [Figure 4-84](#) for the following procedures.

Install Lower Boom Point

Disregard this procedure if the lower boom points are already attached to the boom top in the working position.

1. Remove the connecting pins (2, View F or G) from the desired lower boom point.
2. Using shackles, rig two lifting slings from an assist crane to the lifting lugs (9, View F) or to the lifting links (10, View G) on the lower boom point.
3. Lift the lower boom point into position at the end of the boom top and install the connecting pins (2, View A, B, or C) with safety pins.
4. Lower the lower boom point until the lifting slings are slack and disconnect the shackles and lifting slings.
5. Remove the pins (6 and 7, View D) and the links (8) from the shipping position.

6. Install the links (slotted ends toward boom top) between the lower boom points and the boom top using the appropriate long and short pins as shown in View E. Secure the pins and links with safety pins.

! WARNING

Crush Hazard!

The lower boom point can shift and crush your hand when removing the connecting pins.

- Properly support the lower boom point as instructed in the following procedure before removing the connecting pins.

Removing Lower Boom Point

1. Remove the required pins (6 and 7, View E) and links (8) from the working position.
2. Store the pins and links in the shipping position (View D).
3. Using shackles, rig two lifting slings from an assist crane to the lifting lugs (9, View F) or to the lifting links (10, View G) on the lower boom point being removed.
4. Lift the lower boom point until the lifting slings are in a visual straight line drawn through the lower boom point's center of gravity (CG). **Do not remove the connecting pins (2) until this step is performed.**
5. Remove the connecting pins (2, View A, B, or C) and lift the lower boom point away from the boom top.
6. Store the connecting pins (2) in the lower boom point holes.

Lower Boom Point Centers of Gravity

Item	mm	in
A	1 466,0	57.7
B	125,0	4.9
C	475,2	18.7
D	1 521,2	59.9
E	23,0	0.9
F	420,0	16.5

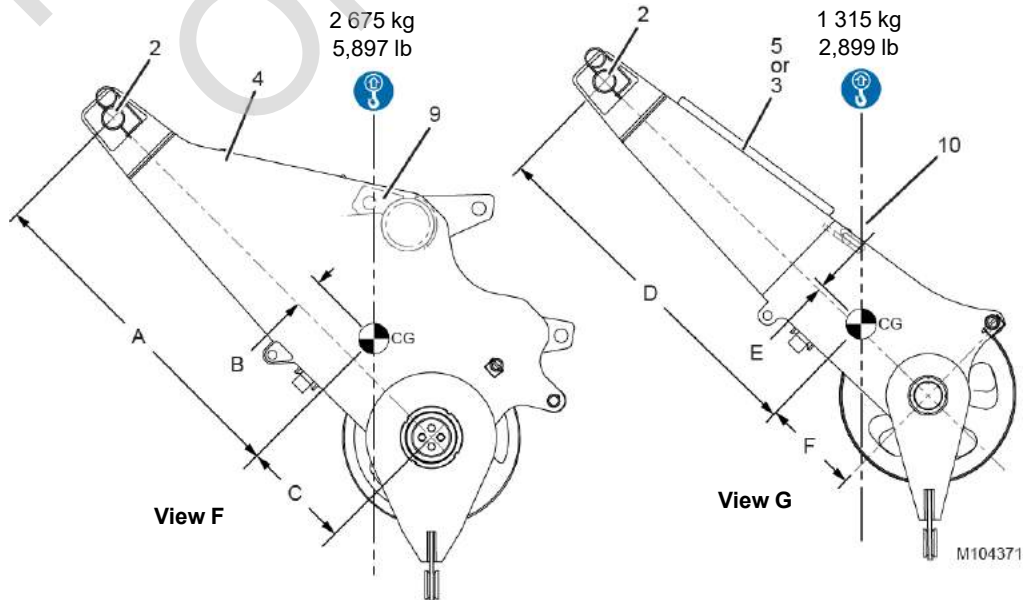
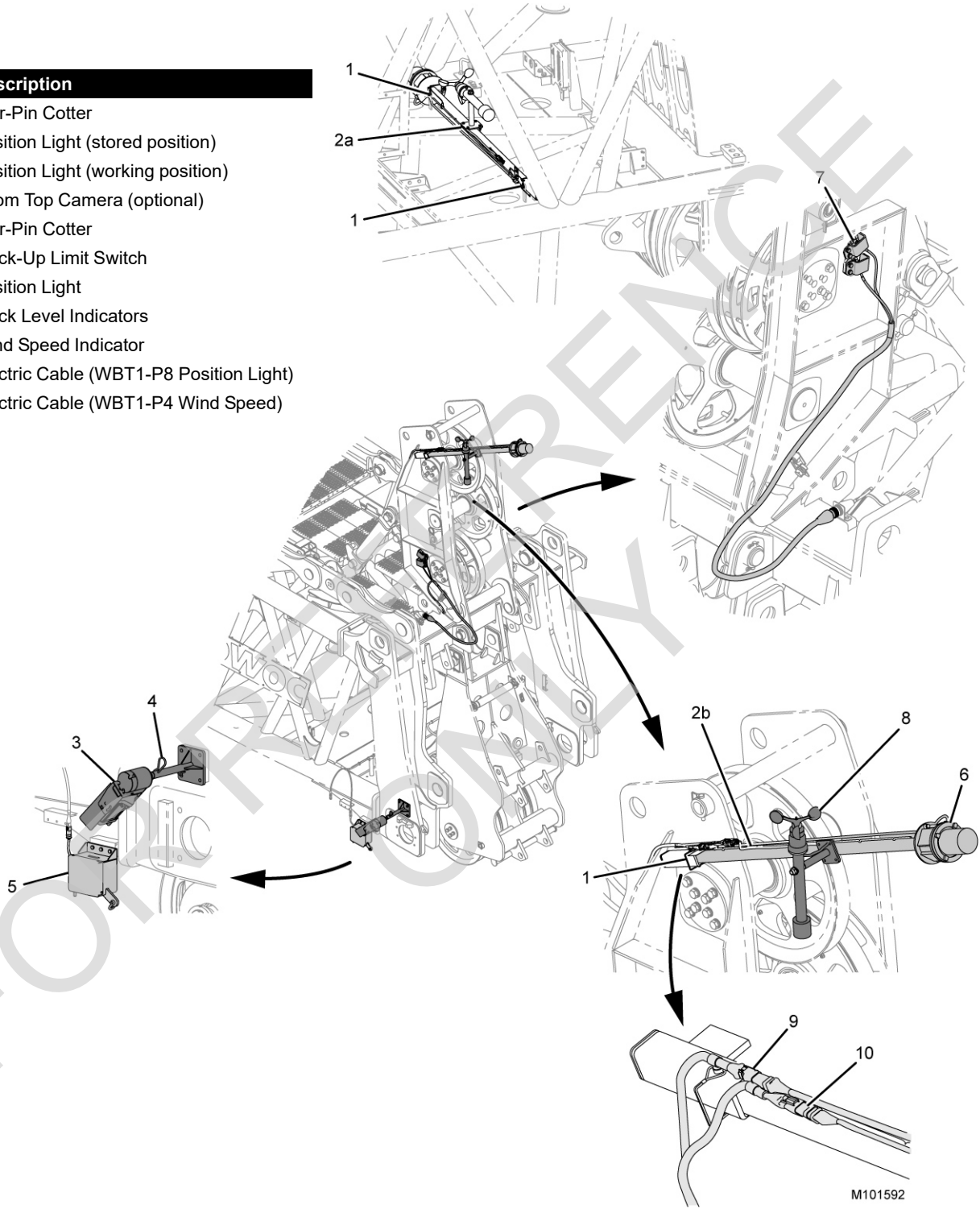


FIGURE 4-84 continued

Item	Description
1	Hair-Pin Cotter
2a	Position Light (stored position)
2b	Position Light (working position)
3	Boom Top Camera (optional)
4	Hair-Pin Cotter
5	Block-Up Limit Switch
6	Position Light
7	Block Level Indicators
8	Wind Speed Indicator
9	Electric Cable (WBT1-P8 Position Light)
10	Electric Cable (WBT1-P4 Wind Speed)



M101592

FIGURE 4-85

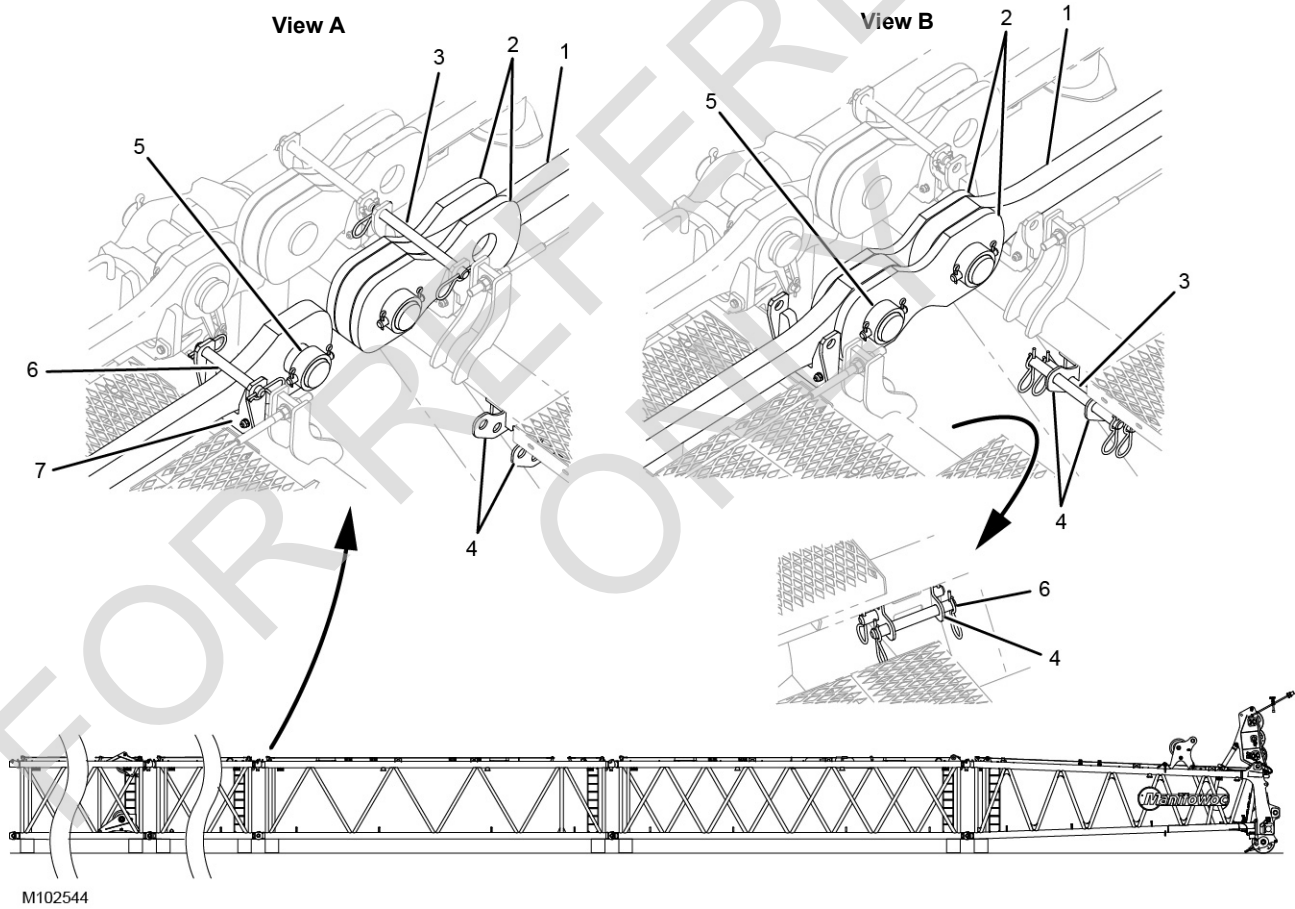
Install Position Light and Wind Speed Indicator

See [Figure 4-85](#) for the following procedure.

1. Remove the camera (3) from storage in the parts box.
2. Install boom top camera (3, optional), fasten with a hair-pin cotter (4), and connect the electric cable.
3. Remove the pins (1) from the position light and wind speed indicator assembly (2a) from the storage lugs in the boom top.
4. Insert the position light and wind speed indicator bracket (2b) into the tube on the right side of the boom top and install a safety pin (8).
5. Install the other safety pin in the top hole of the bracket.
6. Connect the electric cable (9) from the boom top to the electric cable from the position light.
7. Connect the electric cable (10) from the boom top to the electric cable from the wind speed indicator.

FOR REFERENCE ONLY

Item	Description
1	Strap
2	Link
3	Pin with Cotter Pins
4	Pin Storage Bracket
5	Pin with Collar, Retaining Pin, and Cotter Pins
6	Pin with hair-pin cotter
7	Strap Bracket



M102544

FIGURE 4-86

Connect Boom Straps

See [Figure 4-86](#) for the following procedure.

The boom straps and, if equipped, the luffing jib straps are shipped on the boom sections as shown in View A.



WARNING

Falling Load Hazard!

The luffing jib backstay straps can be stored on the boom sections for shipping.

Unless stated otherwise on the appropriate Boom Capacity Chart, luffing jib backstay straps, links, and retaining hardware must be removed from the boom sections during operation without a luffing jib.

If required per the capacity chart, remove the luffing jib straps, links, and connecting hardware from the boom sections.

To connect boom straps, start at the boom top and proceed as follows:

1. Remove cotter pins and pins (3, View A) and store them in the brackets (4, View B).
2. Remove cotter pin, collar, and retaining pin (5, View A).
3. Rotate links (2, View A) rearward from the shipping position to the working position (View B).
4. Install the retaining pin, collar, and cotter pin (5, View B). The PIN HEADS for the boom straps MUST FACE OUT.
5. Repeat the above steps for both straps at both ends of each boom section.

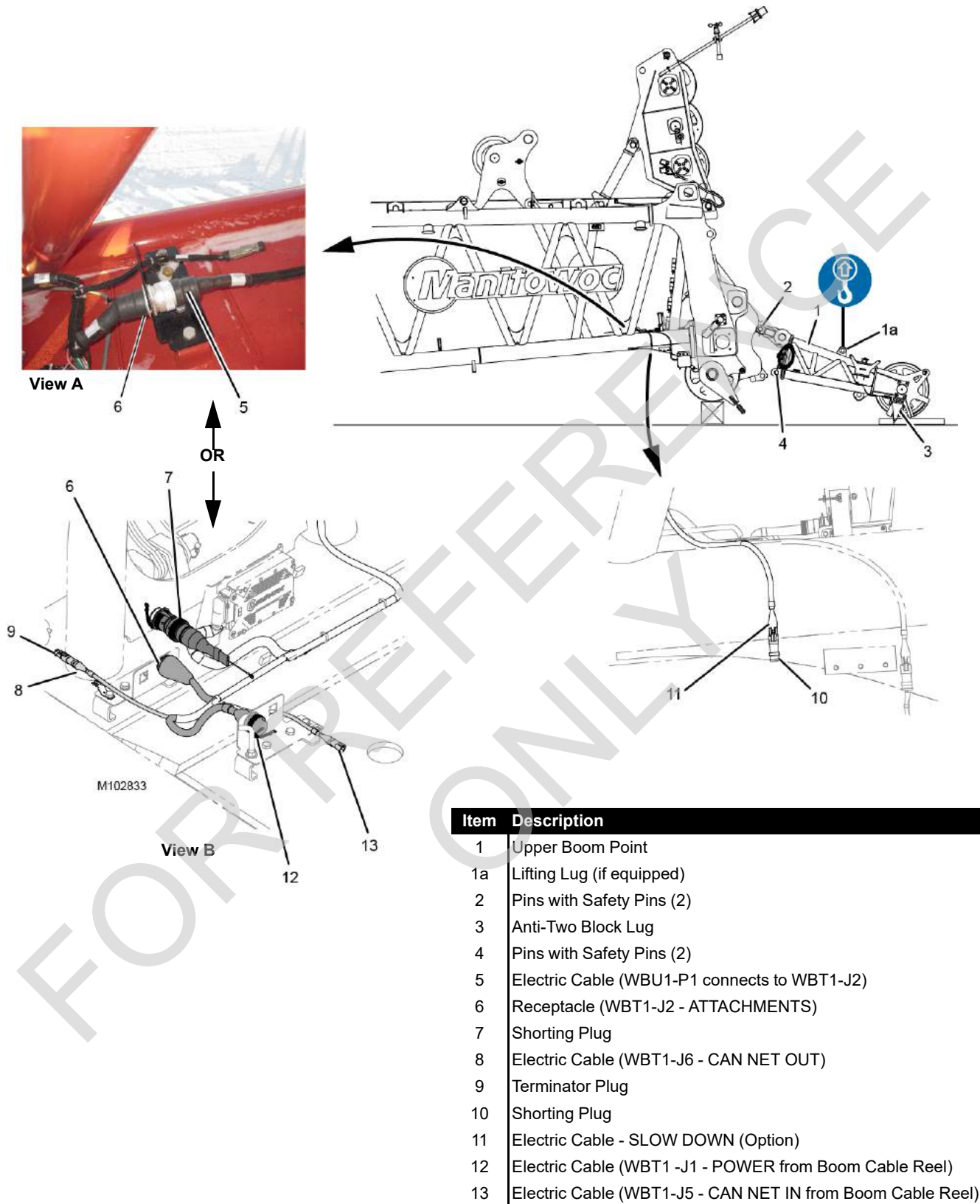


FIGURE 4-87

Install Upper Boom Point



WARNING

Tipping Crane Hazard!

To raise some boom and jib lengths, the upper boom point must be removed. The crane will tip if this is not done.

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

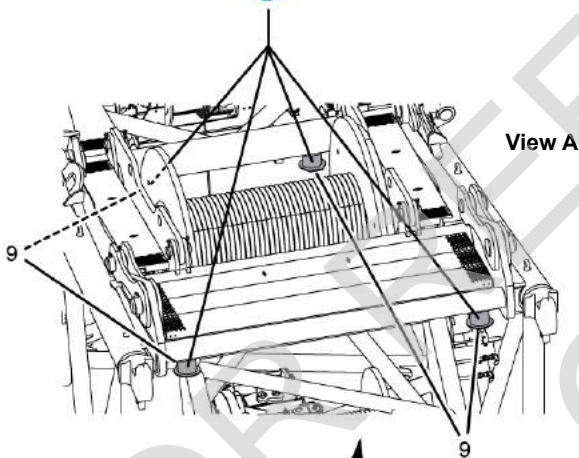
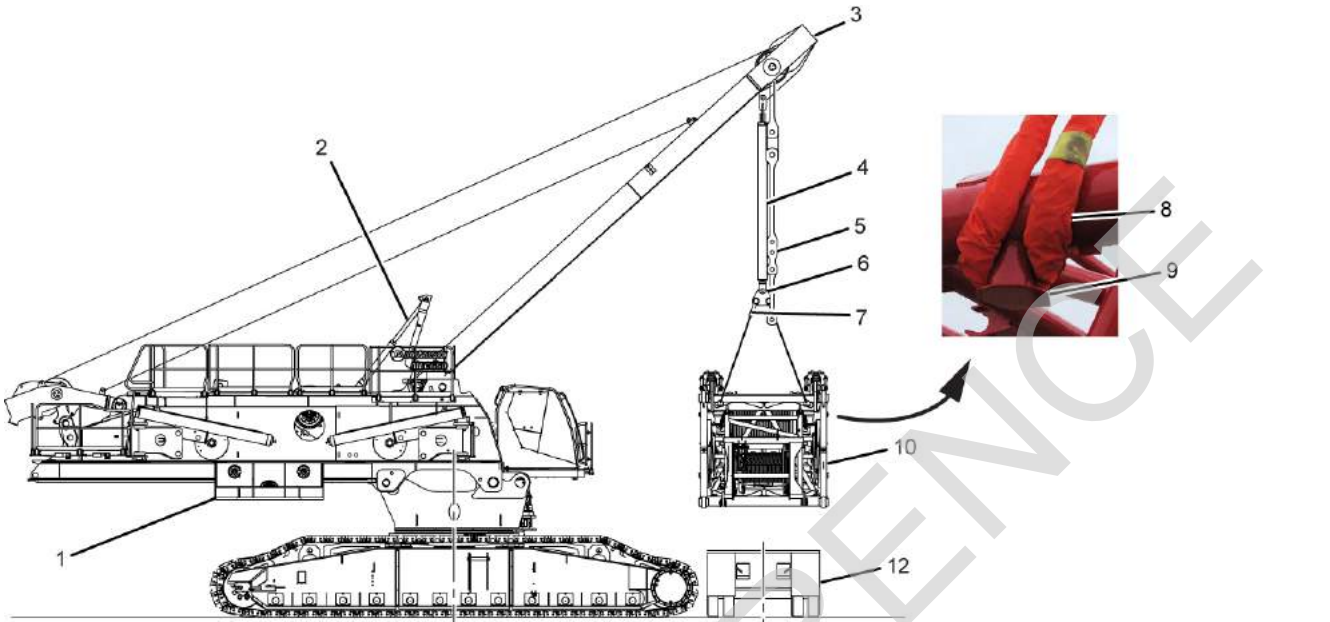
See [Figure 4-87](#) for the following procedure.

1. Attach lifting slings from the self-erect cylinder (or an assist crane) to the upper boom point (1).
Current cranes have a lifting lug (1a).
2. Lift the upper boom point into position at the lower boom point.
3. Remove the upper safety pins and pins (2) from the upper boom point. The lower pins can remain in place.
4. Align the upper holes in the upper boom point with the holes in the lower boom point and install the upper pins and safety pins (2).
5. Lower the upper boom point so the sheaves rest on blocking high enough to prevent the anti-two block lug (3) from contacting the ground.

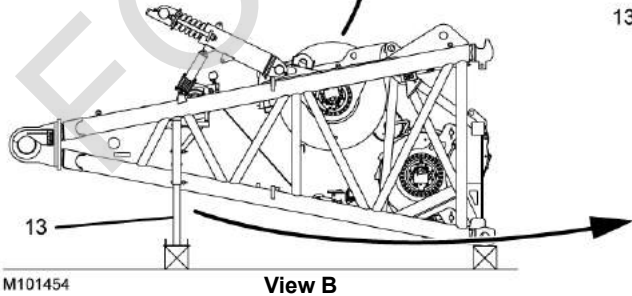
6. Disconnect the lifting slings.
7. Connect the electric cable (5) from the upper boom point to the receptacle (6) in the boom top (View A).
The electric cable is stored on the brackets on the left side of the upper boom point.
8. Install the lower pins (4), as follows, when the boom is raised:
 - a. Remove the lower pins (4) from the upper boom point.
 - b. Slowly boom up to align the bottom connecting holes.
 - c. Install the lower pins (4).

Connect Terminator/Shorting Plugs at Boom Top

- If the crane will not be equipped with a luffing jib, the terminator plug (9) must be connected to the CAN NET OUT electric cable (8) in the boom top.
- If the crane will not be equipped with an upper boom point or a fixed jib, the shorting plug (7) must be connected to the ATTACHMENTS receptacle (6).
- If the crane will not be equipped with the anti-two block slow down option, the shorting plug (10) must be attached to the SLOW DOWN electric cable (11).

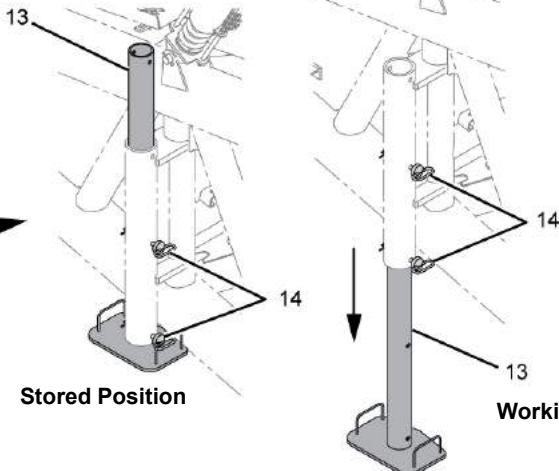


View A



View B

M101454



Stored Position

Working Position

Item	Description
1	Counterweight Tray Installed or Removed
2	Mast-Assist Arms
3	Mast in Operating Range
4	Self-Erect Cylinder
5	Live Mast Straps
6	Rod End
7	2-SH 1 - Shackle 55 t (60.60 USt)
8	4-SL 4 - Sling - 3,80 m (12.50 ft) - 11 340 kg (25,000 lb)
9	Lifting Lug
10	Boom Top
11	See Liftcrane Mast Handling Chart
12	Trailer
13	Support Pedestal
14	Fixed Pins

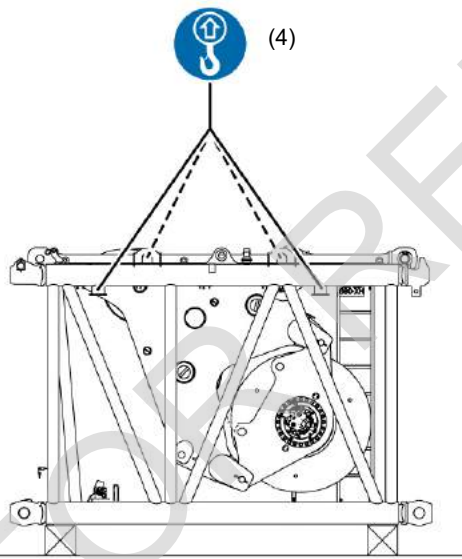
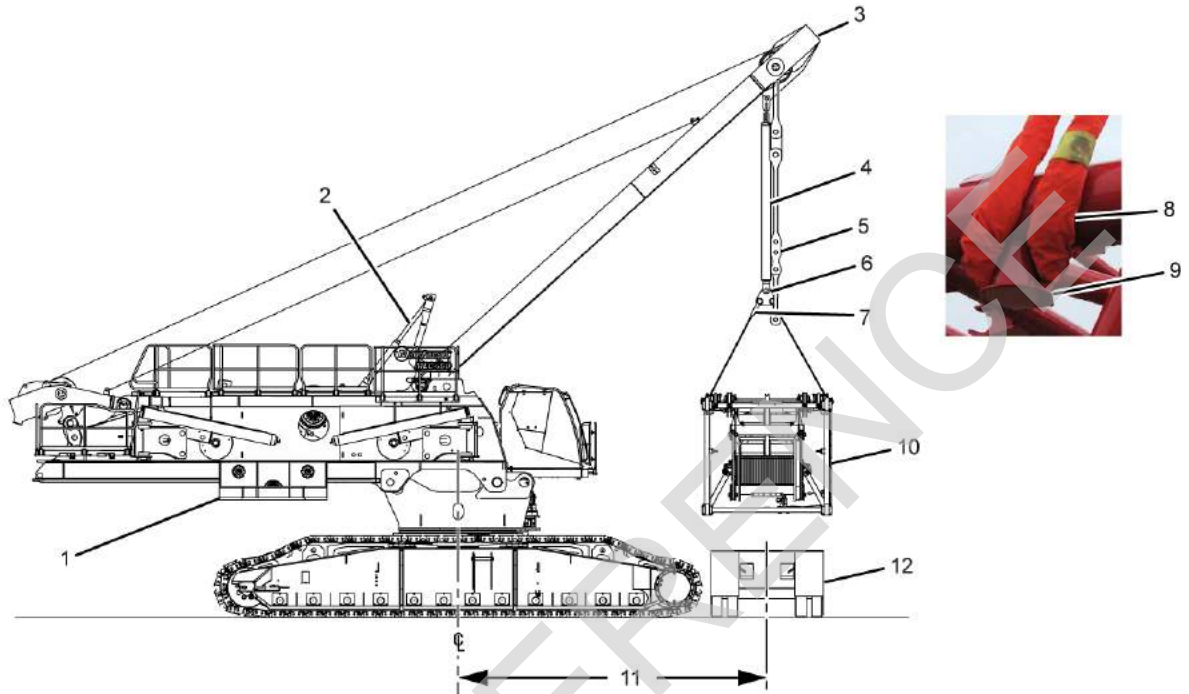
FIGURE 4-88

Prepare Boom Butt

See [Figure 4-88](#) for the following steps.

NOTE: To lift boom butt, use shackles and lifting slings attached to the self-erect cylinder rod end. Reference charts found in [Figure 4-7 on page 4-6](#).

1. Rig four lifting slings from the self-erect cylinder rod end using shackles.
2. Position the trailer carrying the boom butt on the desired side of the crane at the specified radius.
3. Attach the four nylon lifting slings to the four lifting lugs on the boom butt (View A).
4. Lift the boom butt from the trailer and position boom butt so that the pedestals can be extended.
5. Remove the trailer.
6. Remove the fixed pins from the support pedestals.
7. Lower the support pedestals, and secure them with the fixed pins.
8. Lower the boom butt onto blocking (View B).
9. Remove the nylon slings



M101439

Item	Description
1	Counterweight Tray Installed or Removed
2	Mast-Assist Arms
3	Mast in Operating Range
4	Self-Erect Cylinder
5	Live Mast Straps
6	Rod End
7	2-SH 1 - Shackle 55 t (60.60 USt)
8	4-SL 4 - Sling - 3,80 m (12.50 ft) - 11 340 kg (25,000 lb)
9	Lifting Lug
10	4M Insert
11	See Liftcrane Mast Handling Chart
12	Trailer

FIGURE 4-89

Prepare 4M Insert

See [Figure 4-89](#), for the following steps.

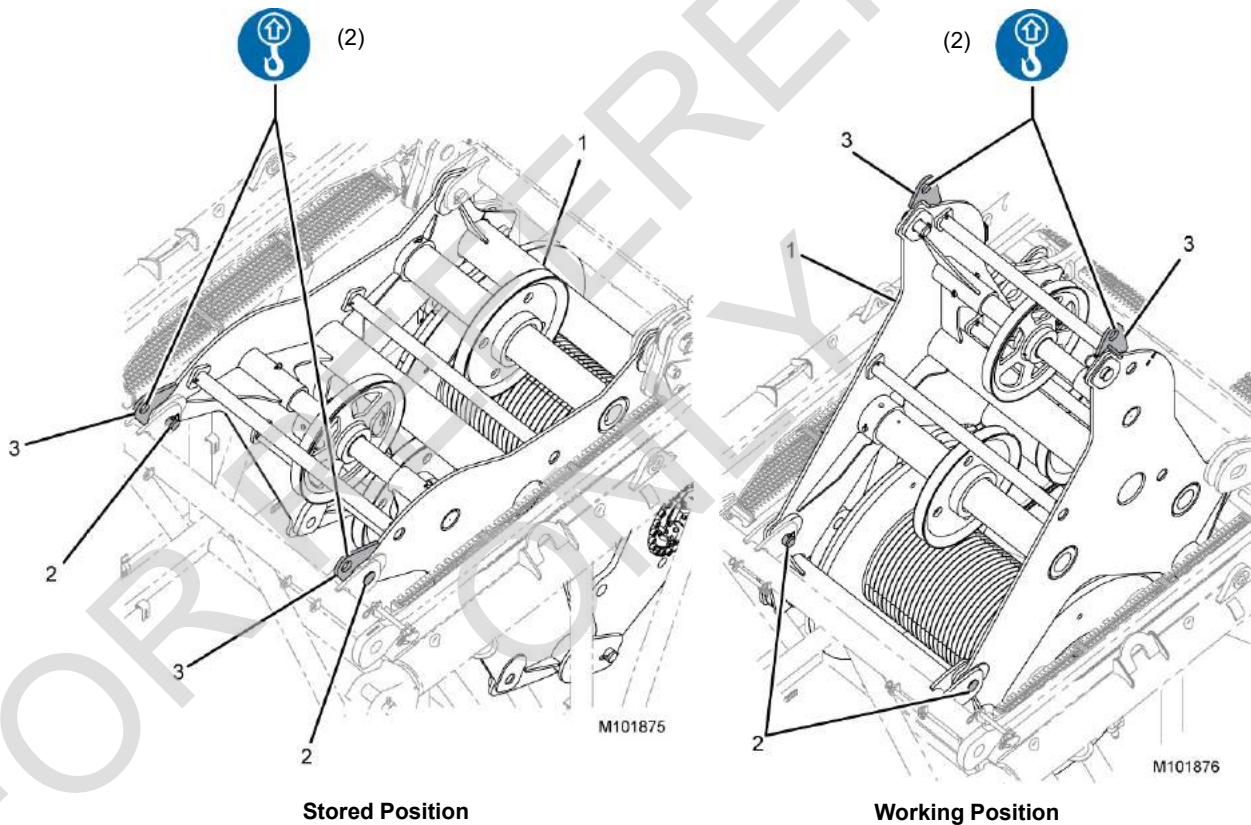
NOTE: To lift inserts, use shackles and lifting slings attached to the self-erect cylinder rod end. Reference charts found in [Figure 4-7 on page 4-6](#).

1. Position the trailer carrying the 4M insert on the desired side of the crane at the specified radius.
2. Attach four nylon lifting slings to the four lifting lugs on the 4M insert.
3. Lift the 4M insert from the trailer and remove the trailer.
4. Align the 4M insert with the boom butt for installation.

Raise Wire Rope

See [Figure 4-90](#), for the following steps.

1. Connect two nylon slings to the wire rope guide lifting lugs (3) using shackles and raise until slack is removed from slings.
2. Remove safety pins and pins (2).
3. Raise the wire rope assembly until the holes align in the working position.
4. Install the pins and safety pins.
5. Lower self-erect cylinder to create slack in the slings, remove shackles and slings.



Item	Description
1	Wire Rope Guide
2	Pins and Safety Pins
3	Lifting Lugs

FIGURE 4-90

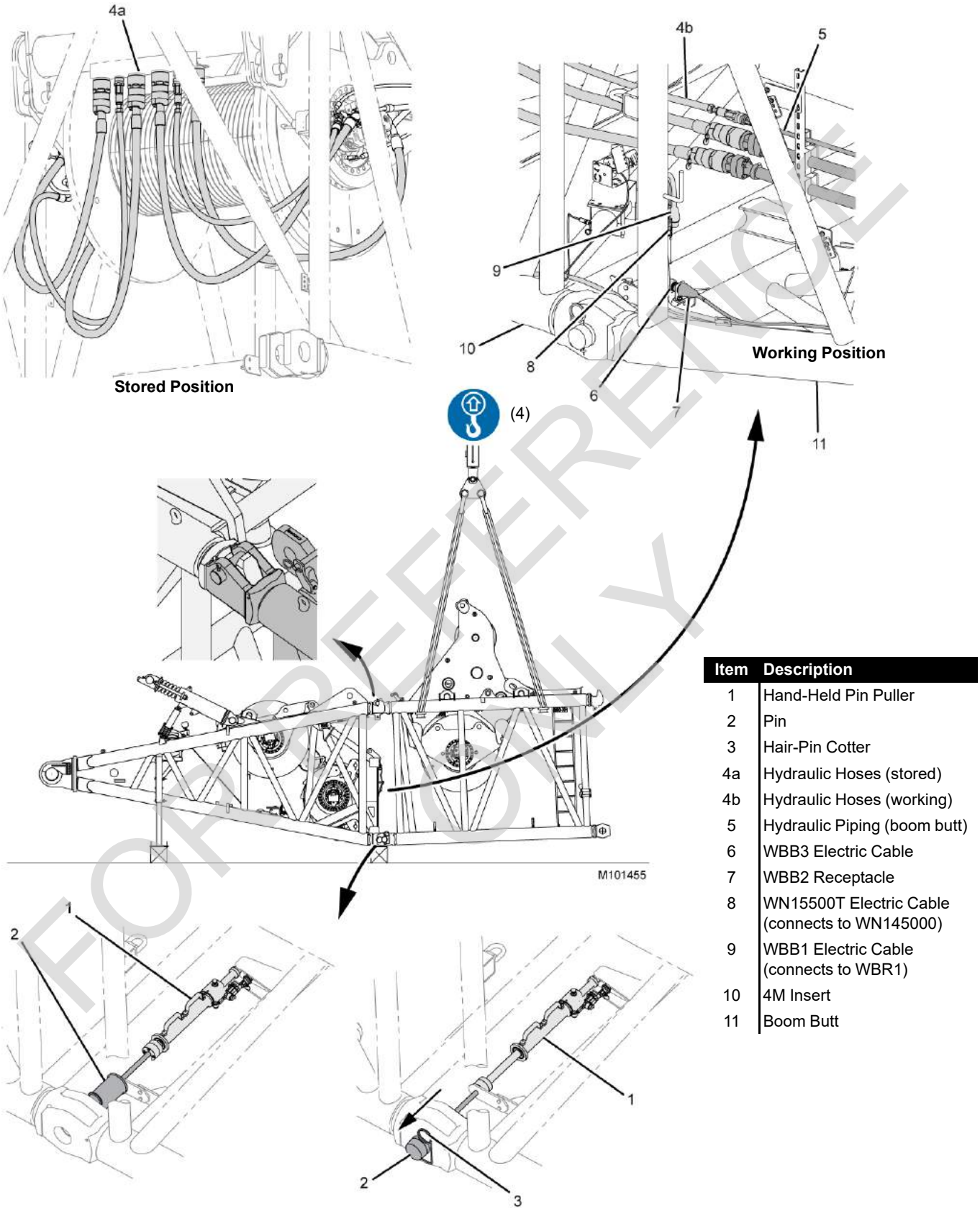


FIGURE 4-91

Connect 4M Insert to Boom Butt

See [Figure 4-91](#), for the following steps.

NOTE: To lift inserts, use shackles and lifting slings attached to the self-erect cylinder rod end. Reference charts found in [Figure 4-7 on page 4-6](#).

1. Attach four nylon lifting slings (4-SL 4) 3,80 m (12.50 ft) to the self-erect cylinder rod end using two shackles (2-SH 1) 55 t (60.60 USt).
2. Attach the four lifting slings to the four lifting lugs on the 4M insert.
3. Lift the 4M insert from the blocking and align the insert with the boom butt.
4. Hook the fixed horizontal pin onto the hooked connector and lower until the lower holes align.
5. Install pins (2) using the pin puller (1) and secure them with the safety pins (3). See ["Connect Hand-Held Pin Puller" on page 4-37](#) for more information.

OR, manually install the pins (2) and the safety pins (3). The pins are stored in holders on the insert.

6. Remove the nylon slings.
7. Remove the hoses (4a) from the stored position, remove the dust caps from the connectors, and thoroughly clean all connections.
8. Connect the hydraulic hoses (4b) from the 4M insert to the hydraulic piping connectors (5) on the boom butt.
9. Connect the electric cable (6) from the 4M insert to the electric receptacle (7) on the boom butt.
10. The two electric cables (8 & 9) are coiled on the boom butt and must be run through the 4M insert to the 12M insert cable reels.

Lower Carbody Platform

See [Figure 4-92](#), for the following steps.

NOTE: The front carbody platform must be lowered before the boom butt can be installed onto the adapter frame.

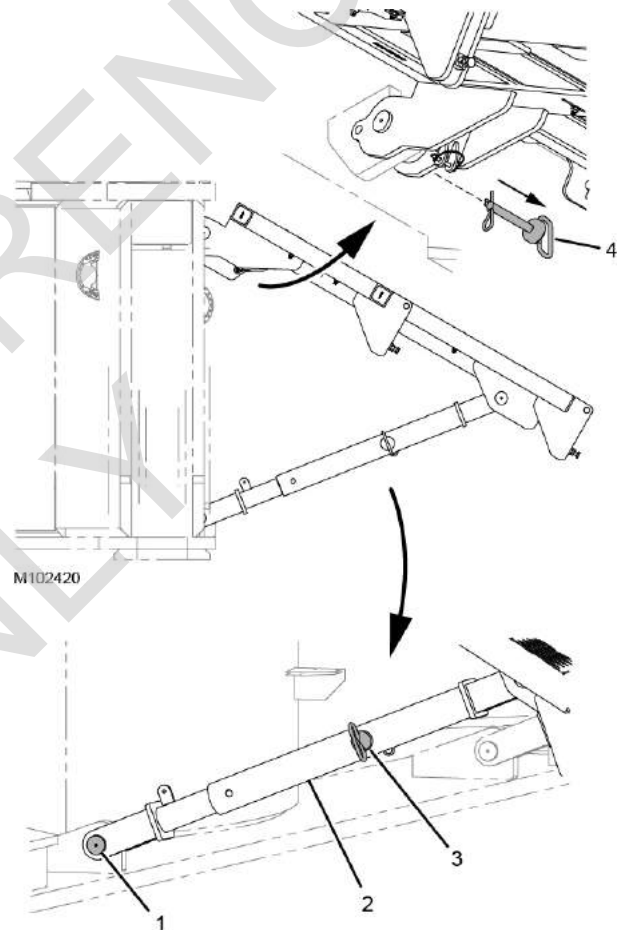
1. Remove the carbody ladder assembly from the front carbody platform.
2. Using a forklift or an assist crane with a sling:
 - a. Support the weight of the carbody platform assembly.
 - b. Remove safety pins and hitch pins (4) and set aside until platform is raised to the working position.
 - c. Remove the hitch pins (3) from the struts (2).

- d. Lower the carbody platform assembly until the holes in the struts (2) align and insert the hitch pins (3).
- e. Lower forklift or assist crane and remove sling.

CAUTION

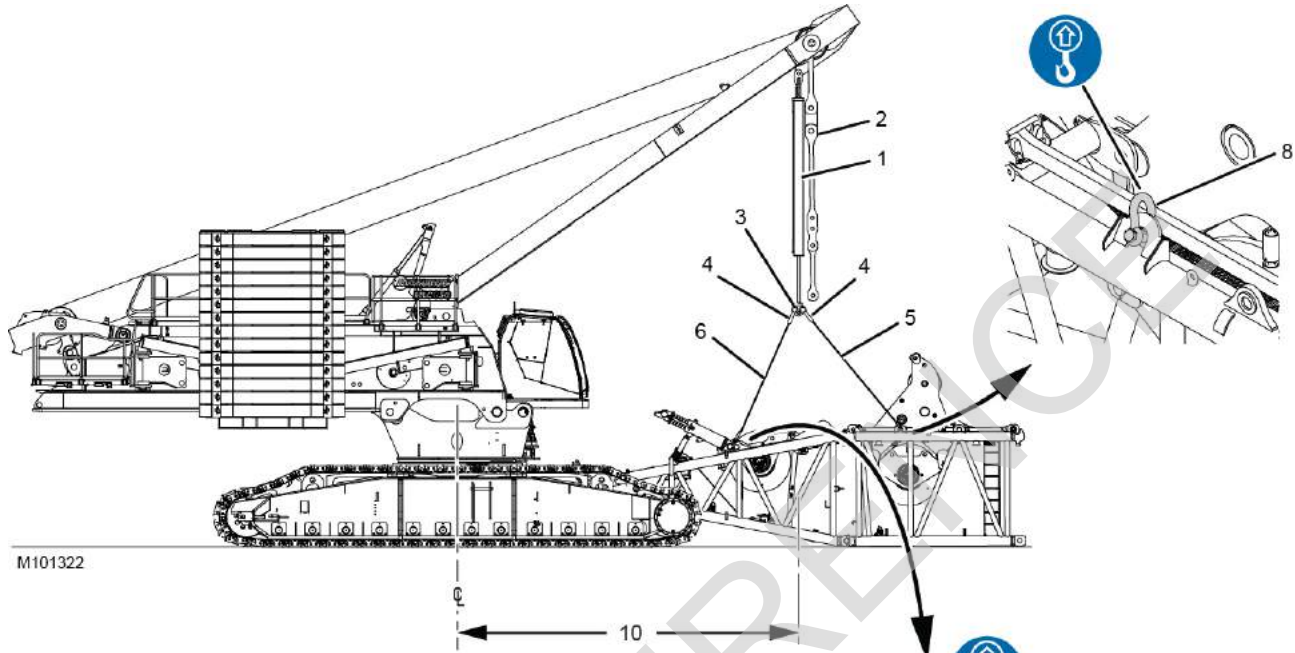
Equipment Damage!

Damage will occur if the carbody platforms are not lowered before the installation of the boom butt to the upperworks.



Item	Description
1	Wire Locking Pin
2	Strut
3	Hitch Pin
4	Hitch Pin with Safety Pin

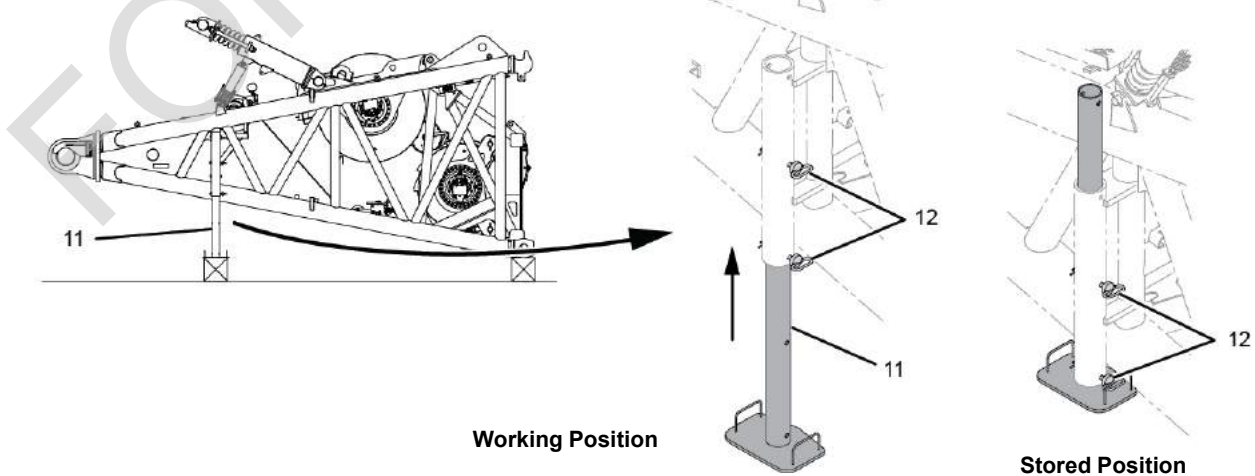
FIGURE 4-92



M101322

Item Description

- 1 Self-Erect Cylinder
- 2 Live Mast Straps
- 3 Rod End
- 4 2-SH 1 - Shackles - 55 t (60.60 USt)
- 5 2-SL 1 - Slings - 3,30 m (10.83 ft) - 45 360 kg (100,000 lb)
- 6 2-SL 2 - Slings - 3,10 m (10.30 ft) - 18 144 kg (40,000 lb)
- 7 2-SH 3 - Shackles - 40 t (44 USt)
- 8 2-SH 2 - Shackles - 17 t (18.70 USt)
- 9 Not Used
- 10 See Liftcrane Mast Handling Chart
- 11 Support Pedestal
- 12 Fixed Pins



Working Position

Stored Position

FIGURE 4-93

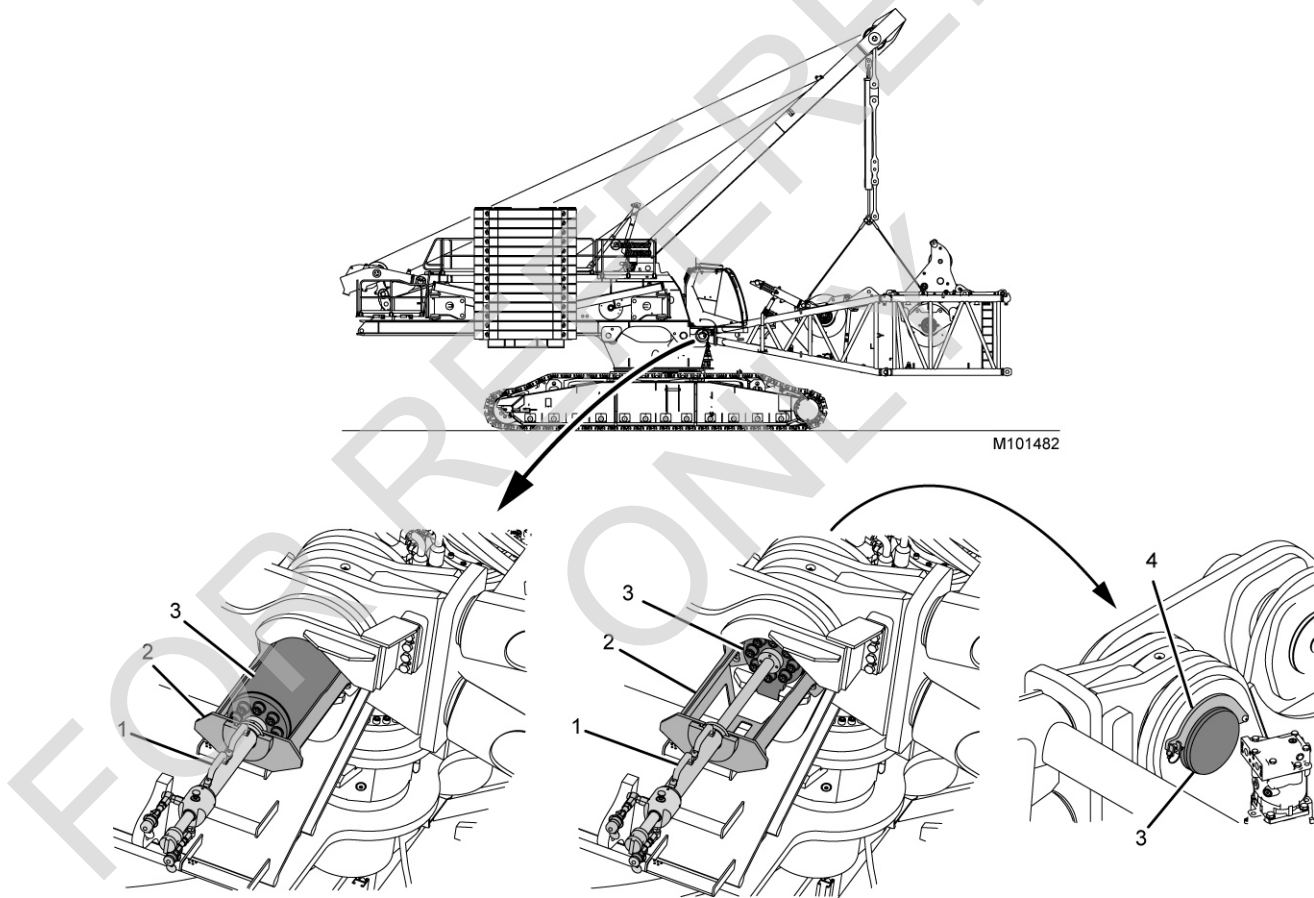
Connect Boom Butt to Crane

See [Figure 4-93](#), for the following steps.

1. Rig the lifting slings (5 and 7) to the self erect cylinder rod end with shackles (4).
2. Rig the lifting slings (5 and 7) to the combined boom butt and the 4M insert with shackles (6 and 8).
3. Lift the combined boom butt and 4M insert enough to lift the boom butt support pedestals off of the ground.
4. Remove the fixed pins (12) from the boom butt support pedestals (11).
5. Raise the support pedestals (11), and secure them with the fixed pins (12) in the stored position.

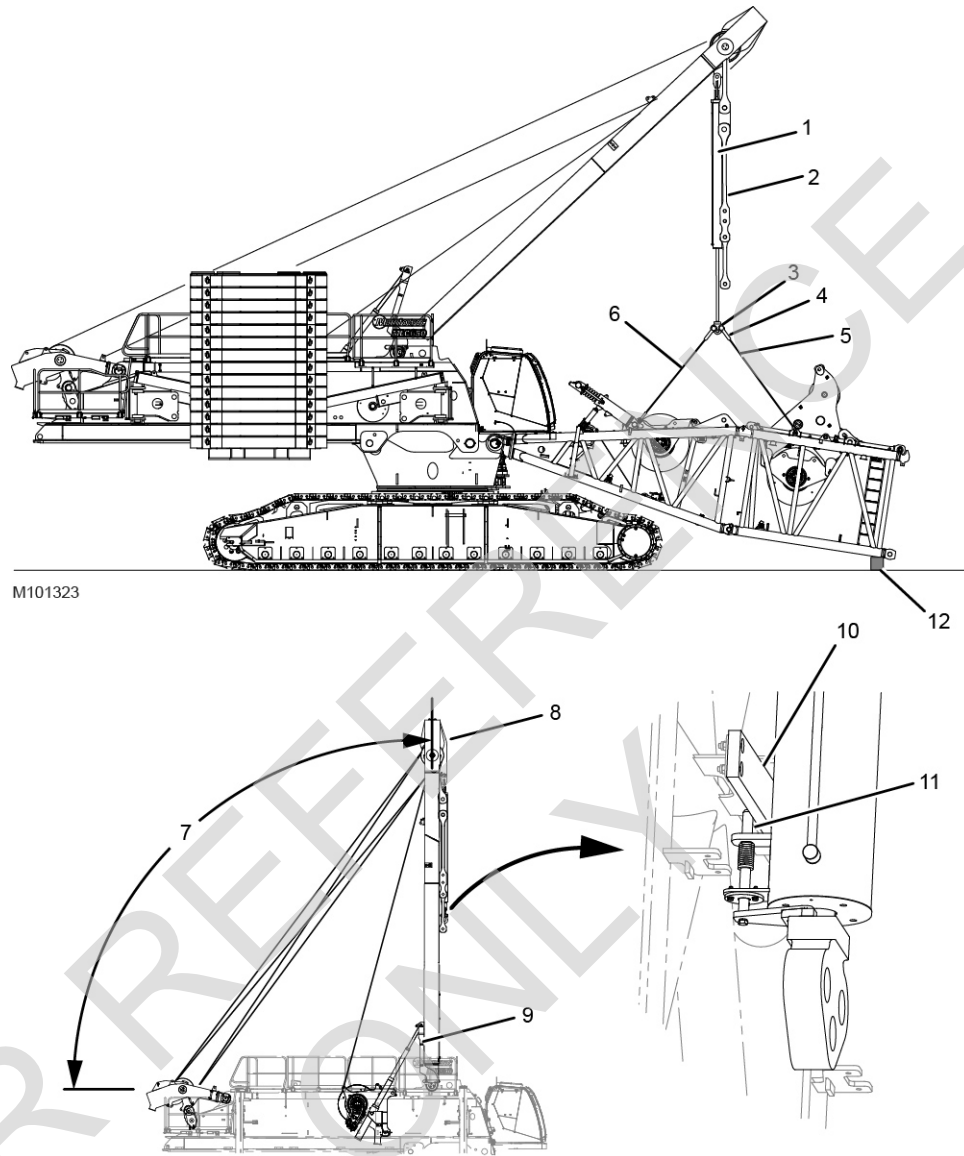
See [Figure 4-94](#), for the following steps.

1. Lift the boom butt and 4M insert to align with the adapter frame mounting holes.
2. Install the pin puller cage (2) for installing the boom butt hinge pin (3).
3. Install the hand-held pin puller (1). See "[Connect Hand-Held Pin Puller](#)" on page 4-37 for more information.
4. Remove the safety pin (4) and flip the keeper plate (4) up.
5. Place the boom butt hinge pin (3) into the pin puller cage (2) and use the hand-held pin puller (1) to install the pin securing the boom butt to the adapter frame.
6. Flip the keeper plate (4) down into the groove of the pin (3) and install the safety pin (4).
7. Repeat steps 2-6 for the second pin.



Item	Description
1	Hand-Held Pin Puller
2	Pin Puller Cage
3	Boom Butt Hinge Pin
4	Keeper Plate and Safety Pin

FIGURE 4-94



M101323

Item	Description
1	Self-Erect Cylinder
2	Live Mast Straps
3	Rod End
4	2-SH 1 - Shackles - 55 t (60.60 USt)
5	2-SL 2 - Slings - 3,30 m (10.83 ft) - 45 360 kg (100,000 lb)
6	2-SL 2 - Slings - 3,10 m (10.30 ft) - 18 144 kg (40,000 lb)
7	85° Mast Angle
8	Live Mast
9	Mast Assist Arms
10	Retention Bracket
11	Pin
12	Blocking

FIGURE 4-95

Lower Boom Butt and 4M Insert

See [Figure 4-95](#), for the following steps.

1. Confirm that the mast assist arms (9) are fully raised before proceeding.

NOTE: The following will occur if the mast is raised to vertical when the mast assist arms are down:

- The mast will stop rising.
- The hazard warning buzzer will sound and the MAST ASSIST ARMS DOWN icon will appear in the fault screen of the main display.



- Make sure the mast assist arms are up before raising the mast to vertical.

2. Lower the combined boom butt and 4M insert onto blocking (6) on the ground.
3. Remove the shackles and slings (4, 5, and 6).

! WARNING

Mast Damage Hazard!

Do not exceed a maximum mast angle of 158° or mast will damage will occur.

4. Boom up until the mast angle is at 85° (7).
5. Fully retract the self-erect cylinder (1) until the pin (11) is secure under the retention bracket (10).

! DANGER

Falling Mast/Boom Hazard!

Prevent the mast and the boom from falling:

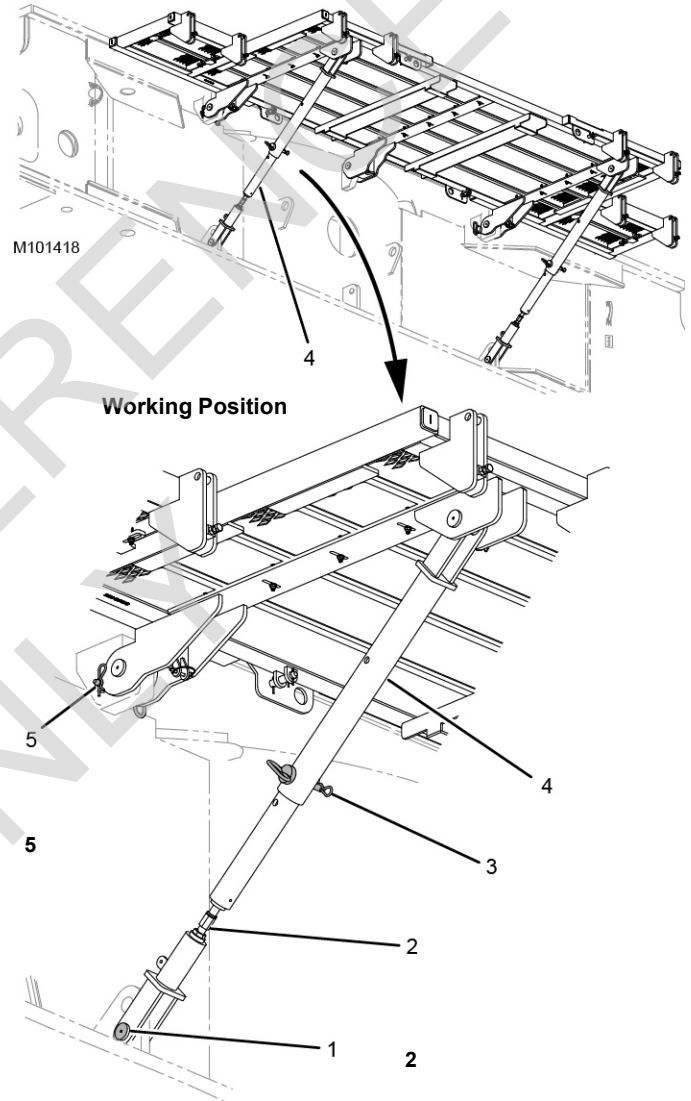
- Fully lower the mast-assist arms before raising the boom. The mast can buckle and collapse if it contacts the mast-assist arms with a fully rigged boom.

Raise Carbody Platform

See [Figure 4-96](#), for the following steps.

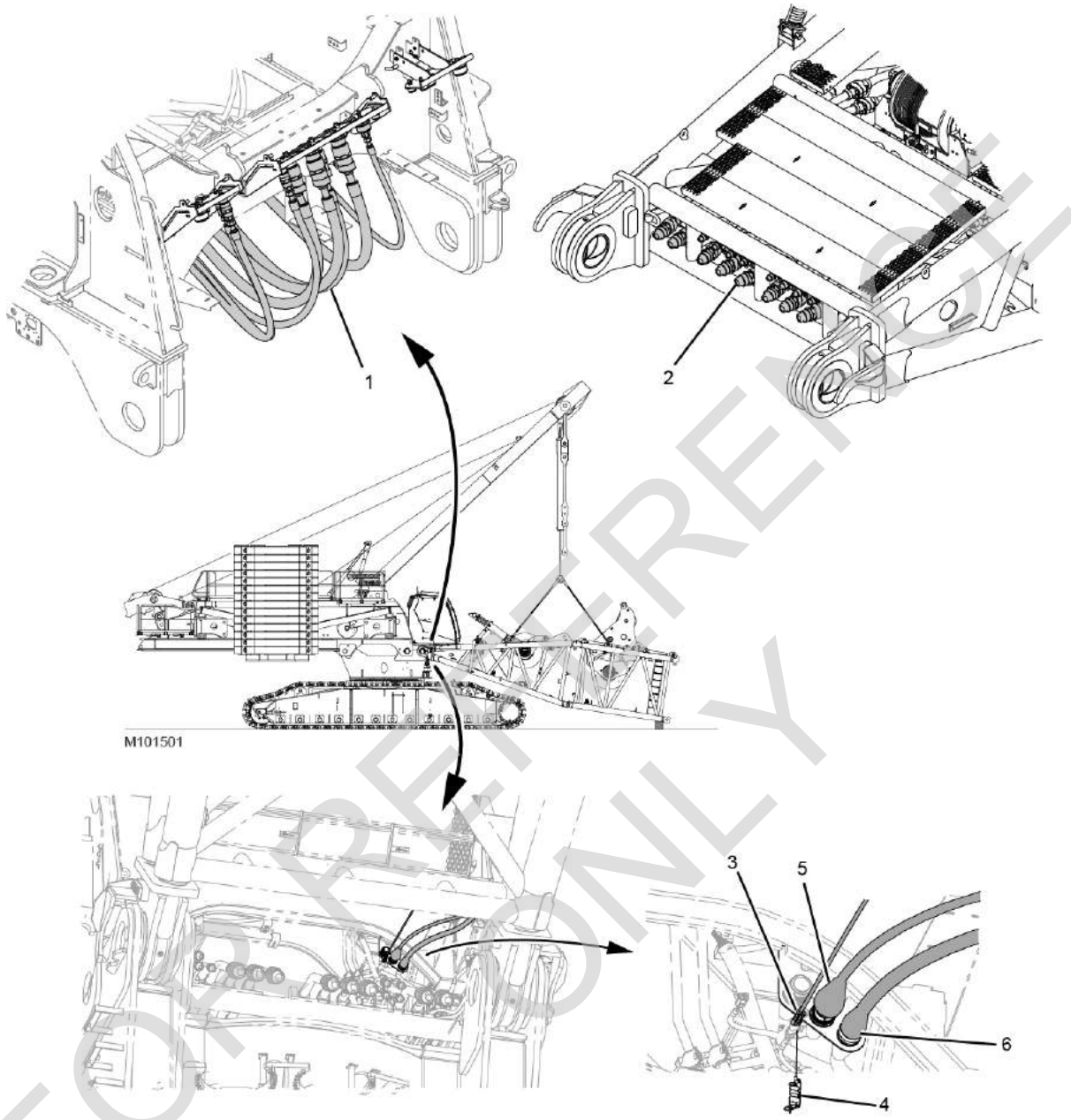
1. Use an assist crane or forklift to hold the carbody platform.
2. Remove the hitch pins (3).

3. Raise the carbody platform to the working position.
4. Insert the hitch pins (3).
5. Insert the hitch pins and safety pins (5).
6. Level the carbody platform if necessary by turning the adjusters (2) until level.
7. Lower and remove assist crane or forklift.



Item	Description
1	Wire Locking Pin
2	Adjuster
3	Hitch Pin
4	Strut
5	Hitch Pin with Safety Pin

FIGURE 4-96



M101501

Item	Description
1	Hydraulic Hoses (stored)
2	Hydraulic Piping (boom butt)
3	Electric Cable - CAN D
4	CAN TERMINATOR
5	WBB2 Cable Connects to WFR2
6	WBB1 Cable Connects to WRL2

FIGURE 4-97

Connect Hydraulic Hoses from Crane to Boom Butt

See [Figure 4-97](#), for the following steps.

1. Remove the hoses from the stored position on the crane and the dust caps from the couplers.
2. Thoroughly clean all hydraulic connections.
3. Connect the hydraulic hoses from the crane to the couplers on the boom butt. Match the identification tags on the hoses to the identification tags on the couplers.

NOTE: The quantity of hydraulic hoses from the crane to the boom butt will vary depending on your drum options.

See [Figure 4-98](#), for the following steps.

1. Remove the cotter (1) and hitch pins (2) from the hose storage bracket (3).
2. Flip the hose storage bracket (3) up, align bracket holes, and insert hitch (2) and cotter pins (1).

3. Remove the cotter (1) and hitch pins (2) from the hose storage brackets (4).
4. Flip the hose storage brackets (4) up, slide them down, align the hose storage bracket holes, and insert the hitch pins (2) and cotter pins (1).

Connect Electric Cables from Boom Butt to Crane

See [Figure 4-97](#), for the following steps.

1. Remove the dust caps from the electric cables and receptacles.
2. Thoroughly clean all electric connections.
3. Disconnect the CAN terminator (4) from the end of electric cable (3) and attach the dust cap to the terminator.
4. Connect the electric cable (5) from the boom butt to the receptacle on the crane.
5. Connect the electric cable (6) from the boom butt to the receptacle on the crane.

Item	Description
1	Cotter Pins
2	Hitch Pins
3	Hose Bracket
4	Hose Brackets

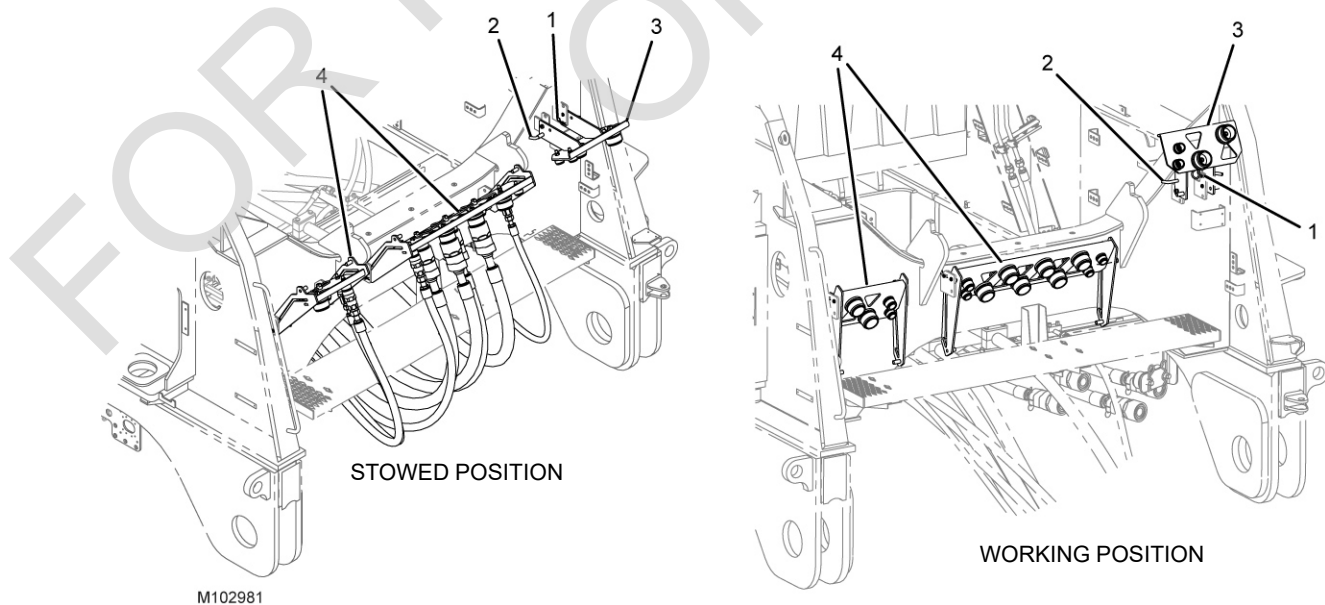
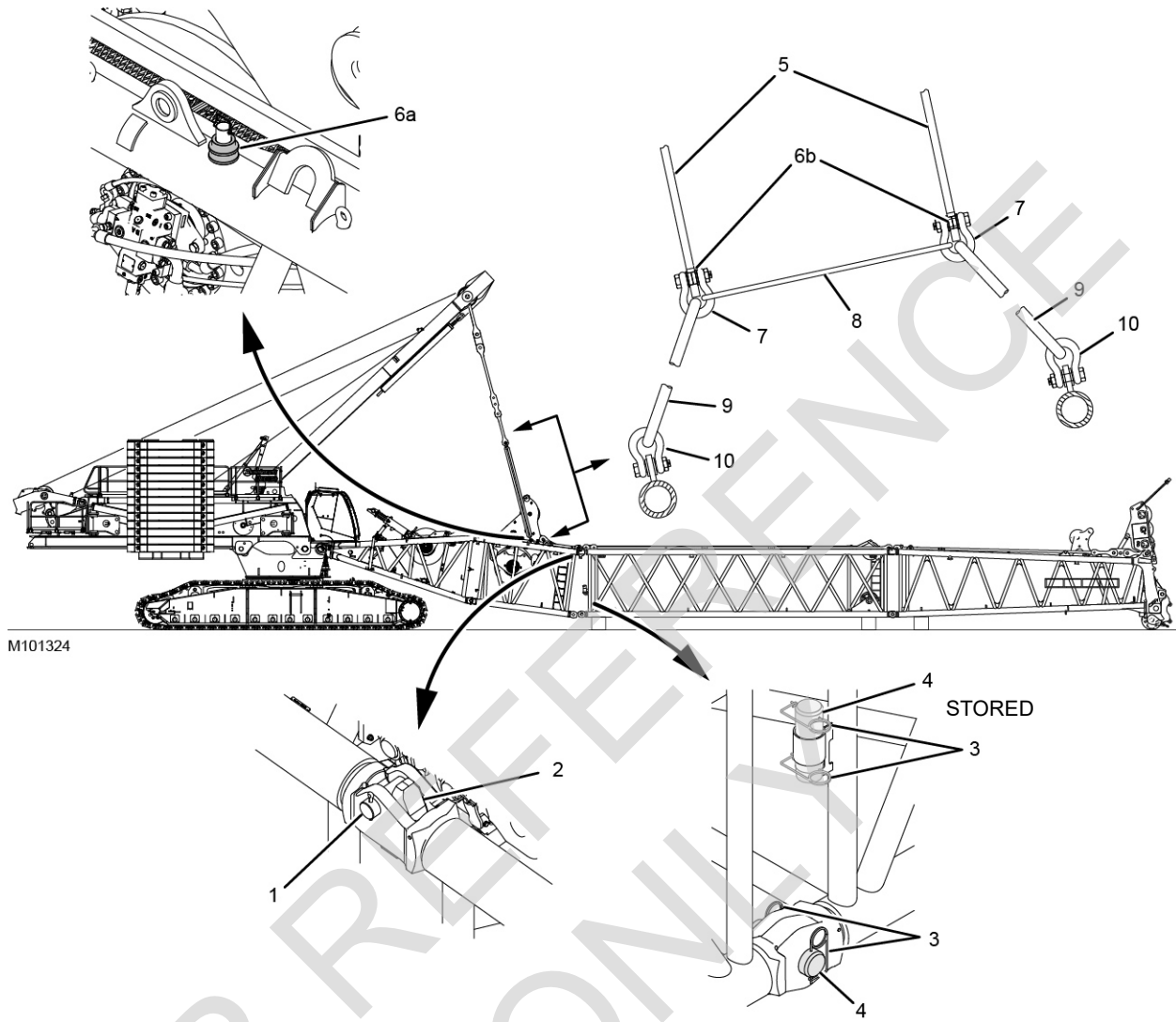


FIGURE 4-98



M101324

Item	Description
1	Fixed Horizontal Pin
2	Hooked Connector
3	Safety Pins
4	Pins
5	Live Mast Straps
6a	4-Bushings (stored position)
6b	4-Bushings (working position)
7	2-SH 3 - Shackles - 40 t (44 USt)
8	1-SL 3 - Spreader Sling - 1,60 m (5.25 ft) - 9 072 kg (20,000 lb)
9	2-SL 1 - Slings - 3,30 m (10.83 ft) - 45 360 kg (100,000 lb)
10	2-SH 3 - Shackles - 40 t (44 USt)

FIGURE 4-99

Connect 4M to Boom

NOTE: If not already done, install the counterweight boxes. See: ["Install Counterweight Boxes" on page 4-81](#)

See [Figure 4-99](#), for the following steps.

1. Boom down to attach the live mast straps (5) to the 4M closing lugs using the Manitowoc supplied shackles and slings.
2. Remove the bushings from the stored position (6a) and place the bushings (6b) into the live mast straps (5).
3. Install the shackles (7) with the spreader sling (8) between the straps (5).
4. Connect the slings (9) to the shackles (7) and then connect the slings (9) to the 4M insert using shackles (10).
5. Boom up to lift the 4M insert clear of the ground.
6. Position the crane so the 4M insert is in line with the 12M insert with sheaves.
7. Travel forward slowly, swing, and boom up and down as needed to engage the hooked connectors (2) on the 4M insert with the fixed horizontal pins (1) on the 12M insert with sheaves.

WARNING Tipping Hazard!

Prevent crane from tipping:

- Block the crawlers — if required per the capacity chart — before attempting to raise the boom.
8. Check the appropriate capacity chart to see if the crawlers need to be blocked to raise the boom. If so, proceed as follows:
 - a. Mark the ground at the center of the front crawler rollers or the drive tumbler.

See the Crawler Blocking Diagram in the Capacity Chart Manual for blocking requirements.

- b. Boom down to disengage the hooked connectors (2) on the 4M insert from the fixed horizontal pins (1) on the adjacent insert.
- c. Slowly travel in reverse several feet.
- d. Place the required blocking on the ground at the points marked in step [8a](#).
- e. Repeat step [7](#) while traveling onto the blocking.

WARNING

Crushing Injury Hazard!

Prevent serious crushing injury:

- Do not stand inside the boom sections while installing the connector pins — **STAND OUTSIDE BOOM.**
9. Raise the 4M insert until the bottom connector holes are aligned.
 10. Insert the pins (4) in the lower connecting holes and secure them with safety pins (3). The pins are stored in holders on the adjacent insert.
 11. Boom down to disconnect boom handling shackles and slings.
 12. Remove the bushings (6b) from the live mast straps (5) and store (6a) them on the 4M insert.

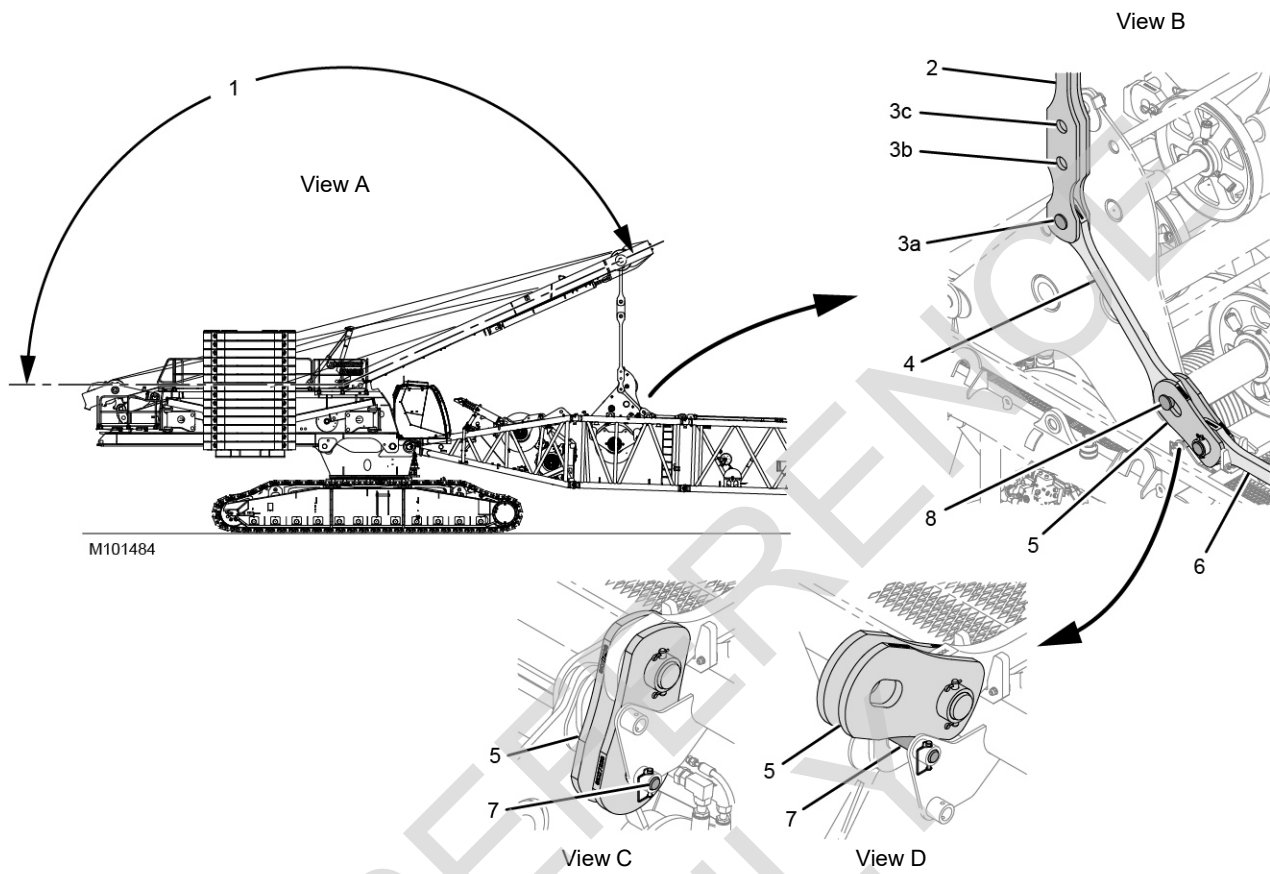
WARNING

Equipment Damage!

Do not boom up past the alignment of the lower pin connector holes.

Do not boom up after lower pins are installed.

- Damage to mast or boom butt and 4M insert could occur or mast damage could occur.



M101484

Item	Description
1	158° Mast Angle (maximum)
2	Live Mast Link
3a	Hole "A"
3b	Hole "B"
3c	Hole "C"
4	Strap
5	Link
6	4M Strap
7	Pin and Safety Pin
8	Pin, Collar, Cotter Pin

FIGURE 4-100

Connect Mast Straps to Boom Straps

See [Figure 4-100](#), for the following steps.

1. Confirm that the mast-assist arms (View A) are fully raised before proceeding.

NOTE The following will occur if you attempt to raise the mast when the mast assist arms are down:



- The mast will stop rising.
- The hazard warning will come on and the MAST ASSIST ARMS DOWN icon will appear in the fault bar of the Main Display Working Screen.
- Make sure the mast assist arms are up before raising the mast.



WARNING

Mast Damage Hazard!

Do not exceed a maximum mast angle of 158° or mast damage will occur.

2. Lower the live mast angle to approximately 158° (1, View A).
3. Remove safety pins and pins (7, View C) from the stored position.
4. Raise the links (5, View D) to the working position and insert the pins and safety pins (7, View D).
5. Remove the cotter pin, collar, and pin (View B) from the end of the strap (4).
6. Place the strap (4) between the links (5), align the holes, and insert the pins, with heads toward the outside of the boom.
7. Install the collar and safety pin.
8. Repeat steps 3-7 for the other strap.

NOTE: Lifting configurations will require the use of either Hole "A", "B", or "C". Refer to boom make up table

for the necessary live mast adjustment hole identification (3a, 3b, or 3c, View B).

9. Using the switch on the remote control or on the right control console (in cab), fully LOWER the mast-assist arms.



DANGER

Falling Mast/Boom Hazard!

Prevent the mast and the boom from falling:

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

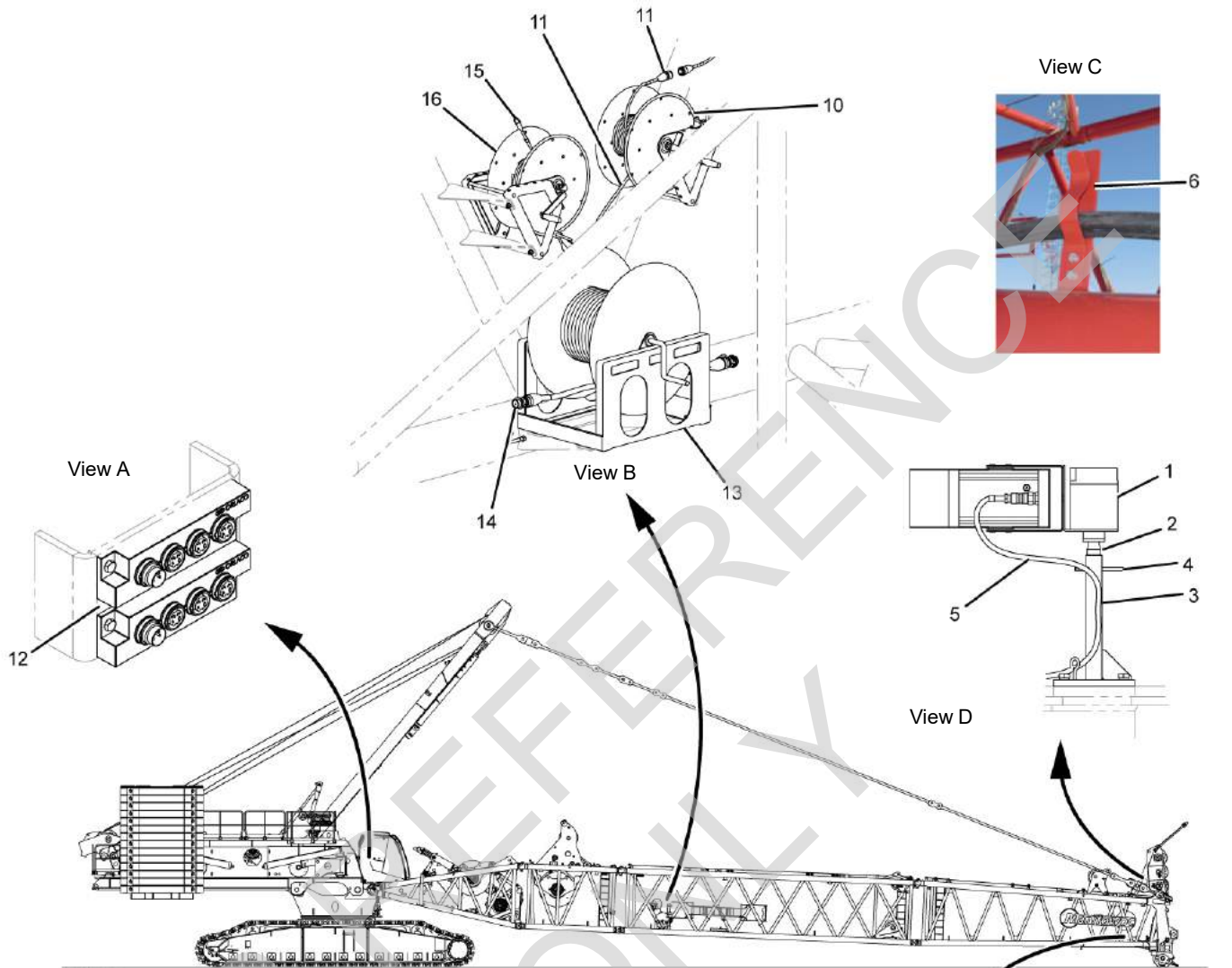
Deactivate Setup Mode

1. Turn off the power switch on the remote control and deactivate it in the Mode Selection Group of the Main Display.
2. Store the remote control in the storage compartment on the left side of the operator cab (see [Figure 4-12 on page 4-12](#)).
3. For current production cranes (CCM-10 software version 0.022 and newer), deactivate the self-erect cylinder in the Mode Selection Group of the Main Display.
4. Select the proper Liftcrane Capacity Chart in the configuration screen of the RCL/RCI Display.

NOTE The following will occur if you attempt to raise the boom when the mast assist arms are up:

- The boom hoist will not operate.
- The hazard warning will come on and the MAST ASSIST ARMS UP icon will appear in the fault bar of the Main Display Working Screen.
- Make sure the mast assist arms are down before raising the mast and boom.139





M101325

Item	Description
1	Camera (Optional)
2	Camera Shaft
3	Bracket
4	Hair-Pin Cotter
5	Electric Cable CCTV (WJT3 connects to WBR3)
6	Cable Clip
7	WBT1-P3 (connects to the A2B lower point slow)
8	CAN NET IN Electric Cable
9	Electric Cable (WBT1-J1)
10	CCTV Cable Reel (Optional)
11	Electric Cable CCTV (WBR3)(Optional)
12	Camera Switchers
13	Electric Cable Reel
14	Electric Cable (WBR1 connects to WBT1)
15	Electric Cable (WN14500-cable reel)
16	Electric Cable Reel (CAN NET)

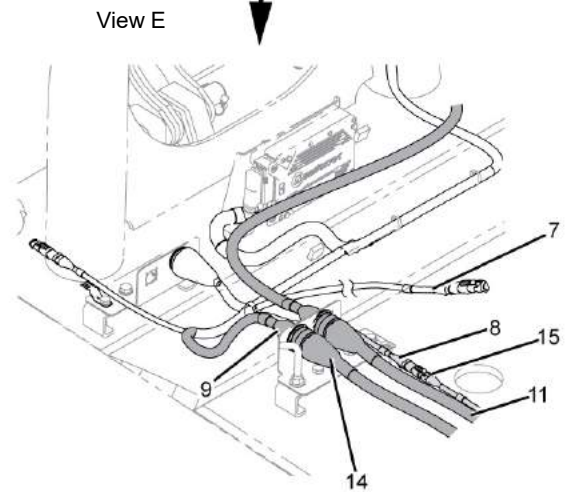
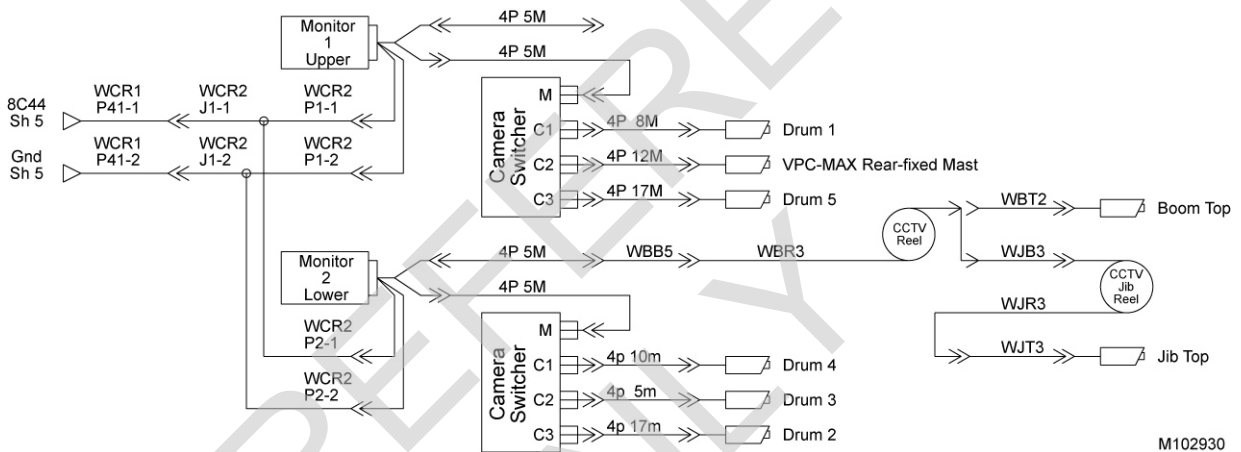


FIGURE 4-101

Connect Camera and Electric Cables

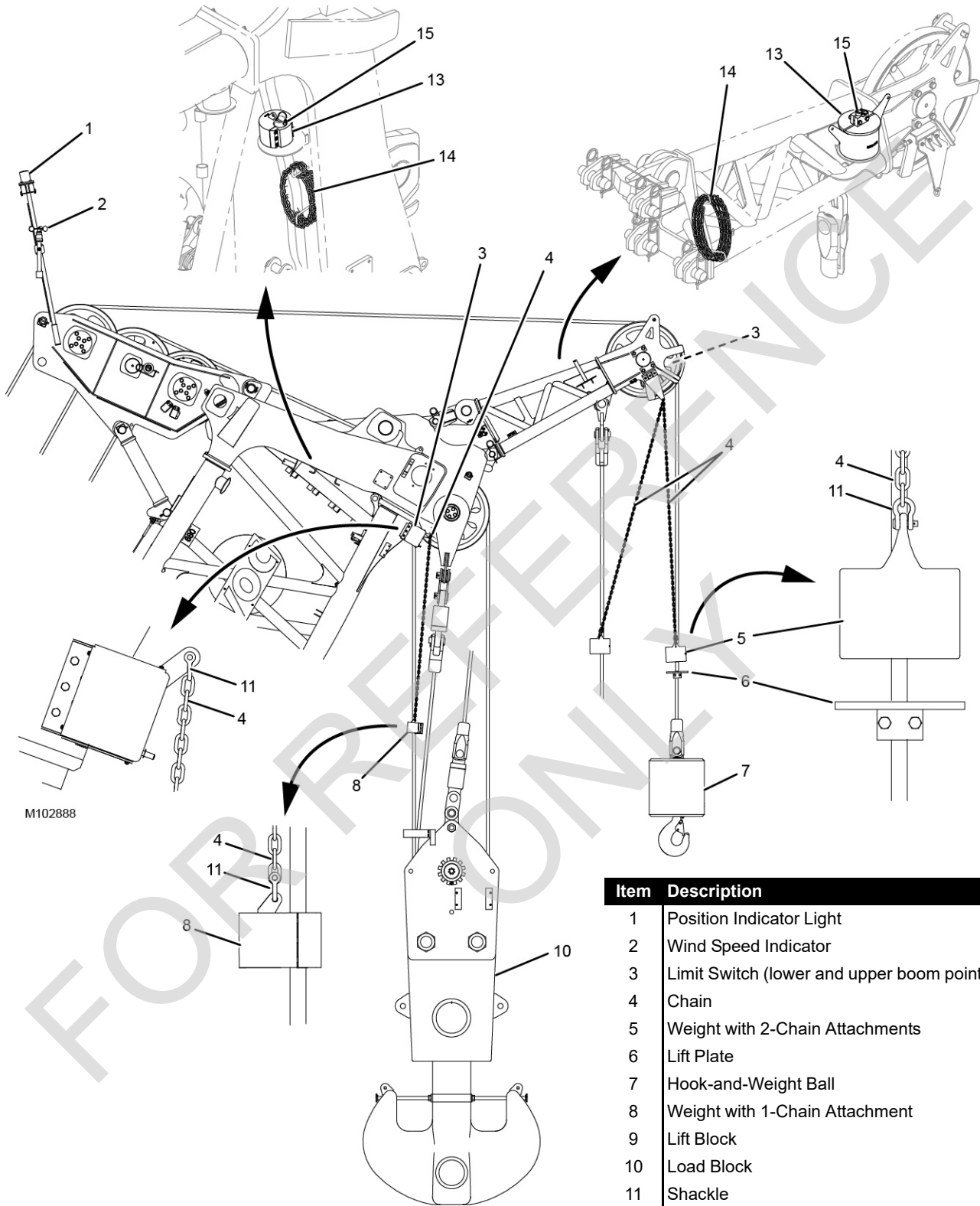
See [Figure 4-101](#), for the following steps.

1. Pay out the electric cables (10, 13, and 16, View B) from the cable reels in the 12M insert with sheaves and connect the electric cables to the cable clips (6, View C) on the bottom left chord of the boom sections.
2. Connect the electric cables (View B) to the cable connections (View E) on the boom top.
3. Connect the electric cables from the boom butt to the suggested receptacles in the camera switchers (12, View A). See the following diagram ([Figure 4-102](#)).
4. Disconnect the CAN terminator (8, View E) from the CAN NET IN electric cable (8).
5. Connect WN145000 electric cable (15, View E) to the CAN NET IN electric cable (8).
6. Connect the strain relief cable to the J-bolt.
7. Connect the WBR1 electric cable (14, View C) to the WBT1 receptacle (9).
8. Connect the CCTV cable (11, WBR3) to the camera cable (5, WJT3) (this is an option).



M102930

FIGURE 4-102



Item	Description
1	Position Indicator Light
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	Lift Block
10	Load Block
11	Shackle
12	Weight and Chain Storage
13	Weight Storage
14	Chain Storage
15	Safety Pin

FIGURE 4-103

Install the Boom Load Lines

1. Route the load lines up the boom. See [Figure 4-165 on page 4-204](#).
2. Pull the load lines approximately 20 ft (6,1 m) past the end of the boom.
3. Install the load block(s)(10) and hook-and-weight ball (7) after the boom is raised to a convenient height. See Boom Raising Procedure on ["Boom Raising Procedure" on page 4-134](#).

If equipped, the rigging winch can be used to assist in pulling the load lines. See ["Rigging Winch Operation" on page 4-202](#).

4. Read the following topics:

- ["Wire Rope Installation" on page 4-195](#).
- ["Load Line Reeving" on page 4-205](#).
- ["Wire Rope Specifications" on page 4-206](#).
- Reeving diagrams at the end of this section

Install the Boom Block-Up Limit Components

Install the block-up limit components as shown in [Figure 4-103](#). The chains (14, stored) and weights (15, stored) are shipped on the top and the point.

FOR REFERENCE ONLY

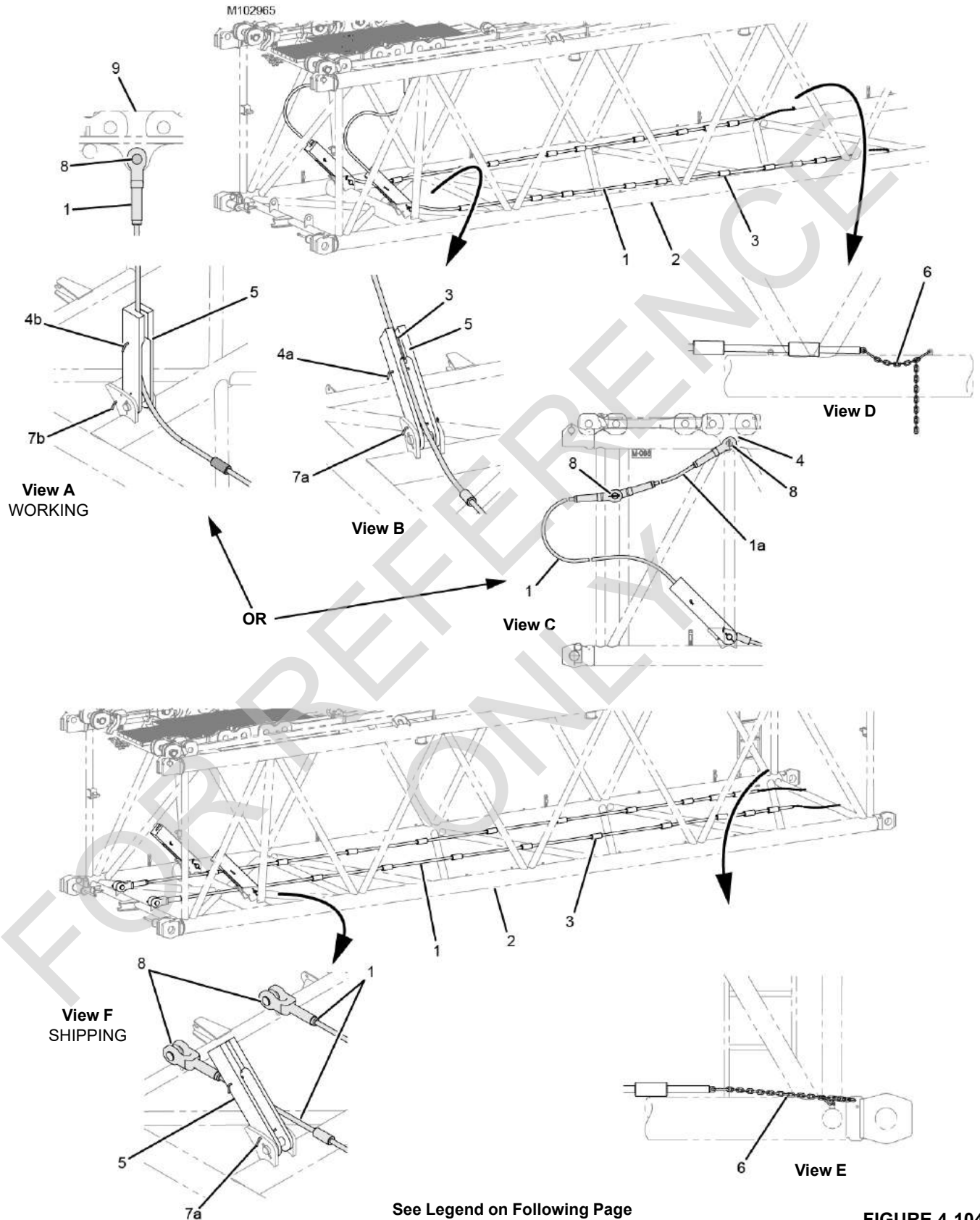


FIGURE 4-104

RAISE BOOM

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

Pre-Raising Checks

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 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 wire rope guide (if required) is installed at proper insert.
- Intermediate suspension insert (if required) is installed in proper position.
- Intermediate suspension pendants (if required) are secured in proper operating position and sockets are in working position.
- Drop-down suspension (if required) is installed in proper position.
- Drop-down suspension pendants (if required) are secured in proper operating position and sockets are in working 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.
- Electric cables from crane control system are connected to cable reel in boom butt.
- Electric 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. Consult the selected capacity chart for applicable deducts and boom length raising limitations.
- Wind is within allowable limits for operation as shown in Wind Conditions document located at end of Section 3.

Boom Raising Procedure

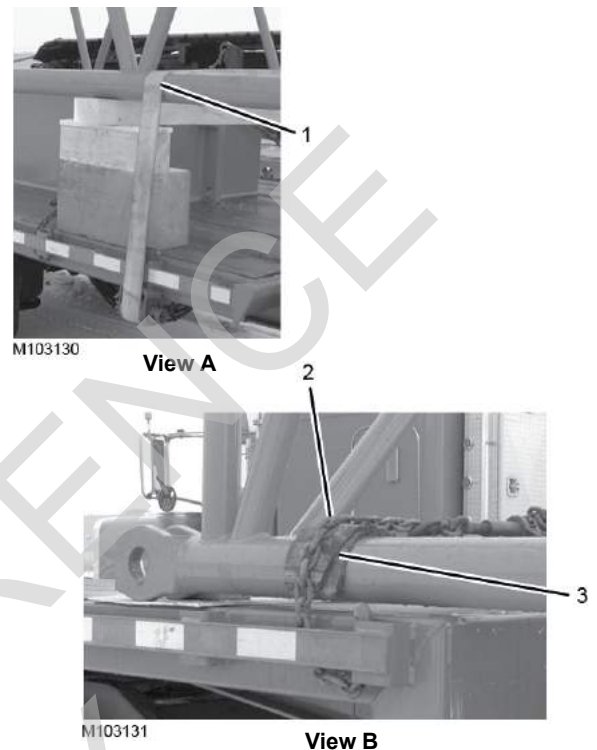
1. Verify that the pre-raising checks have been performed.
2. SLOWLY start to boom up:
 - a. Have an assistant watch the boom straps as the boom rises.
Signal the operator to STOP raising the boom if the straps get caught on the brackets, pins, or timber guards. Correct the problem before continuing.
 - b. If equipped with suspension pendants —
 - **intermediate:** perform [step 7](#) (a through h) on [page 4-133](#)
 - **drop-down:** perform [step 19](#) (a through f) on [page 4-99](#)
 Signal the operator to STOP raising the boom if the pendants get caught or do not rise smoothly out of the inserts. Correct the problem before continuing.
3. SLOWLY continue to boom up.
4. When there is enough tension on the straps, the operating limit will become active indicating to switch to VPC Setup Mode.
5. If equipped with an upper boom point, stop when the bottom holes in the upper boom point are aligned with the holes in the boom top. Install the connecting pins. [Figure 4-87 on page 4-110.](#)

6. 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-or-weight ball.
7. Install the load block(s) and hook-or-weight ball at the lower and upper boom points.
8. Install the block-up limit components at the boom points. [Figure 4-103 on page 4-130.](#)
9. 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-or-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.
10. Install the load block or hook-or-weight ball at the jib point.
11. Install the block-up limit components at the jib point.
12. 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.
13. Once into the chart, a second operating limit will become active indicating to switch off the VPC Setup Mode.

NOTE: When the VPC Setup Mode is turned off, the VPC may reposition itself, depending on the crane configuration.

14. Once the boom is raised:
 - 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. Check that the boom stop is adjusted for the proper maximum boom angle.
 - d. Check that the RCL/RCI is properly calibrated.

SHIPPING CRANE COMPONENTS



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 4-106

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 4-106](#), 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 4-106](#), 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 ([Figure 4-106](#), View A) to prevent bending the chords.

CRANE DISASSEMBLY

Read all of the topics on [page 4-1](#) through [page 4-10](#) before proceeding.

Preparing Crane

1. Position the crane in the disassembly area.
2. If required, position a **block under the boom end of the crawlers**. See the following:
 - Appropriate Liftcrane Boom or Jib Capacity Chart for blocked crawler requirements.
 - Crawler Blocking Diagram in the Capacity Chart Manual for blocking dimensions.



DANGER

Tipping Hazard!

Do not attempt to lower the boom or the boom and jib to the ground until the crawlers are blocked, if required. Otherwise, the crane will tip.

Lowering Boom

1. 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.
2. Swing the boom in line with the crawlers and slowly lower the boom.
 - 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 when the upper boom point just contacts the ground.
 - d. Position a block under the boom top sheaves to prevent them from digging into the ground.
3. If equipped with suspension pendants —
 - intermediate ([Figure 4-104 on page 4-132](#))
 - drop-down ([Figure 4-79 on page 4-98](#))

make sure the pendants lower into the corresponding insert as the boom lowers.
4. Continue to lower the boom until the boom straps are resting in the brackets on the top of the boom sections, and the mast is at approximately 158° (see [Figure 4-38 on page 4-47](#)).
5. Stop the engine.

Removing Block-Up Limit Components

Remove the block-up limit weights and chains (see [Figure 4-103 on page 4-130](#)) and store them as shown.

- The chain and weight for the lower boom point are stored on brackets in the boom top.
- The chain and weight for the upper boom point are stored on brackets on the upper boom top.

Storing the Load Lines

1. Disconnect the button sockets, the swivels, and the links from the boom and jib tops (see [Figure 4-167 on page 4-206](#)).
2. Disconnect the load lines from the button sockets.
3. Wind the load lines onto the load drums and secure them for shipping.
4. Store the button sockets, the swivels, the links, and the connecting pins in the parts box.

Removing Boom Top Cameras

Reverse the camera installation steps (see [Figure 4-101 on page 4-128](#)) and store the camera in the job box.

- Clean all cable connectors and dust caps.
- Securely fasten dust caps to all cable ends and receptacles.

Disconnecting Boom Butt Electric Cables

Reverse the installation steps (see ["Connect Electric Cables from Boom Butt to Crane" on page 4-123](#)).

- Clean all cable connectors and dust caps.
- Securely fasten dust caps to all cable ends and receptacles.

Store the electric cables on the boom butt (see [Figure 4-91 on page 4-116](#)) and secure them with plastic wire ties.

Be sure to install the CAN terminator (4, [Figure 4-108 on page 4-137](#)) on the end of the electric cable or you will encounter faults when the engine is started.

Disconnecting Boom Butt Hydraulic Hoses

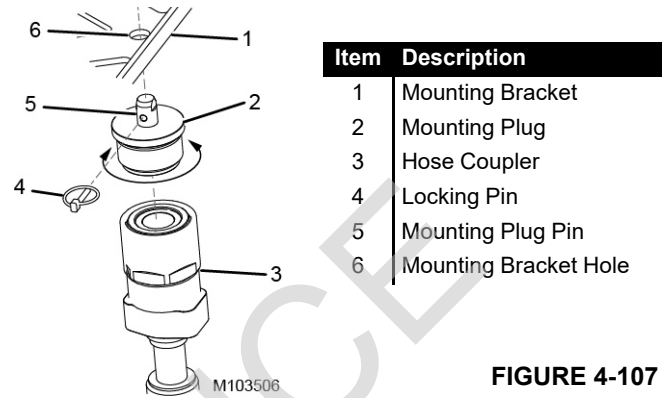
Disconnect the hydraulic hoses between the boom butt and the rotating bed.

- Clean all hose couplers and dust caps.
- Securely fasten dust caps to all hose couplers.
- Store the hydraulic hoses as shown (1, [Figure 4-108](#)).

The quantity of hydraulic hoses from the crane to the boom butt will vary depending on the drum options.

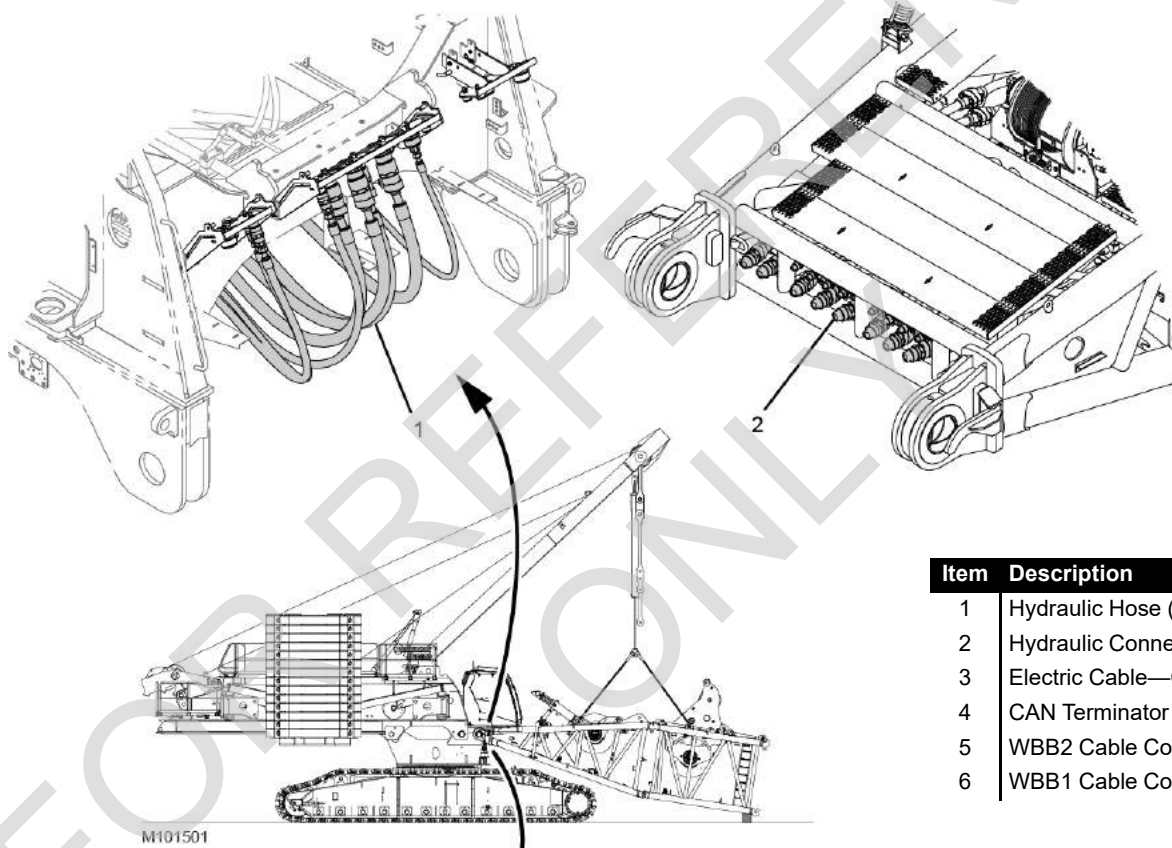
See [Figure 4-107](#) for the following steps:

1. Hold onto the mounting plug (2) and remove the locking pin (4).
2. Disconnect the hose coupler (3) from its working position and screw the mounting plug into the hose coupler.
3. Align the mounting plug pin (5) with the mounting bracket hole (6) on the mounting bracket (1) and secure with the locking pin.
4. Repeat steps for remaining hoses.



Item	Description
1	Mounting Bracket
2	Mounting Plug
3	Hose Coupler
4	Locking Pin
5	Mounting Plug Pin
6	Mounting Bracket Hole

FIGURE 4-107



Item	Description
1	Hydraulic Hose (stored) (qty 8)
2	Hydraulic Connector (boom butt)
3	Electric Cable—CAN D
4	CAN Terminator
5	WBB2 Cable Connect to WFR2
6	WBB1 Cable Connect to WRL2

4

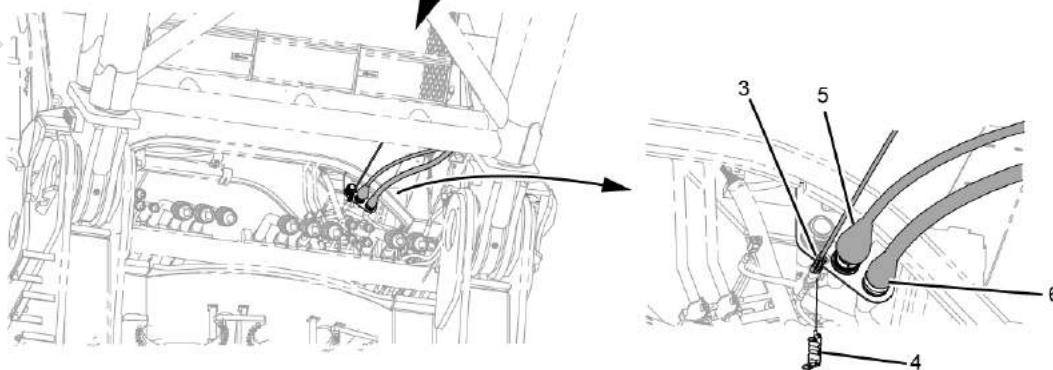
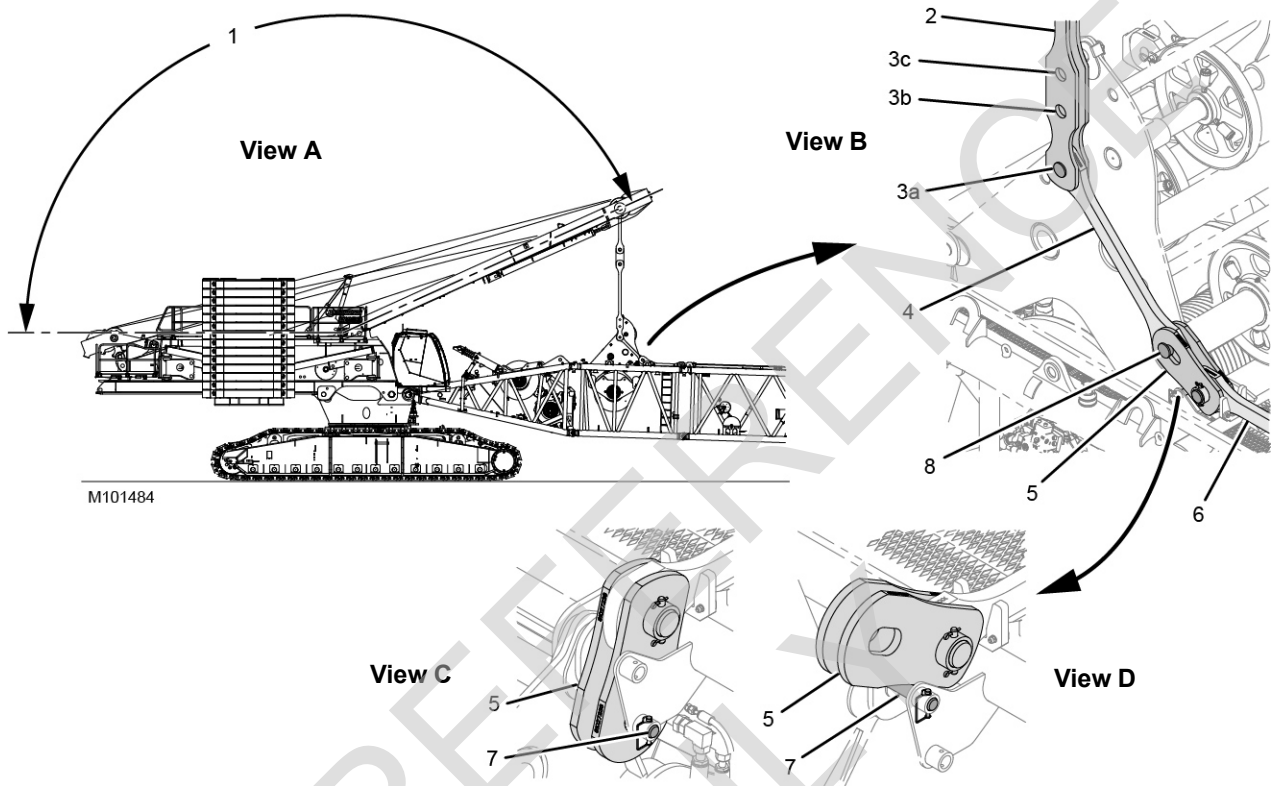


FIGURE 4-108



M101484

Item	Description
1	Live Mast Angle (maximum)
2	Live Mast Link
3a	Hole A
3b	Hole B
3c	Hole C
4	Strap
5	Link
6	Strap
7	Locking Pin and Pin
8	Retaining Pin

FIGURE 4-109

Activating Setup Mode

Perform the steps under [Setup Mode on page 4-13](#).

Disconnecting Mast Straps from Boom Straps

See [Figure 4-109](#) for the following steps:

- Using the switch on the remote control or on the right control console (in cab), fully RAISE the mast assist arms. Confirm that the mast assist arms (View A) are fully raised before proceeding.

NOTE The following will occur if you attempt to raise the mast when the mast assist arms are down:



- The mast will stop rising.
- The hazard warning will come on and the MAST ASSIST ARMS DOWN icon will appear in the fault bar of the Main Display Working Screen.
- Make sure the mast assist arms are up before raising the mast.



WARNING

Mast Damage Hazard!

Do not exceed a maximum mast angle of 158° or mast damage will occur.

- Lower the live mast (1, View A) to approximately 158°.
- Secure the strap (4) and remove the cotter pin, collar, and retaining pin (8) connecting the strap to the link (5).
- Lift the link, remove the locking pin and pin (7, View D), rotate the links down into the stored position (View C), and install the locking pin and pin (7, View C).
- Repeat steps 5 and 6 for the other strap.

Lowering Carbody Platform

It is necessary to lower the carbody platform before disconnecting the 4M from the boom.

See [Figure 4-110](#) for the following procedure:

- Using an assist crane and slings or a forklift, slightly raise the platform to relieve pressure from hitch pins (3 and 4).
- Remove the hair-pin cotter and hitch pin (4, two locations).
- Remove hitch pin (3, two locations).
- Lower carbody platform until lower holes in strut (2) align.
- Insert hitch pin (3, two locations) securing platform.

Item	Description
1	Wire Locking Pin
2	Strut
3	Hitch Pin
4	Hitch Pin

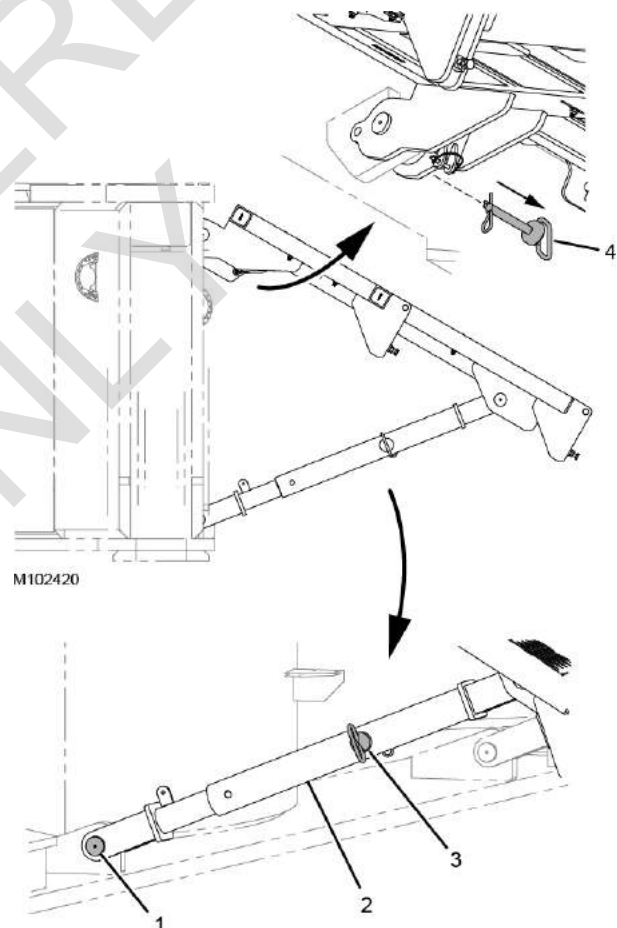
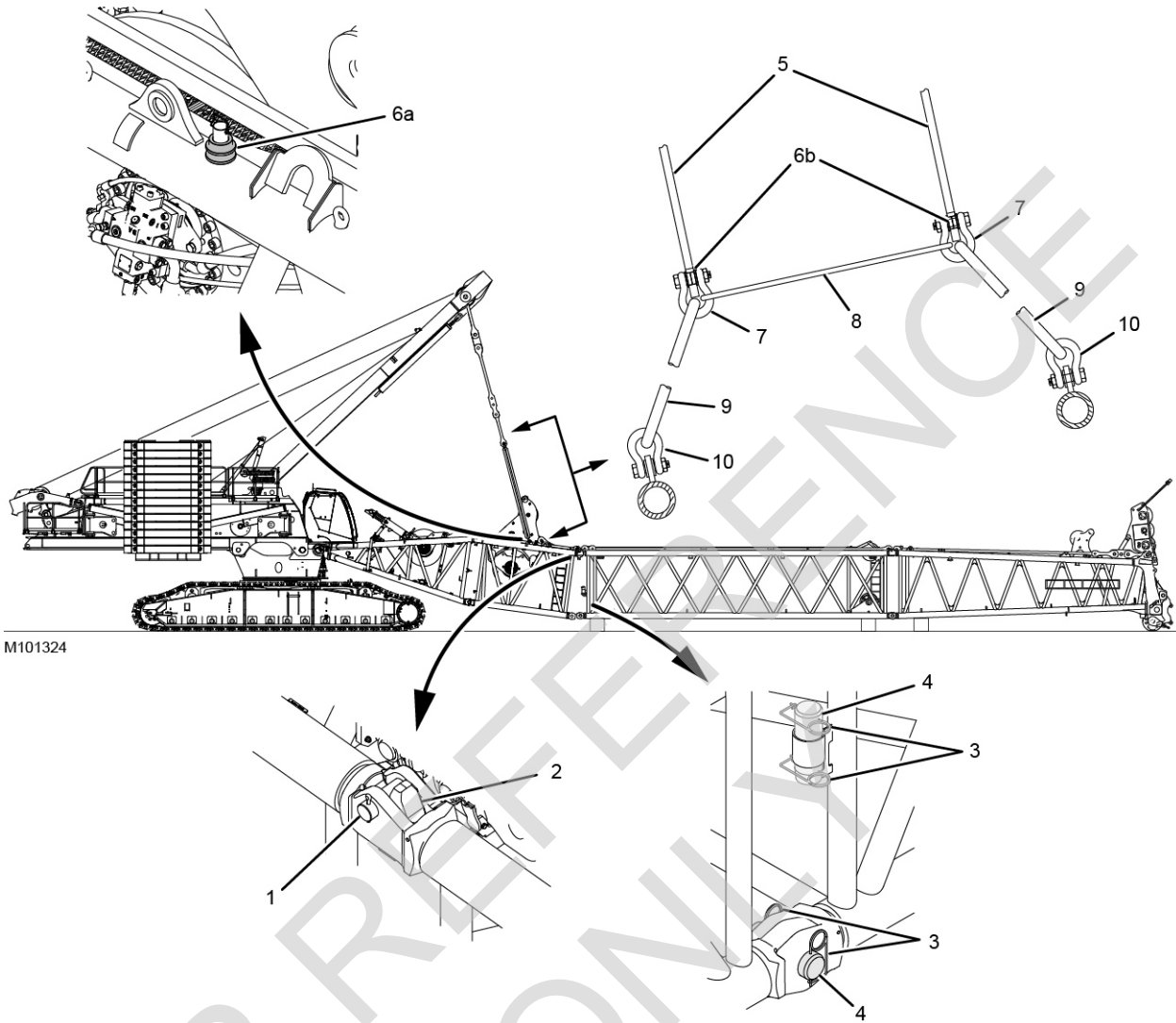


FIGURE 4-110



M101324

Item	Description
1	Fixed Horizontal Pin (qty 2)
2	Hooked Connector
3	Safety Pin (qty 2)
4	Lower Connecting Pin (qty 2)
5	Live Mast Strap (qty 2)
6a	Bushing (stored position) (qty 4)
6b	Bushing (working position) (qty 4)
7	SH 3 Shackle – 40 t (44 USt) (qty 2)
8	SL 3 Spreader Sling – 1,60 m (5.25 ft), 9 072 kg (20,000 lb)
9	SL 1 Sling – 3,30 m (10.83 ft), 45 360 kg (100,000 lb) (qty 2)
10	SH 3 Shackle – 40 t (44 USt) (qty 2)

FIGURE 4-111

Disconnecting Boom from 4M Insert

See [Figure 4-111](#) for the following procedure:

1. Attach the live mast straps (5) to the 4M lugs using the Manitowoc supplied shackles and slings.
2. Remove the bushings (6a) from the stored position and place the bushings (6b) into the live mast straps.
3. Install the shackles (7) with the spreader sling (8) between the live mast straps.
4. Connect the **SL 1** slings (9) to the **SH 3** shackles (7).
5. Connect the **SL 1** slings (9) to the 4M insert using **SH 3** shackles (10).
6. Boom up slightly to remove pressure from the lower connecting pins (4).
7. Remove the safety pins (3), connect the hand-held pin puller, and remove the lower connecting pins.

See ["Connect Hand-Held Pin Puller" on page 4-37](#) for more information.

8. Lower the boom onto the blocks and continue lowering until the hooked connector (2) releases from the upper fixed horizontal pin (1).



WARNING

Crushing Injury Hazard!

Stand outside the boom to prevent serious crushing injury, do not stand inside the boom sections when removing the connector pins.

9. Slowly move the crane away from the boom and position the crane, boom butt, and 4M in the desired disassembly area.
10. Lower the boom butt and 4M onto blocking to disconnect the live mast straps, shackles, and slings.
11. Remove the bushings (6b) from the live mast straps and store the bushings (6a) on the 4M insert.

Deploying Self-Erect Cylinder

See [Figure 4-112](#) for the following steps:

1. Raise the live mast (1) to an approximately 85° angle (2).
2. Extend the self-erect cylinder (3) to allow the pin (4) to release from the retention bracket (5).

Item	Description
1	Live Mast
2	85° Angle
3	Self-Erect Cylinder
4	Pin
5	Retention Bracket

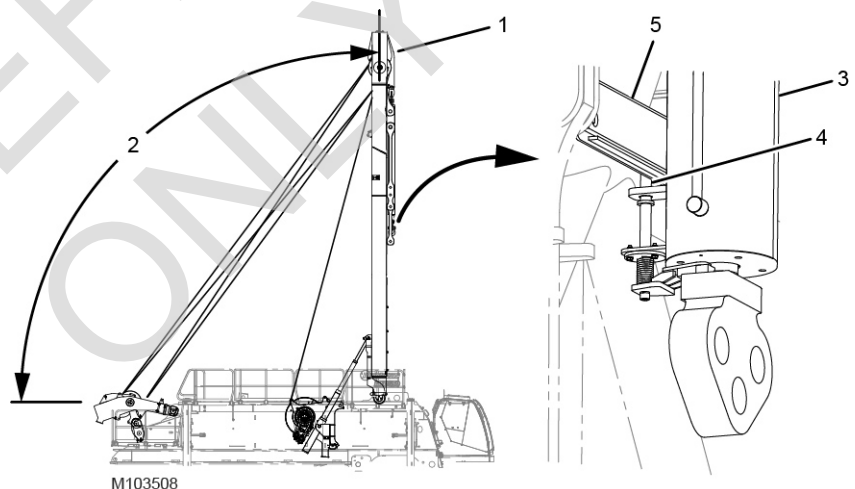


FIGURE 4-112

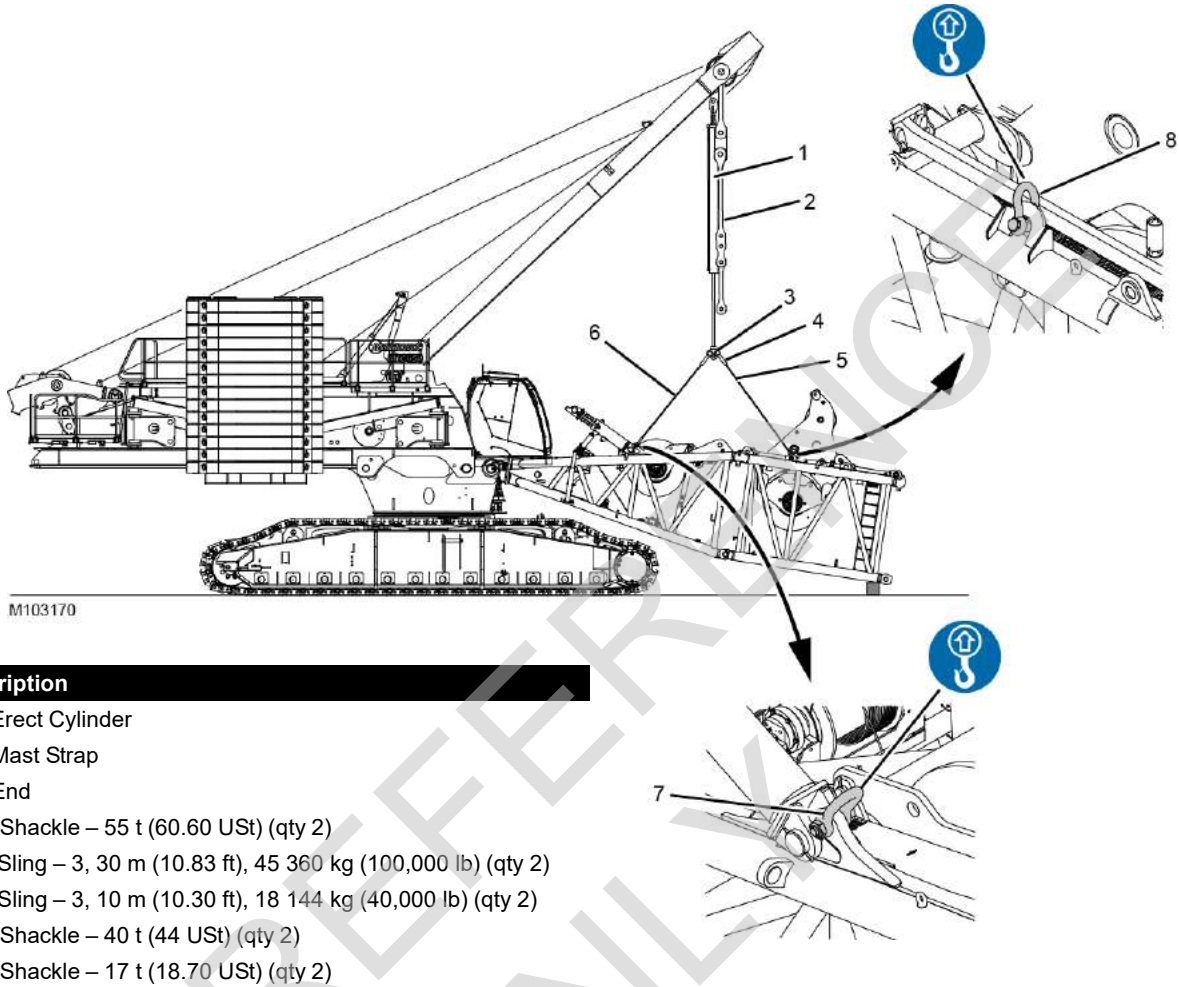


FIGURE 4-113

Item	Description
1	Self-Erect Cylinder
2	Live Mast Strap
3	Rod End
4	SH 1 Shackle – 55 t (60.60 USt) (qty 2)
5	SL 1 Sling – 3, 30 m (10.83 ft), 45 360 kg (100,000 lb) (qty 2)
6	SL 2 Sling – 3, 10 m (10.30 ft), 18 144 kg (40,000 lb) (qty 2)
7	SH 3 Shackle – 40 t (44 USt) (qty 2)
8	SH 2 Shackle – 17 t (18.70 USt) (qty 2)

Removing Boom Butt and 4M

See [Figure 4-113](#) for the following procedure.

1. Lower the live mast to approximately 158°.
2. Extend the self-erect cylinder (1) as needed to connect the appropriate slings (5 and 6) and shackles (7 and 8).
3. Retract the self-erect cylinder to remove slack from the slings.

Make sure the self-erect cylinder is vertical before lifting against the boom.

CAUTION

Avoid Structural Damage to Mast or Cylinder!

- Do not attempt to raise the boom butt with the mast.
- Use only the self-erect cylinder to raise the boom butt during the following steps.



WARNING

Crushing Injury Hazard!

Stand outside of the boom to prevent serious crushing injury, do not stand inside the boom sections when removing the connector pins.

See [Figure 4-114](#) for the following procedure:

4. Install the pin puller cage (2) and hand-held pin puller (1). See [Figure 4-30 on page 4-36](#) for more information.
5. Connect hydraulic hoses to the rotating bed and pin puller connection.
6. Retract the self-erect cylinder to lift the boom butt and 4M to a horizontal position as shown.
7. Remove the safety pin from the keeper plate and rotate the keeper plate (4, both sides) up.

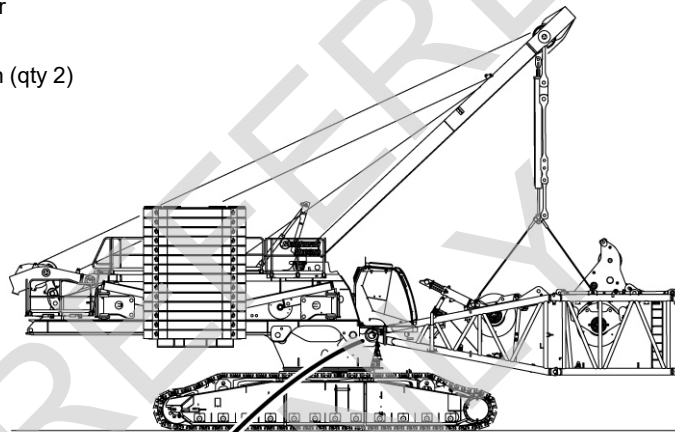
8. Use the hand-held pin pullers to remove the boom butt hinge pins (3).
9. Remove the boom butt hinge pins.
10. Retract the self-erect cylinder to lift the boom butt and 4M to clear the pin holes in the adapter frame.
11. Push boom butt hinge pins back into the working position, rotate the keeper plates down into the groove of the boom butt hinge pins, and install the safety pins.

! WARNING
Moving Load Hazard!

The boom butt and 4M may swing away from the crane when the boom butt hinge pins are disengaged. Prevent personnel from being struck by the boom butt and 4M:

- Warn all personnel to stand well clear of the boom butt and 4M.
- Stabilize the boom butt and 4M with taglines.

Item	Description
1	Hand-Held Pin Puller
2	Pin Puller Cage
3	Boom Butt Hinge Pin (qty 2)
4	Keeper Plate (qty 2)



M101482

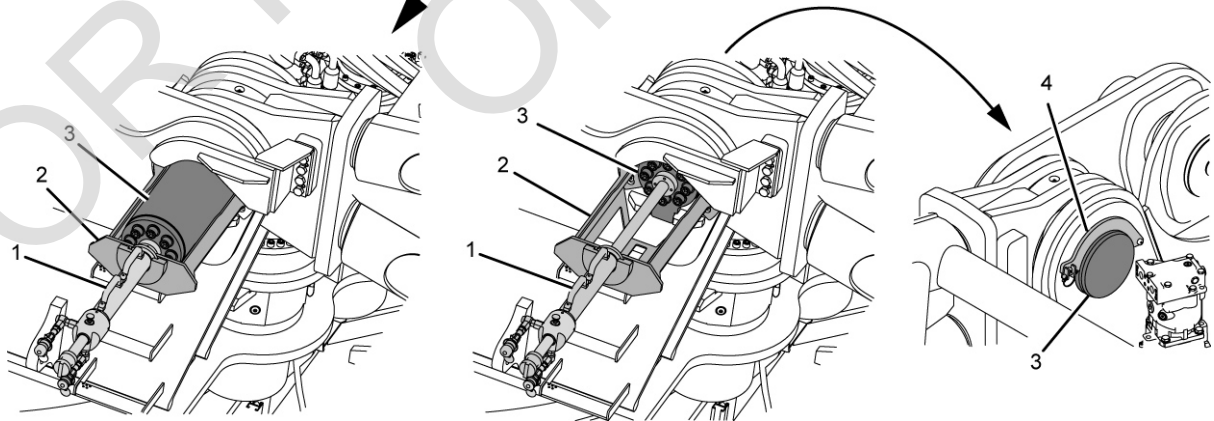


FIGURE 4-114

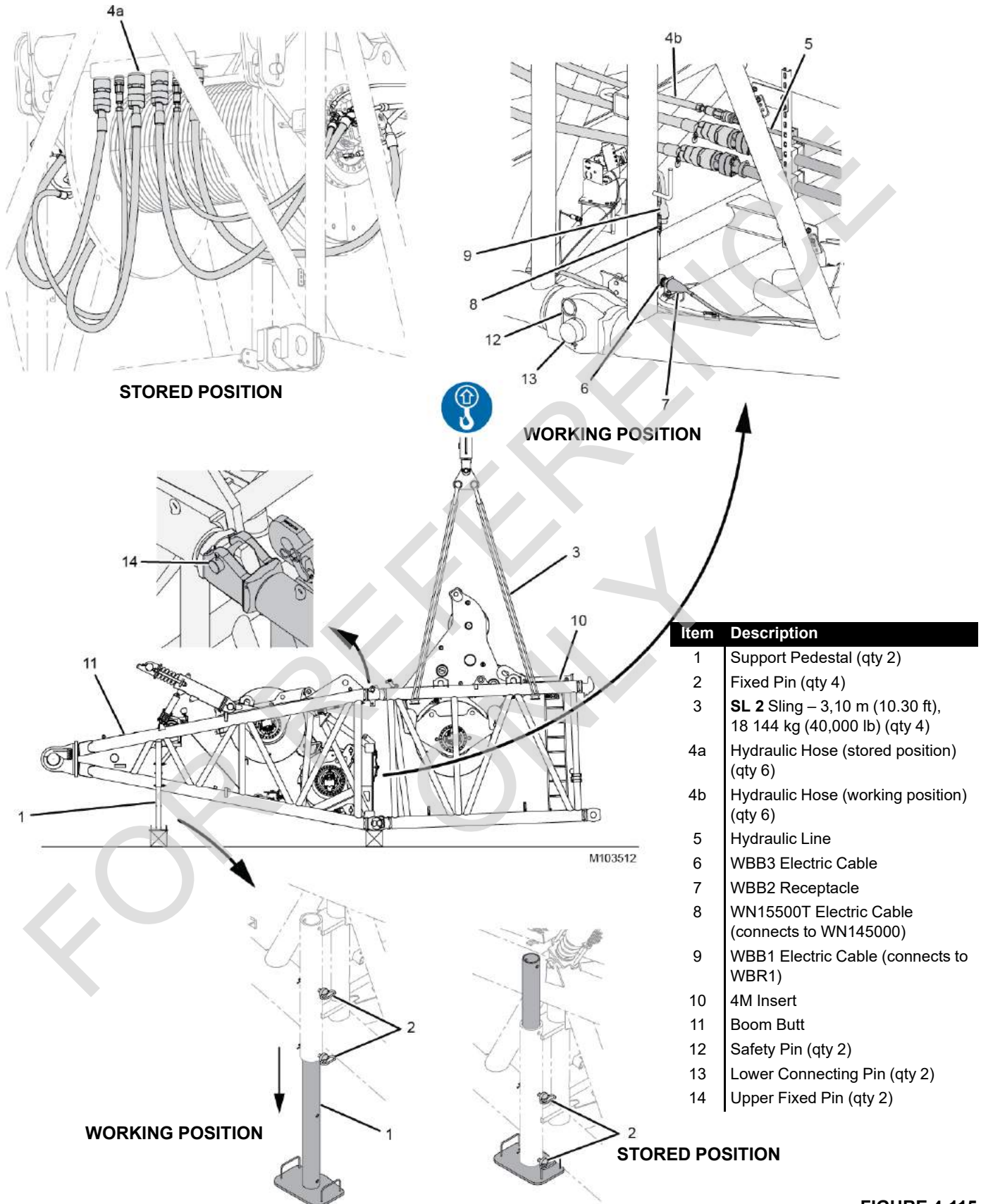


FIGURE 4-115

Separating 4M Insert from Boom Butt

See [Figure 4-115](#) for the following procedure:

1. Lower boom butt (11) and 4M insert (10) close to the ground.
2. Remove the fixed pins (2, stored position) on the support pedestal (1) on both sides of the boom butt. Lower the boom butt support pedestals until the holes align, and insert the fixed pins (2, working position).
3. Arrange blocking under the support pedestals and at the end of the boom butt section as shown.
4. Lower the boom butt onto the blocking.
5. Remove the **SL 2** slings (3) from the boom butt and 4M insert.
6. Attach the **SL 2** slings to the 4M insert (10).
7. Disconnect the electrical cables and securely fasten the dust caps to all cable ends or receptacles. Store and secure cables with plastic wire ties.

Be sure to install any CAN terminator plugs to avoid electrical faults.

8. Disconnect the 4M hydraulic hoses (4b) from the boom butt hydraulic line (5).
 - Clean all hose couplers and dust caps.
 - Securely fasten dust caps to all hydraulic couplers.
 - Store the hydraulic hoses (4a).

9. Remove the safety pins (12) from the lower connecting pins (13).
10. Either install the hand-held pin puller and remove both of the lower connecting pins (13),
 - OR** manually remove both lower connecting pins (13) and store them in the holders on the insert.
11. Lift the 4M insert. As the 4M insert rises, it will tilt toward the boom butt, allowing the two sections to separate at the bottom.
12. Continue to lift the 4M insert to allow the upper fixed pins (14) to release from the upper hooked connector on the boom butt.
13. Place the 4M insert on a trailer and disconnect the lifting slings.
14. Secure the 4M insert to the trailer (see ["Shipping Crane Components" on page 4-135](#)).

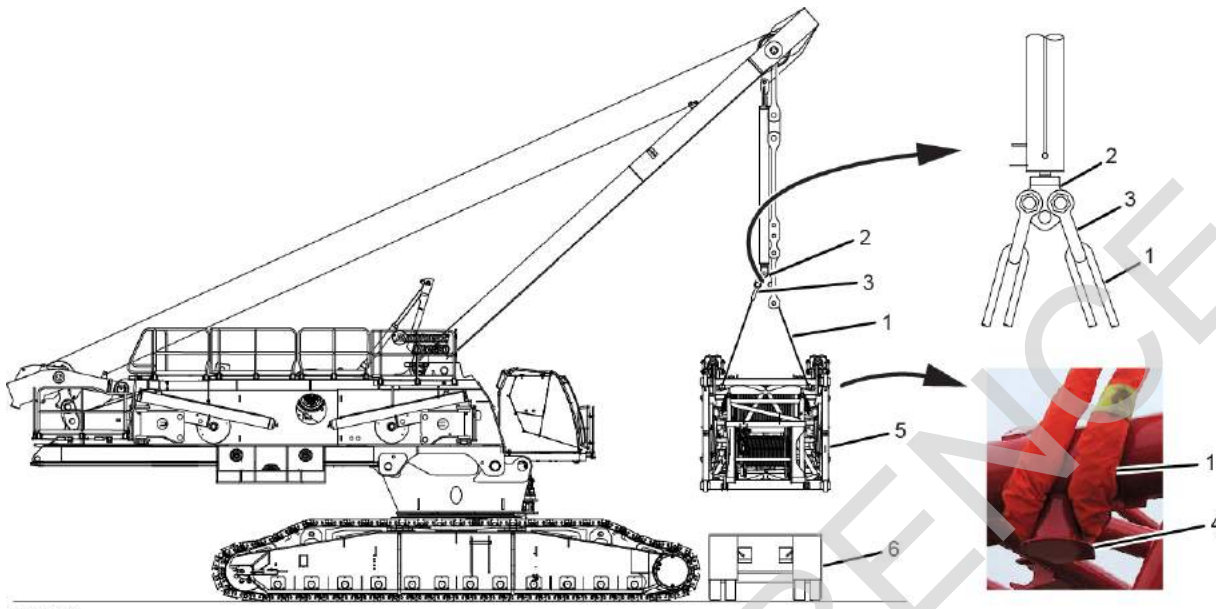
Lowering the Wire Rope Guide

See [Figure 4-116](#) for the following procedure:

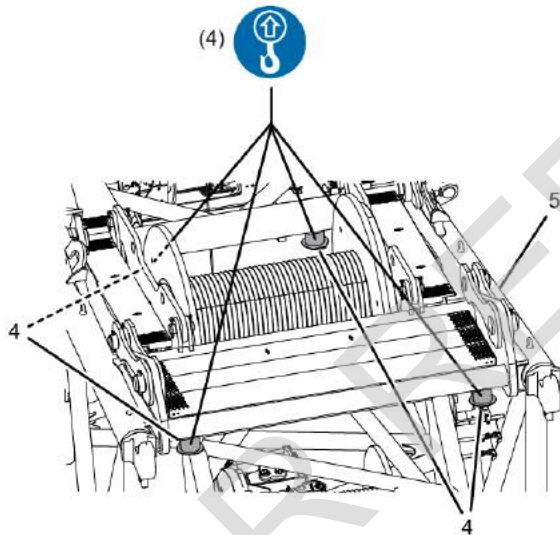
1. Attach lifting slings to the lifting lugs (3).
2. Remove safety pins and pins (2, working position).
3. Lower the wire rope guide (1).
4. Install the pins and safety pins (2, stored position).
5. Remove lifting slings.



FIGURE 4-116



M103513



Item	Description
1	SL 4 Sling – 3,80 m (12.50 ft), 11 340 kg (25,000 lb) (qty 4)
2	Rod End
3	SH 1 Shackle – 55 t (60.60 USt) (qty 2)
4	Lifting Lug (qty 4)
5	Boom Butt
6	Trailer

FIGURE 4-117

Loading Boom Butt

See [Figure 4-117](#) for the following procedure:

1. Rig four **SL 4** slings (1) from the self-erect cylinder rod end (2) using **SH 1** shackles (3).
2. Attach slings to the lifting lugs (4) on the boom butt (5).
3. Raise the boom butt and place it on the trailer (6).
4. Disconnect the four nylon lifting slings from the four lifting lugs on the boom butt.
5. Secure the boom butt to the trailer (see ["Shipping Crane Components"](#) on page 4-135).

Raising Carbody Platform

See [Figure 4-118](#) for the following procedure:

1. Using an assist crane and slings or a forklift, slightly raise the platform to relieve pressure from the hitch pins (3) and remove them.
2. Raise the carbody platform until upper holes in the strut (2) align.
3. Insert hitch pin (3).
4. Insert the hitch pin with hair-pin cotter (4).

Item	Description
1	Wire Locking Pin
2	Strut
3	Hitch Pin (qty 2)
4	Hitch Pin with Safety Pin (qty 4)

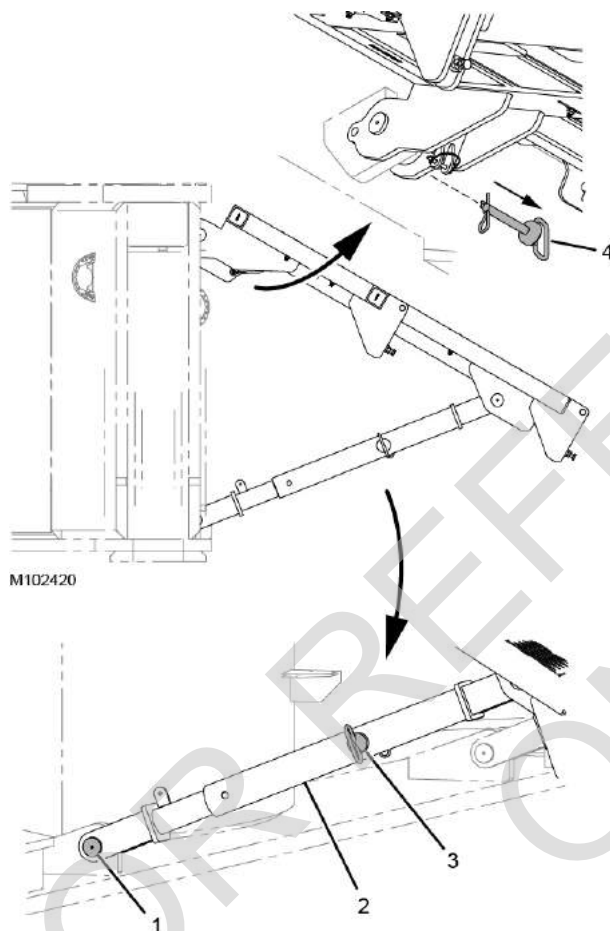


FIGURE 4-118

Disassembling Boom.

Read and understand all of the topics under ["Boom And Jib Rigging—General"](#) on page 4-86 through [page 4-89](#).



WARNING

Crush Hazard!

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

Fall Hazard!

The boom sections are equipped with catwalks and ladders for accessing boom components during crane assembly and disassembly. Take every precaution to prevent falling off boom sections. See ["Personal Fall-Protection"](#) on page 4-3.

If the MLC650 will be used to disassemble the boom, remove the counterweight boxes and tray before proceeding. Refer to the following bulleted procedures:

- ["Install Counterweight Boxes"](#) on page 4-81.
 - ["Install Counterweight Tray"](#) on page 4-75.
1. Disconnect the electric cables in the boom top. Reverse the steps under ["Connect Camera and Electric Cables"](#) on page 4-129.
Be sure to connect the terminator and shorting plugs shown in ["Connect Terminator/Shorting Plugs at Boom Top"](#) on page 4-111.
 2. Remove the upper boom point. Reverse the steps under ["Install Upper Boom Point"](#) on page 4-111.
 3. Remove and store the boom top position light and wind speed indicator. Reverse the steps under ["Install the Boom Block-Up Limit Components"](#) on page 4-131.
 4. Lower the boom top wire rope guide. Reverse the steps under ["Raise Boom Top Wire Rope Guide"](#) on page 4-103.
 5. Disconnect and store the boom straps and links. Reverse the steps under ["Connect Boom Straps"](#) on page 4-109.
 6. Disassemble the boom sections. Reverse the steps under ["Assemble Boom Inserts and Top"](#) on page 4-93.
 7. Lift the boom sections as shown in ["Boom Assembly"](#) on page 4-93.

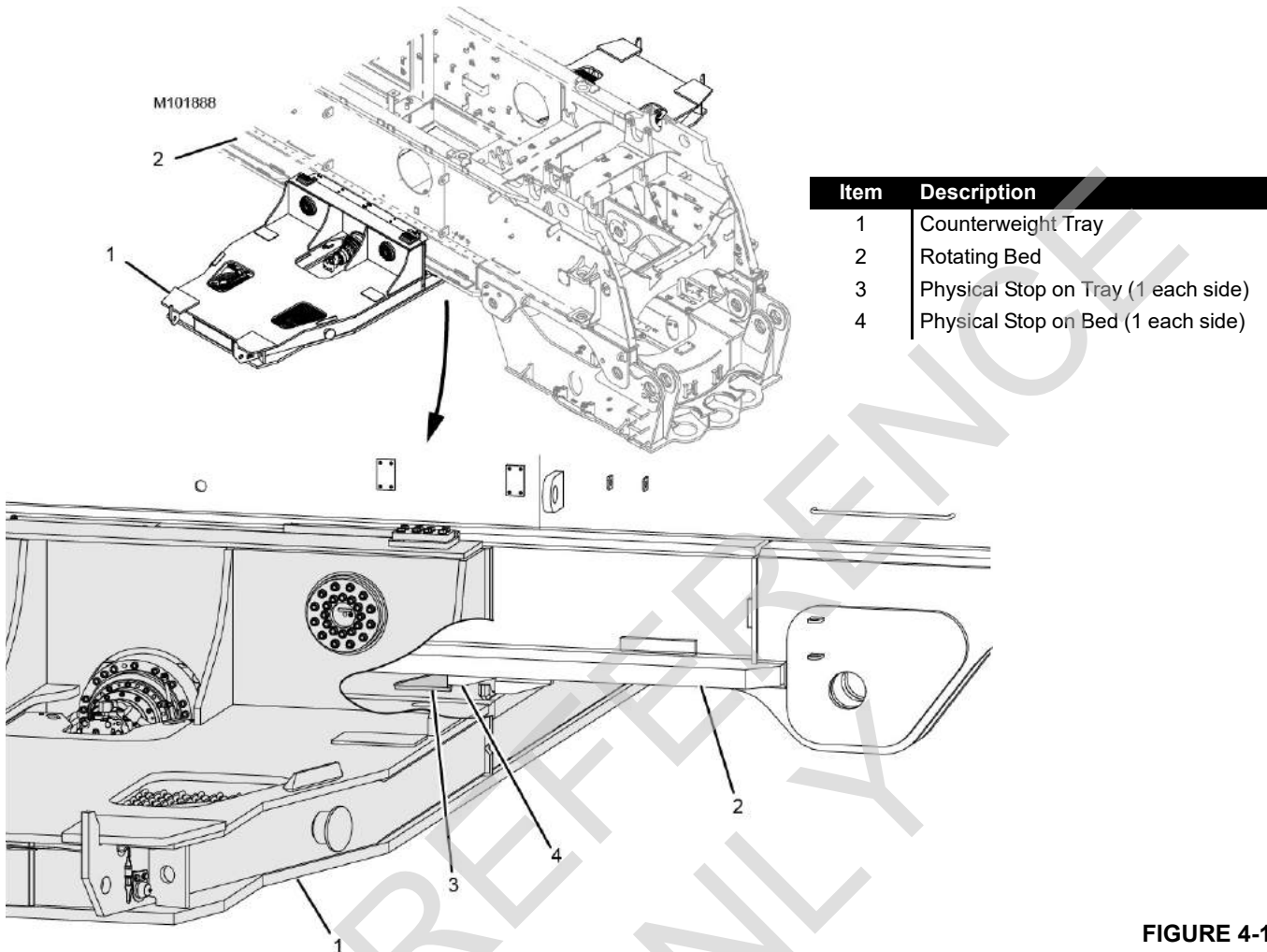


FIGURE 4-119

Removing Counterweight Boxes

WARNING
Crushing Hazard!

To prevent the crane from tipping and the counterweight boxes from falling off the tray during disassembly, do not remove the counterweight boxes until the counterweight tray is traveled to the position in step 1 shown in [Figure 4-119](#). The crane will tip.

To prevent the counterweight boxes from falling and crushing personnel see the following.

- Do not lift more than two boxes at a time. The lifting lugs may break, causing the boxes to fall.
- Remove the counterweight boxes in the sequence specified in step 4 of this procedure.

1. Using the switch on the remote control, travel the counterweight tray forward until the physical stop on the

tray (3, [Figure 4-119](#)) contacts the physical stop on the bed (4).

See [Figure 4-120](#) for the remaining steps.

NOTE: The counterweight boxes must be removed with an assist crane.

2. Loosen the turnbuckles (7) and remove the counterweight chain assemblies (2) from the counterweight tray lugs (6).

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

3. Store the counterweight chain assemblies in the counterweight tray after the counterweight boxes are removed.

4. Remove the counterweight boxes in the following sequence:

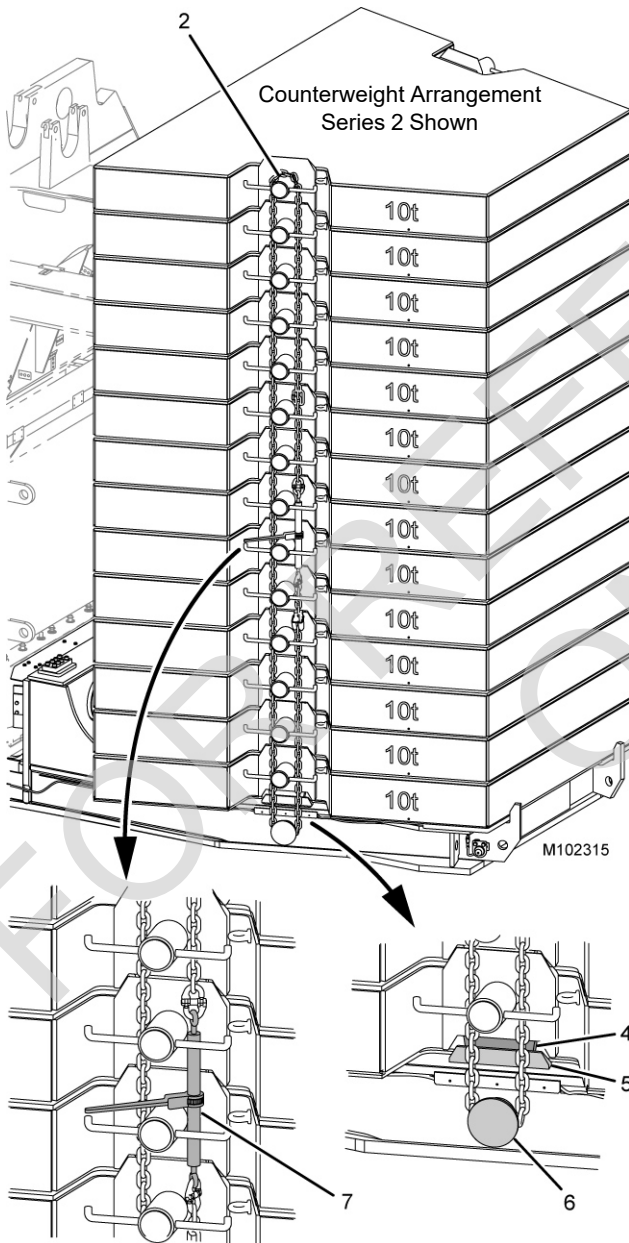
- a. Remove one counterweight box from either side of the tray.

- b. Remove two counterweight boxes from the other side of the tray.
- c. Continue removing the counterweight boxes in an alternating sequence, two boxes at a time.
- d. Finally, remove one counterweight box from the required side.

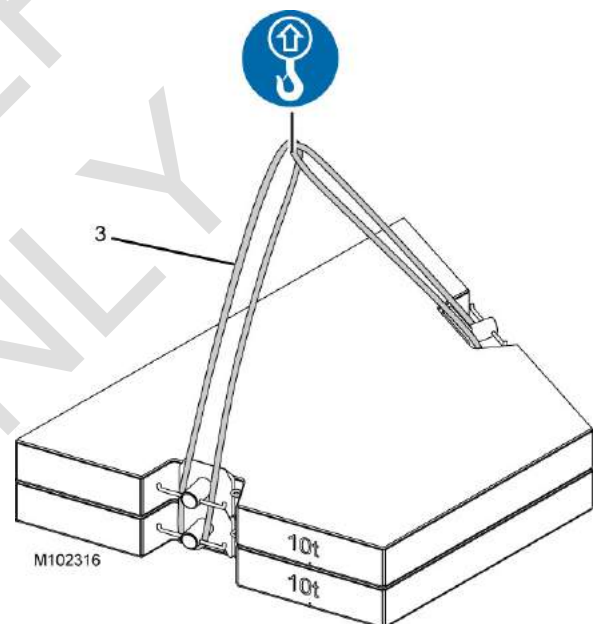
NOTE: A difference of no more than one counter weight box must be maintained side-to-side during disassembly.

The disassembly procedure is the same for all counterweight arrangements.

- 5. Attach **SL 4** slings (3) around the lifting lugs on the counterweight boxes. Two counterweight boxes may be lifted at one time.
- 6. Lift the counterweight boxes off the counterweight tray and place them on a trailer for shipping.
- 7. Disconnect the **SL 4** slings.
- 8. Repeat steps 5 – 7 until all of the counterweight boxes are removed.
- 9. Securely attach the counterweight box to the trailer with tie-downs.



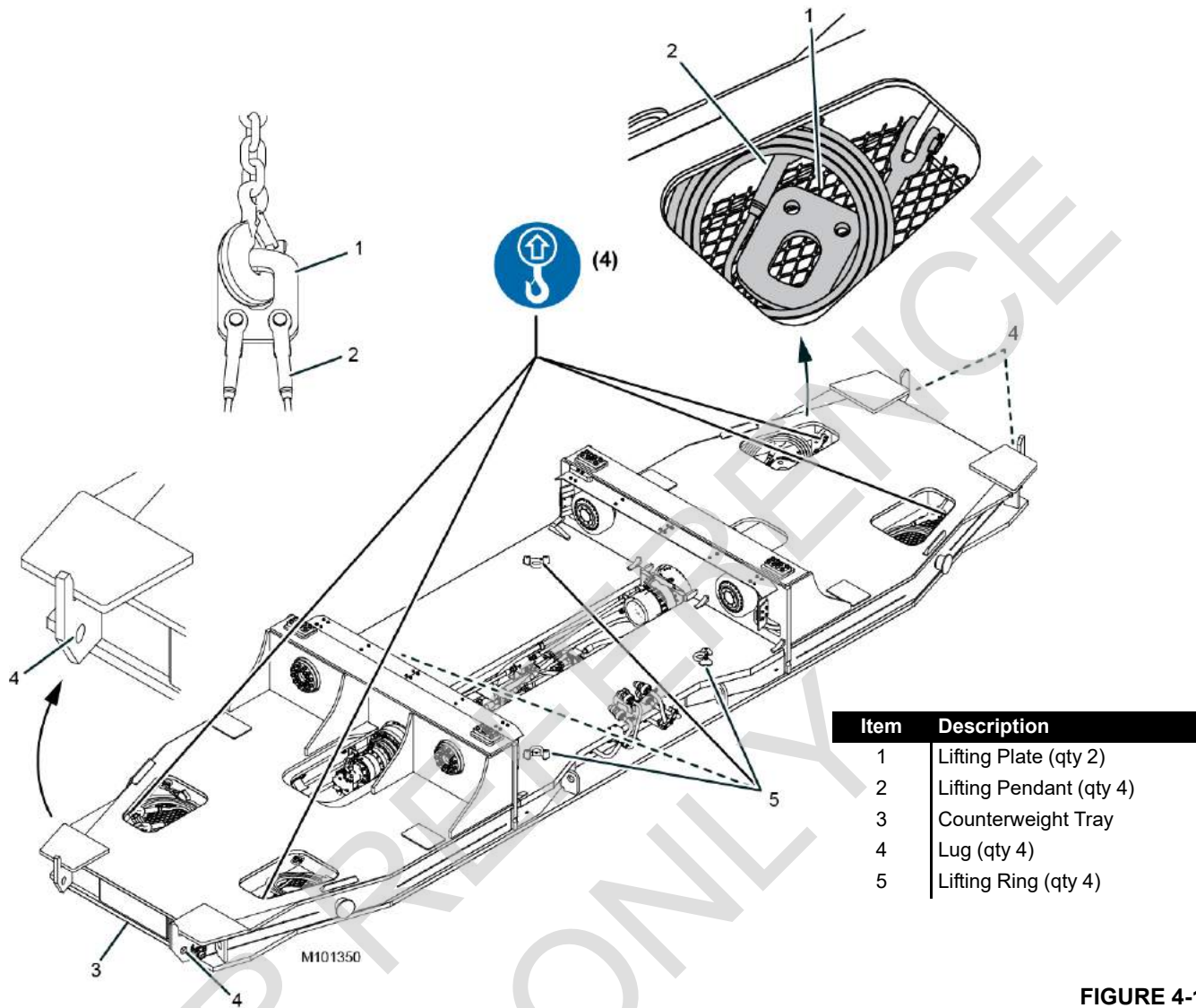
Series	Item 2	Quantity
1	Each Side	Total
1	9	18
2	14	28
3	19	38



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

FIGURE 4-120

4



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

FIGURE 4-121

Preparing Counterweight Tray for Removal

! DANGER
Tipping Crane Hazard!

Prevent the crane from tipping over.
 Do not attempt to remove the counterweight tray unless the crawlers are installed.

See [Figure 4-121](#) for the following procedure:

NOTE: For ease of counterweight tray handling and lifting, Manitowoc provides four lifting pendants (2) and two lifting plates (1), and two lifting lugs on each side of the tray. The counterweight tray must be removed with an assist crane.

1. Position the live mast in the operating range so it is out of the way.
2. Using the switch on the remote control, travel the counterweight tray (3) rearward until the limit switch stops it.
3. Using the lifting plates (1), attach four lifting pendants (2) to the hook block of the assist crane.

The other end of the pendants are attached to the lifting lugs in the counterweight tray.
4. Attach hand-held taglines to the lugs (4) on the rear corners of the tray. Have ground personnel control the swinging of the tray with the taglines.
5. Hoist with the assist crane so the lifting slings are taut.

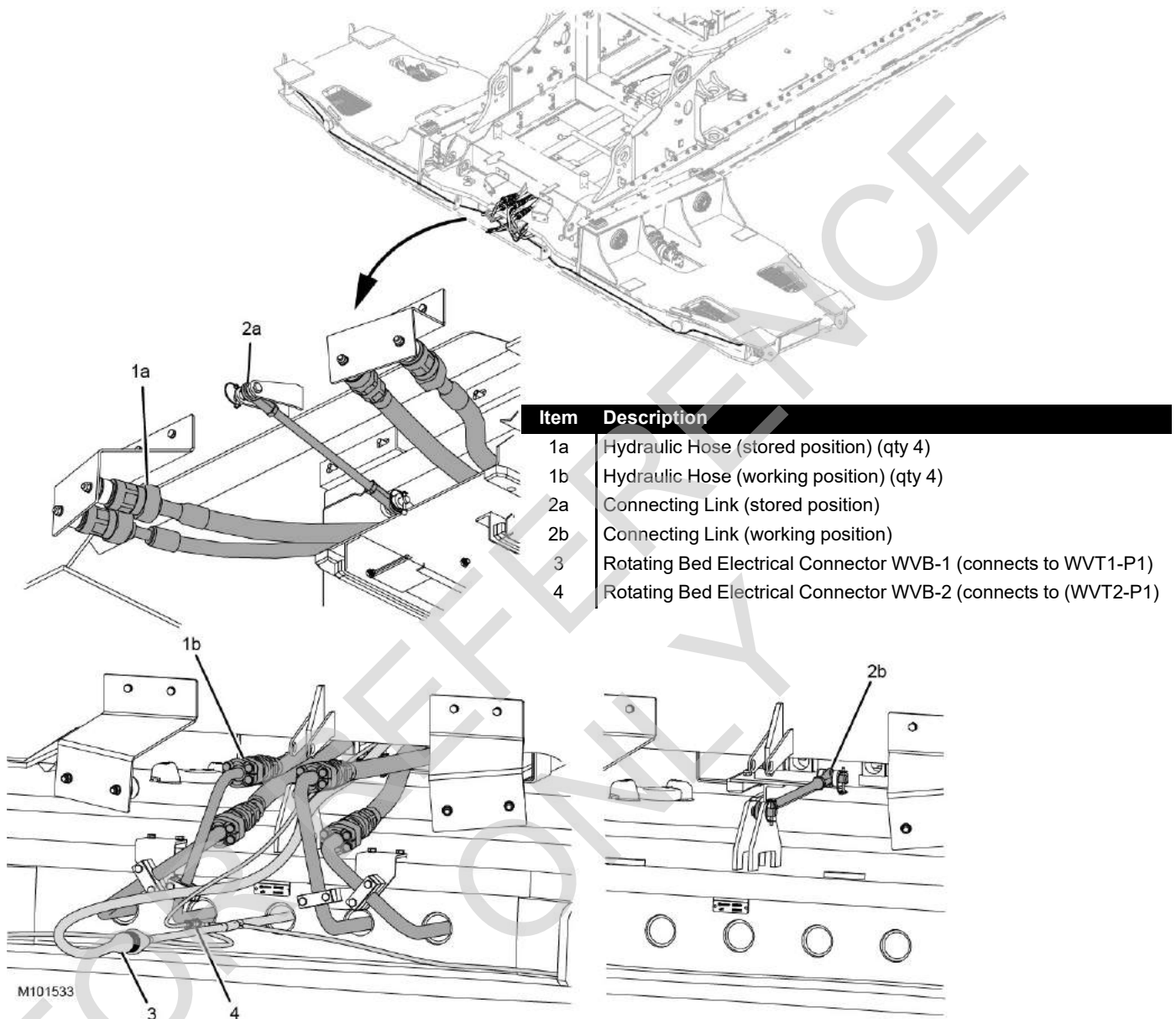


FIGURE 4-122

Disconnecting Counterweight Tray Hydraulics and Electrical Wiring

See [Figure 4-122](#) for the following procedure:

1. With the counterweight tray attached to the assist crane, disconnect the four hydraulic hoses (1b) from the working position and connect them to the stored position.

2. Disconnect the rotating bed electrical connectors (3 and 4).
3. Disconnect the connecting link (2b) from the working position and connect it to the rotating bed in the stored position.

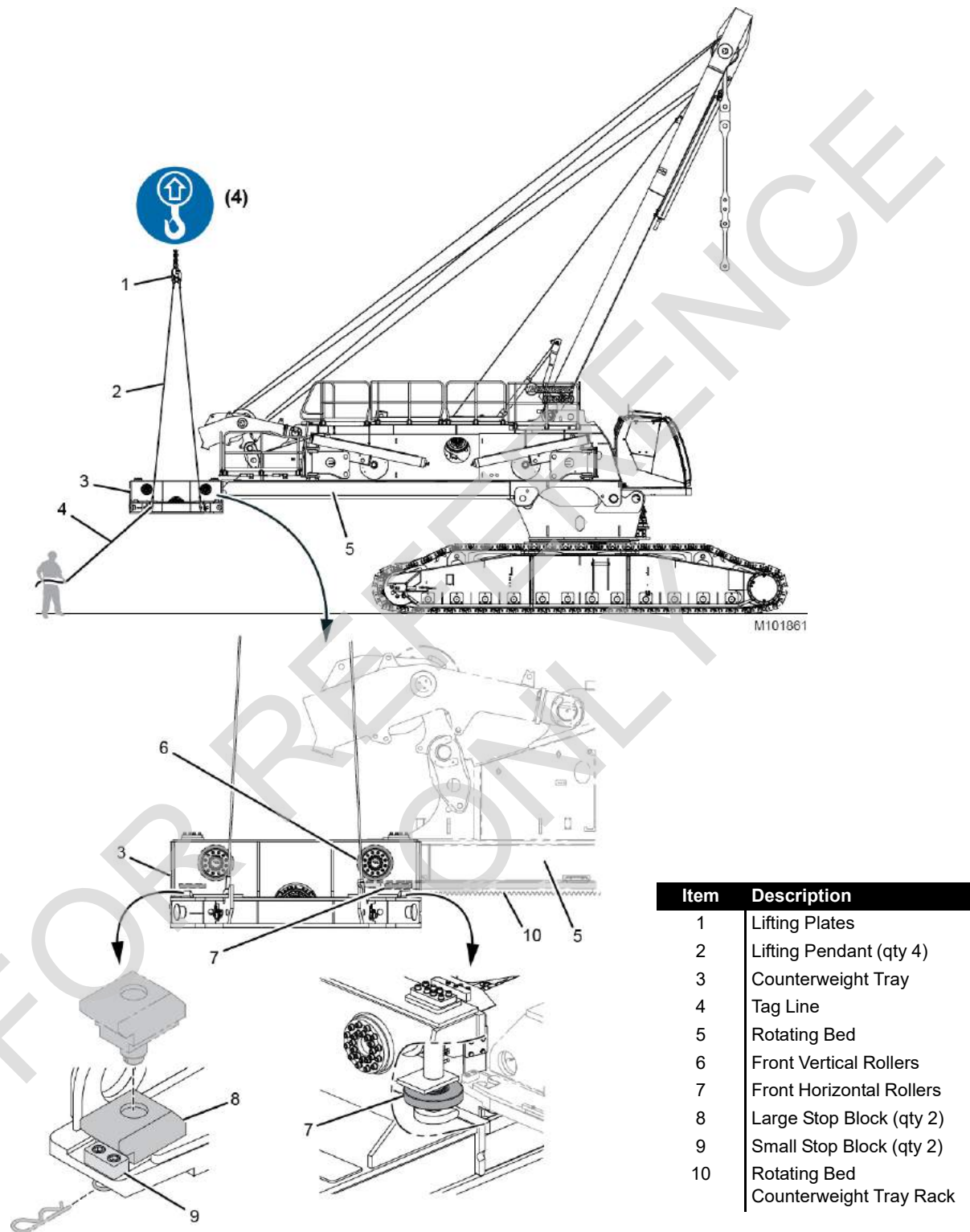


FIGURE 4-123

Removing Counterweight Tray

See [Figure 4-123](#) for the following procedure:

1. Remove the hair pin cotter from the two large stop blocks (8) and set aside.
2. Lower, travel, swing, and boom the assist crane as required to remove the counterweight tray (3).
3. Lower the counterweight tray onto a trailer and secure it with tie-downs.
4. Slacken the lifting pendants (2).
5. Disconnect the lifting pendants and the lifting plates (1) from the assist crane block hook.
6. Coil the lifting pendants (2, [Figure 4-121](#)) into the storage pockets.
7. Place the lifting plates (1, [Figure 4-121](#)) in the storage pockets.
8. Store the counterweight chain assemblies in the storage pockets in the counterweight tray.

 **WARNING**
Falling Load Hazard!

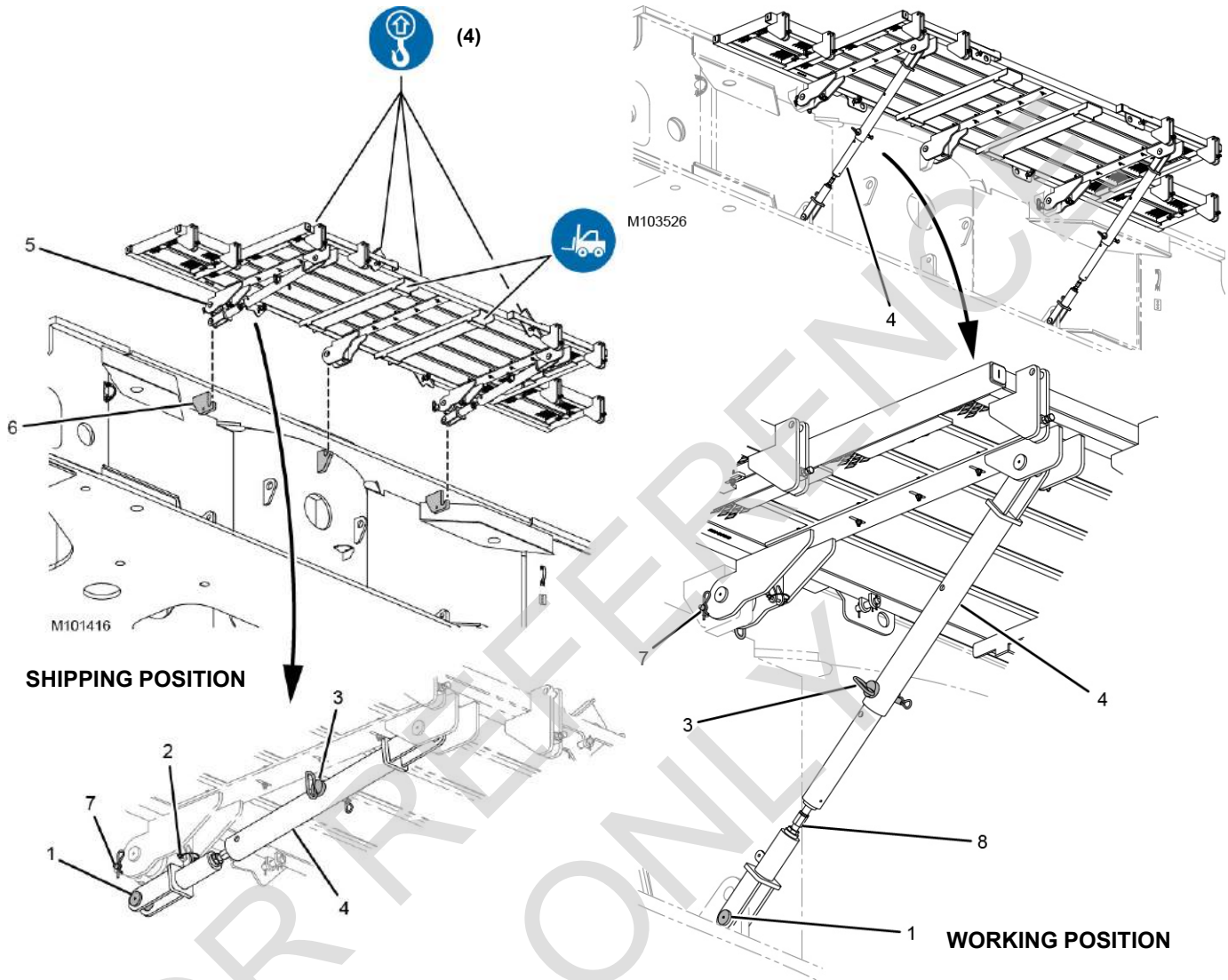
Prevent counterweight tray from falling.

The lifting slings are provided for lifting only the counterweight tray. Do not attempt to lift the counterweight tray with the counterweight boxes installed. The pendants could break, allowing the tray to fall.

Falling Hazard!

Prevent personnel from falling.

Do not allow personnel to ride the counterweight tray while it is being lifted.



Item	Description
1	Wire Locking Pin (qty 2)
2	Safety Pin (qty 2)
3	Hitch Pin (qty 2)
4	Strut (qty 2)
5	Platform Bracket
6	Carbody Platform Bracket
7	Hitch Pin (qty 2)
8	Adjuster

FIGURE 4-124

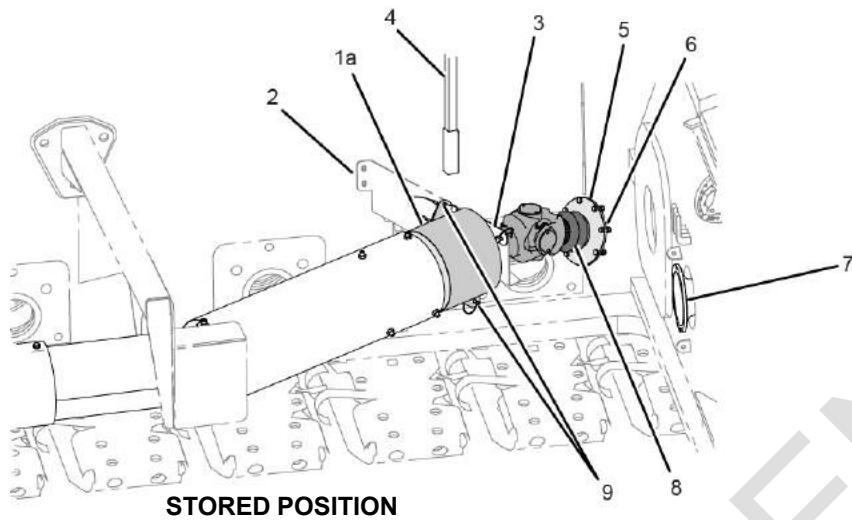
Removing Carbody Platforms

See [Figure 4-124](#) for the following procedure:

NOTE: An assist crane or forklift must be used to remove the carbody platform.

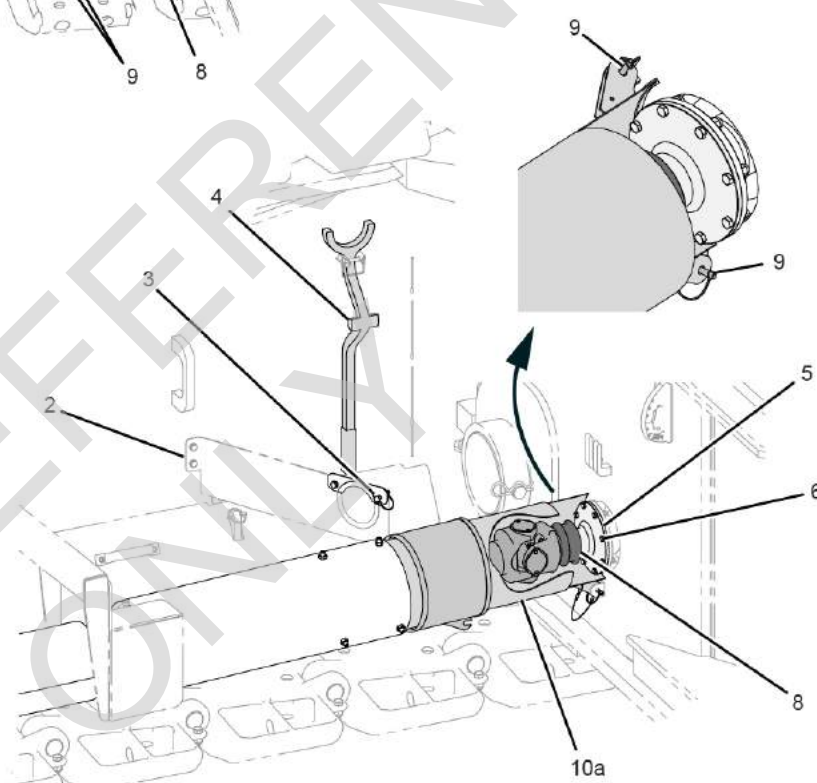
1. Lift and remove the ladder assembly from the carbody platform.
2. Use an assist crane or forklift to slightly lift the carbody platform to remove weight from the pins.
3. Remove the hitch pin (3, two locations).
4. Remove the wire locking pin (1, two locations), slide the bottom of the strut (4) into the top of the strut until the upper holes align, and insert the hitch pin (3). Store the wire locking pins.
5. Remove the safety pin (2, two locations), swing the strut (4) up towards the platform bracket (5) until the holes align in the shipping position, and insert the safety pin (2, two locations).
6. Remove the hitch pins (7, two locations).
7. Lift the carbody platform and remove from the carbody.
8. Repeat steps 1–7 for the second carbody platform.

FOR REFERENCE ONLY



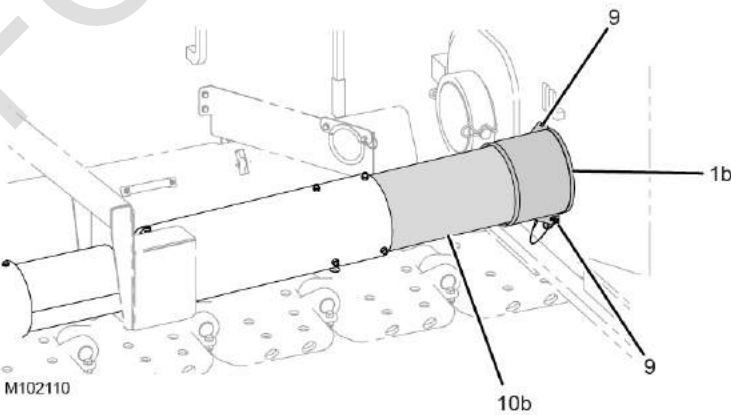
STORED POSITION

Item	Description
1a	Drive Shaft Guard (stored position)
1b	Drive Shaft Guard (working position)
2	Storage Bracket
3	Safety Pin
4	Drive Shaft Lever
5	Drive Shaft Disconnect Flange
6	Flange Lock Nut and Bolt (qty 8)
7	Companion Flange
8	Collar
9	Safety Pin (qty 2)
10a	Drive Shaft Guard (disassembly view)
10b	Drive Shaft Guard (working position)



WORKING POSITION

DISASSEMBLY VIEW



M102110

FIGURE 4-125

Disconnecting and Storing Drive Shafts

See [Figure 4-125](#) for the following procedure:

1. Remove safety pins (9) and pull the drive shaft guard (1b) away from the collar (8).

NOTE: Move the portion of the guard shown only. The drive shaft could spin abruptly. Stand clear of the drive shaft.

2. Insert the drive shaft lever (4, see Disengaged Collar View on [Figure 4-125 continued](#)) into the forked bracket on the carbody and pull the lever to release the collar.
3. Remove the safety pin (3) from the storage latch and open the latch.

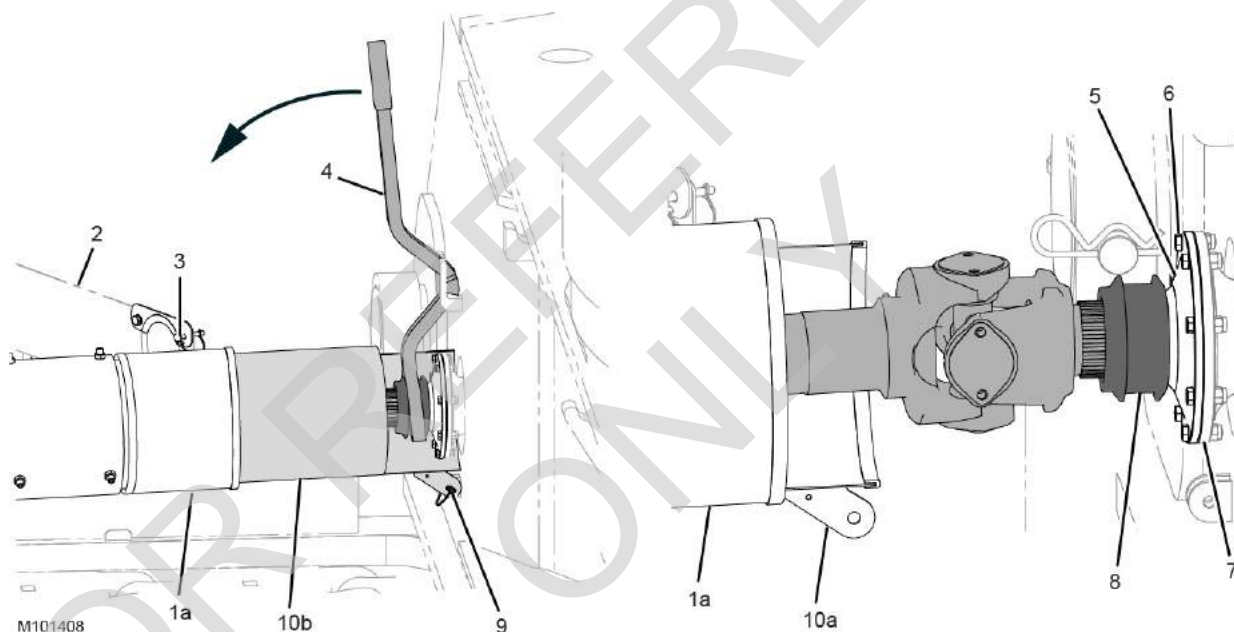


WARNING

Rotating Drive Shaft Hazard!

The crawler drive shaft rotates at a high speed.

- Make sure the crawler drive shaft is securely attached at both ends.
- Make sure the collar is fully engaged with the splines.
- Make sure the guards are in place and securely attached at both ends during operation.
- Do not attempt to service the drive shaft until the crane has been parked and the engine stopped.



DISENGAGED COLLAR VIEW

FIGURE 4-125 continued

4. Remove the bottom flange lock nuts and bolts (6) first. Remove the top outermost flange lock nuts and bolts last (easiest nuts and bolts to access).
5. With one flange lock nut and bolt remaining, have assistants support the drive shaft assembly with the drive shaft guard. Do not support the assembly by holding the flange (5) or the shaft with hands.
6. Remove the last flange lock nut and bolt carefully by using a long extension to create distance between hands and the drive shaft disconnect flange.
7. Remove the safety pins and pull the drive shaft guard (10b) back to expose the drive shaft.
8. Lift the drive shaft and place it into the drive shaft storage bracket (2).
9. Secure the drive shaft in the storage bracket by closing the storage latch and inserting the safety pin.
10. Install and tighten the flange bolts and lock nuts into the drive shaft disconnect flange for storage.

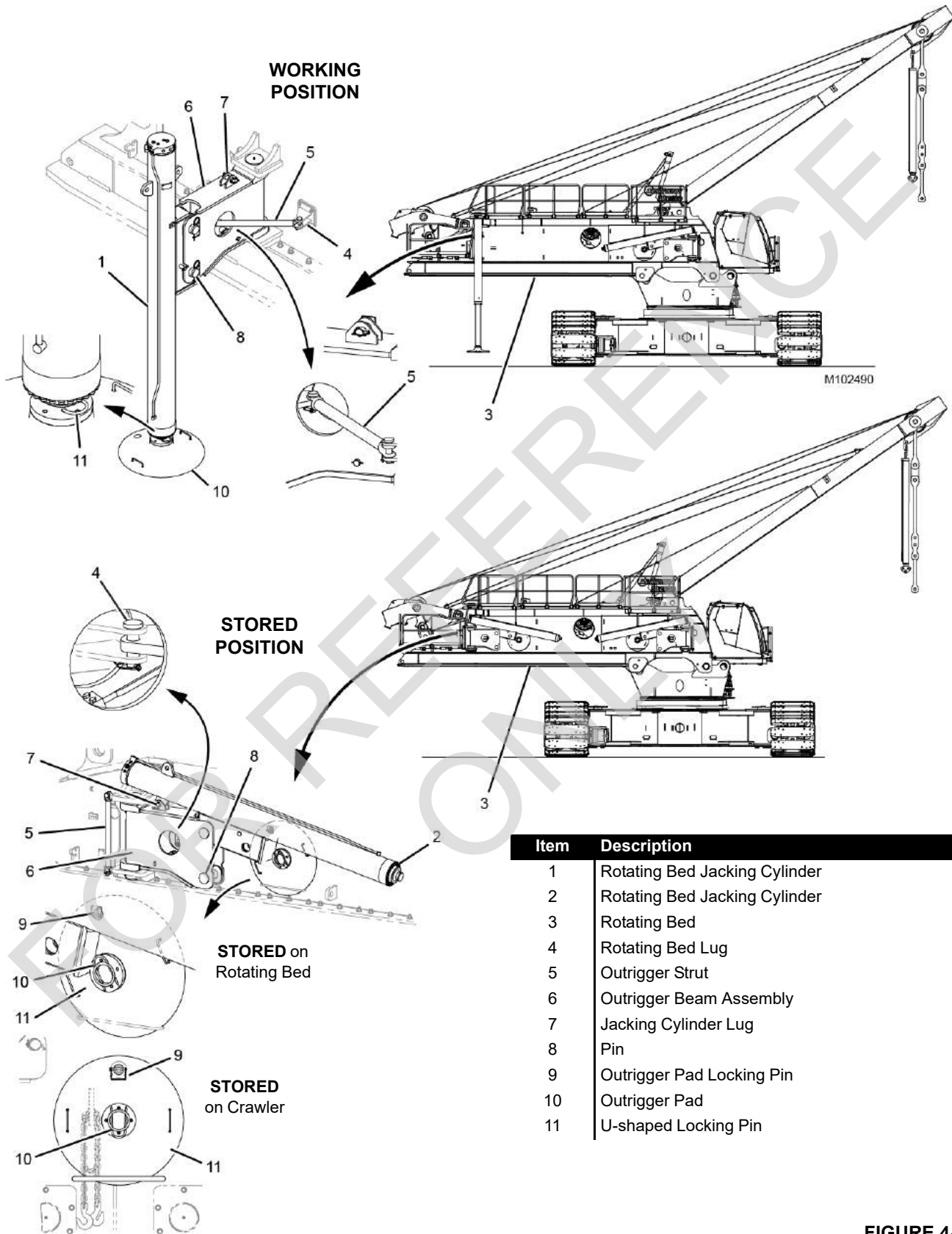


FIGURE 4-126

Deploying Rear Rotating Bed Jacking Cylinders

See [Figure 4-127](#) for the following procedure:

1. Remove the pins (1) from ladder (2a). Lower the ladder to the shipping position.
2. Remove the rear platform locking pins (3) and lift the rear platform (4a) from the working position to the shipping position.
3. Repeat steps 1 and 2 for the opposite platform.

See [Figure 4-126](#) for the remaining steps:

4. Remove the retaining pins from the outrigger strut (5, stored position).
5. Remove the connecting pin from the rotating bed lug (4, stored position).
6. Swing the outrigger beam assembly (6) from the stored position to the working position.
7. Install the pins and safety pins to connect the outrigger strut (5, working position) from the rotating bed lug to the outrigger beam assembly.
8. Remove the jacking cylinder locking pin and pin (8, stored position) from the outrigger beam assembly.
9. Remove the locking pin and pin from the jacking cylinder lug (7), which secures the rotating bed jacking cylinder (2) in the stored position.
10. Use the remote control to lower the rotating bed jacking cylinder to the working position.
11. Install the pin (8, working position) and locking pin to secure the rotating bed jacking cylinder.

12. Remove the outrigger pad locking pin (9) and remove the outrigger pad (10) from the stored position.

NOTE: The outrigger pad weighs 30 kg (65 lb).

13. Install the outrigger pad locking pin back in the lug on the rotating bed (stored position).
14. Place the outrigger pad on the ground below the jacking cylinder and remove the U-shaped locking pin (11, stored position) from the outrigger pad.
15. Using the remote control, extend the rotating bed jacking cylinder (1) until the end of the cylinder aligns with the outrigger pad. Adjust the pad to align with the cylinder as required.
16. Install the U-shaped locking pin (11, working position).
17. Repeat steps 4-16 for each rotating bed jack assembly.

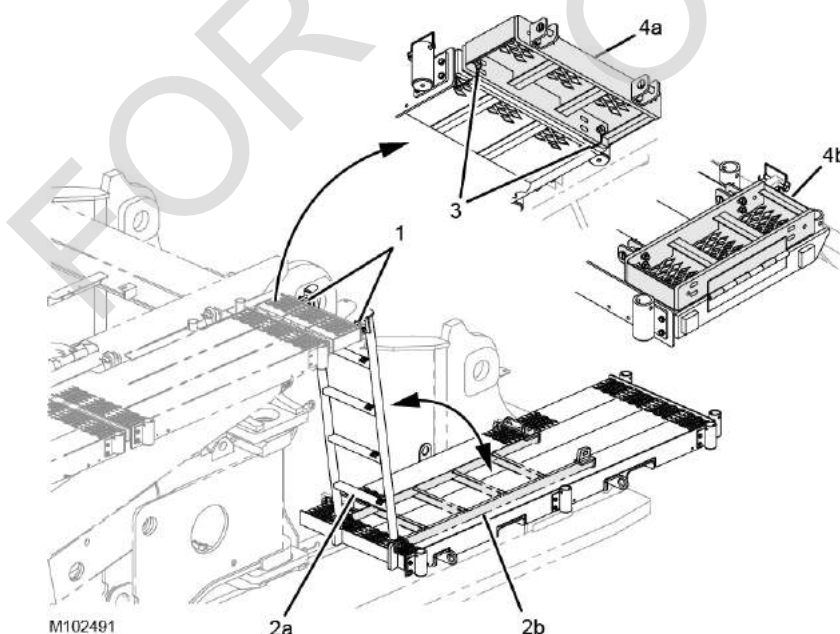
WARNING **Moving Part Hazard!**

To avoid serious crushing injury, warn all personnel to stand clear of jacks.

18. Place the unused pins into the stored position.

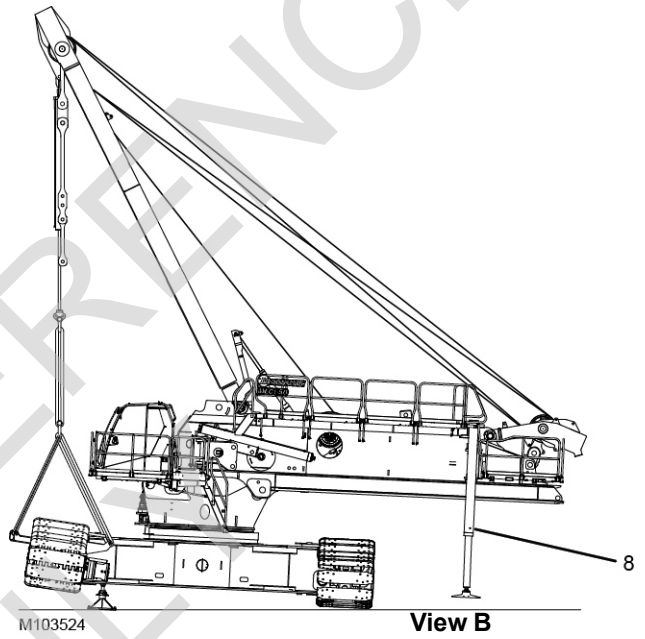
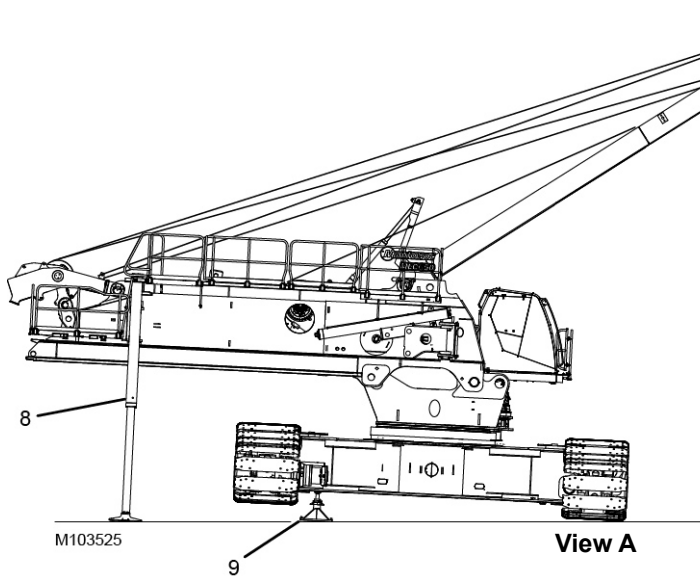
See [Figure 4-127](#) for the following procedure:

19. Lower the upper rear platform (4a) and secure with locking pins.
20. Raise the ladder (2b) from the shipping position to the working position and secure with pins (1).
21. Repeat steps (18-20) for the second rotating bed jacking cylinder and the rear platform assembly.



Item	Description
1	Pin (qty 2)
2a	Ladder (working position)
2b	Ladder (shipping position)
3	Locking Pin (qty 2)
4a	Rear Platform (working position)
4b	Rear Platform (shipping position)

FIGURE 4-127



Item	Description
1	SH 1 Shackle - 55 t (60.60 USt) (qty 2)
2	SL 5 Sling - 2,60 m (8.50 ft), 56 700 kg (125,000 lb)
3	SL 1 Sling - 3,30 m (10.83 ft), 45 360 kg (100,000 lb)
4	SL 2 Sling - 3,10 m (10.30 ft), 18 144 kg (40,000 lb) (qty 2)
5	Safety Pin and Pin (qty 2)
6a	Crawler Lifting Bracket (stored position) (qty 2)
6b	Crawler Lifting Bracket (working position) (qty 2)
7	Chain Sling (qty 4)
8	Rear Rotating Bed Jacking Cylinder (qty 2)
9	Carbody Pedestal (qty 2)

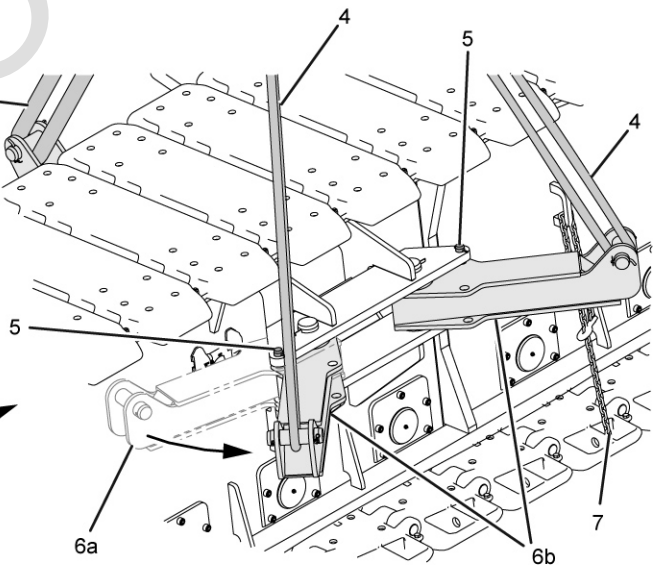
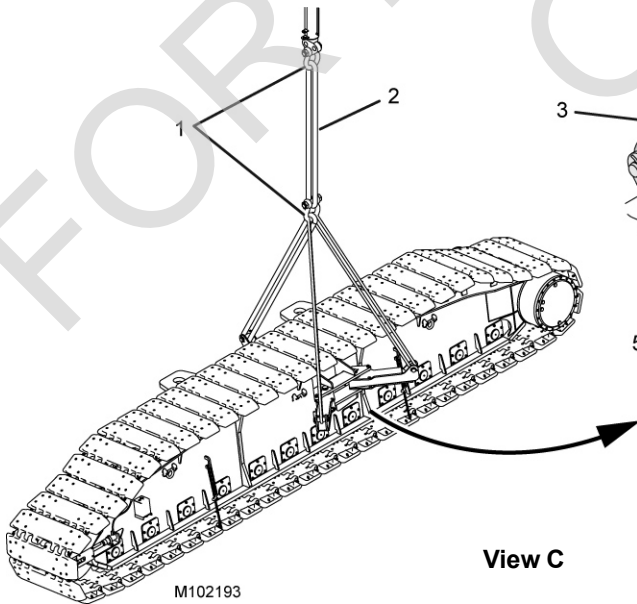


FIGURE 4-128

Removing First Crawler

See [Figure 4-128](#) for the following procedure:



WARNING Crane Tipping Hazard!

To avoid tipping the crane, position the mast at 140° prior to swinging the upperworks.

1. Position the mast at 140°–158° prior to swinging the upperworks.
2. Install chain slings (7) from the crawler frames to the crawler shoes to prevent excessive crawler track sag.

NOTE: Some sag must be allowed to prevent interference between the carbody and crawler pads.

3. Extend the rear rotating bed jacking cylinders (8, View A) to lift the first crawler from the ground and high enough to insert two carbody pedestals (9) under the carbody.

NOTE: Each carbody pedestals weighs approximately 214 kg (470 lb).

4. Install the carbody pedestals and retract the rear rotating bed jacking cylinders until the carbody rests on the carbody pedestals.
5. Swing the upperworks 180° until the rear rotating bed jacking cylinders (8, View B) are parallel to the crawler on the ground.

CAUTION

Parts Damage!

Avoid hitting crawlers and objects with the rotating bed jacking cylinders or outrigger pads while swinging the upperworks.

6. Remove the lynch pins (1, [Figure 4-129](#)) and use the hand holes to remove the carbody cavity platform (2a, [Figure 4-129](#)) from the working position.
7. Remove the safety pins and pins (5), rotate the crawler lifting brackets (6a) from the stored position to the working position and install the pins and safety pins.
8. Remove the hitch pins and pins from the outside crawler lifting brackets (6b).

9. Attach two **SL 2** slings (4) to the outside crawler lifting brackets. Place a hitch pin through each sling and bracket, and install the retaining pin.
10. Remove the hitch pin and retaining pin from the inside crawler lifting bracket.
11. Attach one **SL 1** sling (3) into the bracket, install the hitch pin through the sling and bracket, and install the retaining pin.

Item	Description
1	Lynch Pin (qty 2)
2a	Carbody Cavity Platform (removed)
2b	Carbody Cavity Platform (working position)

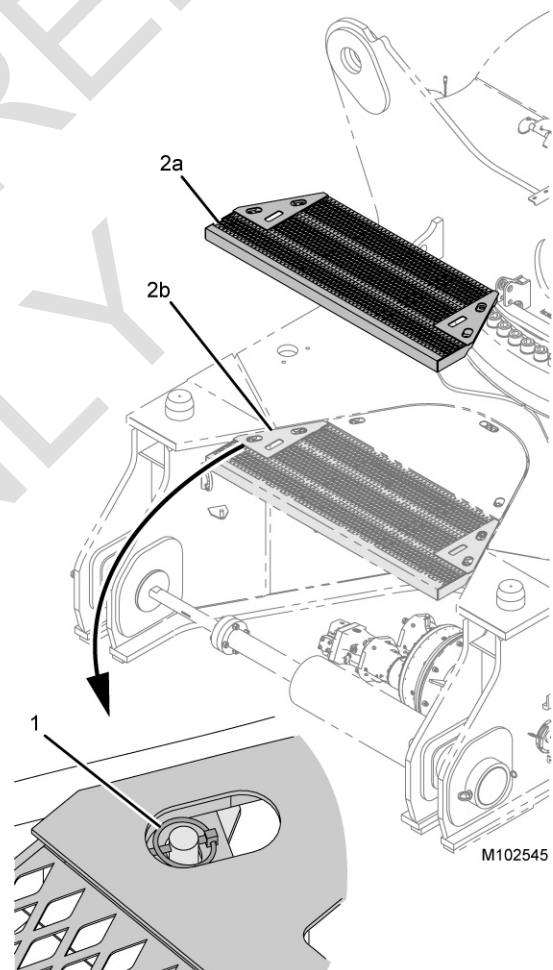
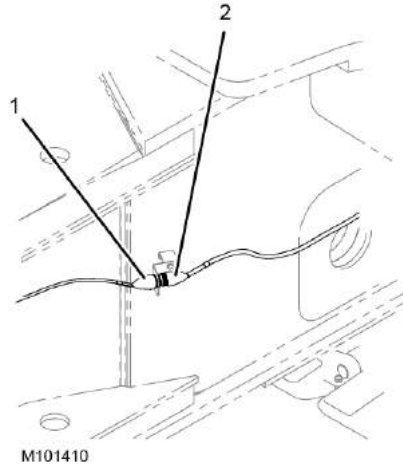
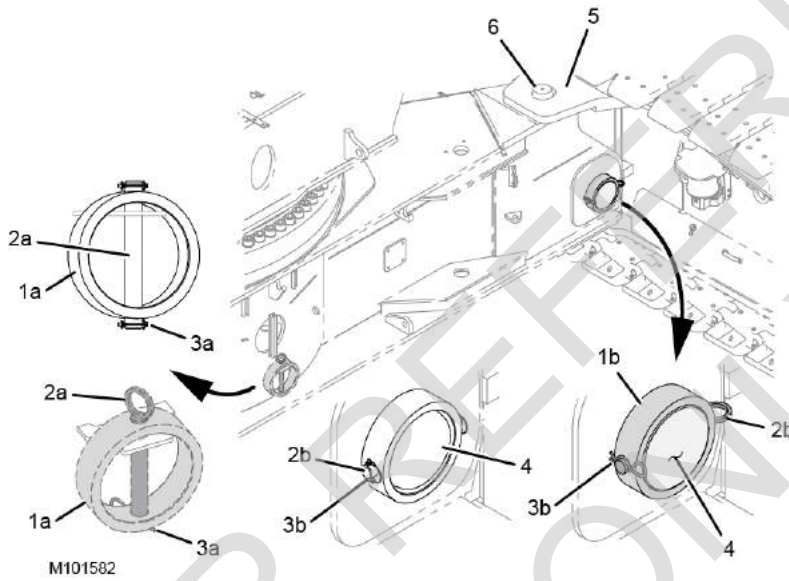


FIGURE 4-129

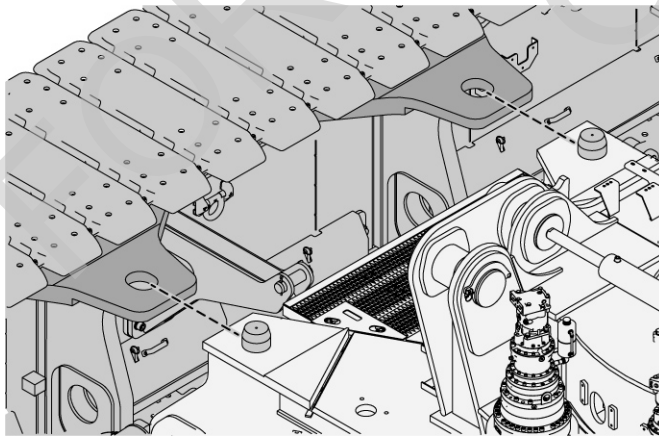


Item	Description
1	Carbody Electrical Cable (WLC1)
2	Crawler Electrical Cable (WLL1-P1)

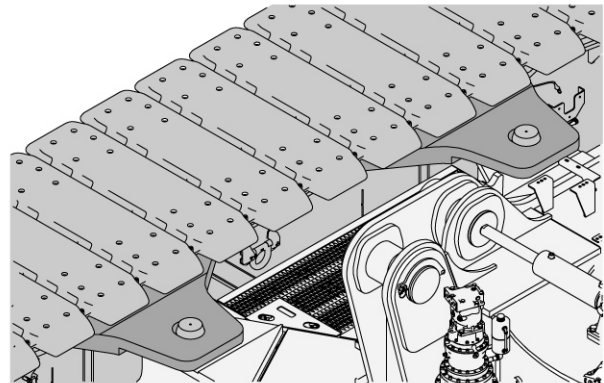
FIGURE 4-130



Item	Description
1a	Collar (stored position)
1b	Collar (working position)
2a	Retaining Pin (stored position)
2b	Retaining Pin (working position)
3a	Hair Pin Cotter or Safety Pin (stored position)
3b	Hair Pin Cotter or Safety Pin (working position)
4	Crawler Pin (qty 2)
5	Crawler Hook
6	Carbody Pin



CRAWLER HOOKS/CARBODY PINS DISENGAGED



CRAWLER HOOKS/CARBODY PINS ENGAGED

FIGURE 4-131

Removing First Crawler (continued)

12. Disconnect the crawler electric cable (2, [Figure 4-130](#)) from the carbody electric cable (1, [Figure 4-130](#)) and store the crawler cable.

See [Figure 4-131](#) for the remaining steps:

13. Remove the hair pin cotter or safety pin (3b), retaining pin (2b), and collar (1b) and place them in the stored position. Repeat the procedure for the other pin on the same crawler.
14. Using the remote control, disengage the crawler pins (4).

NOTE: The crawler pins must be shipped in the retracted position to meet shipping width requirements.

15. Using the live mast, slowly raise the crawler. Lift the crawler hook (5) from the carbody pin (6).
16. Install the carbody platform (2b, [Figure 4-129 on page 4-161](#)) to the working position and secure it with lynch pins (1, [Figure 4-129 on page 4-161](#)).

See [Figure 4-132](#) for the following procedure:

17. Position a trailer (6) next to the crane. Place and secure the crawler assembly (5) onto the trailer with blocking and secure the crawler to the trailer.
18. Remove the slings (3 and 4) from the lifting brackets on the crawler frame.

Item	Description
1	SH 1 Shackle – 55 t (60.60 USt) (qty 2)
2	SL 5 Sling – 2,60 m (8.50 ft), 56 700 kg (125,000 lb)
3	SL 1 Sling – 3,30 m (10.83 ft), 45 360 kg (100,000 lb)
4	SL 2 Sling – 3,10 m (10.30 ft), 18 144 kg (40,000 lb) (qty 2)
5	Crawler Assembly
6	Trailer
7	Carbody Pedestal
8	Outrigger Pad
9	Rotating Bed Jacking Cylinder

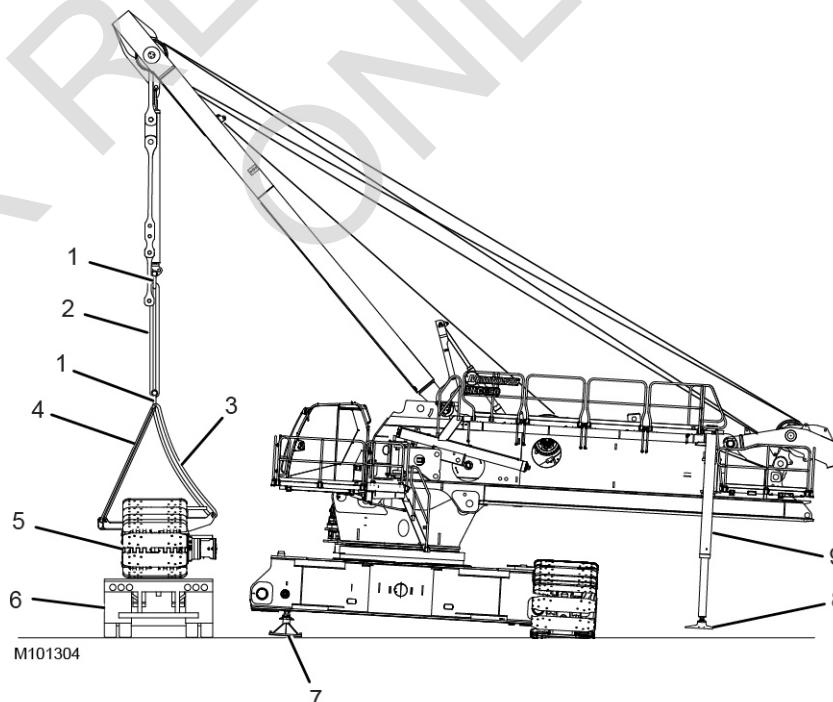
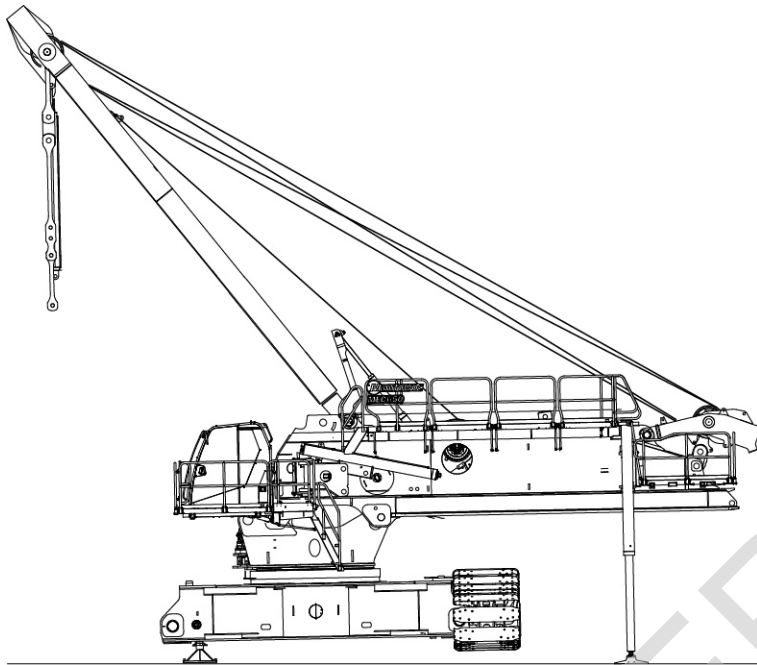


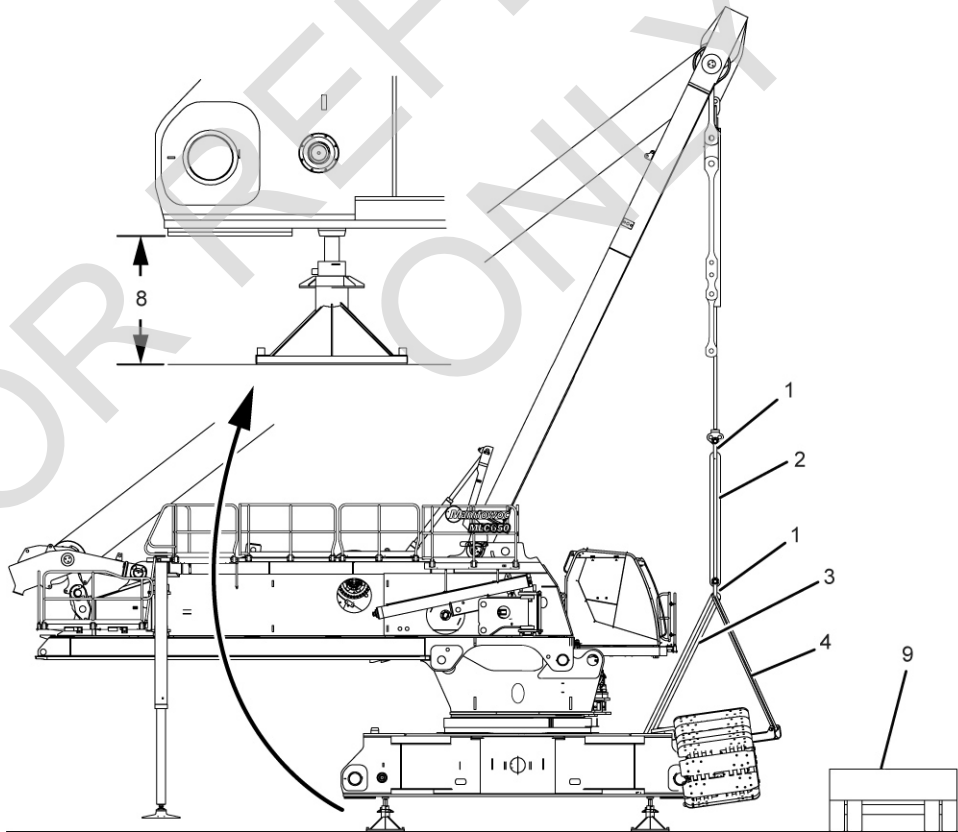
FIGURE 4-132



M101303

View A

Item	Description
1	SH 1 Shackle – 55 t (60.60 USt) (qty 2)
2	SL 5 Sling – 2,60 m (8.50 ft), 56 700 kg (125,000 lb)
3	SL 1 Sling – 3,30 m (10.83 ft), 45 360 kg (100,000 lb)
4	SL 2 Sling – 3,10 m (10.30 ft), 18 144 kg (40,000 lb) (qty 2)
5	Pins and Safety Pin (qty 2)
6a	Crawler Lifting Bracket (stored position)
6b	Crawler Lifting Bracket (working position)
7	Chain Sling (qty 4)
8	Clearance – 584-685 mm (23-27 in)
9	Trailer



M101301

View B

FIGURE 4-133

Removing Second Crawler

See [Figure 4-133](#) for the following procedure:

1. Swing the upperworks 180° until the rear rotating bed jacking cylinders are parallel to the crawler on the ground (View A).
2. Install four chain slings (7, View C) from the crawler frames to the crawler shoes to prevent excessive crawler track sag. Some sag must be allowed to prevent interference between the carbody and crawler pads.
3. Extend the jacking cylinders to raise the crawler so there is enough clearance (8, View B) to install the two carbody pedestals.
4. Install the two carbody pedestals and retract the jacks.
5. Position the trailer (9, View B) along the crawler side of the crane.
6. Disconnect the crawler electrical cable (2, [Figure 4-130 on page 4-162](#)) from the carbody and store the cable on the crawler.
7. Swing the upperworks until the self-erect cylinder and the lifting slings are centered over the crawler (View B).
8. Remove the hitch pin and pin from the inside crawler lifting bracket and attach the **SL 1** sling (3, View C).

9. Remove the safety pins and pins (5, View C), rotate the crawler lifting brackets (6a) from the stored position to the working position, and install the pins and safety pins (View C).
10. Attach the two **SL 2** slings (4, View B) to the **SL 5** sling (2) attached to the self erect cylinder rod end with an **SH 1** shackle (1).

NOTE: Reference the sling and shackle chart found in [Figure 4-7 on page 4-6](#).

11. Remove the hitch pins and pins from the outside crawler lifting brackets. Attach two **SL 2** slings (4, View C) to the outside crawler lifting brackets (6b, View C), place the pins through each sling and bracket, and install the hitch pins.
12. Retract the self-erect cylinder to lift the crawler from the crane. There will be approximately an 8° tilt toward the carbody.
13. Install the carbody cavity platform (2b, [Figure 4-129 on page 4-161](#)) to the working position and secure it with lynch pins (1, [Figure 4-129 on page 4-161](#)).
14. Secure the crawler to the trailer with blocking and tie downs.

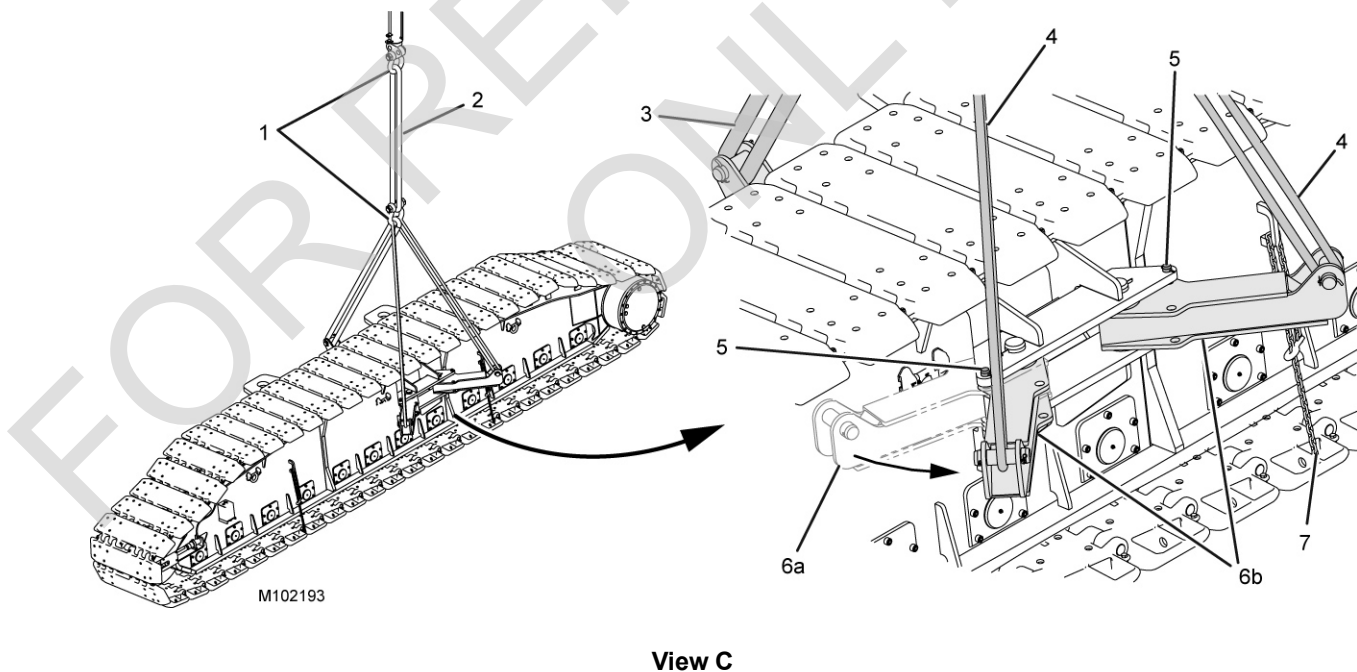


FIGURE 4-133 continued

Item	Description
1a	Adapter Frame Pin (qty 2)
1b	Adapter Frame Pin (qty 2)
2a	Collar (qty 2)
2b	Collar (qty 2)
3a	Adapter Frame Pin (qty 2)
3b	Adapter Frame Pin (qty 2)
4	Rotating Bed Jacking Cylinders (qty 4)
5	Maximum Trailer Height –1168 mm (46 in)

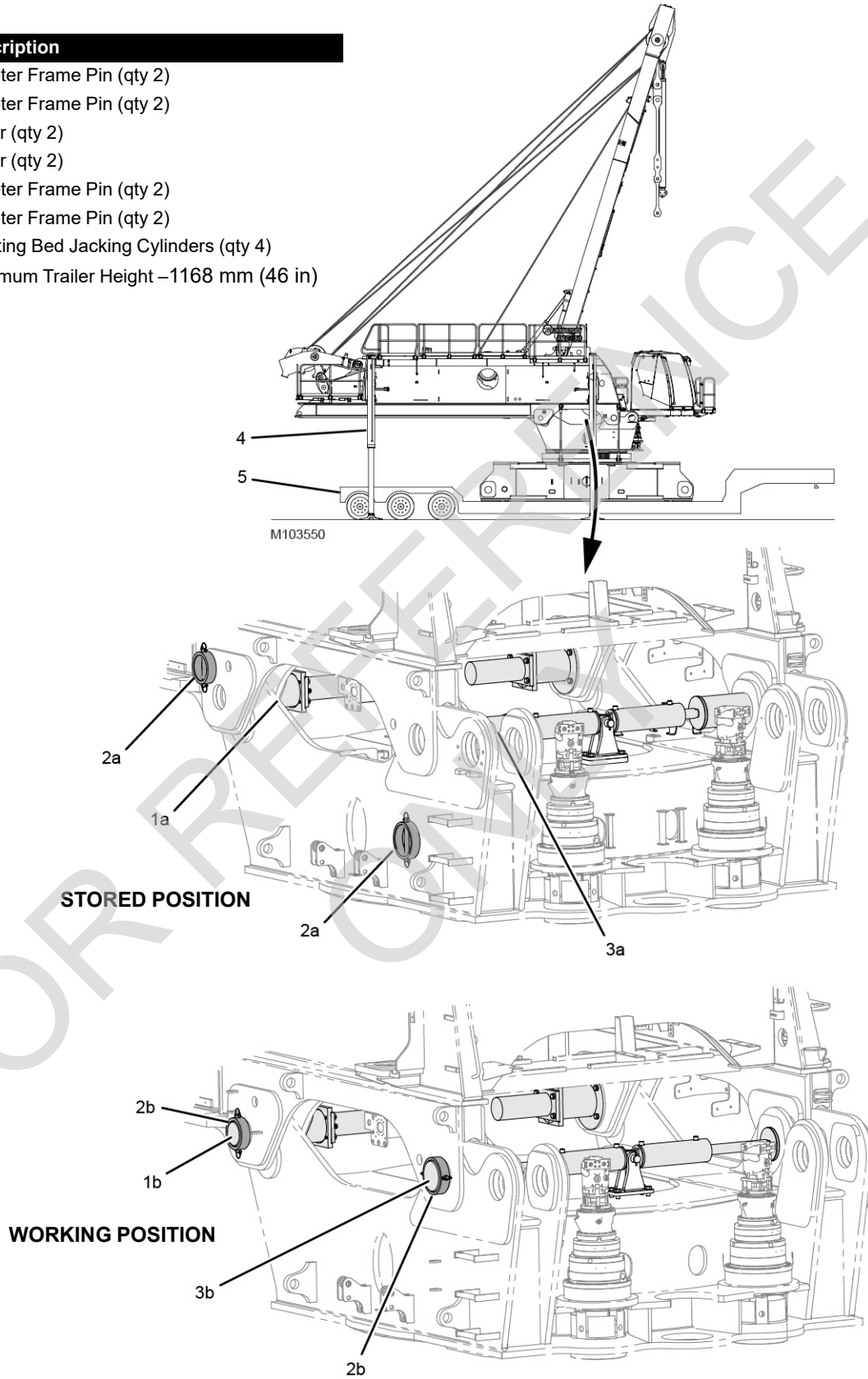


FIGURE 4-134

Disconnecting Carbody from Rotating Bed

See [Figure 4-134](#) for the following procedure:

NOTE: With no blocking under the outrigger pads and with the carbody attached to the rotating bed, the jacking cylinders can lift the carbody to clear a maximum trailer height (5) of 1168 mm (46 in).

1. Center the transport trailer on the carbody.
2. Using the remote control, extend the rotating bed jacking cylinders (4) as required to provide clearance.
3. Back the trailer under the carbody, using caution not to hit the rotating bed jacking cylinders.

CAUTION

Equipment Damage!

Use extreme care when backing the trailer into position:

- Do not hit the jacking cylinders with the trailer.
- Do not hit the carbody.

Provide a signal person to give instructions to the truck driver.

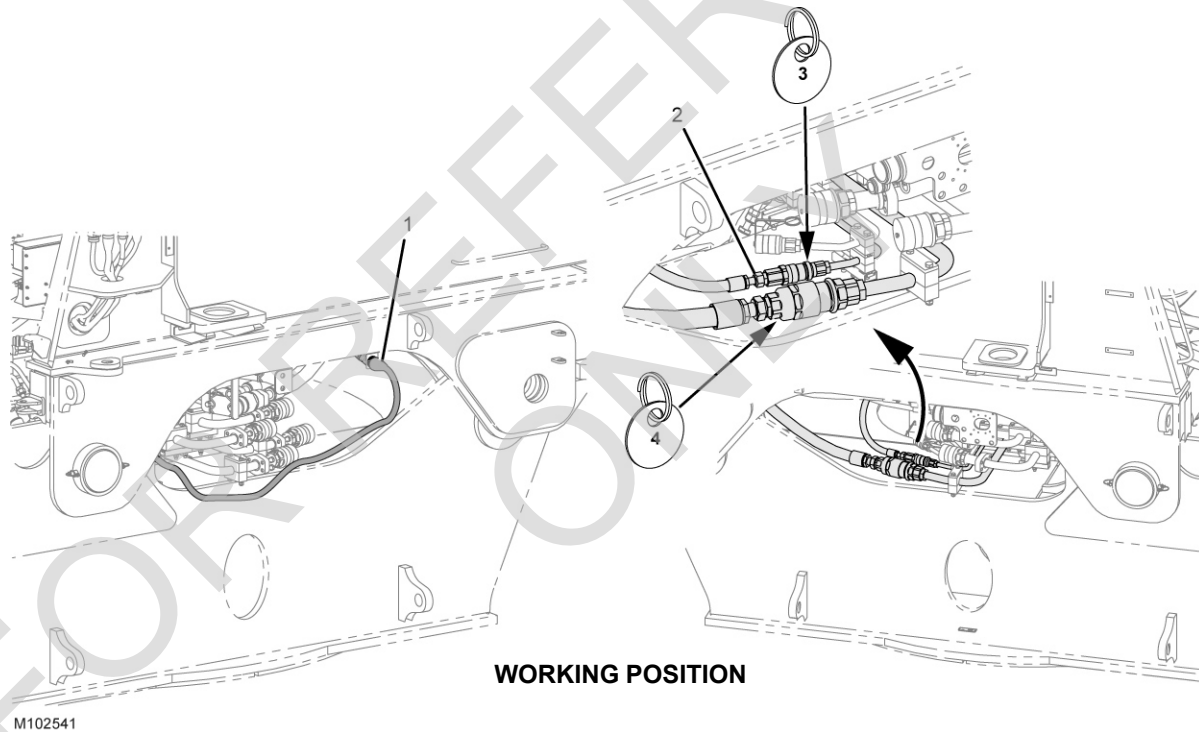
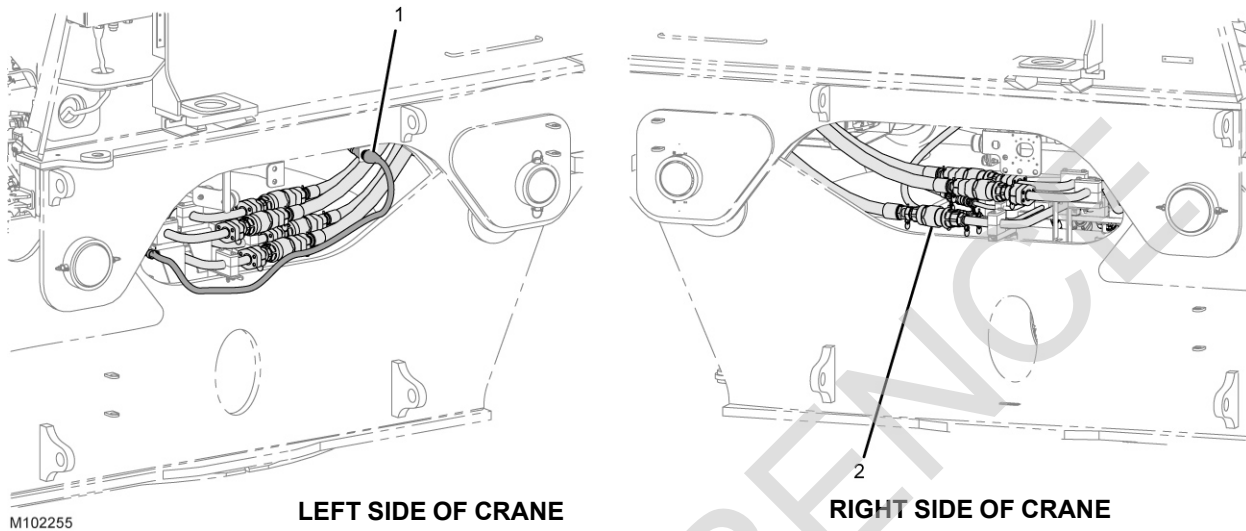
4. Lower the crane onto the trailer until the trailer deck just starts to lower.

CAUTION

Overweight Hazard!

Do not lower the entire weight of the crane onto the trailer. Weight may exceed trailer capacity.

5. Remove the pins and collars (2b) from the front and rear pins (1b and 3b). Place the collars with pins in the stored position.
6. Using the remote control, retract the front and rear pins from the working position (1b and 3b).



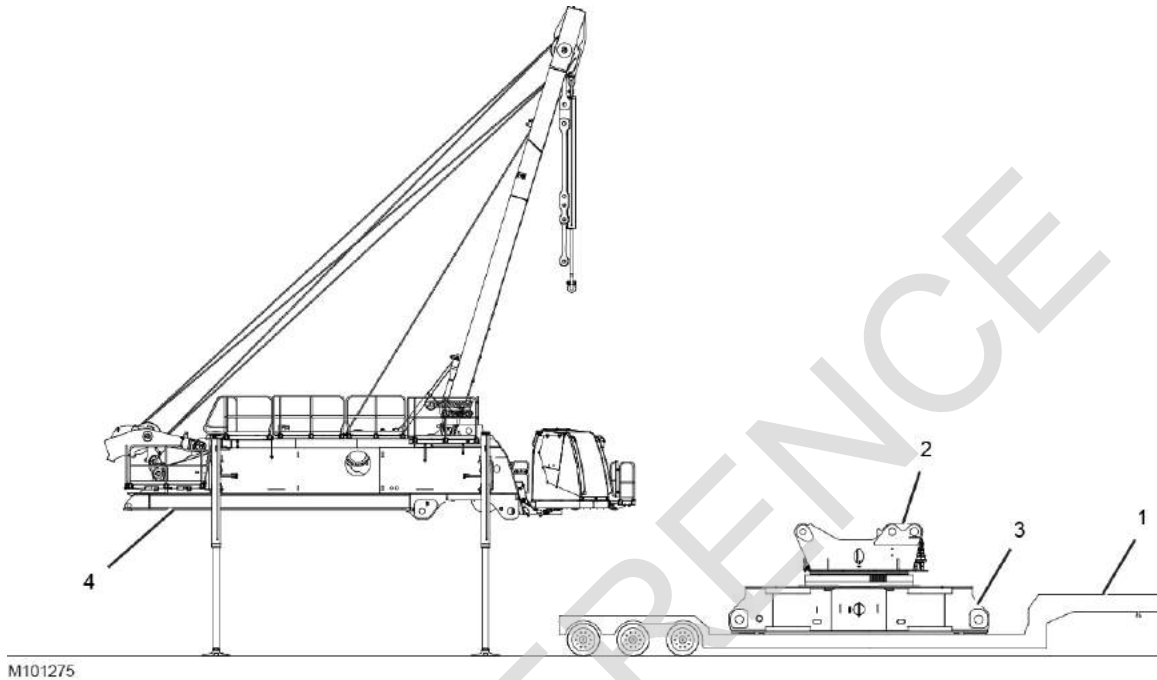
Item	Description
1	Adapter Frame Electrical Cable (WFC1 connects to WRF2-J5)
2	Hydraulic Hose (qty 5)

FIGURE 4-135

Disconnecting Hydraulic Hoses

See [Figure 4-135](#) for the following procedure:

1. Disconnect the adapter frame electrical cable (1).
2. On the right and left side of the crane, disconnect the hydraulic hoses (2) and place them in the stored position.



Item	Description
1	Trailer
2	Adapter Frame
3	Carbody
4	Rotating Bed

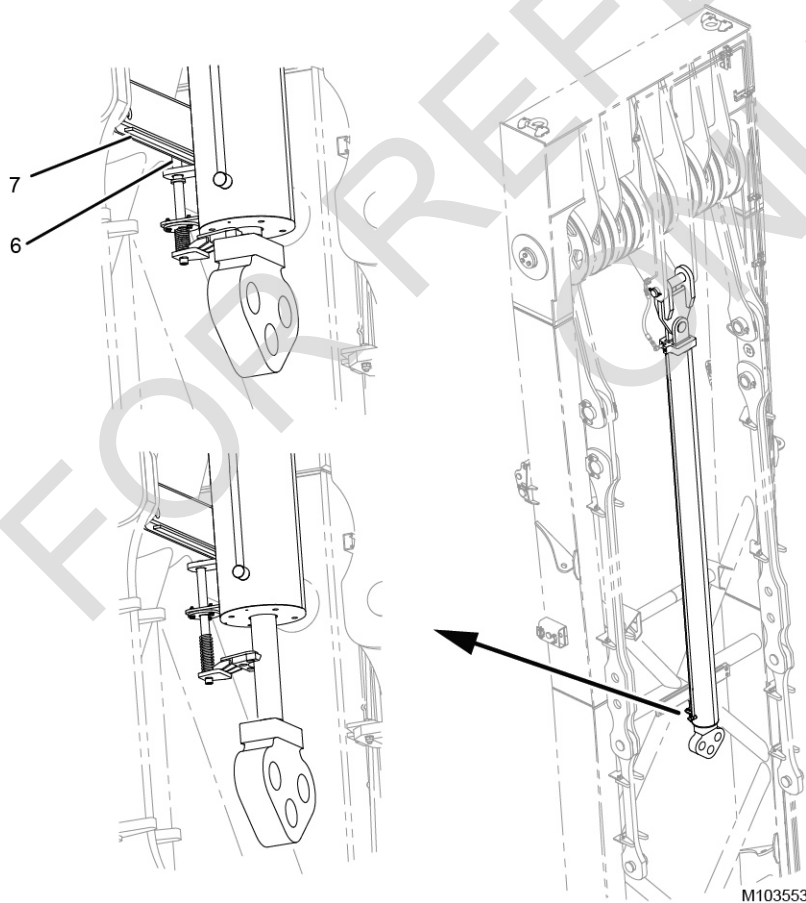
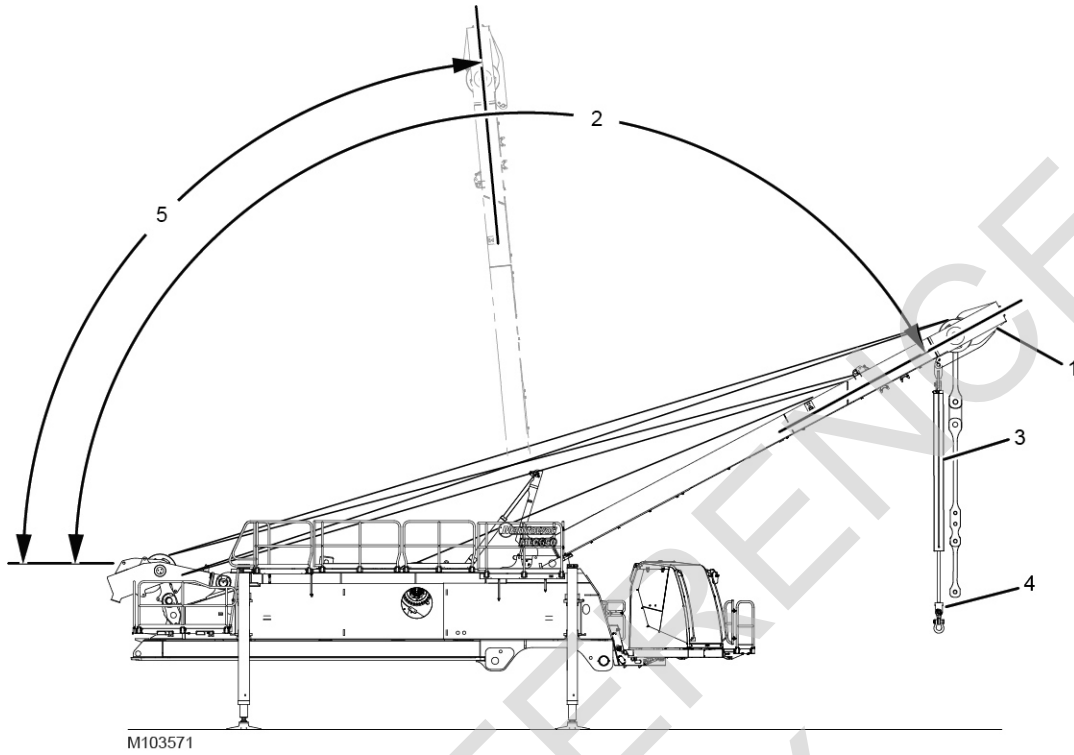
FIGURE 4-136

Removing Carbody and Adapter Frame from Rotating Bed

See [Figure 4-136](#) for the following procedure:

1. Fully extend the rotating bed jacking cylinders to separate the rotating bed (4) from the adapter frame (2) and carbody (3).

2. Remove the trailer (1). Use extreme care not to hit the rotating bed jacking cylinders with the trailer. Have a signal person provide instructions to the truck driver.
3. Secure the carbody and adapter frame to the trailer with tie downs.



Item	Description
1	Live Mast
2	Maximum Live Mast Angle
3	Self-Erect Cylinder
4	Self-Erect Cylinder Rod End
5	85° Angle
6	Pin
7	Retention Bracket

FIGURE 4-137

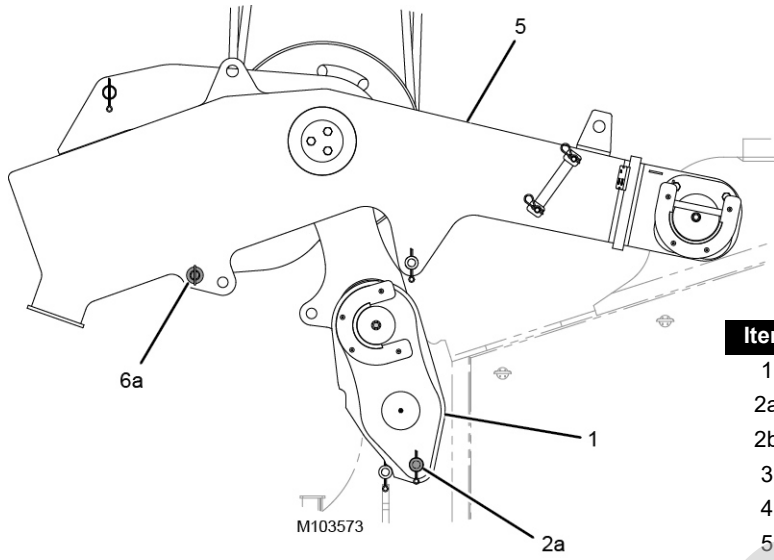
Storing Self-Erect Cylinder

See [Figure 4-137](#) for the following procedure:

1. Raise the live mast (1) to the maximum live mast angle (2), 158°.
2. Fully extend the self-erect cylinder (3) and remove the rigging equipment.
3. Position the live mast at approximately 85° angle (5) so the self-erect cylinder rests on the wear pad.
4. Retract the self-erect cylinder until the pin (6) fully engages the retention bracket (7).

NOTE: If there is no rigging equipment attached to the self-erect cylinder rod end (4), there is no need to raise the live mast to the maximum angle or fully extend the self-erect cylinder.

FOR REFERENCE ONLY



Item	Description
1	Backhitch Assembly
2a	Backhitch Link Pin (working position) (qty 2)
2b	Backhitch Link Pin (shipping position) (qty 2)
3	Locking Pin Storage Bracket
4	Locking Pin (shipping position)
5	Gantry Assembly
6a	Gantry Link Pin (stored position) (qty 2)
6b	Gantry Link Pin (shipping position) (qty 2)
7a	Gantry Pin (shipping position) (qty 2)
7b	Gantry Pin (stored position) (qty 2)

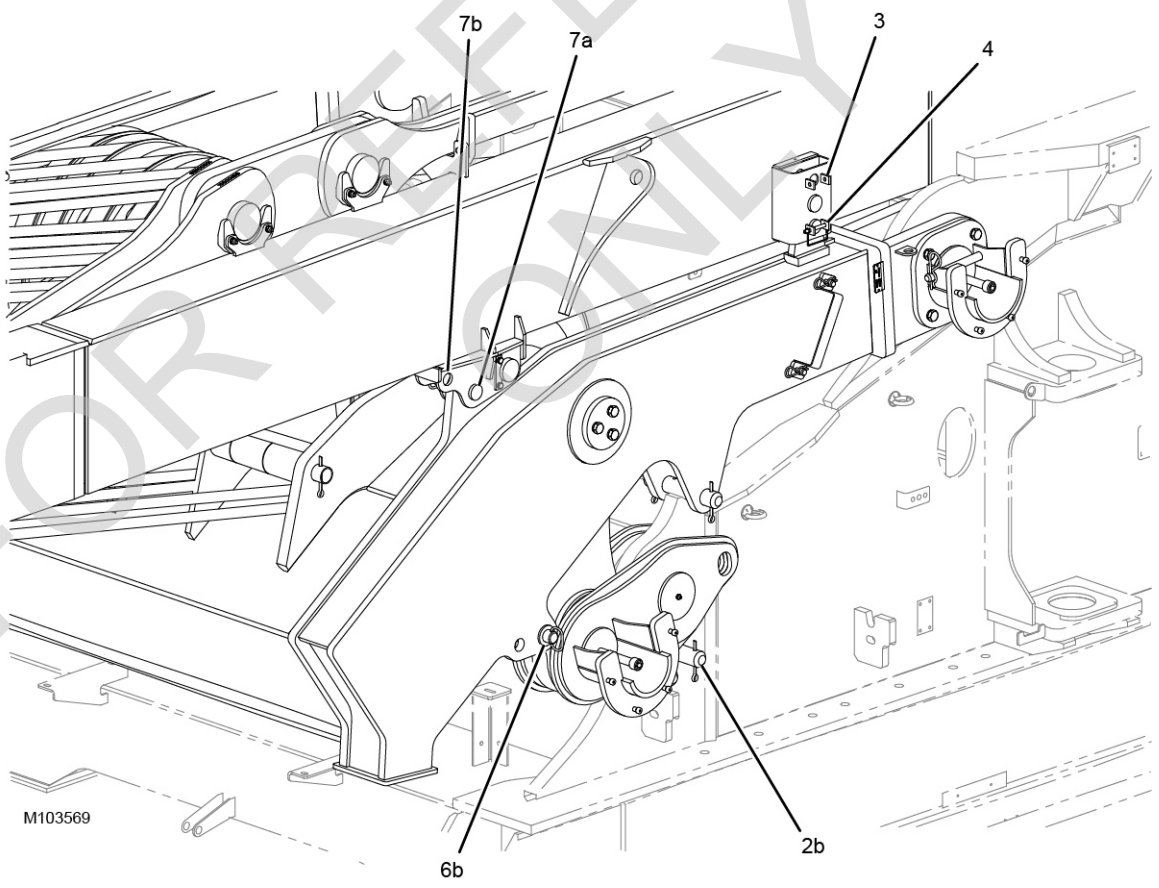


FIGURE 4-138

Securing Live Mast, Gantry, and Backhitch

See [Figure 4-138](#) for the following procedure:

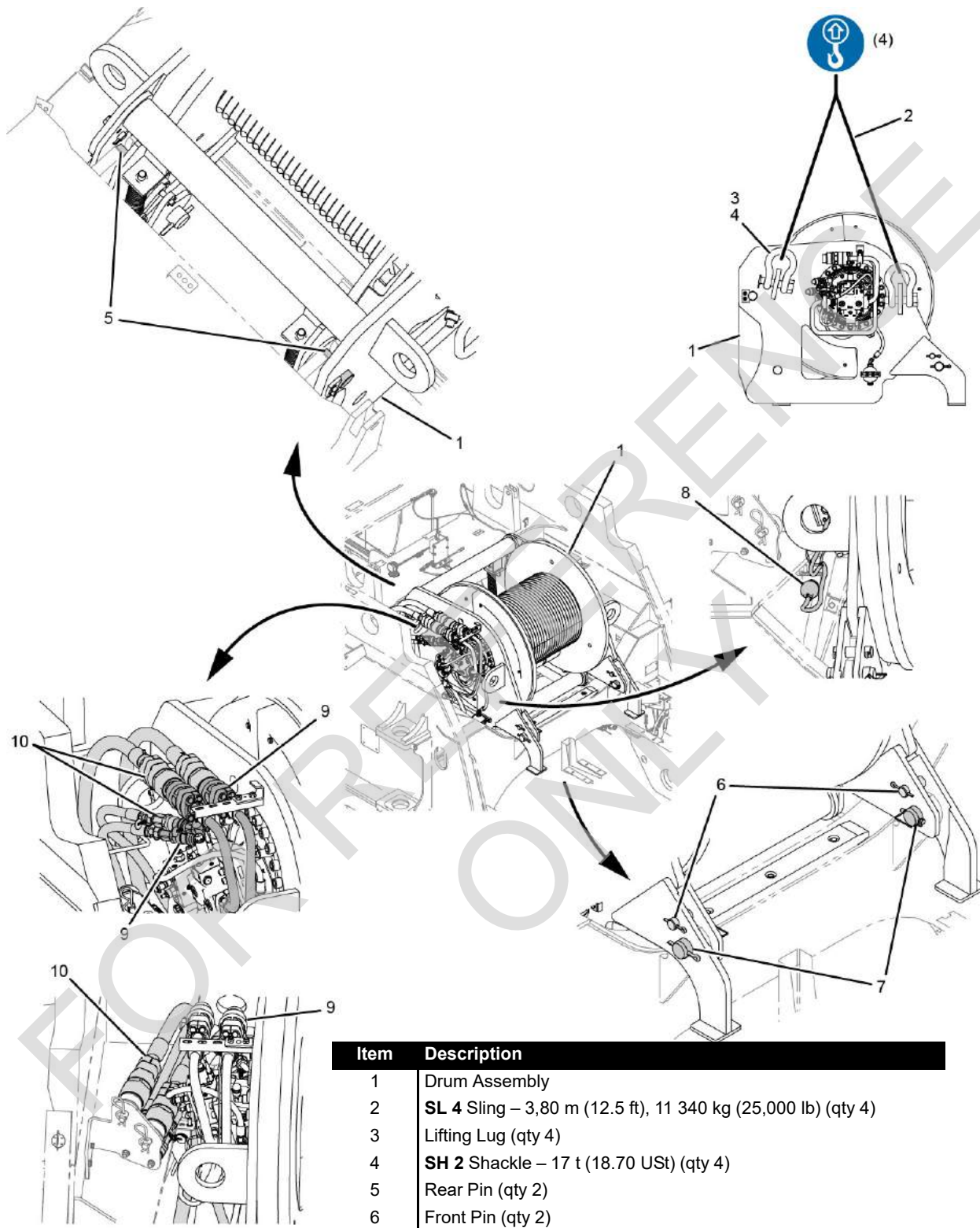
1. Boom up and lower the live mast to 40°.
2. Remove the gantry link pin (6a) from the gantry assembly (5) on both sides.
3. Remove the cotter pin and the backhitch link pin (2a) from the backhitch assembly (1) on both sides.

NOTE: If the pin is difficult to remove, extend the mast raising cylinders to tighten the rope and relieve pressure on the backhitch link pin.

4. After the gantry and backhitch link pins are removed, continue to boom up to lower the live mast until the mast reaches approximately 2°, then stop.

NOTE: As the live mast approaches the horizontal position, the gantry assembly may contact the mast roller. This is acceptable.

5. Lower the live mast the rest of the way using the mast assist cylinders.
6. With the live mast fully lowered, insert the backhitch link pin (2b) into the shipping position.
7. Install the gantry link pin (6b) into the shipping position.
8. Remove the gantry pin (7b) from the stored position and place the gantry pin (7a) in the shipping position.
9. Remove the live mast locking pin from the storage bracket (3) and remove the pin, place the pin and locking pin (4) in the shipping position, securing the live mast to the gantry assembly.



M102832

Item	Description
1	Drum Assembly
2	SL 4 Sling – 3,80 m (12.5 ft), 11 340 kg (25,000 lb) (qty 4)
3	Lifting Lug (qty 4)
4	SH 2 Shackle – 17 t (18.70 USt) (qty 4)
5	Rear Pin (qty 2)
6	Front Pin (qty 2)
7	Locking Pin and Pin (qty 2)
8	Electrical Cable (WRF1-P1)
9	Hydraulic Coupler (qty 4)
10	Hydraulic Hose (qty 4)

FIGURE 4-139

Removing Drum 3

An assist crane is required to lift the drum from the rotating bed.

NOTE: The assist crane must be capable of lifting 6 000 kg (3,200 lb) to a height of approximately 6 m (20 ft) above the ground.

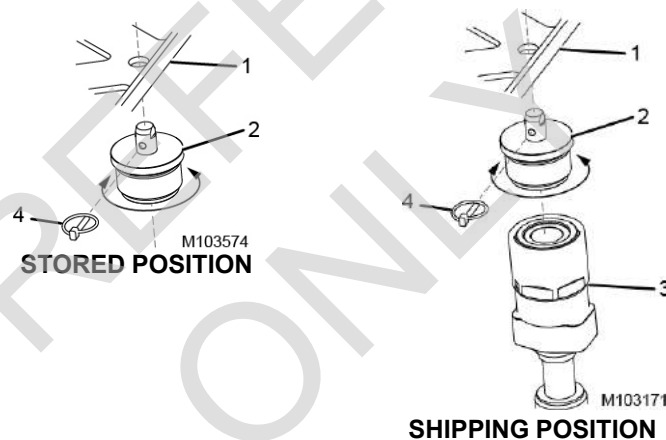
Reference Section 1 of this manual for actual weights of components.

See [Figure 4-140](#) for the following procedure:

1. Remove the locking pin (4) and the mounting plug (2) from the hose storage bracket (1) as shown in the stored position.
2. Disconnect the hydraulic hoses (10, [Figure 4-139](#)) from the hydraulic couplers (9, [Figure 4-139](#)).
3. Screw the mounting plug (2) into the hose coupler (3). Align the mounting plug pin with the hose storage bracket (1) and insert the locking pin as shown in the shipping position.
4. Repeat for the remaining hoses.

See [Figure 4-139](#) for the remaining steps:

5. Disconnect the electrical cable (8) from the drum assembly (1) and store the cable.
6. Attach the **SL 4** slings (2) to the hook of the assist crane.
7. Connect the other end of the slings to the lifting lugs (3) on the drum assembly with the **SH 2** shackles (4). Raise the drum slightly to reduce pressure on the pins.
8. Remove the locking pins and pins (7) and set aside.
9. Remove the front and rear pins (5 and 6).
10. Slowly lift the drum assembly from the rotating bed and place onto the trailer.
11. Disconnect the shackles and the slings from the lifting lugs on the drum assembly.
12. Block and tie down the drum, securing the assembly to the trailer.



Item	Description
1	Hose Storage Bracket
2	Mounting Plug
3	Hose Coupler
4	Locking Pin

FIGURE 4-140

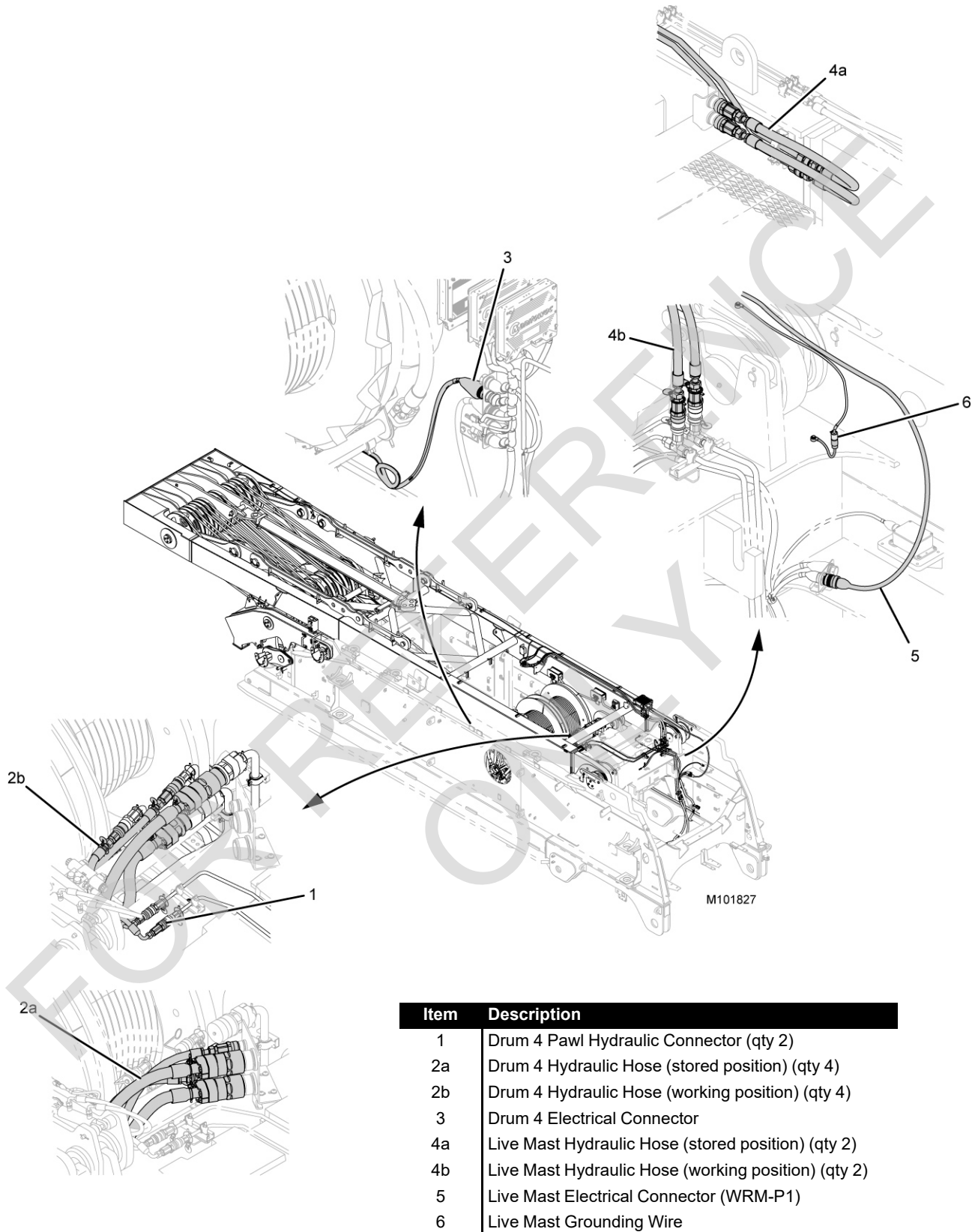


FIGURE 4-141

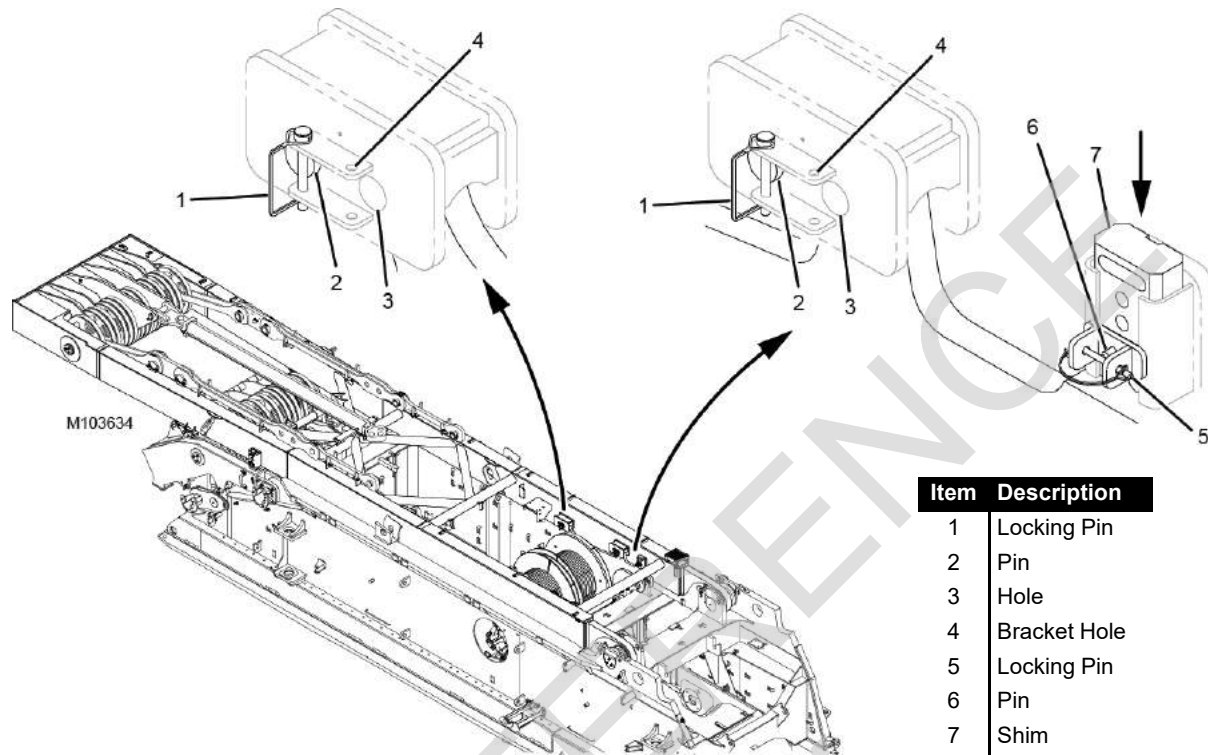


FIGURE 4-142

Disconnecting Live Mast Hydraulics and Electrical Connectors

See [Figure 4-141](#) for the following procedure:

1. Disconnect the drum 4 pawl hydraulic connectors (1).
2. Disconnect the drum 4 hydraulic hoses (2b) from the working position and place the drum 4 hydraulic hoses (2a) in the stored position.
3. Disconnect the drum 4 electrical connector (3) and store the cable.
4. Disconnect the live mast hydraulic hoses (4b) from the working position and place the live mast hydraulic hoses (4a) in the stored position.
5. Disconnect the live mast electrical connector (5).
6. Disconnect the live mast grounding wire (6) from the rotating bed.

Removing Live Mast

NOTE: The procedure shown is the same for both sides.

See [Figure 4-142](#) for the following steps.

1. Disconnect hydraulic hoses and electrical cables and store them.

See "[Disconnecting Live Mast Hydraulics and Electrical Connectors](#)" on [page 4-177](#).

2. Remove locking pin (1) and pin (2) from the stored position and install the pin in hole (3) shipping position. Install locking pin in the bracket hole (4) to secure.
3. Remove locking pin (5) and pin (6) from shim (7). Lower the shim and install the locking pin.

NOTE: The shim needs to be as tight as possible to reduce shifting during transportation.

4. Store the live mast straps as shown in View D, [page 4-42](#).

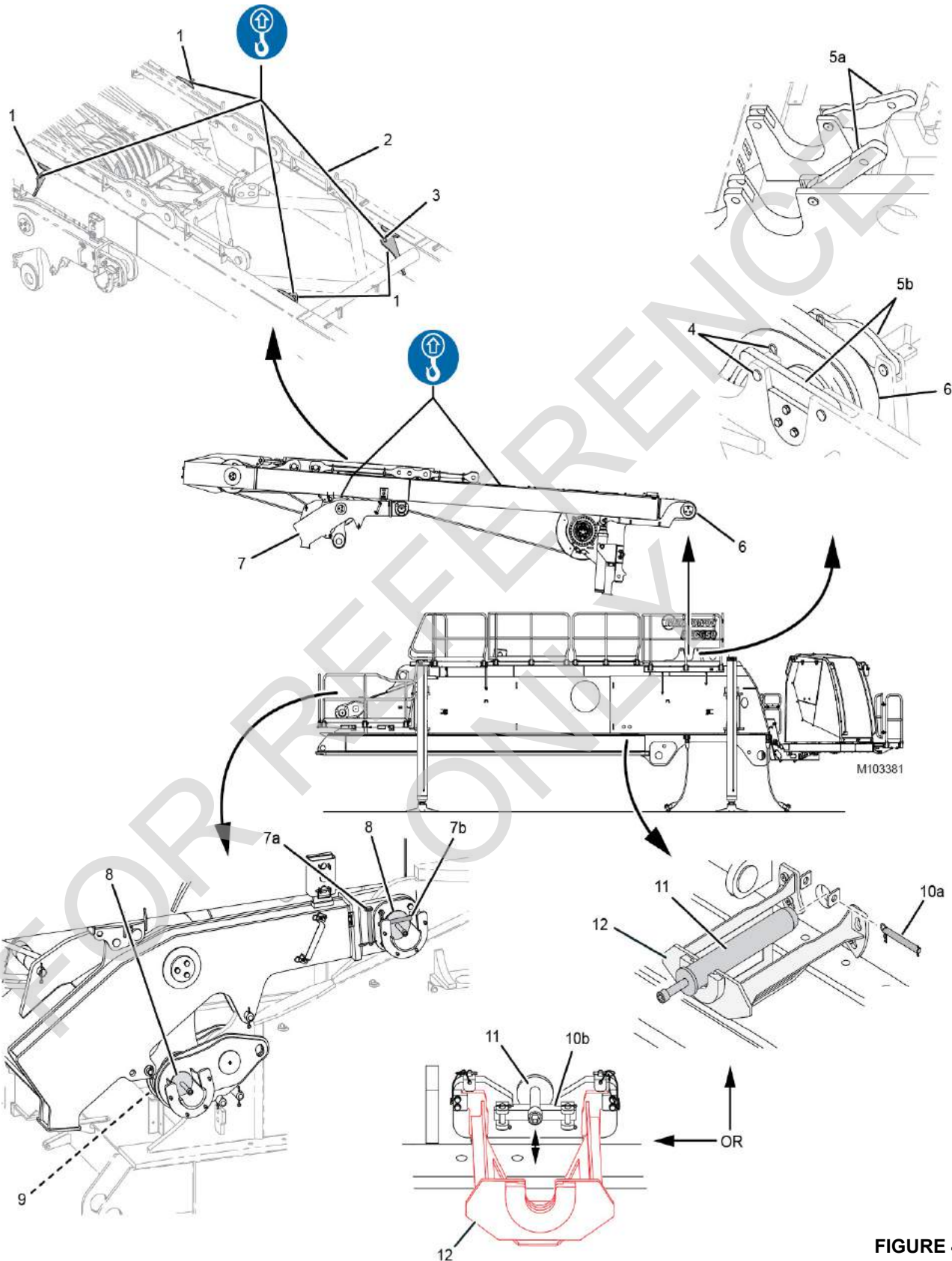


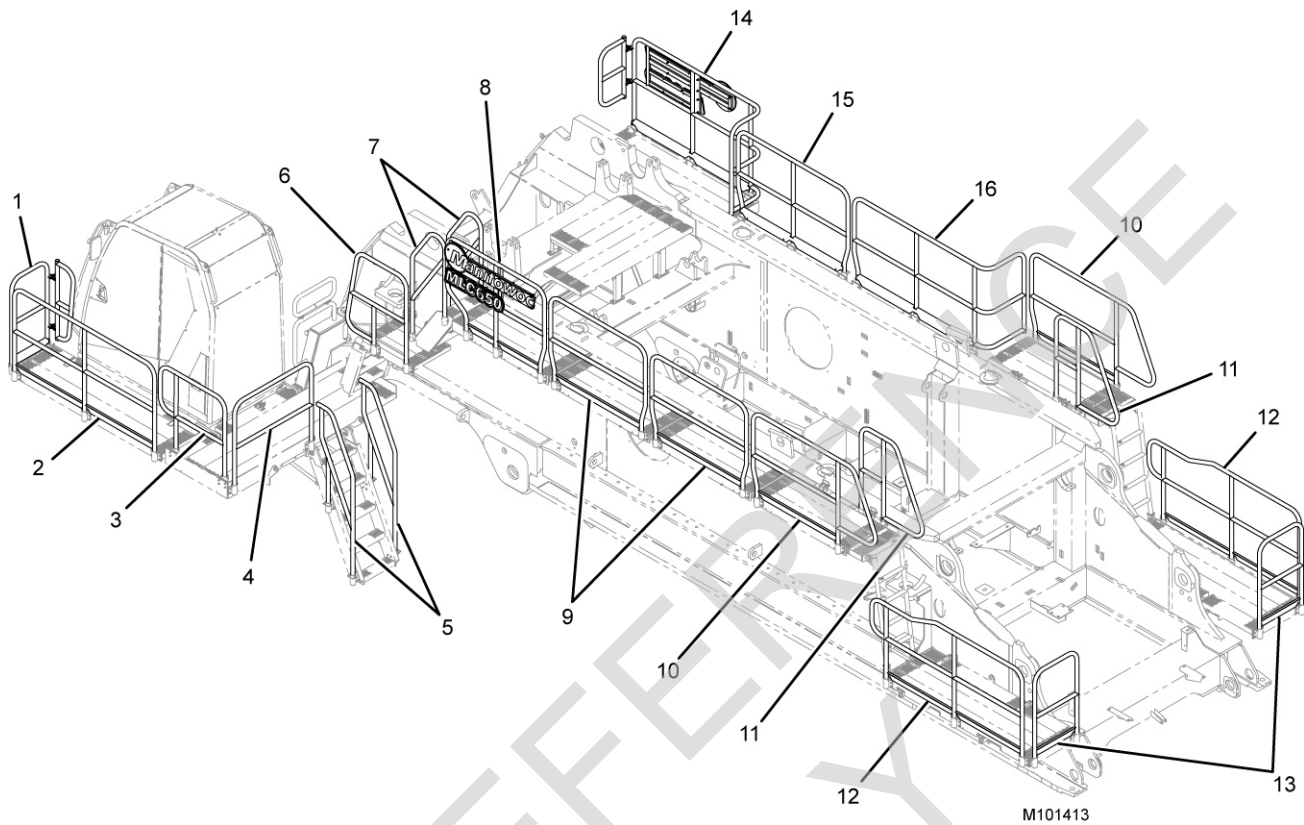
FIGURE 4-143

Legend for [Figure 4-143](#)

Item	Description
1	Live Mast Lift Point (qty 4)
2	SL 6 Sling – 5 m (16.40 ft), 31 751 kg (70,000 lb) (qty 4)
3	SH 2 Shackle – 17 t (18.70 USt) (qty 4)
4	Pin and Hair-Pin Cotter (qty 4)
5a	Live Mast Keeper (open) (qty 2)
5b	Live Mast Keeper (closed) (qty 2)
6	Live Mast Hinge
7	Gantry Assembly
7a	Keeper Pin (stored position)
7b	Keeper Pin (working position)
8	Backhitch/Gantry Operating Pin (qty 4)
9	Hitch Pin and Collar
10a	Hoist Drum Keeper Pin
10b	Hoist Drum Keeper Bar
11	Hoist Drum Operating Pin
12	Pin Puller Cage
13a	Retention Bracket (stored position)
13b	Retention Bracket (working position)

See [Figure 4-143](#) for the remaining steps.

5. Remove the pin and hair-pin cotter (4) from the live mast keepers (5b). Open the live mast keepers (5a) on the rotating bed to allow the live mast hinge (6) to disengage the rotating bed pockets.
6. Using an assist crane, attach **SL 6** slings (2) to the live mast lift points (1) using **SH 2** shackles (3). Lift slightly until a slight tension is felt on the slings.
7. Remove the keeper pins or plates (10a or 10b).
8. Install the pin puller cage (12) and disengage the two hoist drum operating pins (11) using the hand-held pin puller.
See ["Connect Hand-Held Pin Puller" on page 4-37](#) for information on using the pin puller.
9. Remove the keeper pin (7b) from the gantry assembly (7) and place the keeper pin (7a) in the stored position.
10. Remove the hitch pin and collar (9).
11. Using the hand-held pin puller, remove the backhitch/gantry operating pins (8).
12. Remove the retention bracket (13a) from the stored position and place in the retention bracket (13b) working position.
13. Raise the live mast slightly from the rotating bed. Observe the area around the live mast hoist drum as it is being raised from the rotating bed.
NOTE: As the mast assembly is being lifted, it will tilt forward approximately 4°.
14. Once the live mast is in the shipping position, remove the retention bracket (13b) from the working position and place in the retention bracket (13a) stored position.
15. Insert the operating pins (8) into the holes that they were removed from and secure them with the keeper pins (7) or hitch pins and collars (9).
16. Remove and store the pin puller cages (12) and install the hoist drum keeper pins (10a) or bars (10b).



M101413

Item	Description
1	Operator Cab Folding Front Handrail
2	Operator Cab Front Handrail
3	Operator Cab Rear Handrail
4	Operator Cab Back Handrail
5	Operator Cab Ladder Handrail
6	Lower Front Rotating Bed Handrail
7	Upper Front Rotating Bed Handrail
8	Front Left Rotating Bed Handrail
9	Middle Left Rotating Bed Handrail
10	Rear Upper Rotating Bed Handrail
11	Rear Ladder Rotating Bed Handrail
12	Rear Lower Rotating Bed Handrail
13	Back Lower Rotating Bed Handrail
14	Front Right Rotating Bed Handrail
15	Middle Right Rotating Bed Handrail
16	Rear Right Rotating Bed Handrail
17	Lanyard Pin

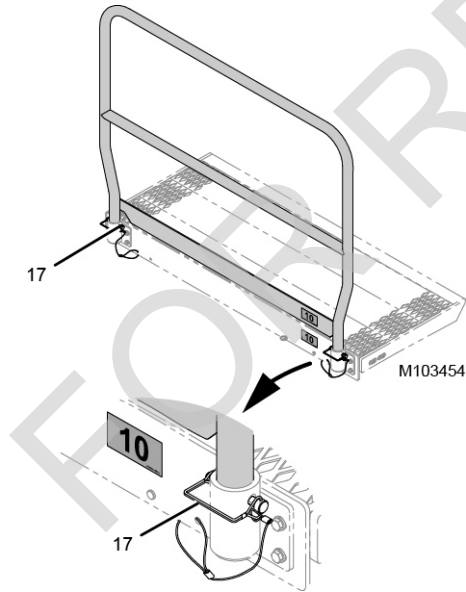


FIGURE 4-144

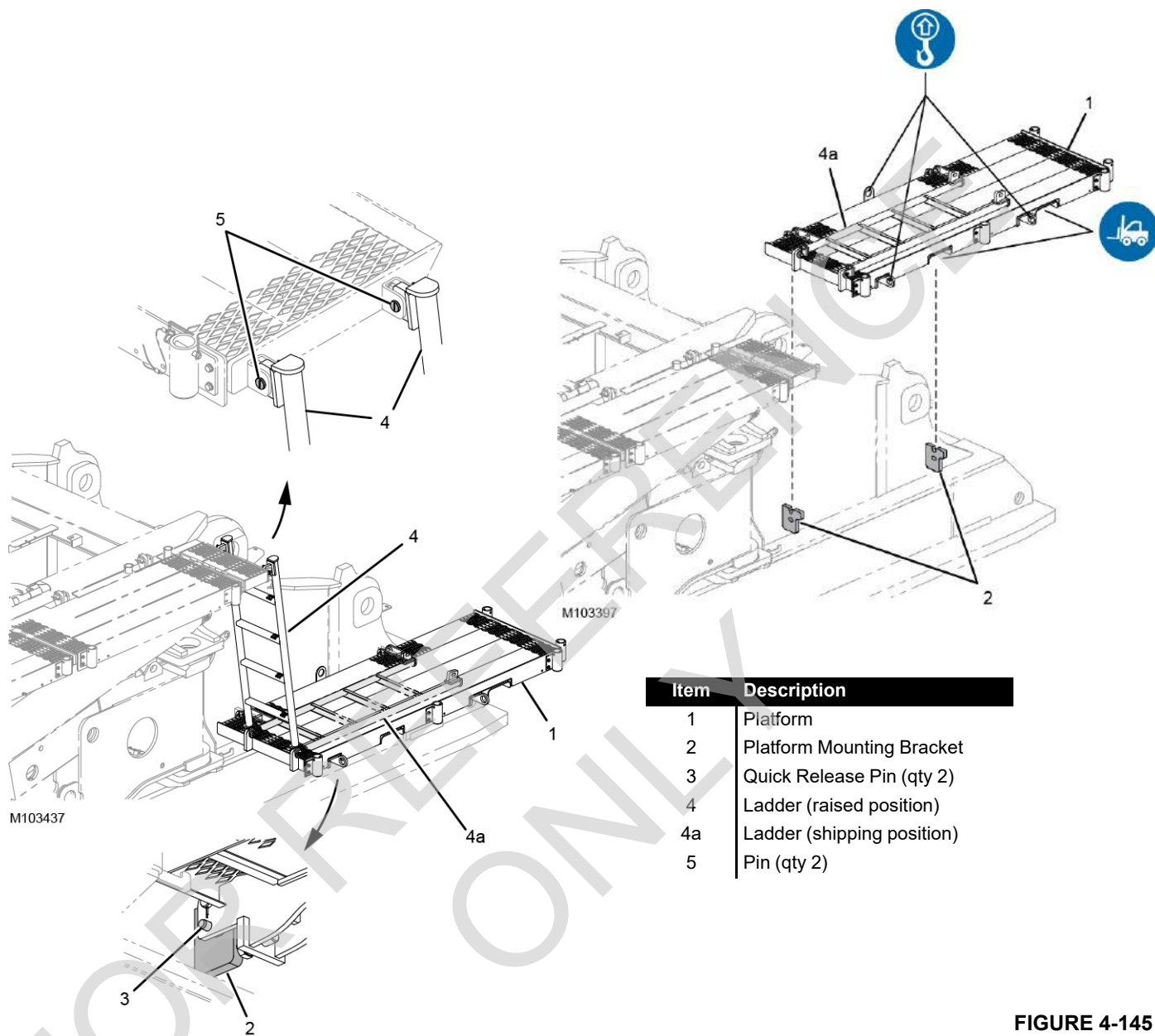


FIGURE 4-145

Removing Rotating Bed Handrails and Rear Platform

NOTE: The handrails (12 and 13) on the left and right sides of the rotating bed (shown in [Figure 4-144](#)) are the same and are removed in the same manner.

See [Figure 4-144](#) for the following procedure:

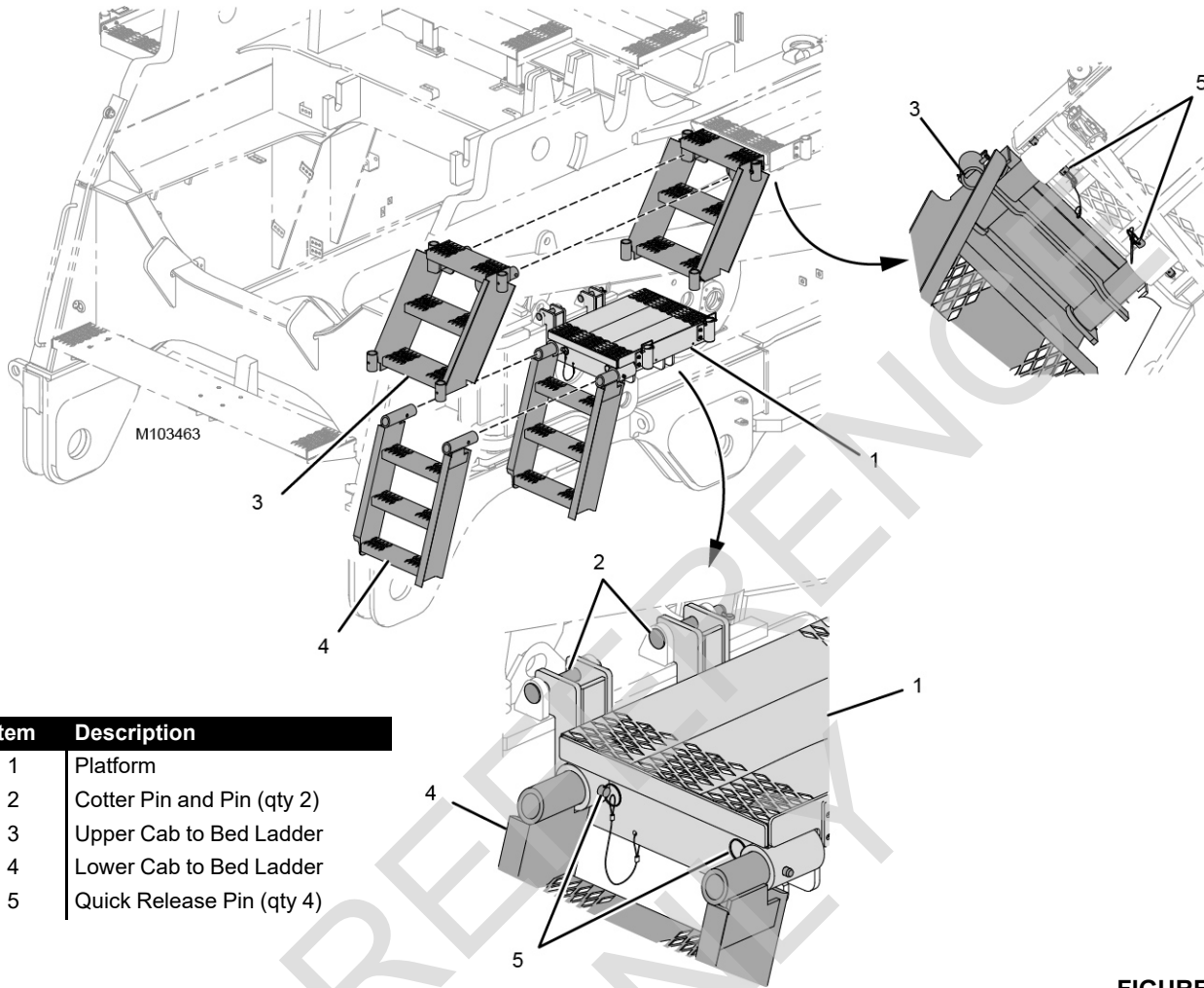
NOTE: Handrails weigh approximately 6–15 kg (15–35 lb).

1. Remove the lanyard pin (17) from handrails (2–16).
2. Remove the handrails and prepare for shipping.

See [Figure 4-145](#) for the following rear platform removal procedure:

3. Remove the pins (5) from the upper platform and lower the ladder (4) to the shipping position. Reinstall the pins.
4. Remove the two pins and quick release pins (3) from the platform mounting bracket (2).
5. Using an assist crane or a forklift, raise and remove the platform (1) and prepare for shipping.

NOTE: The platform and ladder combined weight is approximately 60 kg (133 lb).



Item	Description
1	Platform
2	Cotter Pin and Pin (qty 2)
3	Upper Cab to Bed Ladder
4	Lower Cab to Bed Ladder
5	Quick Release Pin (qty 4)

FIGURE 4-146

Removing Front Platform and Ladders From Rotating Bed and Cab

See [Figure 4-146](#) for the following procedure:

1. Remove the quick-release pins (5) that secure the ladders (3–4) to the platform.

NOTE: The ladders weigh approximately 20 kg (45 lb).

2. Slide the ladders off the sleeves of the platforms and set aside.
3. Remove the cotter pins and pins (2). Remove the platform (1). Reinsert the cotter pins and pins.
4. Prepare the platforms and ladders for shipping.

FOR REFERENCE ONLY

THIS PAGE INTENTIONALLY LEFT BLANK

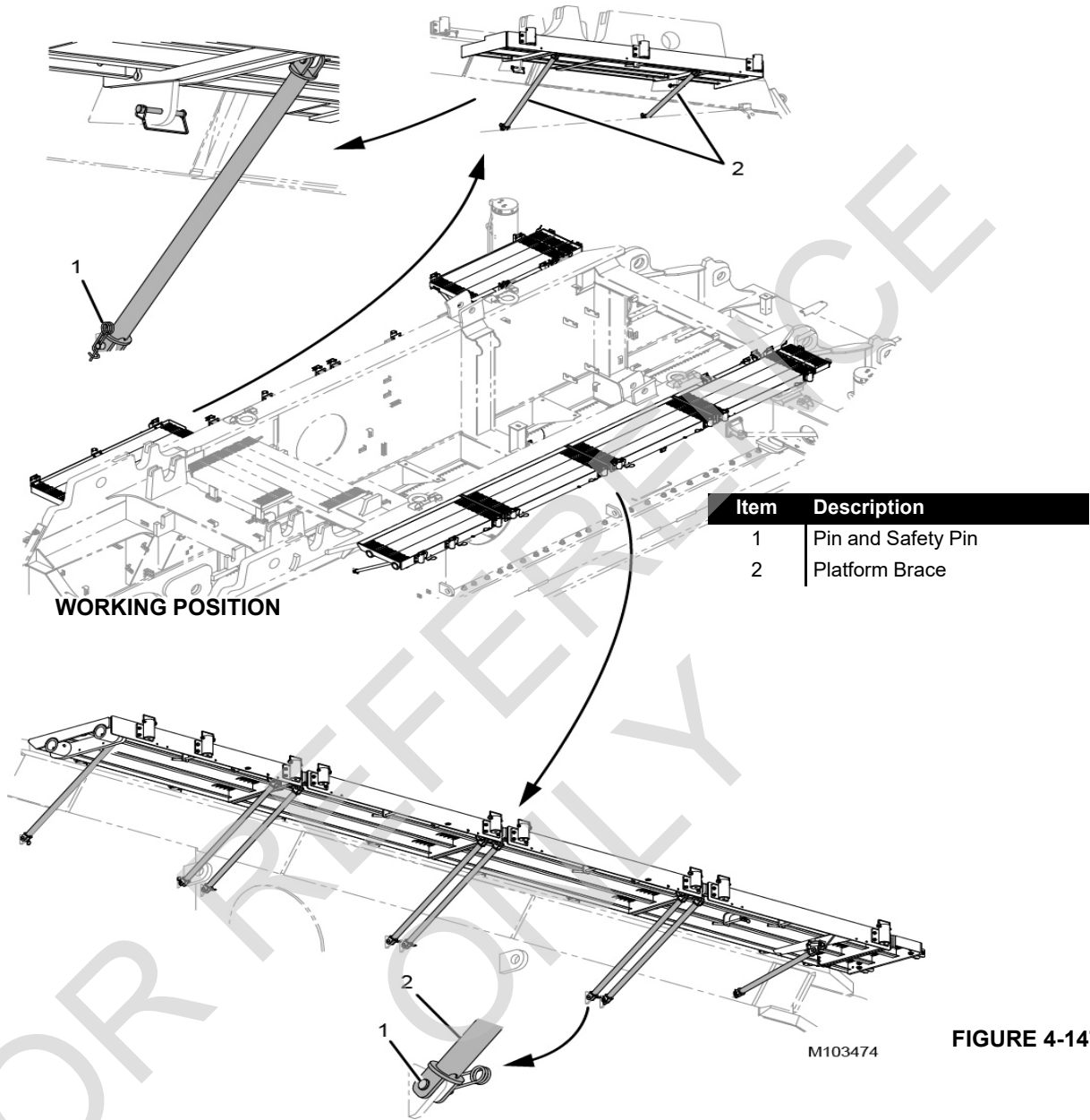


FIGURE 4-147

Storing Rotating Bed Platforms

The rotating bed platforms are attached to the rotating bed and must be flipped up or down to the stored position.

NOTE: Use the anchors (shown in [Figure 4-2](#)) supplied to attach the safety harnesses.

See [Figure 4-147](#) for the following procedure:

1. In the working position, remove the pin and safety pin (1) from the platform brace (2).

See [Figure 4-148](#) to continue the procedure:

2. Insert the pin and safety pin (1) back into the platform

brace (2).

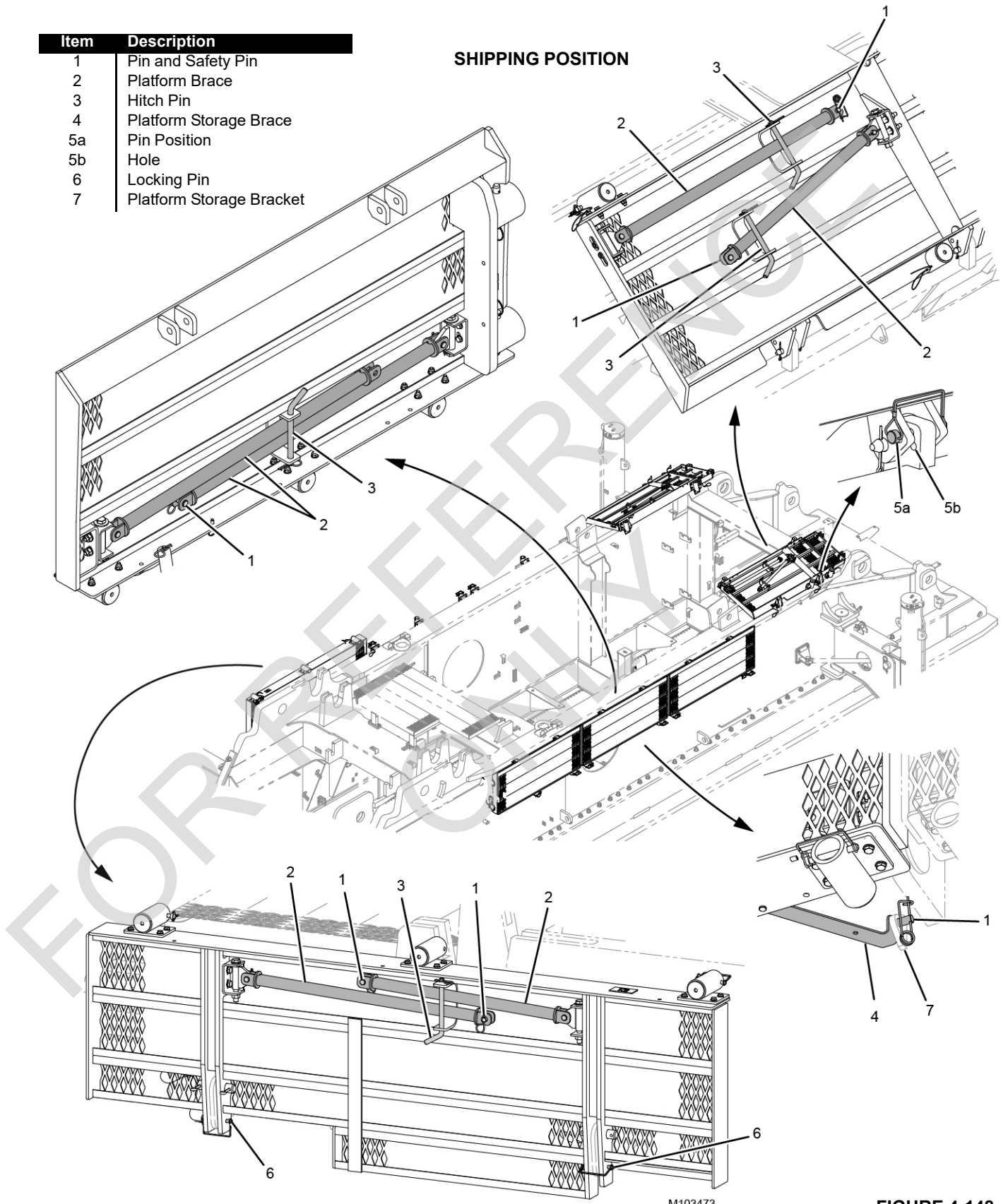
3. Swing the platform brace into the platform and secure with the hitch pin (3).
4. Swing the platforms down (upper rear platforms swing up), attach the platform storage brace (4) to the platform storage bracket (7), and insert the pin and safety pin.

NOTE: The upper rear platforms have two positions for shipping. The pin position (5a) is used for shipping with a live mast, and the hole (5b) is used for shipping without a live mast.

5. Repeat the procedure for each platform section.

Item	Description
1	Pin and Safety Pin
2	Platform Brace
3	Hitch Pin
4	Platform Storage Brace
5a	Pin Position
5b	Hole
6	Locking Pin
7	Platform Storage Bracket

SHIPPING POSITION



4

FIGURE 4-148

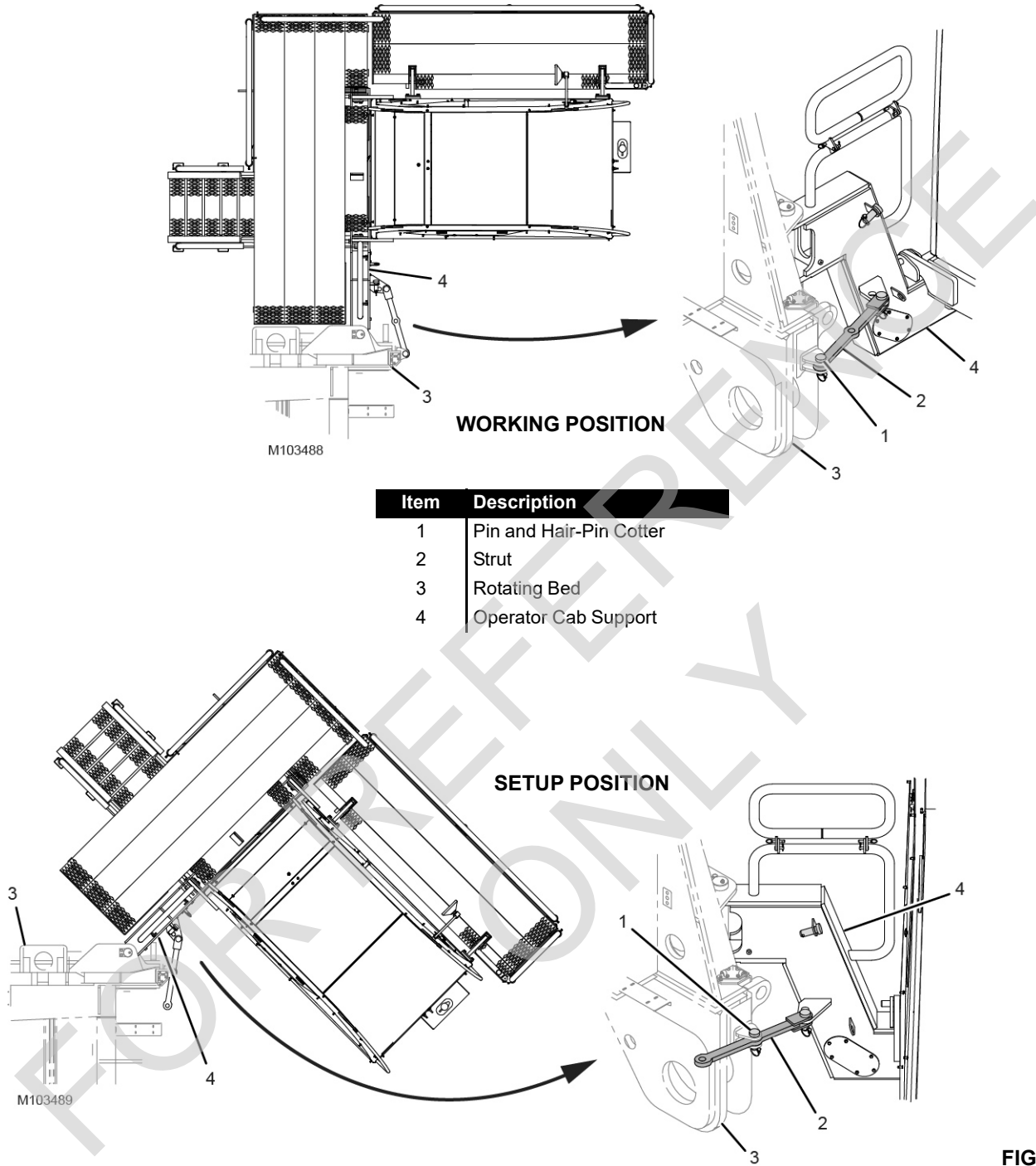


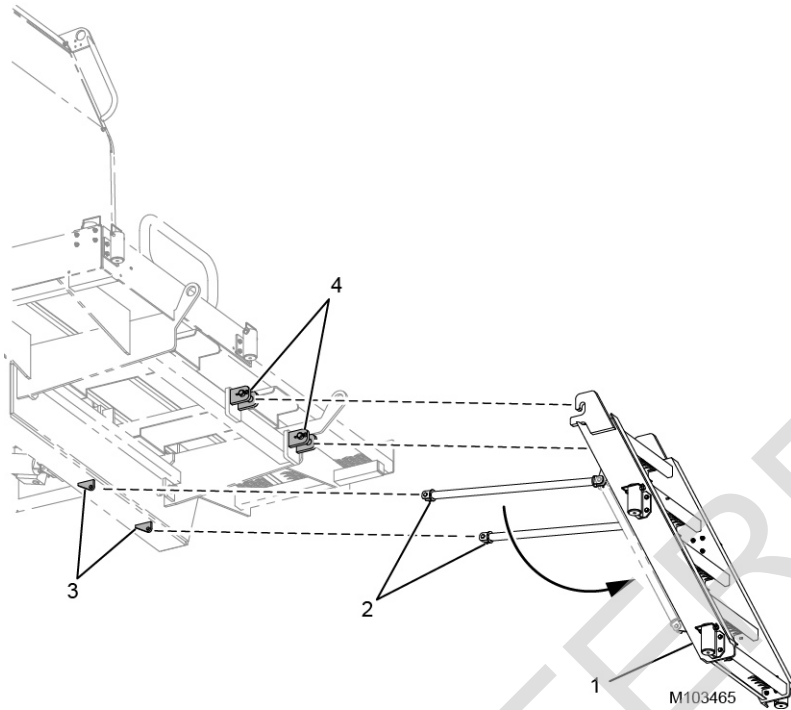
FIGURE 4-149

Moving Operator Cab (Shipping Position)

NOTE: Securing the cab in the setup position allows for access to the cab and removal of the cab platforms and handrails when the rotating bed jacking cylinders are deployed.

See [Figure 4-149](#) for the following procedure:

1. Remove the pin and safety pin (1) from the strut (2) attached to the rotating bed (3) as shown in the working position.
2. Rotate the cab to the setup position and insert the pin and safety pin (1) through the strut (2) to secure the cab.



Item	Description
1	Ladder
2	Strut (qty 2)
3	Strut Bracket (qty 2)
4	Ladder Bracket (qty 2)

FIGURE 4-150

Removing Operator Cab Ladder

See [Figure 4-150](#) for the following procedure:

NOTE: Raise the rotating bed approximately 100 mm (4 in) by extending the jacking cylinders to provide ground clearance to remove the cab ladder.

1. Remove the pins from the strut brackets (3).

2. Disconnect the struts (2) from the strut brackets.
3. Pivot the struts to the stored position and secure with pins.

4. Lift the ladder (1) from the ladder brackets (4).

NOTE: The ladder without handrails weighs approximately 28 kg (62 lb).

5. Prepare the operator ladder for shipping.

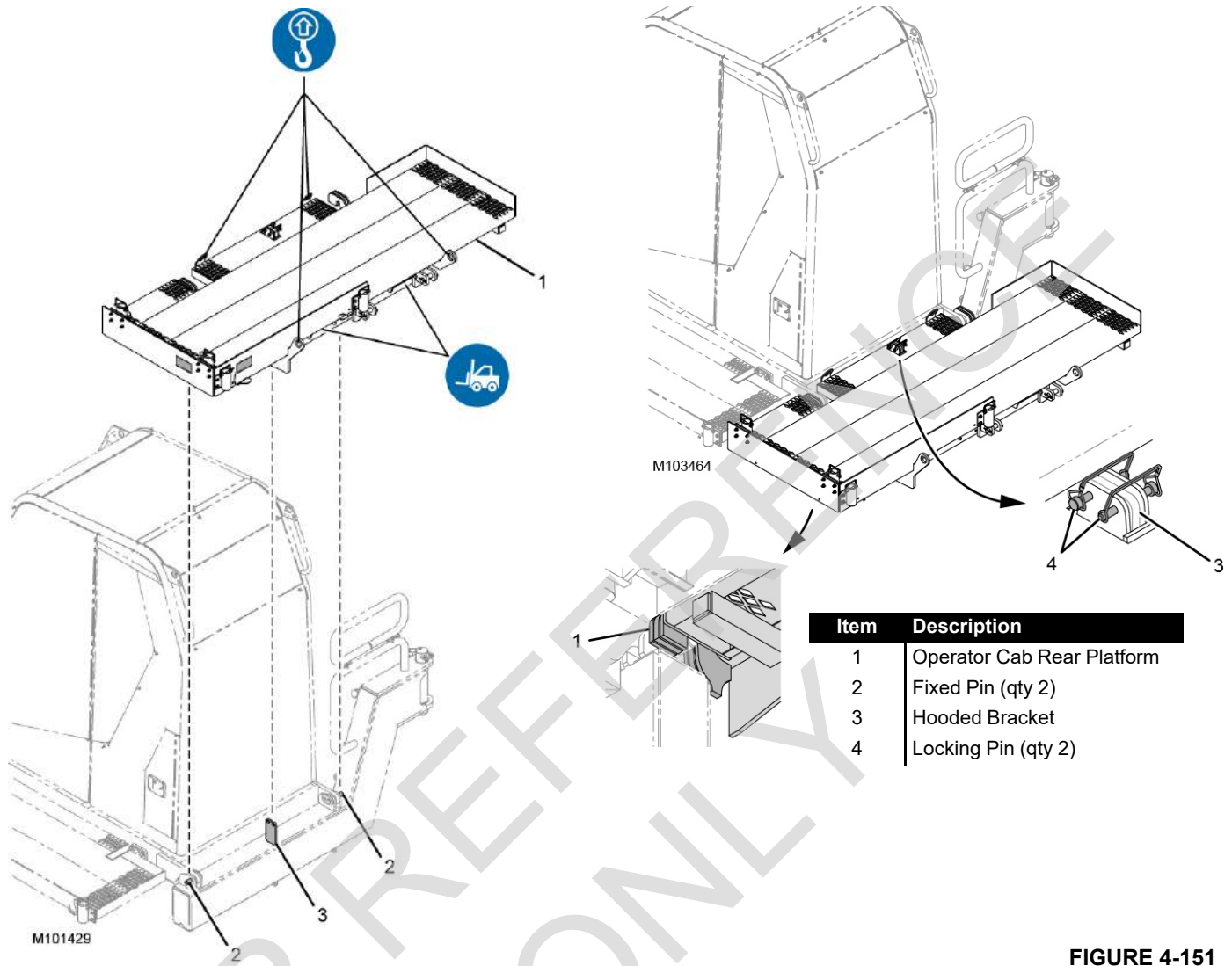


FIGURE 4-151

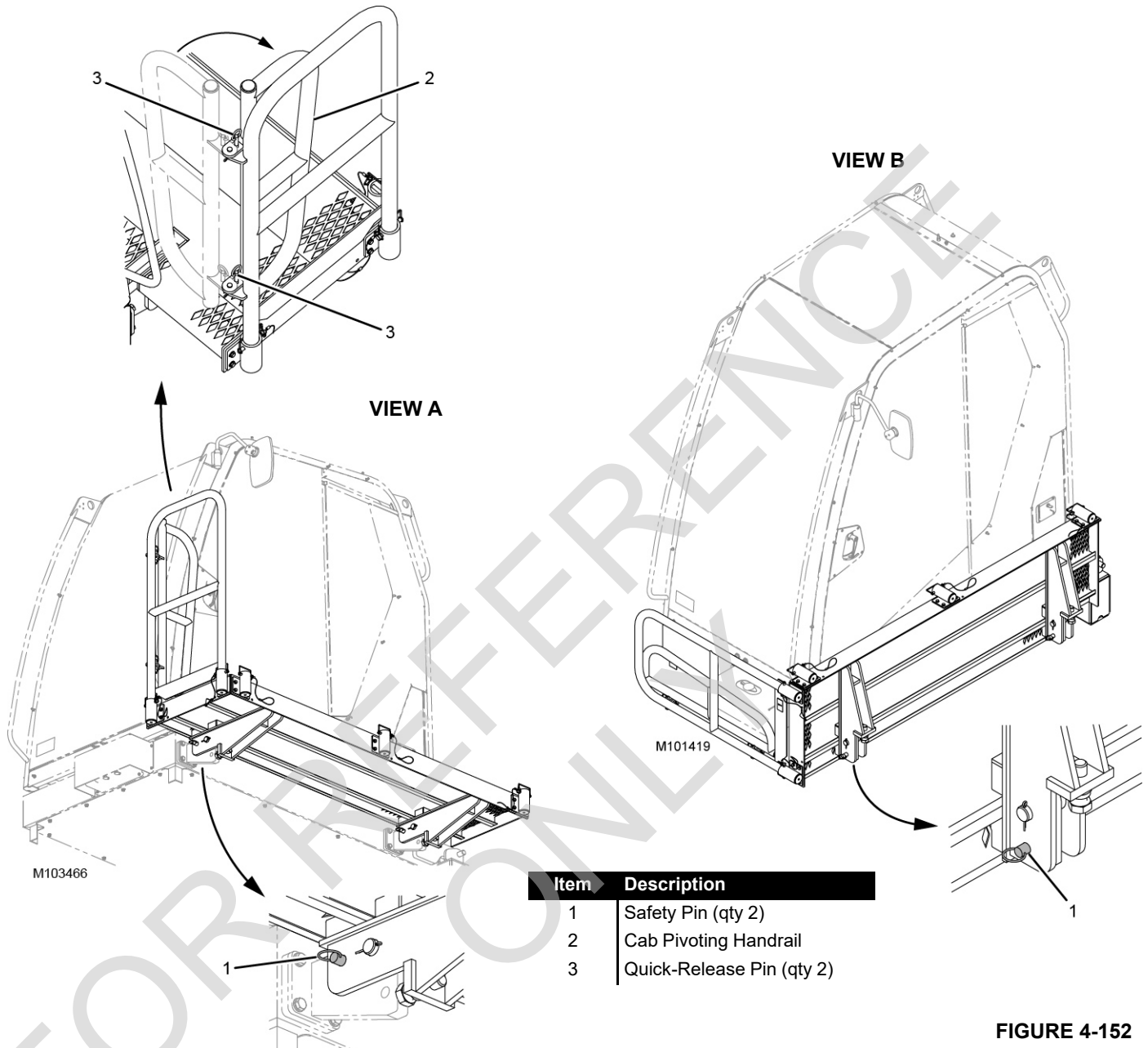
Removing Operator Cab Rear Platform

See [Figure 4-151](#) for the following procedure:

1. Remove the locking pins (4) from the hooded bracket (3).

NOTE: The operator cab rear platform (1) must be removed using an assist crane or forklift.

2. Attach four lifting slings to the lifting lugs and raise the operator cab rear platform from the fixed pins (2).
3. Prepare the operator cab rear platform for shipping.



Item	Description
1	Safety Pin (qty 2)
2	Cab Pivoting Handrail
3	Quick-Release Pin (qty 2)

FIGURE 4-152

Storing Operator Cab Front Platform

See [Figure 4-152](#) for the following procedure:

1. Remove the quick-release pins (3), rotate the cab pivoting handrail (2, View A) and install the quick-release pins.

2. Remove the safety pins (1, View A) from the platform bracket. Position the platform into the stored position and insert the safety pins (1, View B).

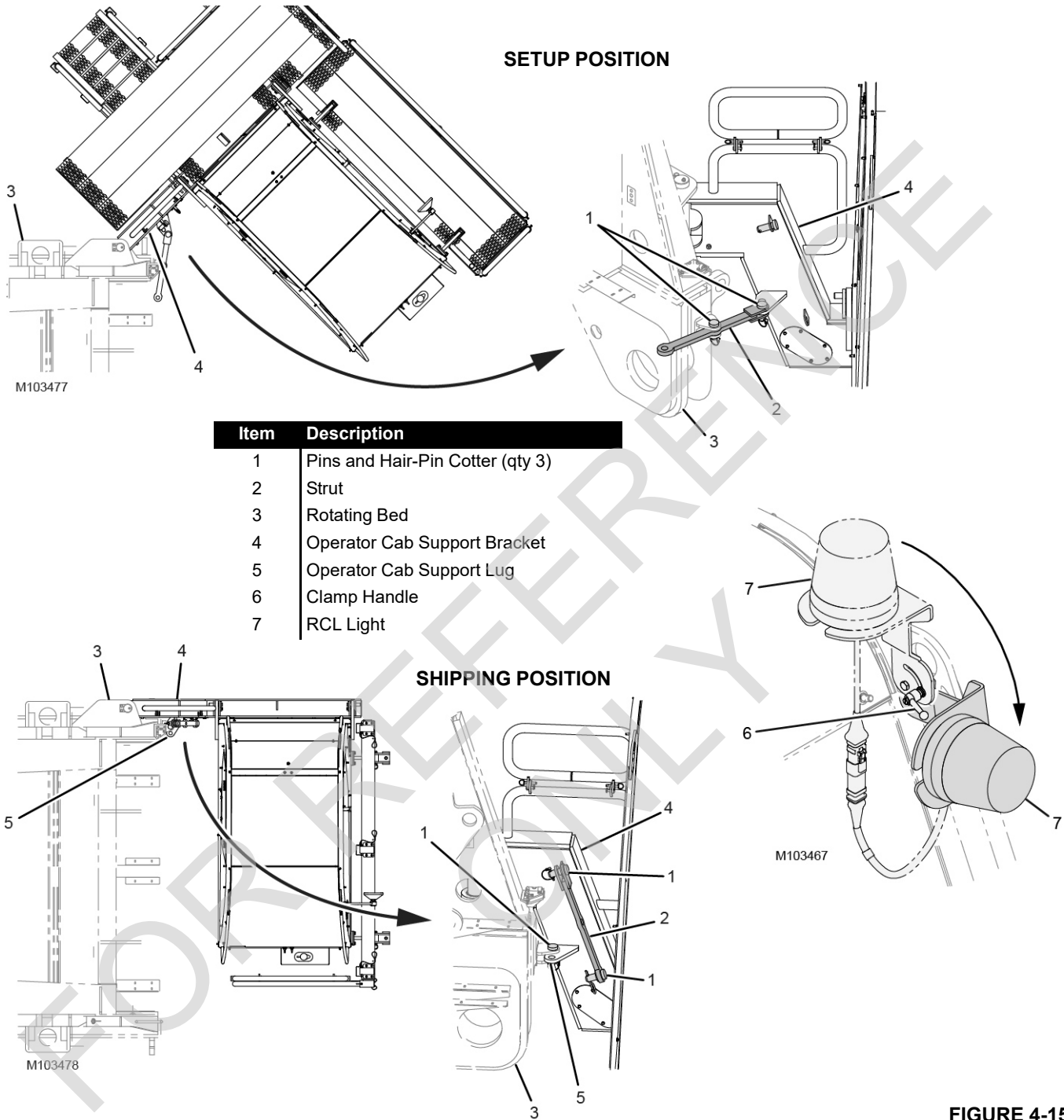
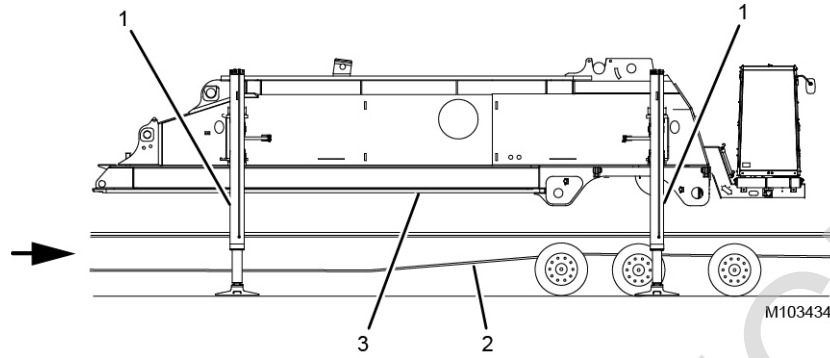


FIGURE 4-153

Securing Operator Cab

See [Figure 4-153](#) for the following procedure:

1. Loosen the clamp handle (6) on the RCL light (7) and move the RCL light to the shipping position. Tighten the clamp handle.
2. Remove the pins and safety pins (1) from the strut (2) shown in the setup position.
3. Place the strut (2) in the shipping position and install the pins and safety pins (1).
4. Rotate the cab to the shipping position.
5. Place the pin and safety pin (1) through the operator cab support lug (5) to secure the cab in the shipping position.



Item	Description
1	Rotating Bed Jacking Cylinder (qty 4)
2	Trailer
3	Rotating Bed

FIGURE 4-154

Extending Rotating Bed Jacking Cylinders

See [Figure 4-154](#) for the following procedure:

1. Align the trailer (2) with the rotating bed (3).
2. Using the remote control, extend the rotating bed jacking cylinders (1) until the rotating bed clears the trailer.
3. Slowly back the trailer under the rotating bed until the beam on the rotating bed is close to the drop deck of the trailer.

CAUTION

Equipment Damage!

Use extreme care when backing the trailer into position.
Do not hit the rotating bed jacks with the trailer.

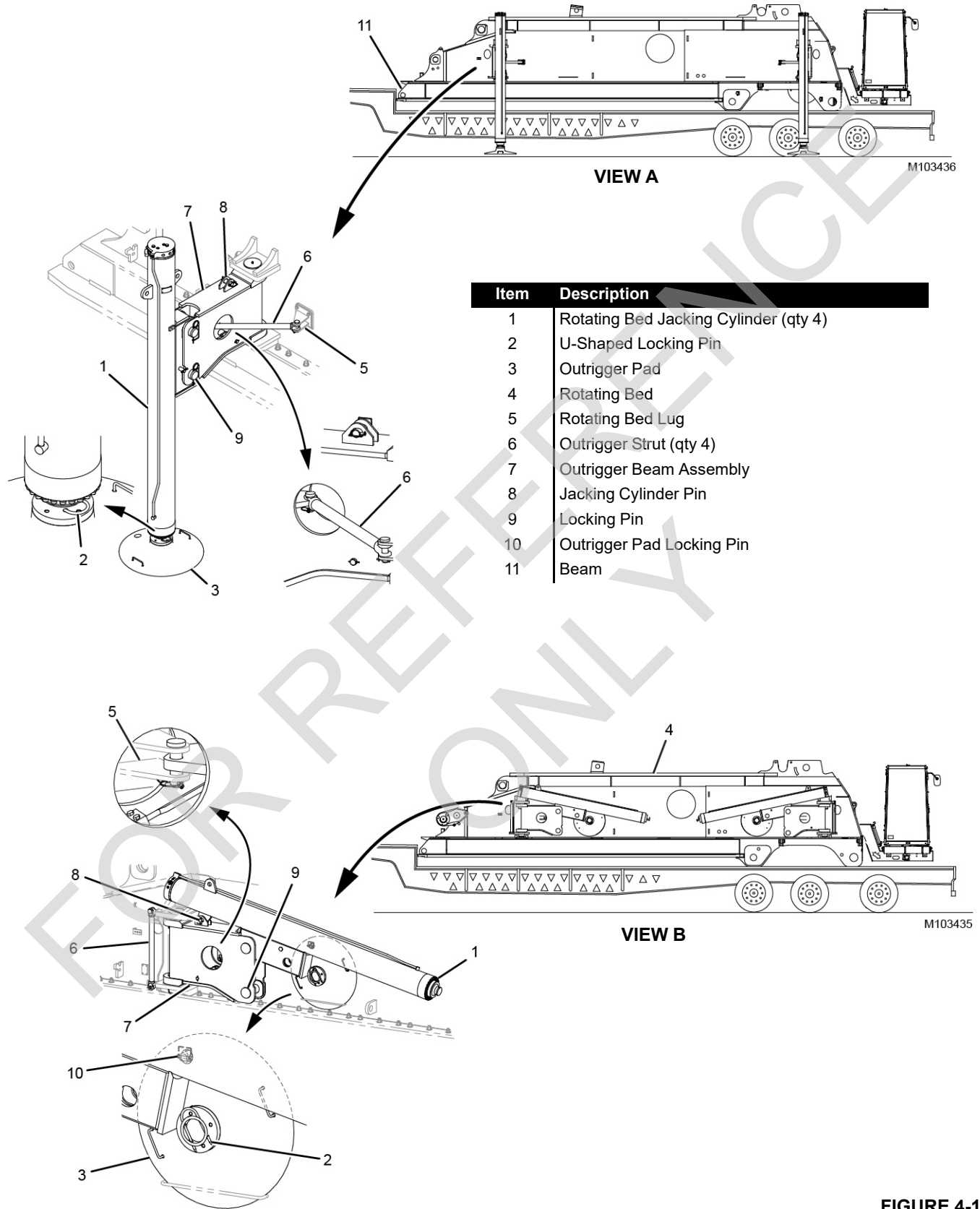


FIGURE 4-155

Lowering Rotating Bed Jacking Cylinders

See [Figure 4-155](#) for the following procedure:

NOTE: A minimum trailer height of 1168 mm (46 in) is necessary to be able to completely retract the rotating bed jacking cylinders.

1. Using the remote control, lower the rotating bed until it is resting on the trailer.

NOTE: The rotating bed beam (11) should be very close to the drop deck.

2. Remove the U-shaped locking pin (2, View A).
3. Retract the rotating bed jacking cylinders (1) completely.
4. Place the U-shaped locking pin back on the outrigger pad.
5. Place the outrigger pad in the stored position, aligning the lug on the rotating bed with the hole on the outrigger pad. Install the outrigger pad locking pin (10, View B).

NOTE: The outrigger pad weighs 30 kg (65 lb).

For shipping, all four outrigger pads should be stored on the rotating bed so the pads are available when the crane arrives at the new job site.

6. Remove the locking pin (9, View A) from the outrigger beam assembly.
7. Remove the jacking cylinder pin (8, View A).
8. Using the remote control, raise the outrigger jacking assembly and secure with the jacking cylinder pin (8, View B).
9. Remove the pins and safety pins from the outrigger struts (6, View A) and place the outrigger struts (6, View B) in the stored position.
10. Swing the outrigger beam assembly (7, View B) toward the rotating bed to the stored position.
11. Secure the outrigger beam assembly to the rotating bed lug (5, View B) with the outrigger pins and safety pins.
12. Repeat steps 2–11 for each rotating bed jacking assembly.
13. Secure the rotating bed to the trailer for shipping.

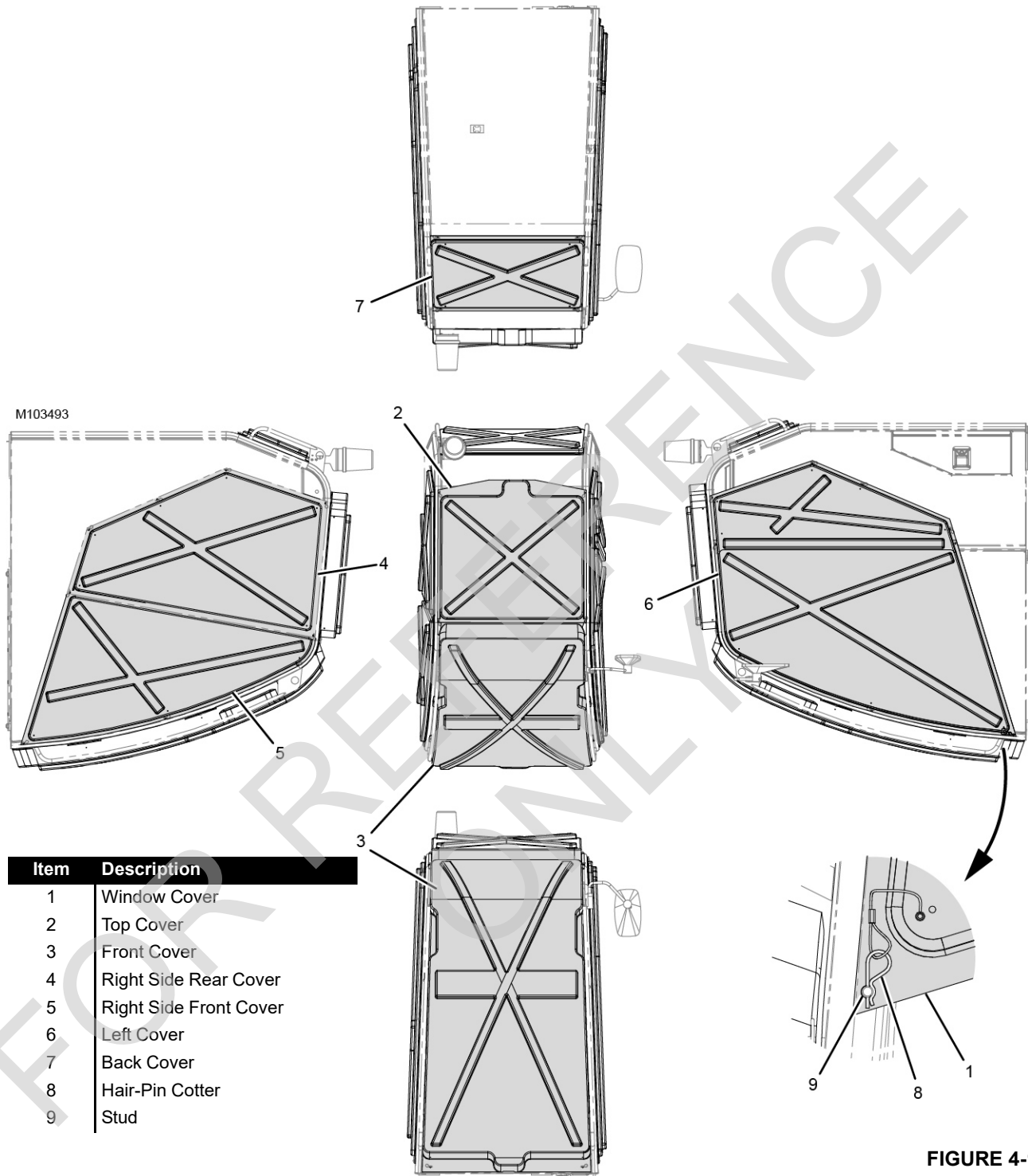


FIGURE 4-156

Installing Cab Window Covers (If Equipped)

See [Figure 4-156](#) for the following procedure:

1. Install the window cover (1) on the appropriate windows aligning the hole in the cover with the stud (3). Slide hair-pin cotters (2) through the hole in the stud.

WIRE ROPE INSTALLATION

NOTE: The wire rope manufacturer's recommendations takes 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

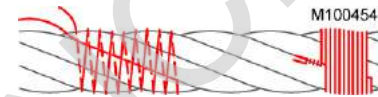
Store the wire rope in coils or on reels off the ground or floor in a clean, dry, indoor location. If outdoor storage is necessary, the wire rope must be covered with a protective wrapper.

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.

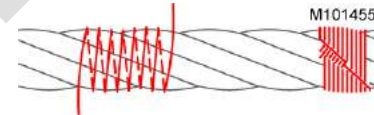
Wire Rope Type	Seizings Required
Preformed	1
Non-preformed	2

Place the free end of the seizing wire in the valley between two strands. 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 4-157

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 underloading 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 4-157](#) 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.

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

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

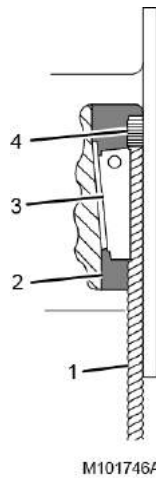
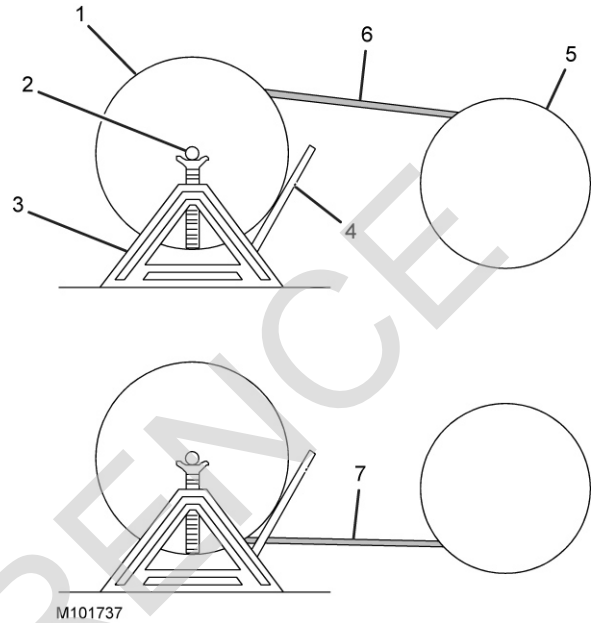


FIGURE 4-158



Anchoring Wire Rope to Drum

See [Figure 4-158](#)

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.

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 4-159

Winding Rope onto Drum

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.

CAUTION

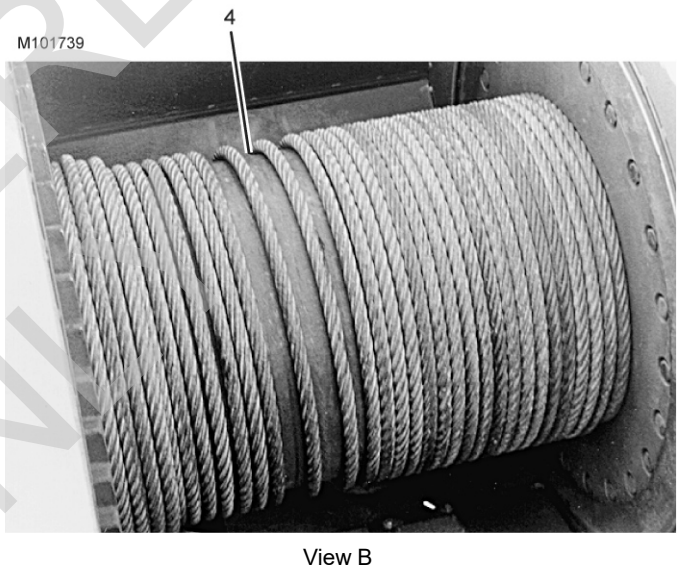
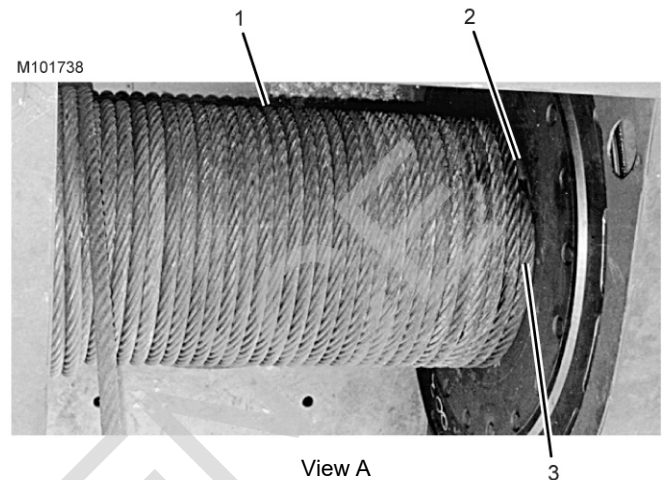
Avoid Wire Rope Damage

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 4-159](#)) 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 4-160](#)).
 - 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 4-160](#)) 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.

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 4-160

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
(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.

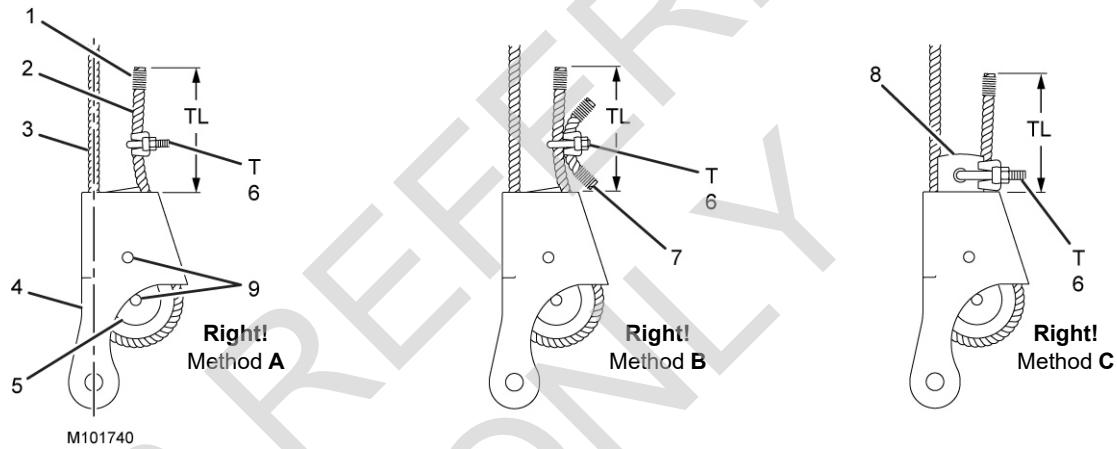
TL (Tail Length)

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!

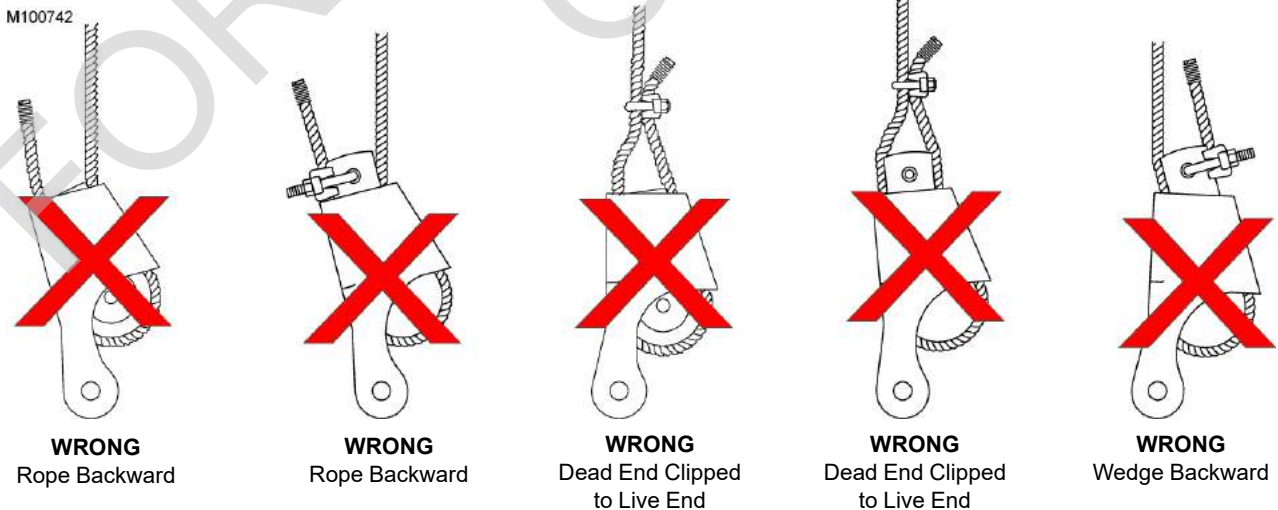


FIGURE 4-161

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 4-161](#)

- 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.
- Allow the dead end of the wire rope to extend past the end of the socket the amount shown.
- Allow the wire rope to assume its natural lay.
- Pull against the wedge and the live end of the wire rope enough to tighten the wedge in the socket.
- Use a brass hammer to seat the wedge and wire rope as deep into the socket as possible.
- 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.

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

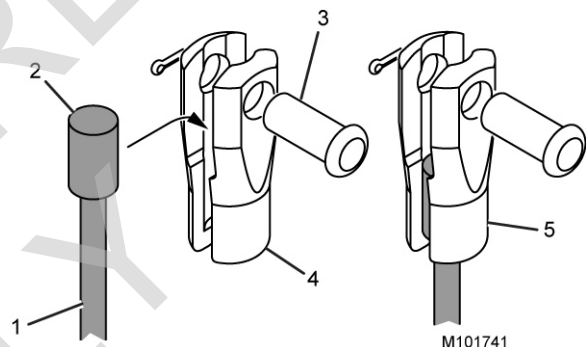


WARNING

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.



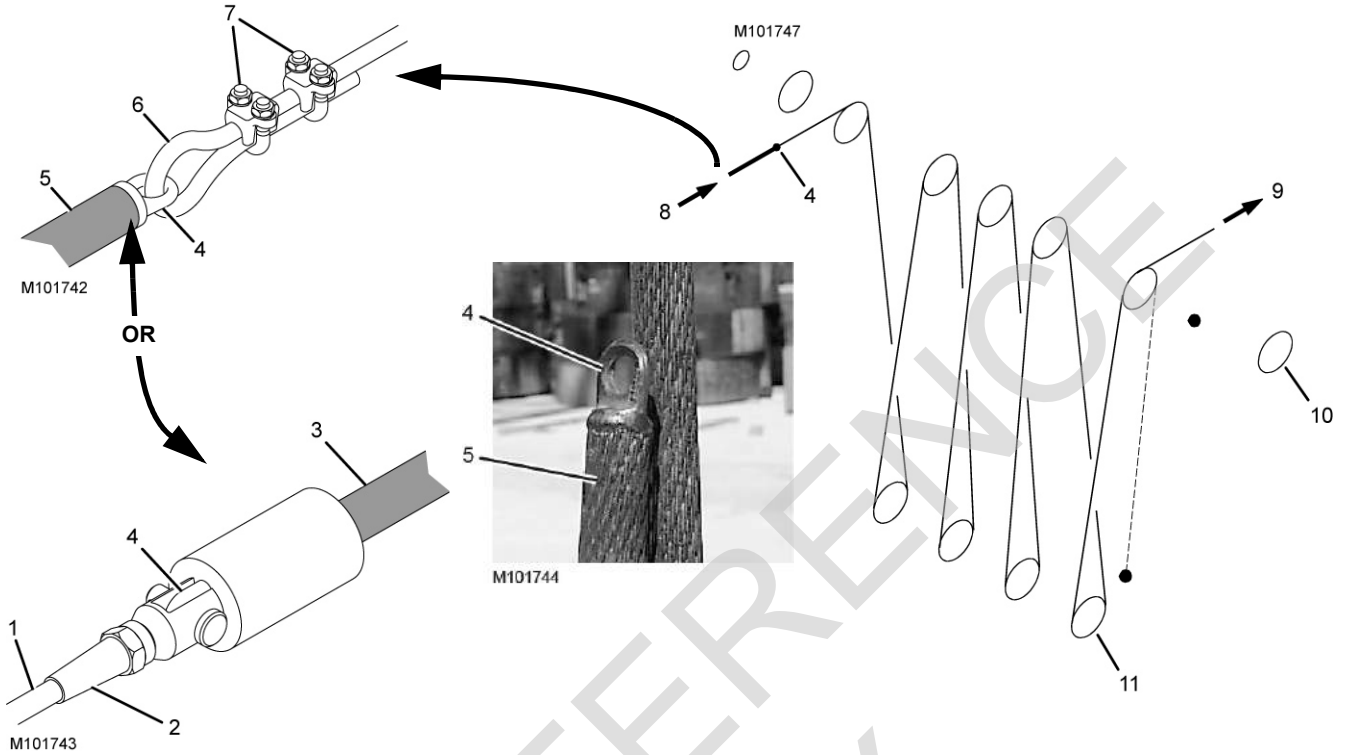
Item	Description
1	Load Line
2	Button
3	Pin
4	Button Socket
5	Locking Screw (behind if equipped)

FIGURE 4-162

Anchoring Wire Rope to Button Socket

See [Figure 4-162](#)

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



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**

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

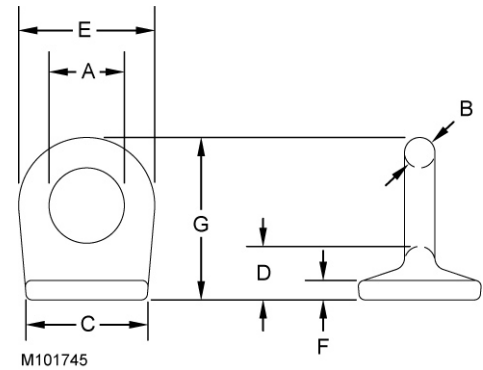


FIGURE 4-163

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 4-163](#)

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 4-163](#).
2. Make sure the rigging line and the attaching hardware (clips and rope connectors) are rated for the approximate capacities shown in [Figure 4-163](#).

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.

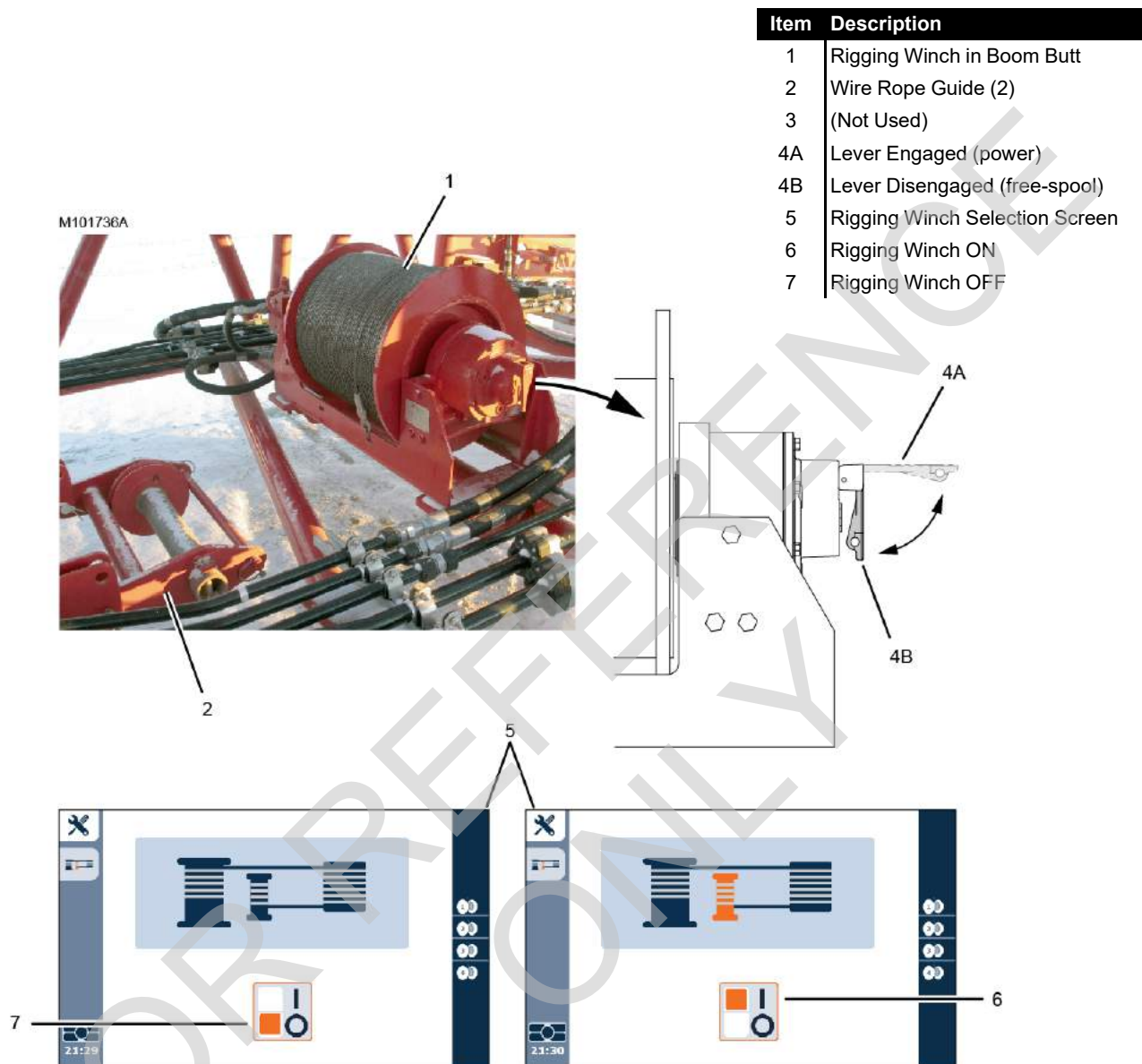


FIGURE 4-164

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 4-164](#) for the following procedures.

Selecting Rigging Winch Mode

TO TURN RIGGING WINCH ON —

1. Scroll to the rigging winch selection screen (5) in the main display. See MLC650 Main Display Operation Manual for instructions.
2. Use either the jog dial on the right console or the scroll keys on the main display to highlight the ON (I) icon (6) in the selection box.
3. Press the select button on the jog dial or on the main display to select the highlighted mode. The screen changes to reflect the change.

TO TURN RIGGING WINCH OFF —

1. Scroll to the rigging winch selection screen (5) in the main display. See MLC650 Main Display Operation Manual for instructions.
2. Use either the jog dial on the right console or the scroll keys on the main display to highlight the OFF (O) icon (7) in the selection box.
3. Press the select button on the jog dial or on the main display to select the highlighted mode. The screen changes to reflect the change.

Operating Rigging Winch

Free-Spool Operation

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

TO TURN FREE-SPOOL OFF engage the lever (4A).

TO TURN FREE-SPOOL ON disengage the lever (4B)

Power Operation

1. Engage the lever to turn the free-spool off.
2. Turn on the rigging winch mode.
3. To ensure the winch gears are properly engaged, proceed as follows:
 - a. Push the Drum 0 control handle forward to slowly rotate the winch drum 90° in the pay out direction.
 - b. Pull the Drum 0 control handle back to slowly rotate the winch drum 90° in the haul in direction.
4. Pay out the rigging line by moving the Drum 0 control handle forward.
5. Reeve the rigging line through the load block and the boom point and connect it to the desired load line as shown in the Rigging Winch Assembly drawing at end of this section.
6. Move the Drum 0 control handle to off and push the corresponding load drum control handle forward to pay out the load line. The rigging winch will haul in the rigging line automatically.

NOTE: Use the engine throttle to increase and decrease rigging winch line pull and to control line slack at the rigging winch.

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

CAUTION

Avoid Rigging Winch or Wire Rope Damage!

The rigging winch 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.



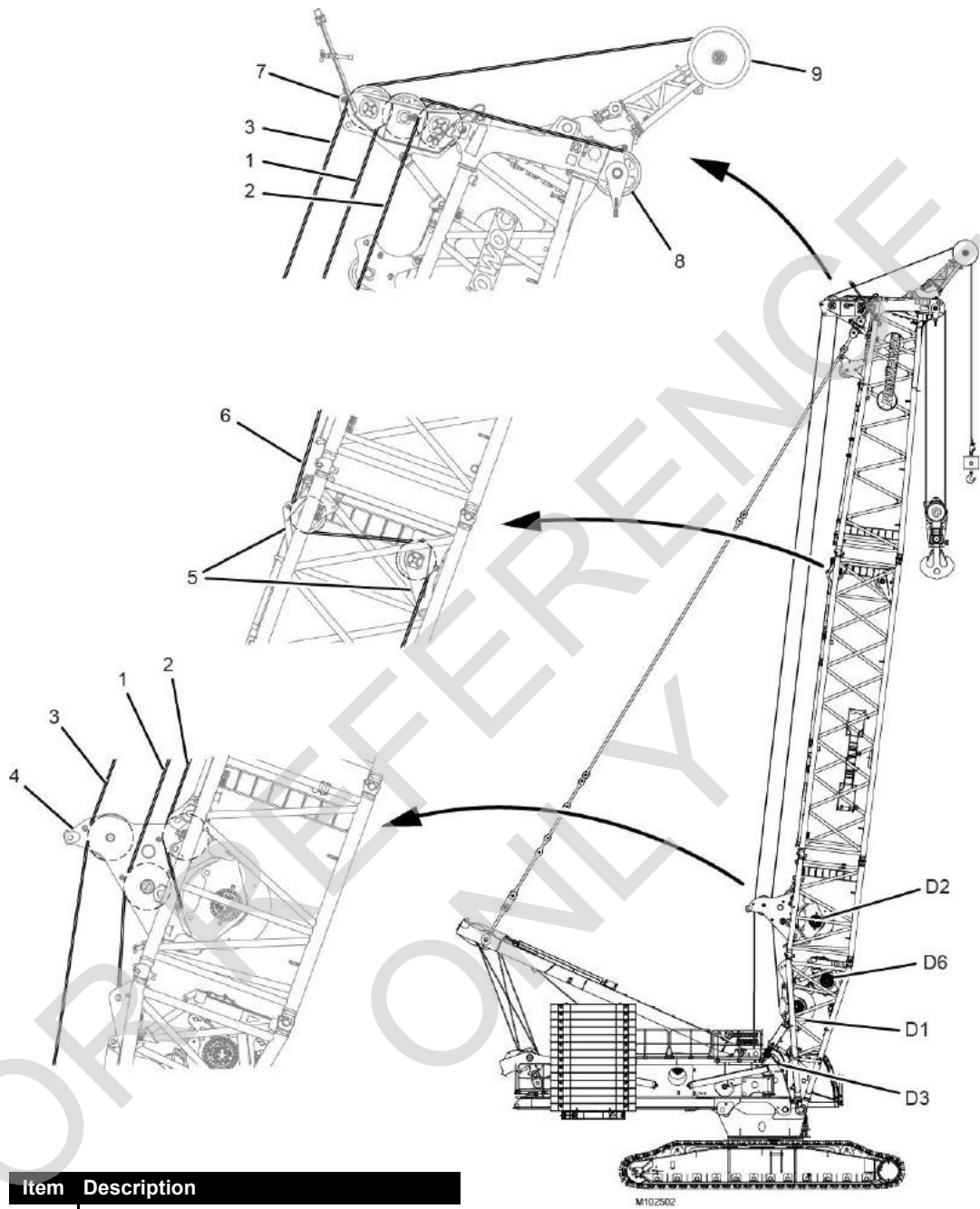
WARNING

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 Guide 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
D1	Drum 1 (Main Hoist)
D2	Drum 2 (Main Hoist Optional)
D3	Drum 3 (Whip Hoist)
D6	Drum 6 (Luffing Hoist)

FIGURE 4-165

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 4-165](#) 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.

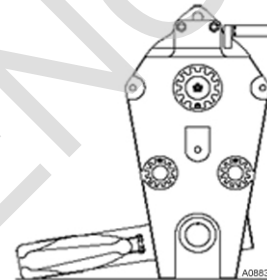


WARNING

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 (2) so it is balanced equally on the duplex hook (1). The lifting slings must be within the angles given in [Figure 4-166](#) to achieve maximum hook capacity. The duplex hook has a hole to which an optional shackle can be attached as shown in [Figure 4-166](#).



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.

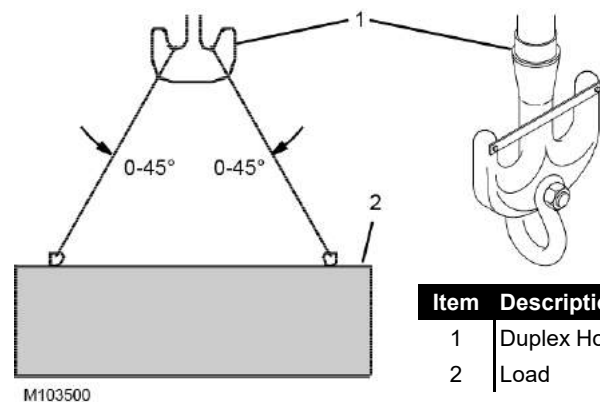


FIGURE 4-166

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.

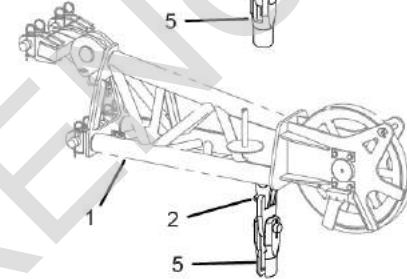
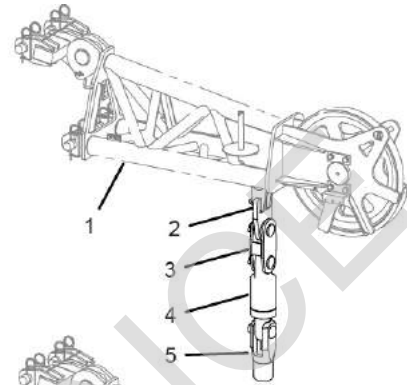
Dead End Locations

See [Figure 4-167](#) for the upper boom point dead end locations and required hardware.

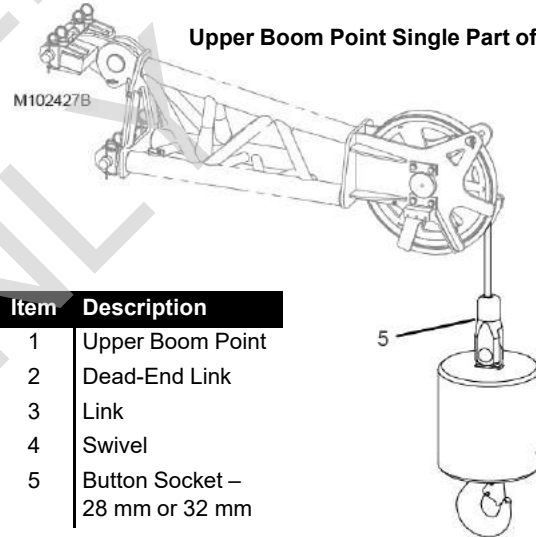
See the Boom Rigging Drawing for the lower boom point dead end locations and required hardware.

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

Upper Boom Point Multiple Parts of Line



Upper Boom Point Single Part of Line



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

FIGURE 4-167

SECTION 5 LUBRICATION

TABLE OF CONTENTS

Lubrication	5-1
Lube and Coolant Product Guide	5-1

FOR REFERENCE ONLY

THIS PAGE INTENTIONALLY LEFT BLANK

FOR REFERENCE ONLY

SECTION 5 LUBRICATION

LUBRICATION

See F2271 at the end of this section.

LUBE AND COOLANT PRODUCT GUIDE

See the publication at the end of this section.

FOR REFERENCE ONLY

THIS PAGE INTENTIONALLY LEFT BLANK

FOR REFERENCE ONLY

SECTION 6 MAINTENANCE CHECKLIST

TABLE OF CONTENTS

Inspection and Maintenance Checklist	6-1
Fiberglass Maintenance	6-1

FOR REFERENCE ONLY

THIS PAGE INTENTIONALLY LEFT BLANK

FOR REFERENCE ONLY

SECTION 6 MAINTENANCE CHECKLIST

INSPECTION AND MAINTENANCE CHECKLIST

See F2273 at the end of this section.

FIBERGLASS MAINTENANCE

See Bulletin W04-009 at the end of this section.

FOR REFERENCE ONLY

THIS PAGE INTENTIONALLY LEFT BLANK

FOR REFERENCE ONLY

ALPHABETICAL INDEX

Assembling, Disassembling, or Operating Crane Near Electric Power and Transmission Lines	2-17
AC Operation	3-81
Accessing Parts	4-2
Accidents	2-19
Assembly And Disassembly Area	4-2
Assembly and Disassembly Notes	4-1
Boom and Jib Assembly Drawings	4-1
Boom And Jib Rigging—General	4-86
Boom Assembly	4-93
Boom Disassembly Safety	2-23
Boom Ladders	4-91
Bypassing Limits in Luffing Jib Setup Mode	3-54
Cab Door Adjustment	3-58
Cab Tilt Adjustment	3-59
Change of Ownership Registration	1-1
Changing Counterweight with Boom/Jib In Air	3-75
Cold Weather Heater Package	3-79
Cold Weather Operation	3-77
Connecting/Disconnecting Hydraulic Hoses and Electric Cables	4-10
Continuous Innovation	2-1
Crane Access Points	2-6
Crane Assembly Components	4-5
Crane Assembly	4-15
Crane Data	1-1
Crane Disassembly	4-136
Crane Orientation	1-1
Crane Orientation	4-1
Crane Weights and Shipping Data	4-2
Crane Weights	1-1
Crane/Attachment Identification	1-1
Crawler Blocking	3-60
Drum and Control Handle Identification	3-56
English and Metric Conversions	1-4
Environmental Protection	2-21
Fiberglass Maintenance	6-1
Fire Extinguishers	2-19
General Safety	4-1
Getting On or Off Crane	2-6
Handling Components	4-3
Hose and Cable Cleanliness	4-10
Hydraulic Hose Identification	4-10
Identification and Location of Components	1-2
Identification and Location of Components	4-14
Inspection and Maintenance Checklist	6-1
Intermediate Suspension	3-60
Introduction	1-1
Liftcrane Mast Handling Capacities	4-1
Load Line Reeving	4-205
Lube and Coolant Product Guide	5-1
Lubrication	5-1
Lubrication	5-1
Maintenance Checklist	6-1
Manitowoc Dealer	1-1

Motion Warning Lights and Alarms	3-36
Nameplates and Decals	2-1
Operating Controls And Procedures	3-1
Operating Controls	3-12
Operating in Wind	3-59
Operating Limits Identification and Operation	3-48
Operating Procedures	3-65
Operational Aids	2-15
Operator Manual/Capacity Chart Storage	2-8
Operator's Cab Emergency Exit	3-58
Optional Attachments	4-1
Outline Dimensions	1-1
Parts Box	4-5
Pedestal/Barge Mounted Cranes	2-25
Personal Fall-Protection	2-7
Personal Fall-Protection	4-3
Personnel Handling Policy	2-24
Pin and Connecting Hole Cleanliness	4-10
Preparing Crane for Operation	3-60
Raise Boom	4-134
Refueling	2-19
Remote Control Activation	3-40
Remote Control Operation	3-42
Remote Control	4-12
Retaining Connecting Pins	4-2
Rigging Winch Operation	4-202
Right Cab Window Operation	3-58
Safe Maintenance	2-19
Safe Operating Practices	2-9
Safety and Information Signs	2-3
Safety Devices	2-15
Safety Information	2-1
Safety Messages	2-1
Service Lights	3-38
Set-Up and Installation	4-1
Setup Mode	4-13
Shipping Crane Components	4-135
Shutdown Procedure or Leaving the Crane Unattended	3-74
Signals	2-14
Standard Hand Signals for Controlling Crane Operations	3-2
Startup Procedures	3-61
Swing Limits	4-8
Symbols Used on Control Consoles	3-4
Symbols Used on Remote Control	3-7
Tightening Hydraulic Couplers	4-10
VPC and VPC-MAX	1-4
Wire Rope Installation	4-195

FOR REFERENCE ONLY

FOR REFERENCE
ONLY