Manitowoc 2250

Operator Manual

Grove Manitowoc National Crane Potain

Manitowoc

OPERATOR MANUAL

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

2250

Crane Model Number

XXXXXREF

Crane Serial Number

This Manual is divided into the following sections:

NOTICE

The serial number of the crane and applicable attachments (luffing jib, MAX-ER®) is the only method your Manitowoc Cranes 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, 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 Cranes dealer or the Manitowoc Crane Care Lattice Team.

⚠ WARNING

To prevent death or serious injury:

- Avoid unsafe operation and maintenance.

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

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

Published 06-24-16, Control # 241-01

THE ORIGINAL LANGUAGE OF THIS PUBLICATION IS ENGLISH

See the Alphabetical Index for More Information

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 1
INTRODUCTION

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

Published 06-24-16, Control # 241-01

1

SECTION 1
INTRODUCTION

CRANE DATA

See the crane data specific to your crane:

- Basic specifications
- EC declaration (if applicable)

CRANE/ATTACHMENT IDENTIFICATION

See Figure 1-1 for the following.

An identification plate is attached to the outside of the operator's cab and to the available attachments (for example, luffing jibs, Ringers, and MAX-ERs).

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

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

TIER 4F ENGINE

This manual applies only to 2250 cranes equipped with a Tier 4F engine.

CHANGE OF OWNERSHIP REGISTRATION

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

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

CRANE ORIENTATION

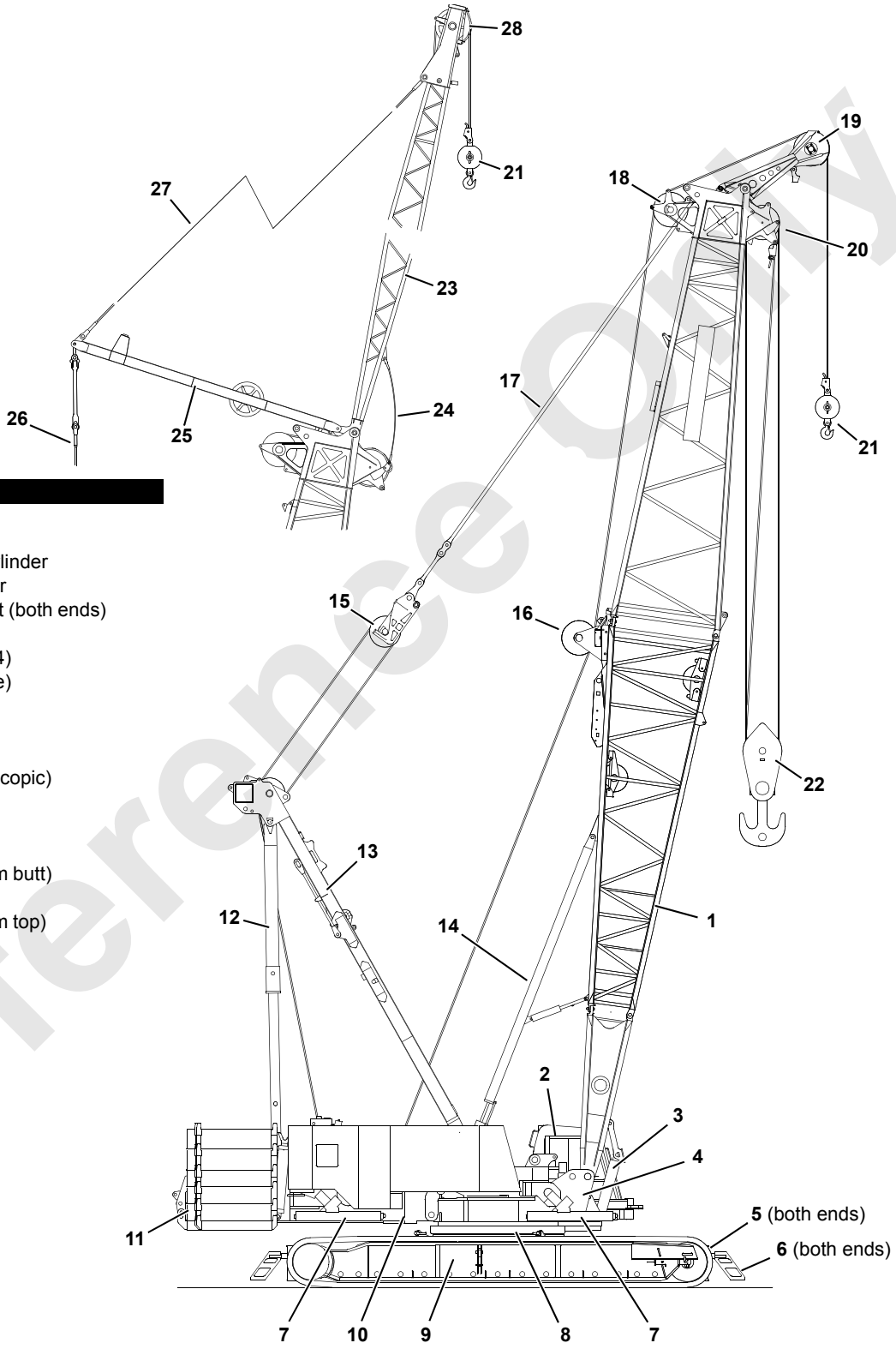
The terms RIGHT, LEFT, FRONT, and REAR refer to the operator's right, left, front, and rear sides when seated in the operator's cab looking forward.

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

FIGURE 1-1

IDENTIFICATION AND LOCATION OF COMPONENTS

Crane Components

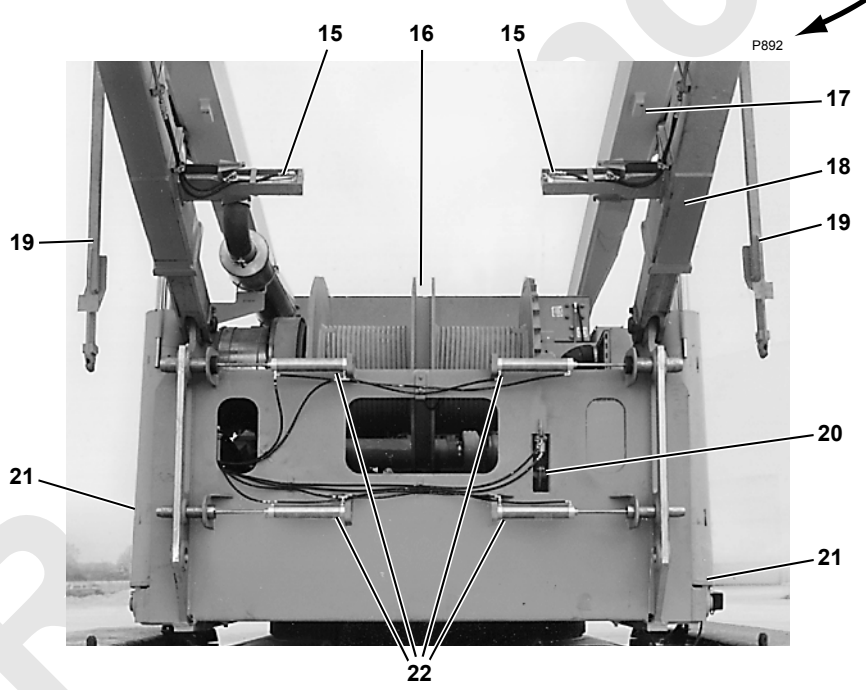


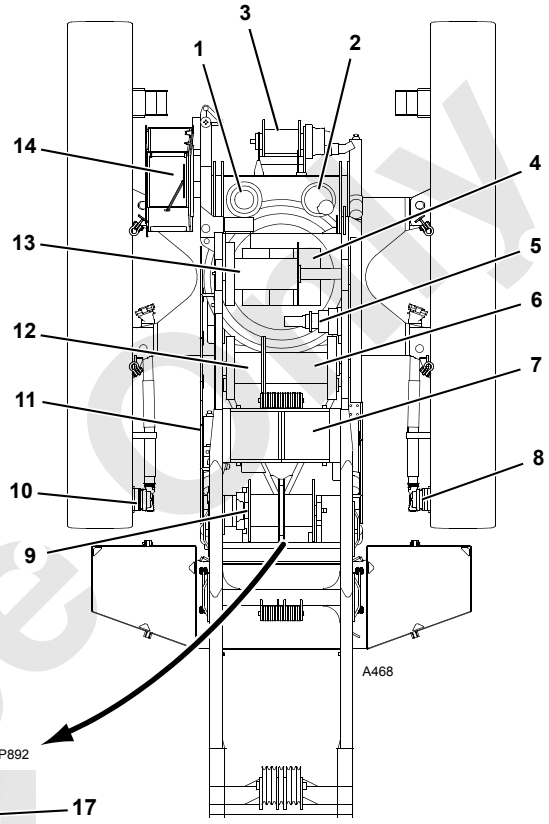
Item	Description
1	#44 Heavy Lift Boom
2	Operator's Cab
3	Boom Butt Handling Cylinder
4	Rotating Frame Adapter
5	Carbody Counterweight (both ends)
6	Step (both ends)
7	Jacking Cylinders (qty 4)
8	Carbody (undercarriage)
9	Crawler (both sides)
10	Rotating Bed
11	Upper Counterweight
12	Backhitch Gantry (telescopic)
13	Gantry
14	Boom Stop
15	Equalizer
16	Wire Rope Guide (boom butt)
17	Boom Straps
18	Wire Rope Guide (boom top)
19	Upper Boom Point
20	Lower Boom Point
21	Weight Ball
22	Load Block
23	Fixed Jib
24	Jib Stop
25	Jib Strut
26	Backstay Pendant
27	Jib Pendant
28	Jib Point

A1048

FIGURE 1-2

Item	Description
1	Left Swing Motor (optional)
2	Right Swing Motor
3	Luffing Hoist Drum
4	Swivel
5	Load Drum(s) Motor
6	Right Rear Load Drum
7	Engine
8	Right Crawler Drive
9	Boom Hoist Drum
10	Left Crawler Drive
11	Pump Drive and System
12	Left Rear Load Drum
13	Front Load Drum
14	Operator's Cab
15	Gantry Backhitch Cylinder (air) (qty 2)
16	Boom Hoist
17	Gantry
18	Gantry Backhitch (telescopic) (qty 2)
19	Counterweight Handling Links
20	Boom Hoist Pawl Cylinder (air)
21	Gantry Lifting Cylinder (hydraulic) (qty 2)
22	Counterweight Connecting Pin Cylinder (air) (qty 4)

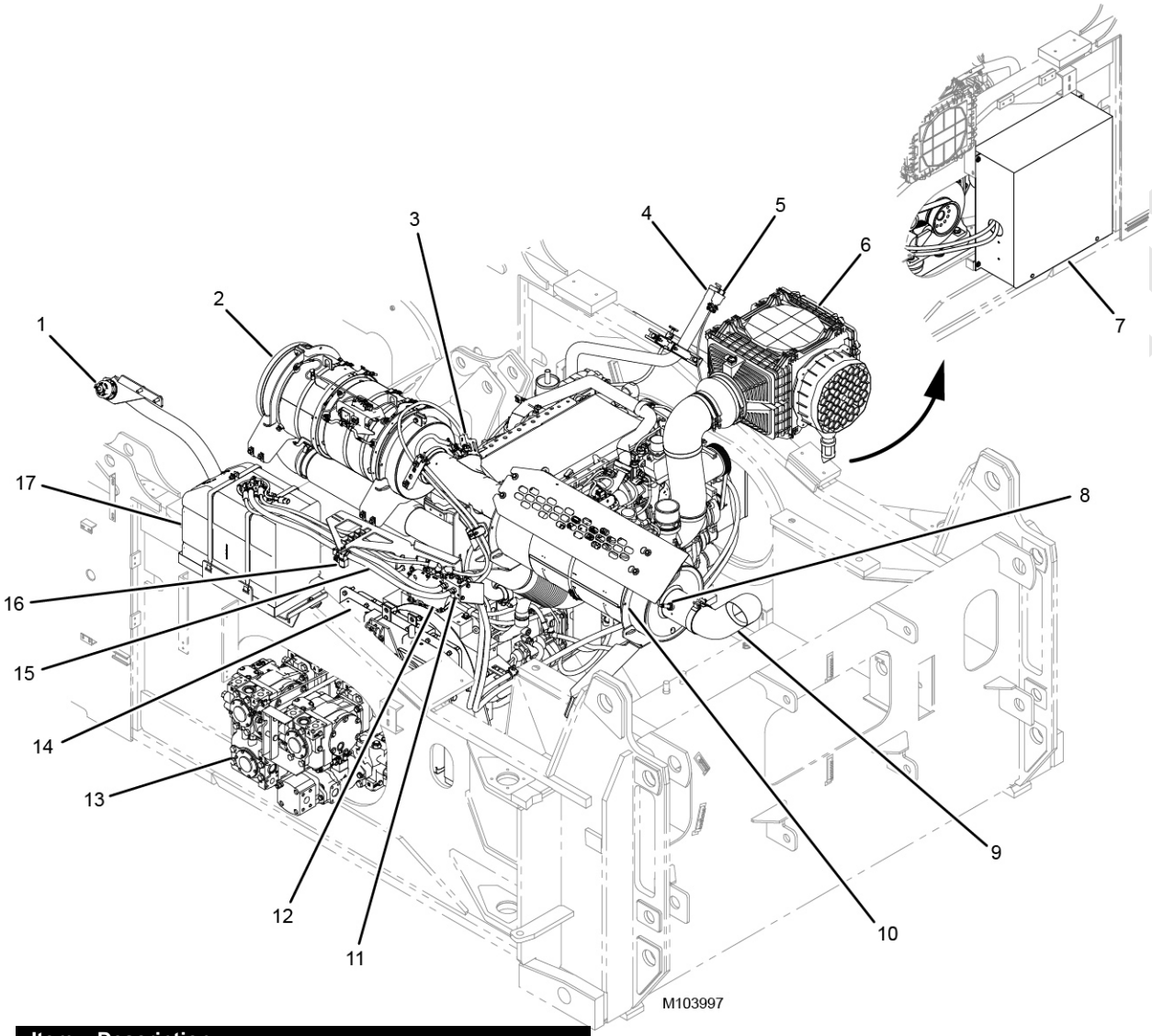




Rear View with Upper Counterweight Removed
(upper counterweight attached to crane with item 22)

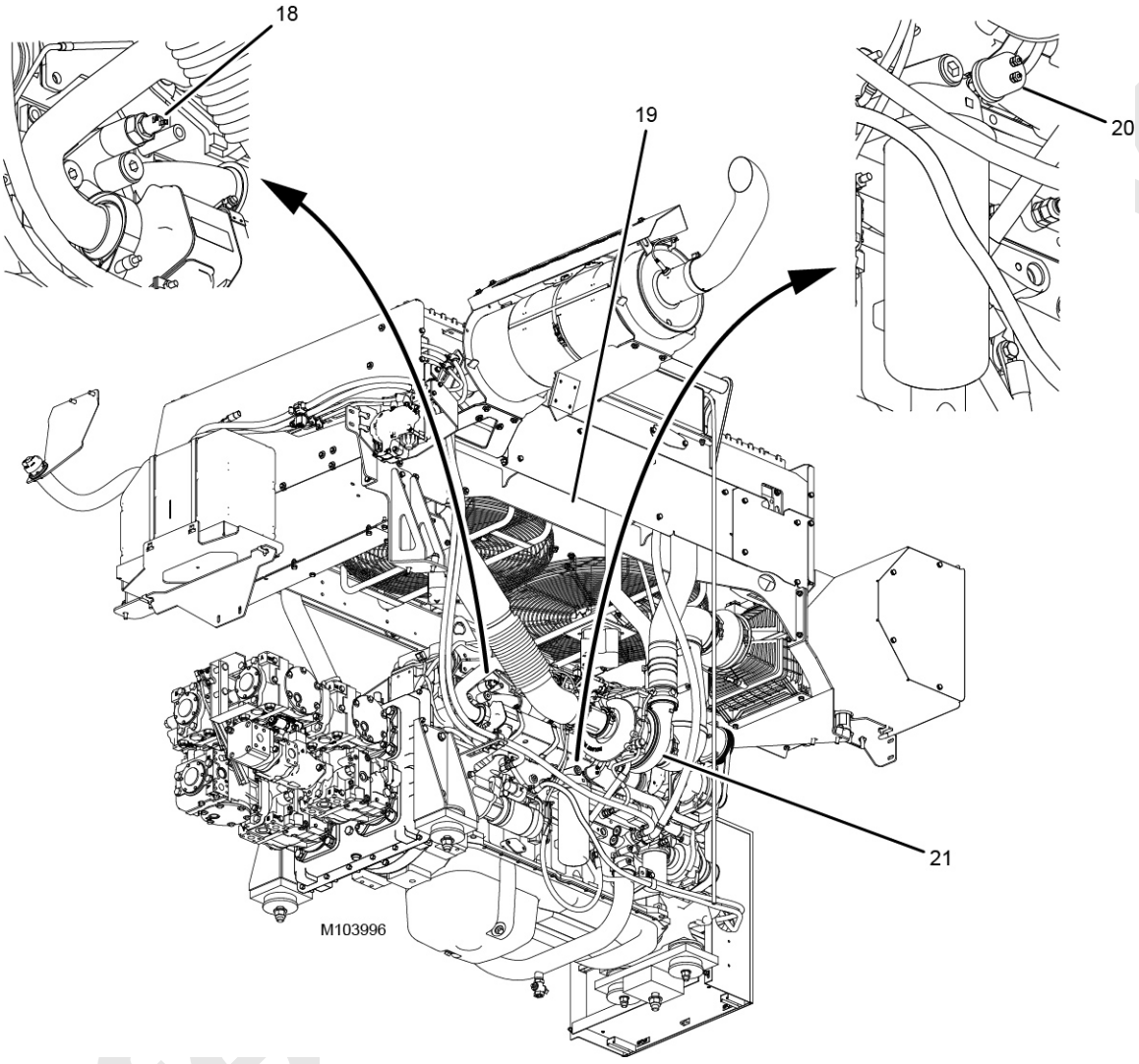
FIGURE 1-3

Engine Components



Item	Description
1	Diesel Exhaust Fluid (DEF) Filler Tube
2	Diesel Particulate Filter (DPF)
3	Diesel Exhaust Fluid (DEF) Dosing Unit
4	Fuel Filler Tube
5	Air Filter Restriction Gauge
6	Air Filter Assembly
7	Battery (qty 2)
8	Temperature Sensor
9	Tail Pipe
10	Selective Catalytic Reduction (SCR) Filter
11	Diesel Exhaust Fluid (DEF) Junction Manifold
12	Diesel Exhaust Fluid (DEF) Supply Pump
13	Drive Pump Assembly
14	Pump Drive
15	Diesel Exhaust Fluid (DEF) Coolant Lines
16	Diesel Exhaust Fluid (DEF) Coolant Control Valve
17	Diesel Exhaust Fluid (DEF) Tank

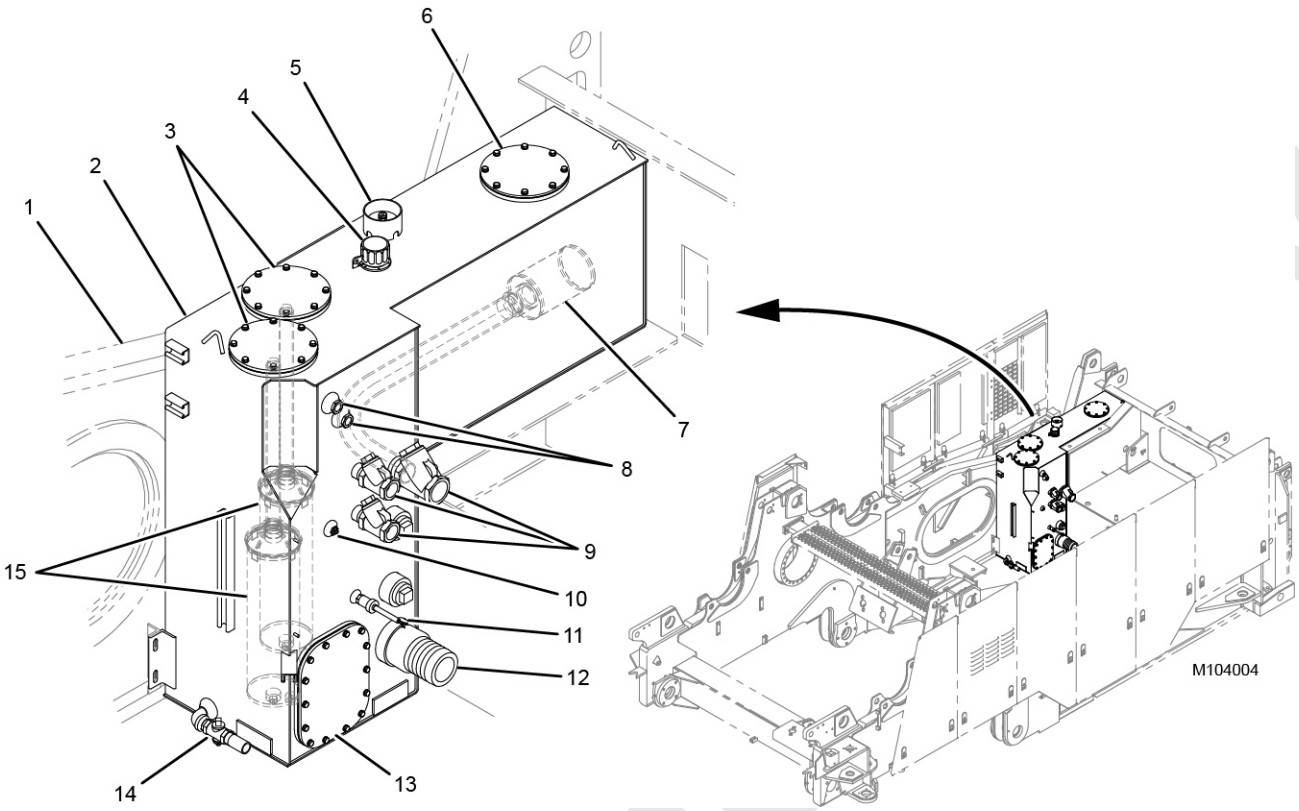
FIGURE 1-4



Item	Description
18	Temperature Switch
19	Cooling Assembly
20	Oil Pressure Switch
21	Turbocharger

FIGURE 1-4 continued

Hydraulic Tank Components



Item	Description
1	Rotating Bed
2	Hydraulic Oil Reservoir
3	Filter Access Cover (qty 2)
4	Fill Cap
5	Level Gauge
6	Clean-Out Cover
7	Diffuser
8	Sight Window (qty 2)
9	Swing Check Valve (qty 3)
10	Temperature Sending Unit
11	Pressure Transducer
12	Hose Adapter
13	Clean-Out Cover
14	Drain Valve
15	Filter (qty 2)

FIGURE 1-5

1

OUTLINE DIMENSIONS

Standard Crane (series 3 counterweight arrangement shown)

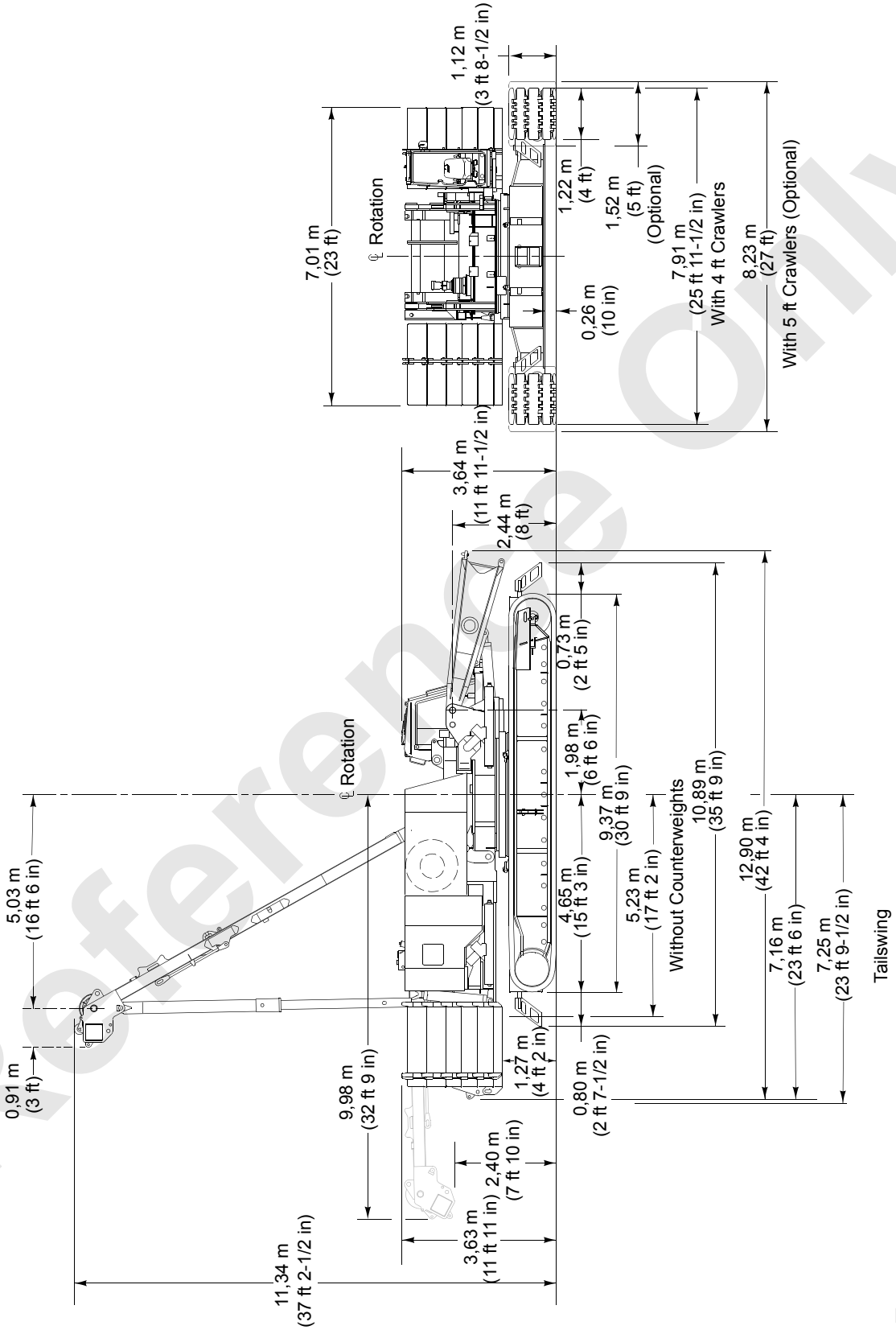


FIGURE 1-6

35-Foot Elevated Cab

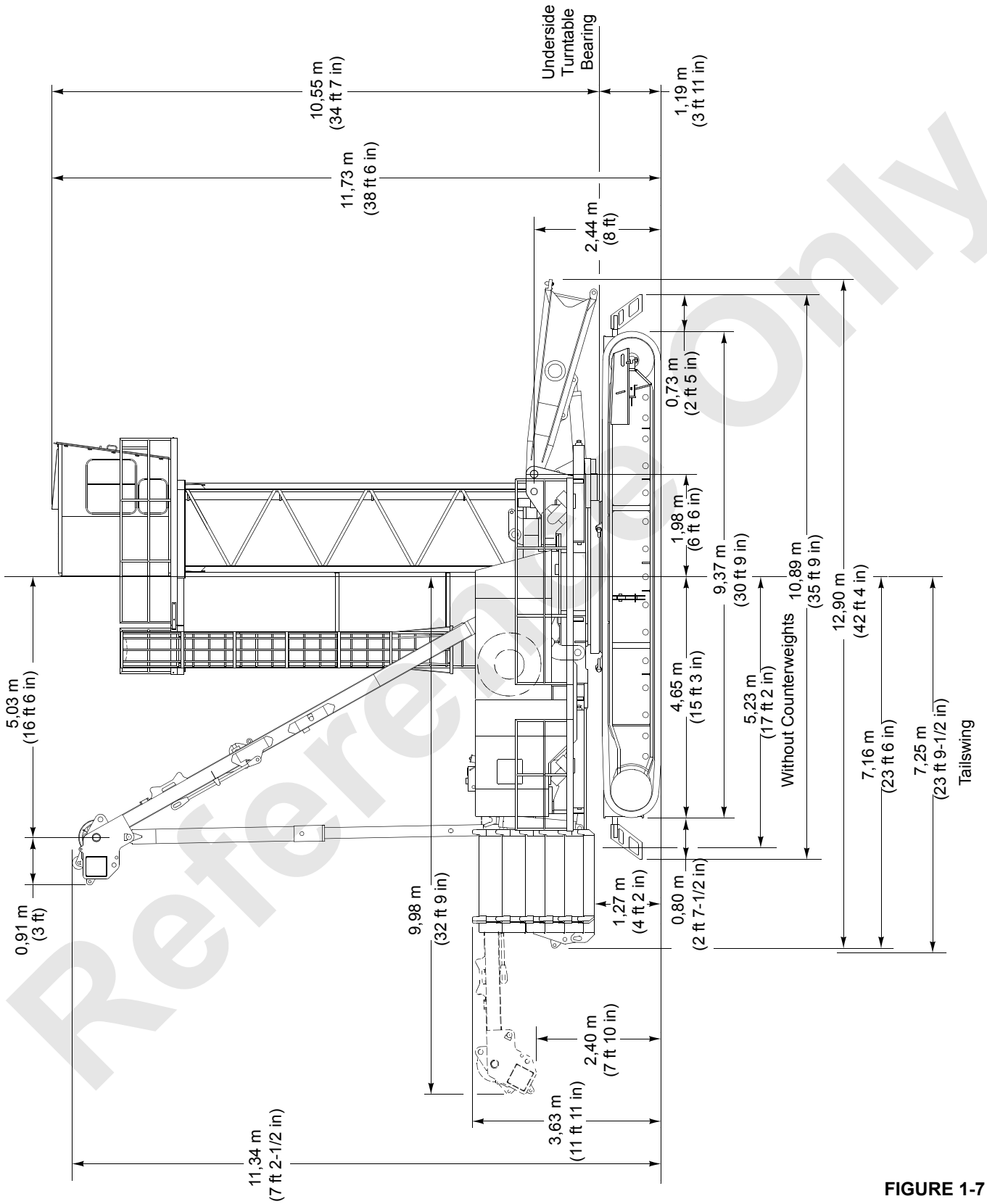


FIGURE 1-7

CRANE WEIGHTS

NOTE: Weights may fluctuate ±3% due to manufacturing tolerances.

Description	Weight Kilograms	Pounds
LIFTCRANE		
Rotating bed and undercarriage complete, counterweight, gantry, backhitch, fully rigged 21,3 m (70 ft) boom No. 44 with one-piece butt and heavy lift top (including upper boom point, 272 t (300 USt) block, and 14 t (15 USt) hook-and-weight ball), boom stops, and load lines		
2250 SERIES 1	203 941	449,615
2250 SERIES 2	249 357	549,740
2250 SERIES 3	294 717	649,740
2250 SERIES 1 with RINGER prep	209 260	461,340
2250 SERIES 2 with RINGER prep	254 676	561,465
2250 SERIES 3 with RINGER prep	300 035	661,465
ROTATING BED MACHINERY MODULE		
Rotating bed rear section, split rear drums with load lines, rotating bed pin pullers, boom hoist, gantry, gantry lifting cylinders, equalizer, boom hoist line, operator's cab, Cummins power plant, hydraulic reservoir (full), and fuel tank (1/2 full)	35 241	77,695
With RINGER prep	38 070	83,930
ROTATING MODULE WITH CARBODY		
Rotating bed front section with bearing turntable, swing drive, carbody with pin pullers, rotating union, piping and installation, 12,2 m (40 ft) boom butt, and boom stops	31 508	69,465
With RINGER prep	33 999	74,955
Replace 12,2 m (40 ft) butt and boom stops with 3,7 m (12 ft) lower two-piece butt	28 791	63,475
CRAWLERS		
9 373 m (30 ft 9 in) crawler assembly with 1 219 m (48 in) treads (each)	24 412	53,820
UPPER COUNTERWEIGHT		
Tray	17 588	38,775
Lifting frame (each) (2 required)	77	170
Center counterweight	16 782	37,000
Lower side counterweight (6 on all SERIES) (each)	7 030	15,500
Upper side counterweight (2 on SERIES 2 and 4 on SERIES 3) (each)	9 071	20,000
Upper power pin with cylinder (each)	13	30
Lower power pin with cylinder (each)	9	20
Center couterweight lifting pendant (each)	9	20
Total rotating bed counterweight - 2250 SERIES 1	76 747	169,200
2250 SERIES 2	94 891	209,200
2250 SERIES 3	113 035	249,200
LOWER COUNTERWEIGHT		
Carbody center counterweight (2 on SERIES 2 and SERIES 3) (each)	13 607	30,000
Carbody side counterweight (4 only on SERIES 3) (each)	6 803	15,000
GANTRY		
8 534 m (28 ft) gantry with polyamide sheaves	5 139	11,330
Backhitch (each leg)	718	1,585

Description	Weight Kilograms	Pounds
Counterweight handling link (each)	40	90
BOOM NO. 44		
12,2 m (40 ft) butt	3 903	8,605
9,1 m (30 ft) top (with lower point, wire rope guide)	5 273	11,625
3,0 m (10 ft) insert	857	1,890
6,1 m (20 ft) insert	1 458	3,215
12,2 m (40 ft) light insert	1 927	4,250
12,2 m (40 ft) insert	2 458	5,420
9,5 m (31 ft 1-3/16 in) basic strap (each)	192	425
3,0 m (10 ft) strap (with connector links) (each)	79	175
6,1 m (20 ft) strap (with connector links) (each)	133	295
12,2 m (40 ft) strap (with connector links) (each)	244	540
1,0 m (3 ft 4-3/8 in) strap (with connector links) (each)	36	80
Intermediate suspension link (each)	29	65
14,5 m (47 ft 6 in) intermediate suspension pendant (each)	108	240
9,0 m (29 ft 5 in) intermediate suspension pendant (each)	79	175
3,0 m (9 ft 9 in) intermediate suspension pendant (each)	47	105
Lower intermediate suspension link with pin (each)	27	60
Upper boom point (single sheave)	421	930
Wire rope guide (on butt)	948	2,090
Equalizer	821	1,810
Strap link (attached to equalizer) (each) (4 required)	11	25
Boom stop (each tube)	374	825
NO. 132 JIB		
6,1 m (20 ft) butt	462	1,020
6,1 m (20 ft) top (with jib point sheaves)	855	1,885
6,1 m (20 ft) insert	362	800
12,2 m (40 ft) basic pendant (each)	79	175
5,8 m (19 ft 2 in) pendant (each)	52	115
Jib stop pendant and link (each)	15	35
Jib stop strut and additional pendants (used with long reach boom top)	38	85
6,1 m (20 ft) strut with sheave and links	616	1,360
20,0 m (65 ft 7 in) backstay pendant (each)	108	240
2,2 m (7 ft 4 in) backstay pendant (each)	36	80
Backstay link (each)	29	65
Backstay spreader	129	285
MACHINE OPTIONS		
10,7 m (35 ft) elevated operator's cab (increase over standard operator's cab)	1 982	4,370
10,7 m (35 ft) elevated operator's cab with 1 321 mm (52 in) wide cab (increase over standard operator's cab)	3 352	7,390
1 143 mm (45 in) wide front drum assembly	2 807	6,190
1 854 mm (73 in) wider RINGER drum assembly (each)	3 315	7,310
Gear case assembly for tandem drums (increase over standard)	124	275
Luffing jib hoist assembly	1 390	3,065
Second swing drive assembly	811	1,790
Supplemental hydraulic reservoir for RINGER	136	300
Boom hinge pin pullers	179	395
RINGER attachment lugs on carbody	1 678	3,700
622 mm (24-1/2 in) diameter lagging for 1 143 mm (45 in) wide front or right rear drum	462	1,020
622 mm (24-1/2 in) diameter lagging for narrow left rear drum	192	425

Description	Weight Kilograms	Pounds
622 mm (24-1/2 in) diameter lagging for 1 854 mm (73 in) wide RINGER drum (each)	816	1,800
BOOM NO. 44 OPTIONS		
9,1 m (30 ft) tapered insert (with wire rope guide)	1 843	4,065
12,2 m (40 ft) long reach top (with lower point)	3 041	6,705
Rigging winch in butt	371	820
272 t (300 USt) load block with swivel hook	3 628	8,000
91 t (100 USt) load block with weight plates	2 177	4,800
55 t (60 USt) load block with weight plates	1 281	2,825
55 t (60 USt) load block with weight plates	2 007	4,425
14 t (15 USt) hook-and-weight ball (swivel)	566	1,250
SELF-ERECT OPTIONS		
Rotating bed jacking system with pads	3 322	7,325
Carbody support pedestals	181	400
Crawler handling arrangement	195	430
3,7 m (12 ft) lower two-piece butt	1 934	4,265
8,5 m (28 ft) upper two-piece butt with wire rope guide	3 354	7,395
Butt raising cylinder and installation	396	875
Assemble and rigging rope guides in butt	950	2,095
27 t (30 USt) load block with weight plates	907	2,000
Rigging line—49 m (160 ft) of 28,6 mm (1-1/8 in) wire rope, 3,48 kg/m (2.34 lb per ft)	170	375
Rigging winch line—244 m (800 ft) of 9,5 mm (3/8 in) wire rope, 0,39 kg/m (0.26 lb per ft)	95	210
WIRE ROPE		
Boom hoist—297 m (975 ft) of 26 mm (1 in) wire rope, 2,75 kg/m (1.85 lb per ft)	818	1,805
Load lines—28,6 mm (1-1/8 in) wire rope, 4,01 kg/m (2.7 lb per ft)	2 510	5,535
Whip line—387 m (1,270 ft) with heavy lift top	1 555	3,430
Whip line—404 m (1,325 ft) with long reach top	1 623	3,580
Hoist line—625 m (2,050 ft) 29 mm wire rope, 4,25 kg/m (2.85 lb per ft)	2 651	5,845
Whip line—387 m (1,270 ft) with heavy lift top	1 642	3,620
Whip line—404 m (1,325 ft) with long reach top	1 712	3,775

ENGLISH AND METRIC CONVERSIONS

Direct Conversion

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

12 ft x 0.3048 = 3,6576 m

Inverse Conversion

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

3,6576 m ÷ 0.3048 = 12 ft

Table 1-1. Conversion Chart

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

Table 1-1. Conversion Chart Continued

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

MANITOWOC CRANES DEALER

For questions about this manual or the 2250 Cranes, contact your Manitowoc Cranes dealer. If you do not know the contact information for your Manitowoc Cranes dealer, locate the Manitowoc Cranes dealer nearest you, as follows.

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

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 2
SAFETY INFORMATION

TABLE OF CONTENTS

Published 06-24-16, Control # 241-01

SECTION 2
SAFETY INFORMATION

WARNING

California Proposition 65!

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

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

California Spark Arrestor!

Operation 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, this information is subject to change without notice.
If you have any questions or concerns regarding these procedures, please contact your Manitowoc Cranes dealer or the Manitowoc Crane Care Lattice Team at www.manitowoccranes.com.

NAMEPLATES AND DECALS

See the Nameplates and Decals Drawing in this manual for more information and location.

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

Used 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 and Table 2-2.

Table 2-1. Common Safety Symbols

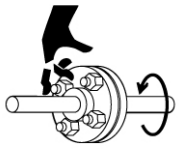
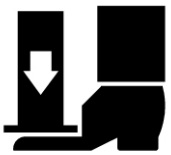
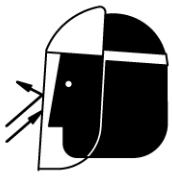
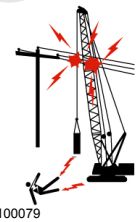
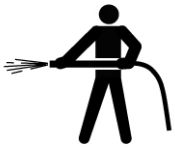
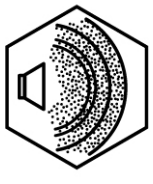
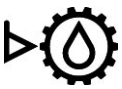
Cut or Crush Hazards					Cut Hazard
 M100090	 M100091	 M100066	 M100065	 M100069	 M100067
Crush Hazards					Fire Extinguisher
 M100070	 M100071	 M100072	 M100073	 M100074	 M100082
Fall Hazards			Falling Boom (Crush) Hazards		Explosion Hazard
 M100083	 M100084	 M100085	 M100068	 M100075	 M100080
Falling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

Table 2-2. 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)**	**Diesel Exhaust Fluid (DEF)**	**No Fuel**	**No Water**	
 M100270	 M100266	 M101972	 M101973	 M101974	

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 for the installation locations of signs.

Ordering Signs

Order replacement safety and information signs from your Manitowoc Cranes dealer.

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

CRANE ACCESS POINTS

WARNING

Crush Hazard!

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:

- Place barricades at all of the accessible swing areas of the crane to prevent personnel from being struck or crushed when the upperworks is in motion.
- Do not climb onto or off the crane while upperworks is being swung or the crane is being traveled.
- Signal the operator for permission to climb on or off the crane.
- Do not swing or travel while personnel are climbing on or off the crane. Stop swing and travel motions. Apply swing brake and turn on travel park.
- Always sound horn to alert personnel before you swing or travel.
- Automatic alarms will sound to alert personnel when the crane is swung or traveled.

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

General

See Figure 2-1 for the following precautions.

WARNING

Falling Hazard!

Falling from any height could result in serious injury or death.

Take necessary precautions to prevent slipping and/or falling off the crane during assembly, disassembly, maintenance, or other work.

Manitowoc Cranes has provided stairways, ladders, and platforms at the locations shown.

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 Cranes.

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

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

CAUTION

Slippery Surface Hazard!

Always keep walkways and platforms clean and dry to prevent slipping.

Walkways and platforms can be slippery when wet, or when oil or grease is spilled on them.

- To reduce the risk of slipping, non-skid material (sand in paint) has been applied to painted walkways and platforms. 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 Cranes.
- Do not use the top of the mast, boom, or jib as walkways unless they have catwalks.

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

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

GETTING ON OR OFF CRANE

Personnel getting on and off the crane shall do so only at steps or 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.

Always maintain three points of contact when climbing ladders—two feet and one hand, or two hands and one foot.

2

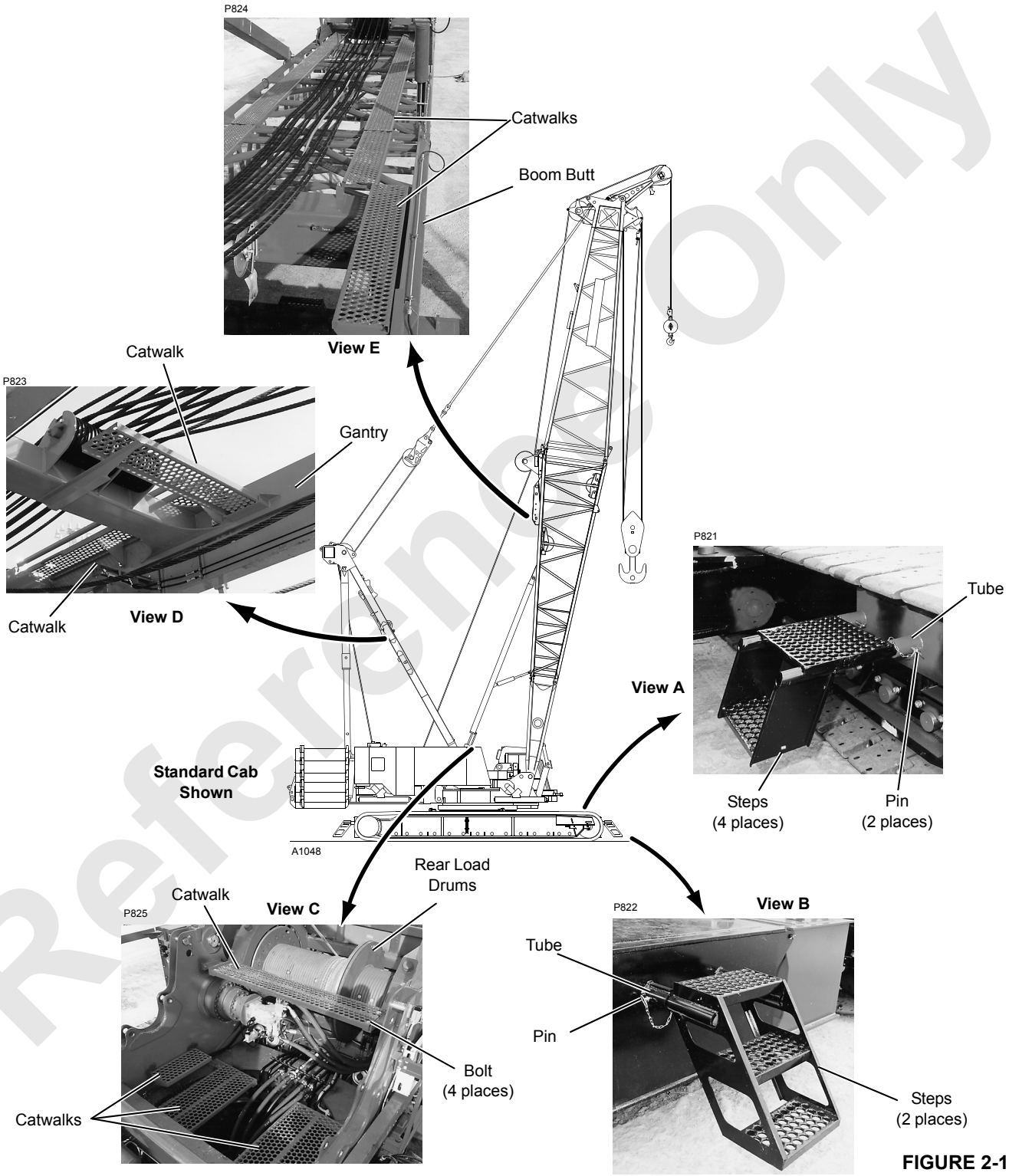


FIGURE 2-1

A03893

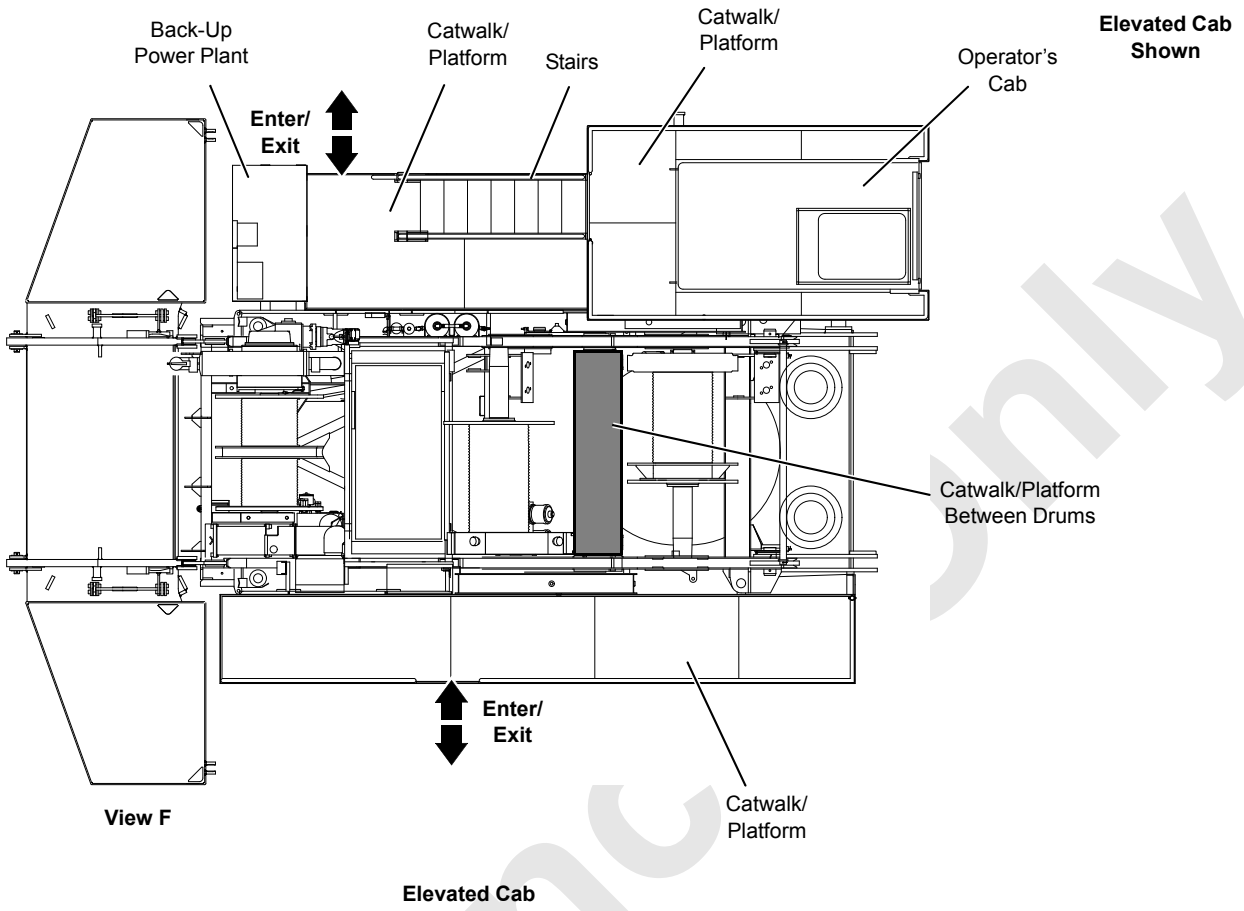


FIGURE 2-1 continued

OPERATOR MANUAL/CAPACITY CHART STORAGE

Manitowoc Cranes provides the following manuals and other important literature with your crane and attachments.

- Operator Manual (Serial Numbered)
  Contains safety information, crane specifications, assembly/erection procedures, operating instructions, and 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.)
- Maintenance Checks and Lubrication Guide
  Contains lists of maintenance checks and lubrication services and their prescribed intervals.
- Rated Capacity Indicator/ Limiter 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 that must be retained in the operator's cab (Operator Manual, Capacity Chart Manual, Maintenance Checks and Lubrication 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 must match the serial number of the crane and attachment in use.

NOTE: Using any other crane model manuals or capacity charts 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 Cranes dealer for the proper manuals or capacity charts.

NOTE: Do not operate the crane or attachment if the proper capacity chart is not in the cab.

Storing Manuals

See Figure 2-2 for the following information.

Store the Operator Manual for the crane and each applicable attachment in the holder in the operator's cab.

Chain the manual to the link provided.

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

FIGURE 2-2

SAFE OPERATING PRACTICES

General

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

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

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

Read the Operator Manual

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

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

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

Because of a program of continuing improvement in product design, Manitowoc Cranes 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 Cranes dealer.

Operator Qualifications

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

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

WARNING

Falling Hazard!

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

NOTE: Operator training and qualification is the crane owner's responsibility.

A 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.

NOTE: The regulations and standards mentioned 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: https://www.osha.gov/

ASME (formerly ANSI) B30 Series American National Standards are available by mail from 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

- The operator shall not engage in any practice that diverts his/her attention while operating the crane.
- The operator shall not operate the crane when he/she is physically or mentally unfit.
- The operator shall be responsible for all operations under his/her direct control. When safety of an operation is in doubt, the operator shall stop the crane's functions in a controlled manner. Lift operations must resume only

after safety concerns have been addressed or if the continuation of crane operations is directed by the lift supervisor.

- The operator shall be thoroughly familiar with the 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.
- 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.

Pre-Start Checks

Before starting the engine, the operator shall perform the following checklist:

- o All daily inspection and maintenance services have been performed.
- o All controls are in the OFF position and all brakes and locking devices are applied or engaged.
- o All personnel are clear of the crane. Deploy a swing radius barrier.

WARNING

Acknowledge All Safety Devices and Operational Aids!

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

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

- See Size of Load on page 2-10 for more information.
- For a description of each safety device and operational aid, see Safety Devices on page 2-14, and Operational Aids on page 2-15 for more information.

- o The operator shall test all controls, limits, and communication systems at the start of each shift. Any defects found must be corrected before operation is begun.
- o The operator shall not start crane movement if the load or designated signal person is not within his/her range of vision or communication.

NOTE: The operator shall obey a stop signal at all times, regardless of who gives it.

- o 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.
- o The operator shall verify that the Capacity Chart being used is the correct one for the crane's configuration (boom length, load line reeving, counterweight).

The operator shall verify the following:

- o All attachments are properly assembled and attached to the crane according to the rigging drawings called for in the Capacity Chart.
- o The counterweight—to include applicable auxiliary counterweight—is in place and of proper weight. The maximum required counterweight must not be exceeded.

WARNING

Moving Load/Tipping Crane Hazard!

Changing weather conditions including but not limited to wind, ice, must be considered when determining the location and configuration of a crane when it will be left unattended.

Leaving the Operator's Cab

The operator shall perform the following operations before leaving the operator's cab for any reason.

1. Park the crane and position the upperworks so that the crane does not interfere with operation of other equipment.
2. Apply travel and swing brakes or locking devices.
3. Land any attached load.
4. 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 the Capacity Chart Manual.

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

5. Place all controls to the OFF position.
6. Apply all drum brakes and pawls.

7. Disengage the master clutch, if equipped.
8. Stop the engine.

NOTE: For more information, see Stopping Engine/ Leaving Crane Unattended on page 3-42 in Section 3.

Power Failure

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

1. Land all suspended loads, if possible, under brake or power control.
2. Apply all brakes and locking devices.
3. Place all controls to the OFF position.

Operating at Night or in Bad Weather

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

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

NOTE: Never operate the crane during an electrical thunderstorm.

When a local weather storm warning exists (including electrical thunderstorm), stop operation and secure the crane.

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

- 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 both.

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

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

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

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

WARNING

Overhead Hazard!

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

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

Handling the Load

Size of Load

- 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.

A "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 that 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 that must be deducted.

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

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

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

Attaching the Load

- 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.
  - Inspect each hook and latch before using.
  - Never use a hook or latch that is distorted or bent.
  - Make sure the spring will force the latch against the tip of the hook.
  - 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.
- 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.
- Do not wrap the load line around the load.
- Use suitable protection between slings and any sharp edges on the load. When synthetic slings are used, the synthetic sling manufacturer's instructions, limitations, specifications, and recommendations must be followed.
- Secure unused legs of a multi-leg sling before handling a load with one leg of sling.

Lifting/Moving the Load

Before lifting or moving a load, the operator or qualified person directing the lift shall make the following checks:

- The 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 a 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 so that the allowable bearing capacity of the underlying member is not exceeded.

NOTE: For ground bearing data go to: http://www.manitowoccranes.com/en/Resources/tools/ground-bearing-pressure

- 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).
- The lift and swing paths are clear of personnel and obstructions.
- The load is free to be lifted.
- The load line is not kinked or otherwise damaged.
- 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.
- The hook is brought over the load in a manner that will minimize twisting or swinging.
- The load line and the boom hoist rope are properly spooled on the drums and seated in the sheaves.
- 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.

NOTE: The load must not lower through applied brakes.

- Unused load drums are parked (working and parking brakes applied, drum pawls engaged, if equipped).
- All personnel are clear of the swing radius of the crane's counterweight.

While lifting or moving the load, the operator shall take the following precautions:

- Accelerate and decelerate the load smoothly to avoid excessive stress on the crane boom and machinery.
- 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.
- 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.
- Use taglines or other restraints to control the load when necessary.
- Do not exceed any swing limitations (areas of operation) given in the Capacity Chart.
- Do not allow the load, the boom, or any other part of the crane to contact obstructions.
- Do not use the crane to drag a load.
- Do not hoist, lower, or swing the load while personnel are on the load or hook. See Personnel Handling Policy on page 2-25.
- Avoid carrying the load over personnel. Loads that are suspended must be blocked or cribbed before personnel are allowed to work under or between them.

- Before lifting a load that requires the use of outriggers (or anytime outriggers are used), fully extend the outrigger beams and jacks so the truck tires do not bear any load.

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

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

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

  - Free of defects
  - Strong enough to prevent crushing, bending, or shear failure
  - Of sufficient thickness, width, and length to completely support the jack pad or float, transmit the load to the supporting surface, and prevent shifting, toppling, or excessive settlement under load
- Fully retract and lock the jacks and the outrigger beams so they cannot extend when not in use.
- 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 in all movements to be made. Decisions such as the necessity to reduce crane ratings, load position, boom position, ground support, and speed of movement must be in accordance with the designated person's decision.
- Do not lower the load or the boom to a point where less than three full wraps of wire rope are remaining on the respective drum (or as otherwise indicated in local, state, or federal regulations).
- Engage the boom hoist pawl when operating with the boom at a fixed radius.
- Engage the luffing hoist pawl when operating with the luffing jib at a fixed radius.

While traveling, the operator shall take the following precautions:

- 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.
- Carry the boom in line with the lowerworks and facing the direction of travel.
- Do not position the boom so high that it could bounce over backward whether traveling with or without load.
- Secure the rotating bed against rotation except:
  - When operating with a MAX-ER attachment
  - When it is necessary to negotiate a turn, and then only when the operator is seated at controls or the boom is supported on a dolly
  - Lash or otherwise restrain unused hooks so they cannot swing freely

Before traveling with a load, the operator should be aware of these additional precautions:

- 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 movement must be in accordance with the designated person's decision.
- Maintain specified tire pressures (truck cranes).
- Avoid sudden starts and stops. Use taglines or other restraints to control the position of the load.

Multiple-Load-Line Operation

WARNING

Overload Hazard

Prevent Possible Injury, and Crane Damage! Avoid overload and side load to crane

Manitowoc Cranes highly recommends that you contact your Manitowoc Cranes 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, and rolling fabricated sections. The multiple lines may be on a common shaft (each with different parts of line) or on multiple shafts (for example, lower boom point and upper point, boom point and fixed jib point).

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

- The qualified lift planner and the crane operator shall read and become familiar with the appropriate capacity charts and wire rope specification charts.
- 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.

For example, if one load line is lifting from the jib point, the proper jib chart applies.

- The crane must be thoroughly inspected by a qualified person prior to setup.
- 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.
- 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 Cranes recommends that its cranes be equipped with Rated capacity indicators/limiters to monitor the load on each load line.

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

- Manitowoc Cranes recommends that each load line be equipped with an anti-two-block device.
- Manitowoc Cranes, capacity charts are based on freely suspended loads. To prevent side load damage to the boom, the jib, and the sheaves ensure the following:
  - 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 points 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 Cranes.
  - 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.
- The crane operator shall be familiar with the characteristics of the crane as it relates to multiple drum operation (simultaneous operation, same or opposite direction, or individual operation).
- 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.
- The load shift when lifting with two hooks may be more unpredictable than typical one-hook lifting.

Holding the Load

When a load is suspended, the operator shall follow these precautions:

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

SIGNALS

- Continuous communication shall be maintained between the operator and the signal person during all crane movements. If communication is disrupted, the operator shall stop all crane movements.
- Signals to the operator must be in accordance with the standard signals shown in Section 3, unless communications equipment (telephone or radio) is used.
- All signals shall be easily understood by the operator at all times. The operator shall not respond to any signal that is not clearly understood.
- 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 not conflict with or have potential to be confused with the standard signals.
- When it is necessary to give instructions to the operator (other than those established by the signal system), all crane motions must be stopped.
- The signal person shall:
  - Be tested by a designated person and show that he or she has a basic understanding of crane operations and limitations, including boom deflection.
  - Be thoroughly familiar with the standard hand signals and voice signals, if used
  - 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.
  - Direct the load so it does not pass over personnel
  - Keep unnecessary personnel out of the crane's operating area
- When moving the crane, the following audible signals must be used:
  - **a.** STOP—one short audible signal
  - **b.** GO AHEAD—two short audible signals
  - **c.** BACK UP—three short audible signals

SAFETY DEVICES

WARNING

Faulty Safety Device Hazard!

Do not operate the crane unless all safety devices listed 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 is not in proper working order, the safety device must be taken out of service and crane operation must not resume until the safety device is again working properly.
- Alternative measures are not permitted to be used for a faulty safety device.
- Always tag out any faulty safety device and place a warning tag in the cab stating that the crane is out of service and must not be used.

Manitowoc Cranes provides the following safety devices on its cranes:

- 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.
- 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.
- 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).
- 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.
- 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.
- 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
- Integral holding device or check valve on each jacking cylinder

OPERATIONAL AIDS

WARNING

Faulty Operational Aid Hazard!

Do not operate crane unless all applicable operational aids listed 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 Cranes 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 seven calendar days after the deficiency occurs.

There is one exception—if the crane user documents that they have ordered the necessary parts within seven calendar days of the occurrence of the deficiency, the repair must be completed within seven calendar days of receiving the parts.

The following procedures are temporary alternative measures if category 1 operational aids are inoperative or malfunctioning:

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

  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:

  - Measure the radius using a tape measure.
  - Measure the boom angle with a protractor-level on the centerline of the boom.
  - 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 it is necessary for the operator to see the mark.
  - 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.

- **Anti-Two-Block Device**

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

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

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

Category 2 Operational Aids

If a Category 2 operational aid is not working properly, it must be repaired no later than thirty calendar days after the deficiency occurs. The exception is that if the employer documents that they have ordered the necessary parts within seven calendar days of the occurrence of the deficiency, and the part is not received in time to complete the repair in thirty calendar days, the repair must be completed within seven calendar days of receiving the parts.

The following procedures are temporary alternative measures if category 2 operational aids are inoperative or malfunctioning:

- **Rated Capacity Indicator/Limiter**

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

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

- **Boom Angle or Radius Indicator**

  - Refer to the pendulum boom angle indicator on the boom butt (viewable from operator's cab).
  - Measure the boom angle with a protractor-level on the centerline of boom.
  - Measure the radius using a tape measure.

- **Jib Angle or Radius Indicator**
  - Make sure you know the boom angle (see **Boom Angle** or **Radius Indicator** on page 2-15).
  - Measure the radius using a tape measure.
- Drum Rotation Indicator
  - 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.
- **Swing Limiter or Proximity Device—Optional**

  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 jobsite obstructions including power lines, or to limit the swing sector specified in the capacity chart).
- **Drum Spooling Limiter (maximum or minimum bail limit)—Optional**

  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 overspooled (rope does not jump off drum) or before there are less than three full wraps of wire rope on the load drum or boom hoist.
- **Closed-Circuit Television (CCTV)—Optional**

  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.

WARNING

Electrocution Hazard!

- 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 Cranes recommends that all parts of crane, boom, and load be kept at least 6 m (20 ft) away from all electrical power lines and equipment less than 350 kV.

WARNING

Electrocution Hazard!

Manitowoc Cranes are not equipped with all features required to operate when the power lines are energized. Refer to table A clearances in the current edition of OSHA 29CFR1926.1408.

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.

- Keep all personnel and their personal belongings (clothing, water coolers, and lunch boxes) away from the crane if it is being operated near electrical power lines or equipment.
- 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 following rules must be followed at all times, even if the electrical power lines or equipment have been de-energized:

- Crane operation is dangerous when close to an energized electrical power source. Exercise extreme caution and prudent judgment. Operate slowly and cautiously when in the vicinity of power lines.
- 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.
- 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.
- Even if the crane operator is not affected by an electrical contact, others in the area may become seriously injured or killed.
- 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.

Setup and Operation

- During crane use, assume that every line is energized ("hot" or "live") and take necessary precautions.
- Position the crane so 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.
- 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.
- 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.

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

Electrocution Hazard Devices

- 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 section may result in serious injury or death.
- Be aware that such devices have limitations and you should follow the rules and precautions outlined at all times even if the crane is equipped with these devices.
- 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.
- 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.
- 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, and moisture). The insulating characteristics of these devices can be compromised if not kept clean, free of contamination, and undamaged.
- 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 the sensing area. Reliance is placed upon the operator in selecting and properly setting the sensitivity of these devices.
- Never rely solely on a device to protect you and your fellow workers from danger.

  Some variables you must 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.
- 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 into contact with an energized power source, the operator shall do the following.

1. Stay in the crane cab. Do not 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 that 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 the crane. Do not step off. Hop away with both feet together. Do not walk or run.

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

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

SAFE MAINTENANCE

WARNING

Neglected Crane Maintenance Hazard!

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

Safety information is intended only as a guide to assist qualified maintenance personnel in safe maintenance. Manitowoc Cranes cannot foresee all hazards that will arise in the field.

Safety remains the responsibility of the maintenance personnel and crane owner.

Maintenance Instructions

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

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

A "qualified person" is 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.

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

Safe Maintenance Practices

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

e. Stop the engine and render the starting means inoperative.

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

- 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 the person at the controls and the person performing the maintenance or repair procedure.
- Wear clothing that is relatively tight and belted.
- Wear appropriate eye protection and approved hard hat.
- Never climb onto or off a moving crane. Only climb on and off the crane when it is parked and only with the operator's permission.

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

  Lift tools and other equipment that cannot be carried in pockets or tool belts onto and off the crane with hand lines or hoists.
- 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.
- Do not remove cylinders until the working unit has been securely restrained against movement.
- Pinch points are impossible to eliminate. Watch for them closely.
- 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 soap and water 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.
- Relieve pressure before disconnecting air, coolant, and hydraulic lines and fittings.
- 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.
- Avoid battery explosion—do not smoke while performing battery maintenance or short across battery terminals to check its charge.
- Read the safety information in the battery manufacturer's instructions before attempting to charge a battery.
- Avoid battery acid contact with skin and eyes. If contact occurs, flush the area with water and immediately consult a doctor.
- Stop the engine before refueling the crane.
- Do not smoke or allow open flames in the refueling area.
- Use a safety-type can with an automatic closing cap and flame arrestor for refueling.
- Hydraulic oil can also be flammable. Do not smoke or allow open flames in the area when filling hydraulic tanks.
- Never handle wire rope with bare hands. Always wear heavy-duty gloves to prevent being cut by broken wires.
- Use extreme care when handling coiled pendants. Stored energy can cause the coiled pendants to uncoil quickly with considerable force.
- When inflating tires, use a tire cage, a clip-on inflater, and an extension hose that permits standing well away from the tire.
- Only use cleaning solvents that are non-volatile and non-flammable.
- Do not attempt to lift heavy components by hand. Use a hoist, jacks, or blocking to lift components.
- 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.

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

a. Disconnect all cables from batteries.

b. Disconnect output cables at the engine junction box.

c. Attach the ground cable from the welder directly to the part being welded and as close to the weld as possible.

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

- 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.
- 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.

WARNING

Overhead Hazard!

Avoid Possible Injury! Do not go under the boom, jib, or mast sections while connecting bolts or pins are being removed.

- Unless authorized in writing by Manitowoc Cranes, do not alter the crane in any way that affects the crane's performance (including welding, cutting, or burning structural members or changing pressures and flows of air and hydraulic components). Doing so will invalidate all warranties and capacity charts and make the crane owner/user liable for any resultant accidents.
- Keep the 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.
- 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.
- Do not store flammable materials on the crane.
- 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.
- Perform a function check to ensure proper operation at the completion of maintenance or repair.

ENVIRONMENTAL PROTECTION

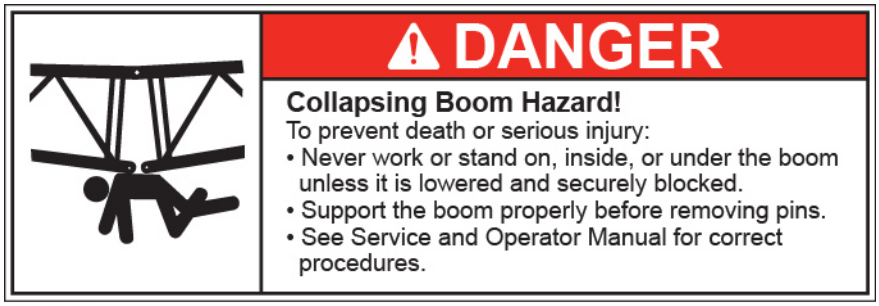
Dispose of waste properly! Improperly disposing of waste can threaten the environment.

Potentially harmful waste used in Manitowoc Cranes includes, but is not limited to, oil, fuel, grease, coolant, air conditioning refrigerant, filters, batteries, and cloths that 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.



M101904

FIGURE 2-3

BOOM DISASSEMBLY SAFETY

DANGER

Collapsing Boom Hazard!

Prevent death or serious injury when disassembling boom sections. Read and adhere to these instructions.

NOTE: The term "boom" used in the following instructions applies to all lattice attachments (for example, boom, fixed jib, luffing jib, and mast).

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.
- The disassembly area is not suitable.
- Safe procedures are overlooked because not enough time is allocated for the task.

General

See Figure 2-3 for a safety decal example.

Safety decals are placed near the connections on each boom section. See Boom Disassembly Decal Drawing for more information.

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

WARNING

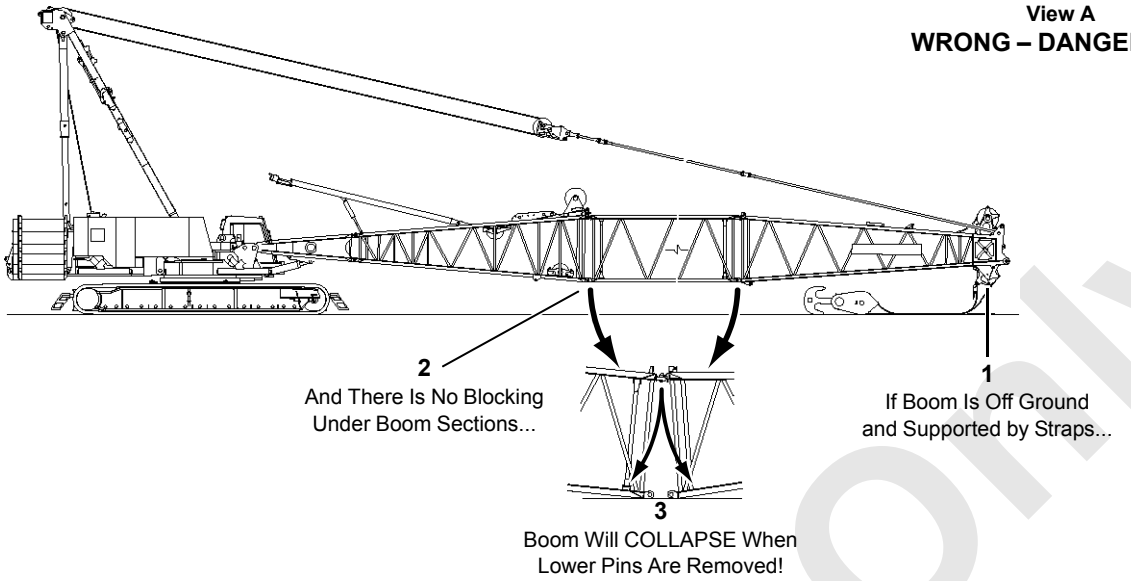
Falling Boom Hazard!

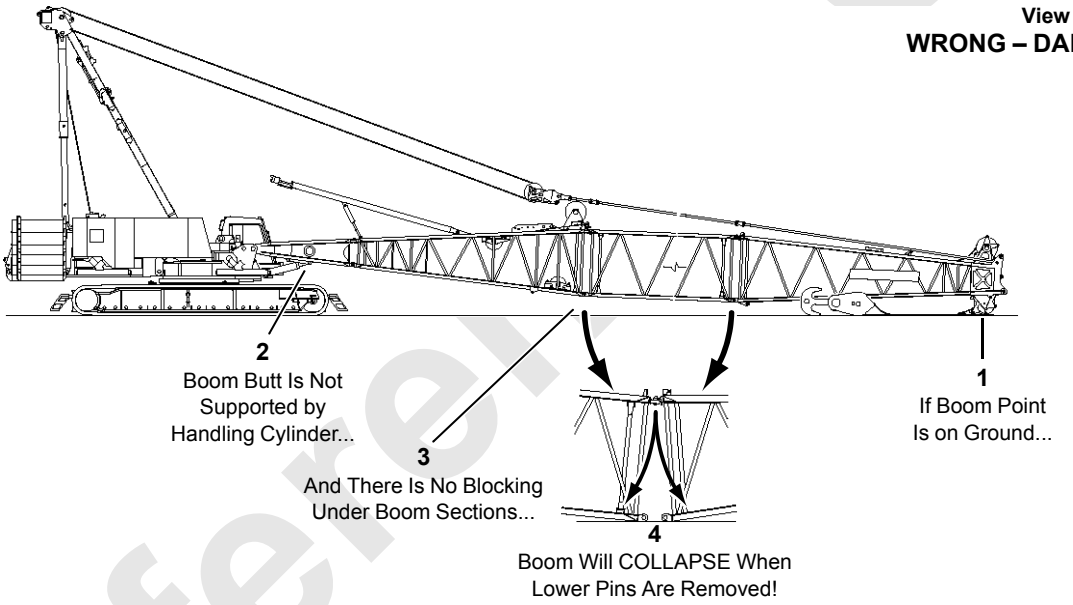
The crane can tip or boom can collapse if excess boom is cantilevered. Never cantilever more boom than specified in Boom Assembly Drawing.

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 and the length of boom. Also take into consideration whether an assist crane or other equipment is required. If possible, secure the area to keep unauthorized personnel and vehicles away.

A1301





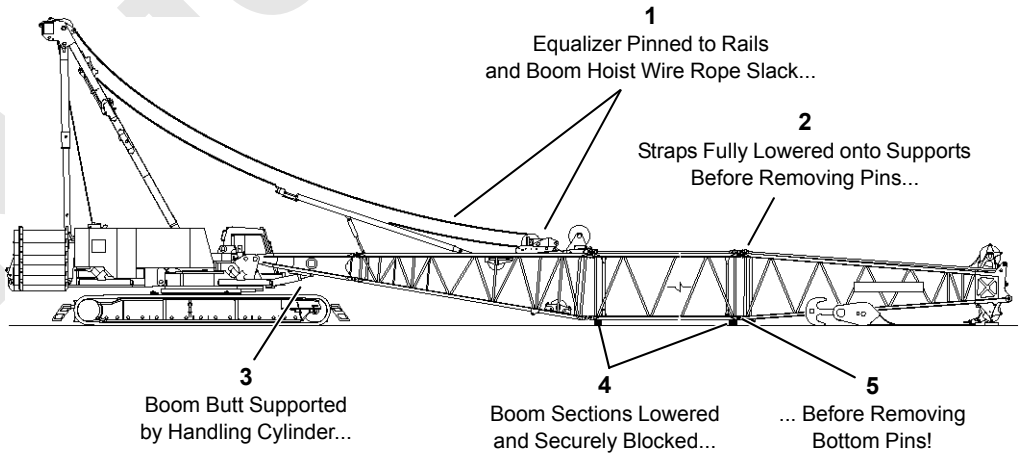


FIGURE 2-4

Pin Removal

DANGER

Collapsing Boom Hazard!

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

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 the load. Pins can be ejected forcefully if the boom has any pressure on it or if the boom is not supported properly.

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.

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 states, "lifting and lowering of personnel using ASME B30 Standard hoisting equipment must be undertaken only in circumstances when it is not possible to accomplish the task by less hazardous means. Unless all of the applicable requirements of this volume are met, the lifting or lowering of personnel using ASME B30 Standard equipment is prohibited."

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

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

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

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

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

  Free fall of the hoist line is prohibited.
- The crane's Operator Manual is in the crane's 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 9 m/s (20 mph) at the hoisted platform height or in electric storms, snow, ice, sleet, or other adverse weather conditions that could affect the safety of personnel.
- Hoisting personnel within 6 m (20 ft) of a power line that is up to 350 kV or within 15 m (50 ft) of a power line that is over 350 kV is prohibitted, except for work covered in OSHA 29CFR1926 subpart V.

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

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

Manitowoc Cranes 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 Cranes 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 cranes 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 Cranes 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 crane's capacity has been exceeded. When a pedestal-mounted crane's is exceeded, hook rollers or other structural components may break, before 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 maximum allowable specified in capacity charts. If the specified crane list and/or dynamic conditions are exceeded, the crane's capacity may be exceeded. Hook rollers or other structural components may break, causing the crane to separate from the pedestal.

WARNING

Tipping Crane Hazard!

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

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

Pedestal-Mounted Crane

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

Definition

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

Examples

- Figure 2-5 illustrates a crane rotating bed mounted on a turret (pedestal) that is securely fastened to the foundation.

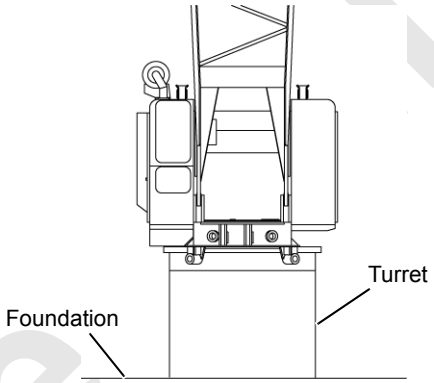
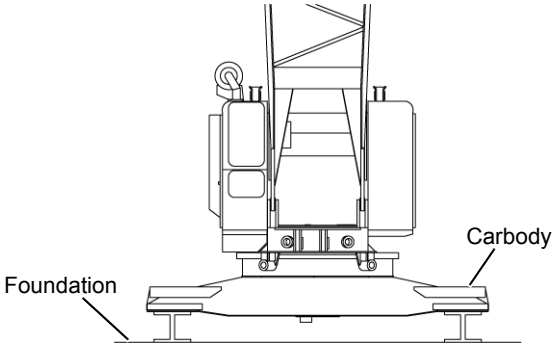


FIGURE 2-5

- Figure 2-6 illustrates a crane rotating bed mounted on a carbody (crawlers removed) that is securely fastened to the foundation.



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

FIGURE 2-6

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.

- Figure 2-7 illustrates a crawler-mounted crane with the carbody anchored with tie-downs to the foundation.

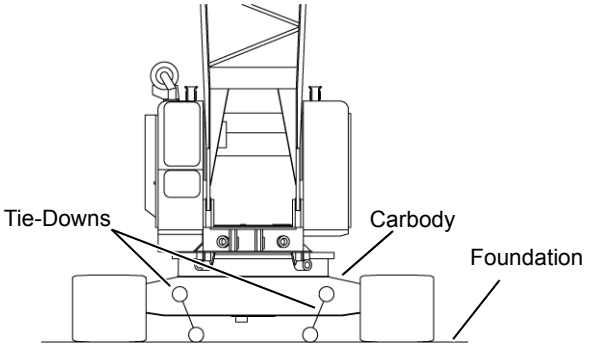
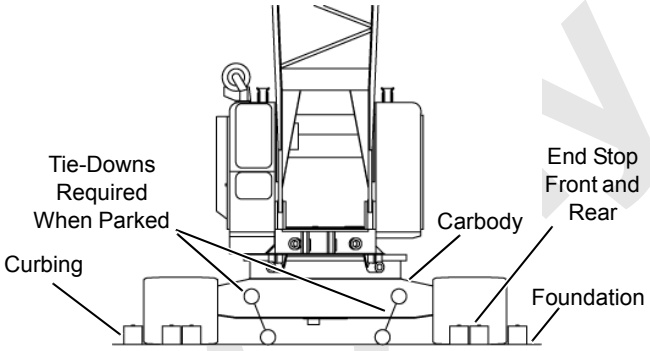


FIGURE 2-7

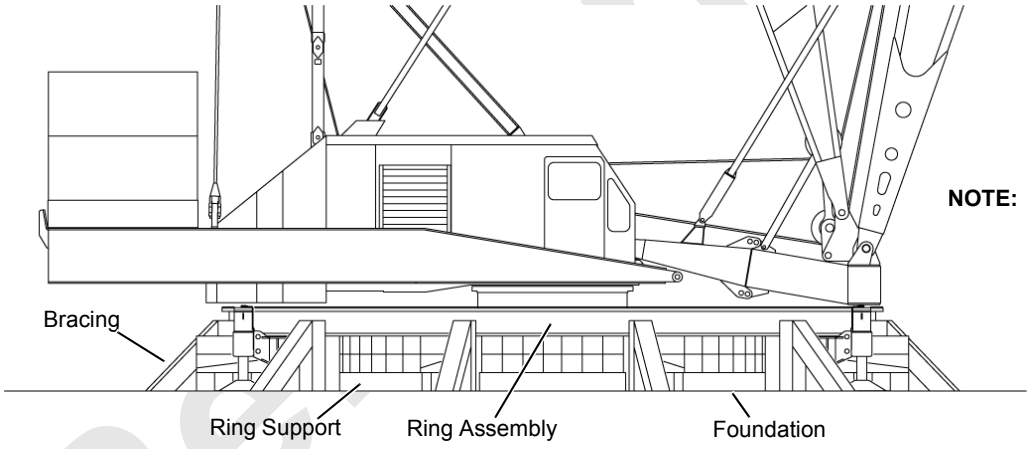
- Figure 2-8 illustrates a crawler-mounted crane working on a timbered area of the barge, ship, or floating platform with the crawlers restrained by curbing and end stops. When not working, the crane carbody is anchored with tie-downs to the foundation. Traveling with load is not permitted.



NOTE: Manitowoc Cranes does not permit traveling with load.

FIGURE 2-8

- Figure 2-9 illustrates a RINGER® (crawler mounted, carbody mounted) supported on blocking, screw jacks, or steel pedestals that are braced and fastened to the foundation in such a manner as to prevent movement.
- A platform mounted RINGER has the ring braced and fastened directly to the foundation to prevent movement.



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

FIGURE 2-9

AXIS		TRANSITIONAL		ROTATIONAL	
Symbol	Name	Static	Dynamic	Static	Dynamic
X	Longitudinal		Surge	Heel List	Roll
Y	Vertical		Heave		Yaw
Z	Lateral		Sway	Trim	Pitch

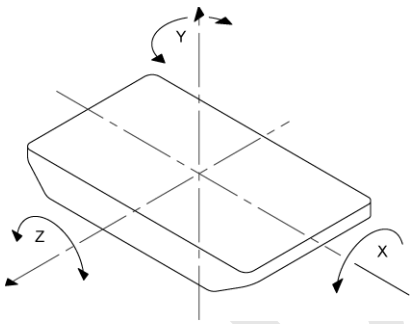


FIGURE 2-10

Capacity Charts

Manitowoc Cranes provides two types of capacity charts for a crane mounted on a barge or other supporting structure under static conditions:

- A capacity chart based on tipping when the crane is anchored only to prevent shifting.
- 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 degrees) and must NOT be exceeded.

Shock Loading

Definition

Shock loads to the crane can be experienced when the barge is subjected to up-and-down movement of wave action (referred to as dynamics). See Figure 2-10 for an illustration of the dynamic conditions of the barge which will influence the crane capacity.

CAUTION

Avoid Structural Damage!

If the crane boom or structure is shock loaded during operation or if 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 Cranes does not recommend crane operation under dynamic conditions.

Operation On Barge

General

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

WARNING

Tipping Crane Hazard!

Tie-downs that 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, ship, or floating platform, the crane user shall verify that the correct capacity chart is being used—pedestal-mounted, barge-mounted, the appropriate degrees list or dynamic capacity chart.

Failing to use the correct capacity chart can result in an accident.

Definitions

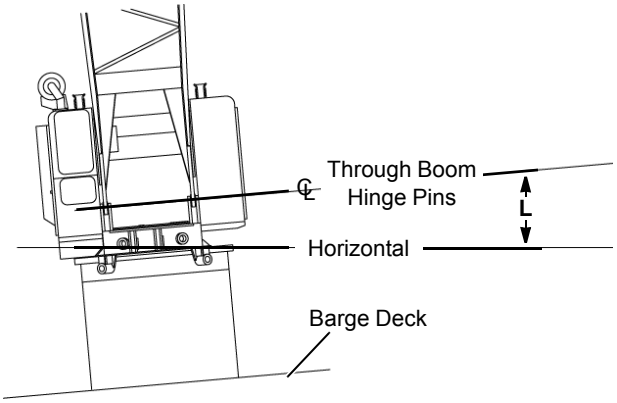
See Figure 2-11 for the following definitions.

- A machine list, as defined by Manitowoc, is the crane's out-of-level (side-to-side) condition as measured by the angle between horizontal and a line drawn through the centerline of the crane's boom hinge pins. This out-of-level condition creates side load and affects the crane's lifting capacity.
- A barge list, (also referred to as heel or trim) causes swingout of the load and may produce side load. When Manitowoc Cranes 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 (side-to-

side) condition of 2-degrees as measured by the angle between horizontal and a line drawn through the centerline of the crane's boom hinge pins.

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

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



L = Degrees of Machine List (maximum allowable is specified in capacity chart)

FIGURE 2-11

Crane Inspection

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

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

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

- 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

Published 06-24-16, Control # 241-01

THIS PAGE INTENTIONALLY LEFT BLANK

Published 06-24-16, Control # 241-01

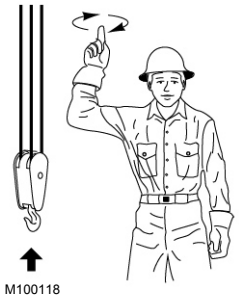
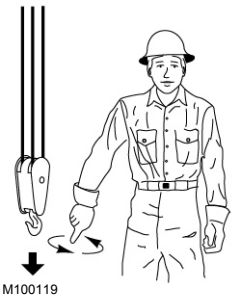
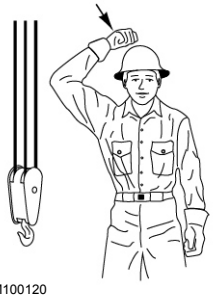
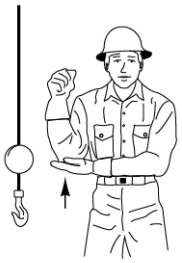
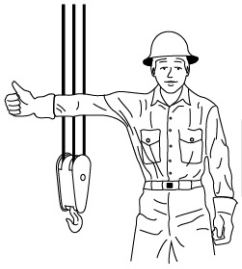
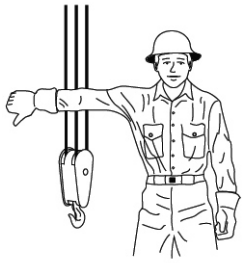
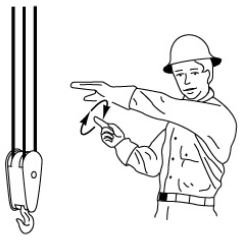
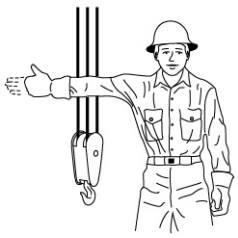
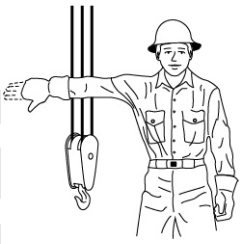
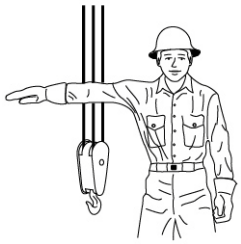
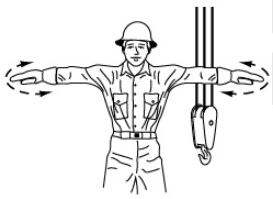
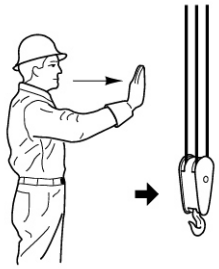
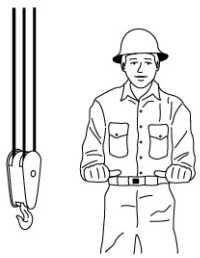
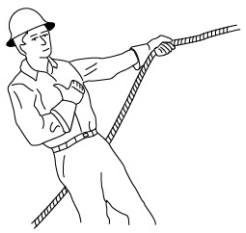
SECTION 3
OPERATING CONTROLS AND PROCEDURES

THIS SECTION STARTS ON THE NEXT PAGE

STANDARD HAND SIGNALS FOR CONTROLLING CRANE OPERATIONS

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

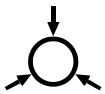
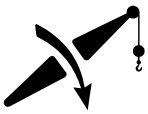
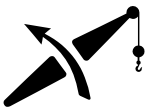
Table 3-1. Standard Hand Signals for Controlling Crane Operations

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

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

SYMBOL IDENTIFICATION

The following symbols are used to identify controls on Manitowoc Cranes. Some symbols shown may not apply to your crane.

Safety Alert: Warning/Caution Operating Limit System Fault Engine Diagnostics	
Air Conditioning	
Air Conditioning Temperature	
Air Pressure Gauge	
Battery Voltage	
Blower (fan)	
Boom (lower)	
Boom (raise)	

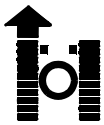
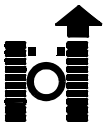
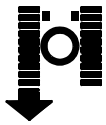
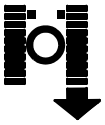
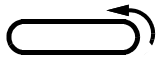
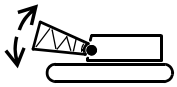
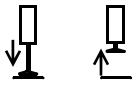
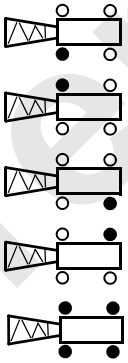
Clam Closing Pressure	
Contrast	
Crawler (travel)	
Crawler Travel Forward (left): Arrow indicates which crawler is operating and direction of travel with drive motors to the rear	
Crawler Travel Forward (right): Arrow indicates which crawler is operating and direction of travel with drive motors to the rear	
Crawler (travel parked)	
Crawler Travel Reverse (left): Arrow indicates which crawler is operating and direction of travel with drive motors to the rear	
Crawler Travel Reverse (right): Arrow indicates which crawler is operating and direction of travel with drive motors to the rear	

FIGURE 3-1

Crawler Travel Speed (low)	
Cylinder (boom)	
Cylinders (gantry)	
Cylinders (jacking) Extend or Retract	
Cylinders (jacking) Cylinder Location *Left Front* *Right Front* *Left Rear* *Right Rear* *All*	
Data (enter)	
Data (save entered)	

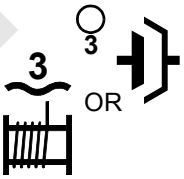
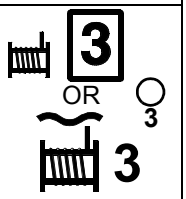
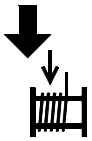
Decrease/Increase	
Dome Light	
Drum (free fall) (with drum number)	
Drum (lower load, boom, luffing jib, or mast—depends on drum use)	
Drum (the number identifies which drum is in use)	
Drum (raise load, boom, luffing jib, or mast—depends on drum use)	
Drum (split)	
Drum Pawl	

FIGURE 3-1 continued

Energize (turn on)	
Engine	
Engine Diesel Exhaust Fluid (DEF) Level	
Engine Exhaust High Temperature	
Engine Pressure	
Engine Run	
Engine Diesel Particulate Filter (DPF) Regeneration	
Engine Diesel Particulate Filter (DPF) Regeneration Inhibited	

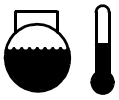
Engine Stop	
Engine Warning	
Engine Start	
Engine Temperature	
Ether Starting Aid	
Fast	
Fuel	
Hazard Warning	

FIGURE 3-1 continued

Heater	
Horn	
Level Warning	
Limit Bypass	
Load (lower)	
Load (raise)	
Locked/Unlocked	
Monitor/Display	

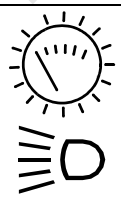
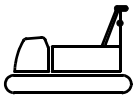
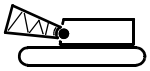
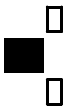
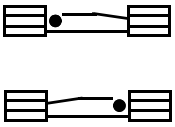
On/Start	
Off/Stop	
Panel Lights	
Park Off	
Park On	
Pins (backhitch)	
Pins (boom hinge)	
Pins (disengage)	

FIGURE 3-1 continued

Pins (engage)	
Pins (left crawler) Pins (right crawler)	
Pins (rotating bed front)	
Pins (rotating bed rear)	
Remote Control	
Rotating Beacon	
Scroll (down)	
Scroll (up)	

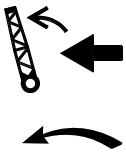
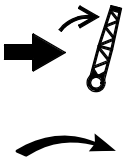
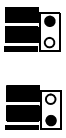
Setup Mode	
Slow	
Stop (emergency)	
Swing	
Swing Left	
Swing Lock	
Swing Right	
Upper Counterweight Switch Lower Counterweight Switch	

FIGURE 3-1 continued

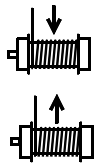
Winch, Rigging (haul in rope) Winch, Rigging (pay out rope)	
Windshield Wiper (front with washer)	
Windshield Wiper (overhead with washer)	

FIGURE 3-1 continued

FRONT WINDOW OPERATION

Closing Window

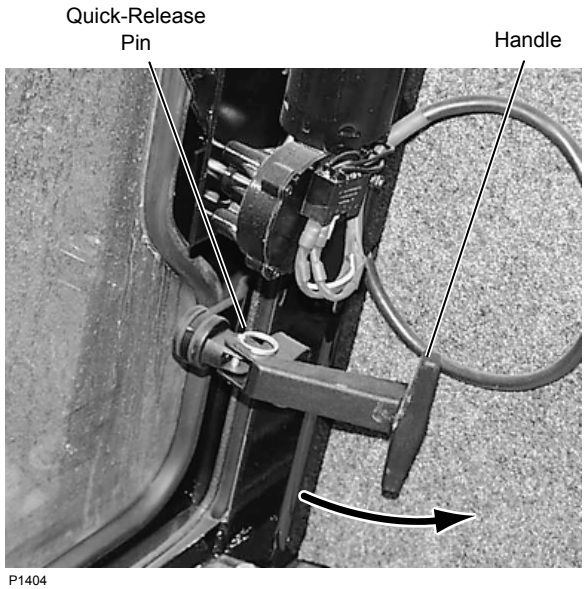


FIGURE 3-2

Rotate the window latch handle to the position shown in Figure 3-2.

Opening Window for Ventilation

FIGURE 3-3

Rotate the window latch handle to the position shown in Figure 3-3. The window can be swung open 203 mm (8 in) for ventilation.

Opening Window for Emergency Exit

Rotate the handle to open the window and pull out the quick-release pin. The window can be swung open fully to allow emergency exit from the cab.

CONTROLS IDENTIFICATION AND FUNCTION

Refer to Figure 3-4 for the following paragraphs identifying controls and their functions.

General

The purpose of the following instructions is to familiarize qualified operators with the location and function of the operating controls for the Model 2250. This topic also contains safety information and a description of operation for each crane function.

Depending on the options your crane is equipped with, some of the controls identified will not apply.

WARNING

Prevent Death or Serious Injury to Personnel!

Avoid possible injury, death, or equipment damage. Read and thoroughly understand the instructions in this manual and in the Capacity Chart Manual.

Contact the Manitowoc Crane Care Lattice Team for assistance if any operating procedure is not clearly understood.

THIS PAGE INTENTIONALLY LEFT BLANK

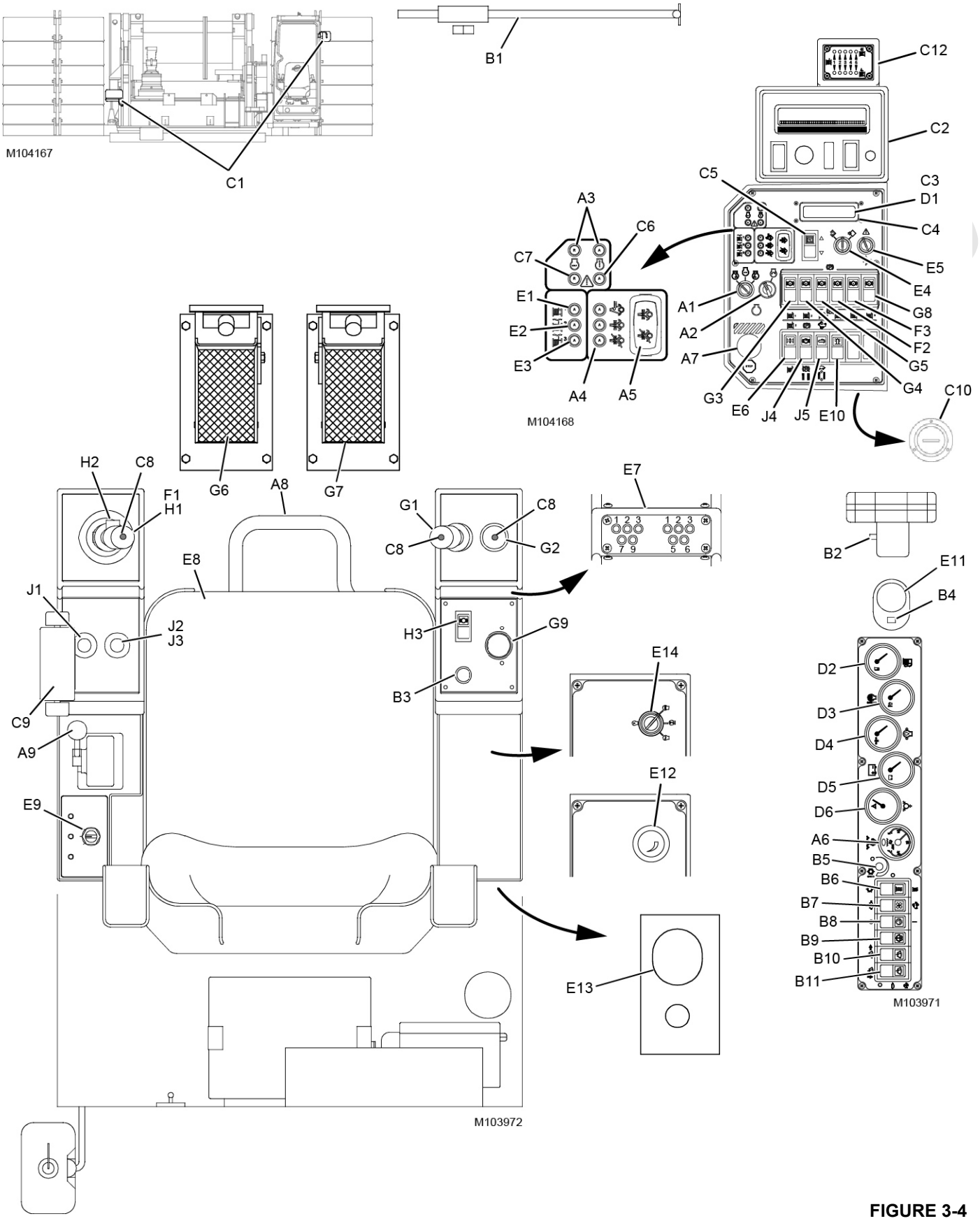

M104167
C1
B1
C12
C2
C3
D1
C4
C5
E5
E4
G8
F3
F2
G5
G4
C10
A3
C6
C7
E1
E2
E3
A4
A5
A1
A2
A7
G3
E6
J4
J5
E10
M104168
G6
G7
H2
C8
F1
H1
A8
G1
C8
C8
G2
E7
E8
J1
J2
J3
H3
G9
B3
E14
E12
C9
A9
E9
E13
M103972
B2
E11
B4
D2
D3
D4
D5
D6
A6
B5
B6
B7
B8
B9
B10
B11
M103971

FIGURE 3-4

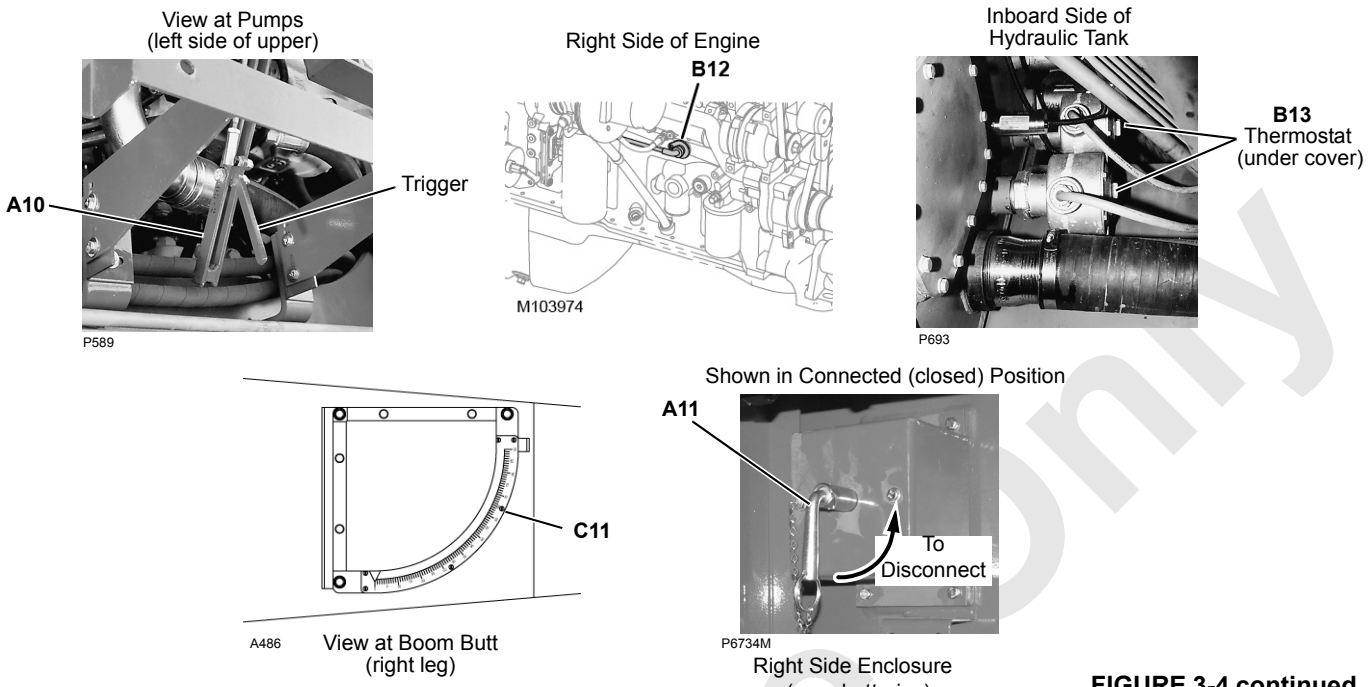


FIGURE 3-4 continued

A—Engine Controls

A1	Engine Run/Stop/Run Key Switch
A2	Engine Start Switch
A3	Engine Lights
A4	Exhaust System Lights
A5	Diesel Particulate Filter (DPF) Switch
A6	Diesel Exhaust Fluid (DEF) Gauge and Light
A7	Emergency Stop Switch
A8	Engine Foot Throttle
A9	Engine Hand Throttle
A10	Pump Drive Disconnect Handle
A11	Battery Disconnect Switch

B—Accessory Controls

B1	Tinted Visor
B2	Defroster Fan
B3	Horn Switch
B4	Dome Light Switch
B5	Air Conditioner Temperature Selector
B6	Air Conditioner/Heater Switch
B7	Air Conditioner/Heater Fan Switch
B8	Panel Lights Switch
B9	Windshield Washer Switch
B10	Front Windshield Wiper Switch
B11	Overhead Windshield Wiper Switch
B12	Engine Block Heater
B13	Hydraulic Oil Heaters

C—Indicators

C1	Mirrors
C2	Load Indicator Console
C3	Crane Level Display
C4	Digital Display
C5	Digital Display Selector Switch
C6	Operating Limit Alert
C7	System Fault Alert
C8	Rotation Indicators
C9	Wind Speed Indicator
C10	Engine Hour Meter
C11	Boom Angle Indicator
C12	Drum Direction Indicator

D—Gauges

D1	Hydraulic Tank Temperature Display
D2	Fuel Level Gauge
D3	Engine Water Temperature Gauge
D4	Engine Oil Pressure Gauge
D5	Battery Voltage Gauge
D6	Air Pressure Gauge

E—Special Controls and Indicators

E1	Drum 1 Free Fall Light
E2	Drum 2 Free Fall Light
E3	Drum 3 Free Fall Light
E4	Crane Mode Selector
E5	Limit Bypass Switch
E6	Drum Selector
E7	Load Drum Indicator Lights
E8	Seat Switch
E9	MAX-ER Controls
E10	Aircraft Warning Beacon (optional)
E11	Dome Light (optional)
E12	Dome Light Dimmer Control (optional)
E13	Clam Closing Control and Air Pressure Gauge
E14	APU Cab Key Switch (optional)

F—Boom/Luffing Hoist Controls

F1	Boom Hoist Handle
F2	Drum 4 Park Switch
F3	Drum 5 Park Switch

G—Load Drum Controls

G1	Left Handle
G2	Right Handle
G3	Drum 1 Park Switch
G4	Drum 2 Park Switch
G5	Drum 3 Park Switch
G6	Left Working Brake Pedal
G7	Right Working Brake Pedal
G8	Drum 9 Park Switch
G9	Auxiliary Drum 5 Handle (optional)

H—Swing Controls

H1	Swing Handle
H2	Swing Holding Brake Switch
H3	Swing Brake Switch

J—Travel Controls

J1	Left Crawler Handle
J2	Right Crawler Handle
J3	Travel Detent Selector
J4	Travel Park Switch
J5	Travel Speed Selector

A—Engine Controls

WARNING

Startup Hazard!

Avoid the possibility of death or serious injury. Avoid unauthorized startups.

Always remove the key before leaving the crane unattended. This practice will prevent unauthorized personnel from starting the engine.

See Figure 3-4 for the following components.

NOTE: Engine start and speed controls are mounted remotely on a junction box on the right side of the rotating bed. See Remote Controls on page 3-51 for operation of the remote controls.

A1—Engine Run/Stop/Run Key Switch

Insert the key and turn it to either RUN position to turn on the crane's electrical system.

Turn the key to the STOP position to stop the engine and turn off the crane's electrical system.

NOTE: Stopping the engine in an emergency will cause all brakes to apply and any operating functions to stop. Be aware that functions will stop abruptly.

A2—Engine Start Switch

CAUTION

Avoid Engine Damage!

Use of any starting aids can result in an explosion and personal injury. Do not use aerosol starting aids such as ether.

See the Engine Manual for cold weather starting instructions and precautions.

Turn the knob clockwise and hold it to start the engine. Release the knob as soon as the engine starts.

NOTE: The Engine Run/Stop/Run key switch must be in the proper RUN position before the engine can be started. If the engine does not crank, turn the Engine Run/Stop/Run key switch to the other RUN position.

The digital display will come on when the Engine Run/Stop/Run key switch is in the proper position. The digital display will go off while the engine is starting.

A3—Engine Lights

Two engine lights are provided, as follows:

Engine Stop Light (red)

CAUTION

Engine Damage!

Avoid engine damage. If this red light comes on, lower all loads and then stop the engine as soon as possible. Do not run the engine until the fault is corrected.

If this light comes on, stop the engine as soon as safely possible.

Engine Warning Light (amber)

If this light comes on, repair the engine fault at the first available opportunity.

A4—Exhaust System Lights

Three amber lights are provided, as follows:

High Exhaust System Temperature

WARNING

Burn Hazard!

Avoid high exhaust temperature and the possibility of a serious burn. Active diesel particulate filter (DPF) regeneration can occur at low engine idle as well as during crane operation. This may result in high exhaust temperature.

Always keep personnel well away from the exhaust to prevent injury.

When on, this light indicates that higher than normal exhaust temperatures exist, normally due to diesel particulate filter (DPF) regeneration. It is normal for this light to come on during normal operation.

Diesel Particulate Filter (DPF) Regeneration

This light displays one of the three following conditions:

- When on, this indicates that the exhaust after-treatment system requires regeneration within the next few hours. Use the diesel particulate filter (DPF) switch to start a manual regeneration cycle.
- If flashing, the DPF is in regeneration mode. The operator may sense a reduction in power. No immediate action is required.
- If flashing and the red engine stop light is on, regeneration is required but is inhibited. The operator

will notice a significant reduction in engine power. Turn off inhibit and perform a manual regeneration cycle immediately.

Diesel Particulate Filter (DPF) Regeneration Inhibited

When on, this light indicates that diesel particulate filter (DPF) active regeneration has been inhibited.

CAUTION

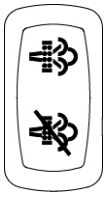
Aftertreatment System Damage!

Do not place the diesel particulate filter (DPF) switch in the INHIBIT position unless directed to do so by a Manitowoc Cranes or Cummins technical advisor.

If DPF regeneration is prevented for an extended period, the DPF will be damaged and require replacement.

Inhibiting regeneration may result in a loss of engine power or shutdown by the engine control module (ECM) and the need to service or replace the DPF.

A5—Diesel Particulate Filter (DPF) Switch



The CENTER position (maintained) is for normal engine operation. In this position, regeneration occurs automatically.

The TOP position (momentary) is for manual regeneration. If manual regeneration is needed as indicated by the diesel particulate filter (DPF) regeneration light, press the top of the rocker switch and then release it. The engine control module (ECM) will control a manual DPF regeneration cycle.

A manual regeneration cycle will begin only if the following conditions exist:

- All joysticks are in the neutral position (no functions engaged).
- The engine is at low idle.
- The accelerator pedal is not being pressed.

NOTE: A guard over the top of the rocker switch prevents accidental manual regeneration.

It is normal for the high exhaust system temperature light to come on during regeneration and remain on for a short time after regeneration.

The BOTTOM position (maintained) inhibits active regeneration. The amber DPF regeneration light will flash and the red Engine Stop light will glow.

Use the INHIBIT position only if directed to do so by the Manitowoc Crane Care Lattice Team or an authorized Manitowoc Cranes technician.

CAUTION

Avoid Exhaust System Damage or Engine Shutdown!

Prolonged engine operation with regeneration inhibited may result in damage to the DPF and loss of engine power or engine shutdown by the engine control module (ECM).

Use the BOTTOM position (INHIBIT) of the diesel particulate filter (DPF) switch only for special circumstances in which it is desirable to inhibit active regeneration.

NOTE: See the engine manufacturer's manual for additional information on regeneration and inhibit.

A6—Diesel Exhaust Fluid (DEF) Gauge and Light

WARNING

Chemical Hazard!

Diesel exhaust fluid (DEF) contains urea. Avoid the possibility of death or serious injury. Do not swallow. If DEF is ingested, contact a physician immediately.

Do not get DEF in your eyes. In case of contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes.

This light indicates the level of the reducing agent in the diesel exhaust fluid (DEF) tank on the left side of the rotating bed.

The crane operator will be warned in the following manners when the DEF tank is low:

- The DEF light (in gauge) is the first warning that the DEF tank is low. The DEF light will glow.
- The amber Engine Warning light (on front console) is the intermediate warning that the DEF tank needs to be filled. The DEF light (in gauge) will also flash.
- The red Engine Stop light (on front console) is the final warning, before inducements kick in, that the DEF tank is low.

NOTE: Once the DEF tank is empty and a key cycle has occurred, or after an extended idle period, engine power will be reduced. The DEF light will flash and the red Engine Stop light will glow steady.

Do not store DEF for long periods of time. DEF will deteriorate relative to time and temperature. Low-quality DEF may require the tank to be drained and the system purged.

If the DEF needs to be stored, keep it out of direct sunlight. Ultra-Violet (UV) rays can degrade DEF. Store DEF in a cool, shaded spot.

A7—Emergency Stop Switch

Push this knob down to stop the engine only in an emergency—for example, if a crane function does not stop when the control handle is released to OFF (center position) or if any other uncontrolled motion of a crane function is observed.

Be aware that when the knob is pushed down, the engine stops, brakes apply, and any operating functions come to an abrupt stop.

NOTE: The knob must be pulled up before the engine can be restarted.

If the Emergency Stop switch has been activated, test all brakes for proper operation before putting the crane back in service. See Section 2 of the Service Manual.

Use the Engine Run/Stop/Run key switch (A1) to stop the engine under normal conditions.

A8—Engine Foot Throttle

Press the pedal to increase engine speed above the hand throttle setting.

Release the pedal to decrease engine speed to idle or to the hand throttle setting.

A9—Engine Hand Throttle

Pull the handle back to increase engine speed.

Push the handle forward to decrease engine speed.

NOTE: The selected engine speed will be maintained when the handle is released.

The speed of the crane functions depends on engine speed and on how far the control handles are moved from OFF.

The 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.

A10—Pump Drive Disconnect Handle

Squeeze and hold the trigger against the handle.

Push the handle toward the engine to engage the gears or pull the handle away from the engine to disengage the gears.

Release the trigger to lock the handle in the desired position.

CAUTION

Avoid Pump Drive Damage!

Pump drive gears will be damaged if the disconnect is not operated properly. See Engine Startup on page 3-33 for instructions and precautions.

A11—Battery Disconnect Switch

Turn the handle clockwise to connect the battery circuit.

Turn the handle counterclockwise to disconnect the battery circuit for the following reasons:

- When servicing the crane's electrical control system
- If desired, to prevent the 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

CAUTION

Engine Damage!

To avoid possible engine fault codes and undesirable operation, make sure the engine ignition switch has been off for two minutes before disconnecting the batteries.

Do not rely on this switch to protect the crane's electronic systems when welding. Disconnect the battery cables at the batteries before welding.

Pull the handle out when in the DISCONNECT position to keep unauthorized personnel from connecting the battery and starting the crane.

B—Accessory Controls

See Figure 3-4 for the following components.

B1—Tinted Visor

Move the visor to the desired position to shade sunlight.

B2—Defroster Fan

The defroster fan has a three-position switch with OFF, LOW, and HIGH settings.

B3—Horn Switch

Press and hold the button to turn on the horn. Sound the horn when necessary to warn or signal personnel while the crane is being operated or serviced.

Release the button to turn off the horn.

B4—Dome Light Switch

The dome light has a two-position switch with ON and OFF settings.

The dome light can be rotated to different positions.

B5—Air Conditioner Temperature Selector

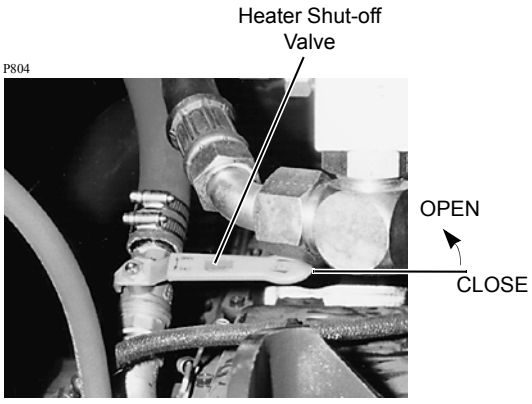
Rotate the knob clockwise for cooler temperatures and counterclockwise for warmer temperatures.

B6—Air Conditioner/Heater Switch

Press the top of the rocker switch to turn on the cab heater.

Center the rocker switch to turn off the cab air conditioner or heater.

Press the bottom of the rocker switch to turn on the cab air conditioner.



Typical 2 Places on Engine

FIGURE 3-5

NOTE: The shut-off valves in the heater hoses (Figure 3-5) at the engine must be open for heater operation.

The shut-off valves can be closed to block hot water flow through the heater core during warm weather.

The shut-off valve in the supply line can be partially opened and closed to regulate heat.

B7—Air Conditioner/Heater Fan Switch

This fan operates only when the heater or air conditioner is on.

Press the top of the rocker switch to turn on the fan at high speed.

Press the bottom of the rocker switch to turn on the fan at low speed.

B8—Panel Lights Switch

Press the top of the rocker switch to turn on the panel lights.

Press the bottom of the rocker switch to turn off the panel lights.

B9—Windshield Washer Switch

Press and hold the top of the rocker switch to spray washing solution onto the upper front window.

Release the rocker switch to stop spraying washing solution onto the upper front window.

NOTE: The washer tank is mounted outside, behind the operator's cab. Fill the tank with a quality brand washing solution that will not freeze during cold weather.

B10—Front Windshield Wiper Switch

B11—Overhead Windshield Wiper Switch

Both wiper switches operate in the same manner, as follows:

- Press the top of the rocker switch to turn on the wiper and operate it in high speed.
- Center the rocker switch to turn on the wiper and operate it in low speed.
- Press the bottom of the rocker switch to turn off the wiper.

B12—Engine Block Heater

To aid starting in cold weather, plug in the heaters at shutdown. Unplug the heaters at startup.

The engine is equipped with a 1500 W block heater (120 V) without a thermostat.

B13—Hydraulic Oil Heaters

The hydraulic tank can be equipped with thermostatically controlled heaters (240 V) designed to keep the oil temperature 17°C (30°F) warmer than ambient temperature. To set each thermostat, remove the cover and turn the knob fully clockwise to 38°C (100°F).

C—Indicators

See Figure 3-4 for the following components.

C1—Mirrors

One adjustable interior mirror is provided to give the operator a view through the rear cab window.

Two adjustable exterior mirrors are provided to give the operator a view to the rear of the crane. Both mirrors can be rotated inward for shipping.

C2—Load Indicator Console

See the RCL Manual for operation.

C3—Crane Level Display

Crane levelness is shown on the Operating Conditions screen of the digital display. See Digital Display Readings on page 3-54 for more information.

WARNING

Tipping Hazard!

Avoid tipping the crane and the possibility of death or serious injury.

Unless otherwise specified on the capacity chart, all crane operations must be performed with the crane level to within one percent of grade—0,31 m (1 ft) in 30,5 m (100 ft). Operating the crane at a greater angle can cause the crane to tip.

C4—Digital Display

This allows the operator to monitor three groups of crane information—operating conditions, operating limits, and system faults. See Digital Display Readings on page 3-54 for tables identifying the information that can be displayed.

C5—Digital Display Selector Switch

Press the top or bottom of the selector to scroll up or down through the display readings. Release the selector when the desired information is displayed.

C6—Operating Limit Alert

This light glows yellow, and a buzzer comes on to alert the operator that an operating limit has been reached (the limit automatically appears on the digital display). See Digital Display Readings on page 3-54 for a list of operating limits, function responses, and corrective actions.

C7—System Fault Alert

This light glows red, and a beeper comes on to alert the operator that a system fault exists (fault automatically appears on digital display). See Digital Display Readings on page 3-54 for a list of system faults, causes, function responses, and corrective actions.

C8—Rotation Indicators

These move up and down to signal the operator through vibration that the boom hoist, luffing hoist, or corresponding load drum is turning.

NOTE: The rotation indicators are pin-type actuators located under the handle covers. Indicator movement corresponds to drum speed.

C9—Wind Speed Indicator

The display shows wind speed velocity and direction at the boom or jib point. (See the manufacturer's instructions for installation, operation, and maintenance instructions.)

C10—Engine Hour Meter

This shows the total number of hours the engine has been run and is located on the front console.

C11—Boom Angle Indicator

WARNING

Overload Hazard!

Avoid overloading the crane and the possibility of death or serious injury.

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.

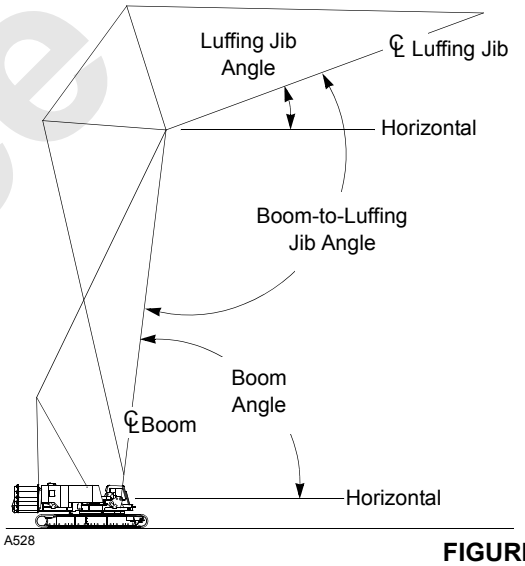


FIGURE 3-6

The boom angle indicator shows the angle of the boom in degrees above horizontal. The boom and luffing jib angles can also be viewed on the Operating Conditions screen of the digital display. See Figure 3-6 for identification of the various boom and luffing jib angles.

C12—Drum Direction Indicator

The drum direction indicator shows the direction of rotation of the drum being used, either up or down.

D—Gauges

See Figure 3-4 for the following components.

D1—Hydraulic Tank Temperature Display

CAUTION

Pump Damage!

Avoid damage to the pumps and related hydraulic parts. Do not operate crane functions until the temperature of the hydraulic oil is at least 16°C (60°F).

The hydraulic tank temperature is shown on the Operating Conditions screen of the digital display. See Digital Display Readings on page 3-54 for more information.

D2—Fuel Level Gauge

This shows how much fuel is left in the fuel tank.

D3—Engine Water Temperature Gauge

This shows the temperature of the coolant in the engine cooling system. See your engine manual for operating conditions.

D4—Engine Oil Pressure Gauge

This shows the pressure of the oil in the engine lubricating system. See your engine manual for operating conditions.

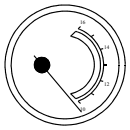
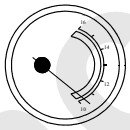
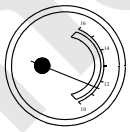
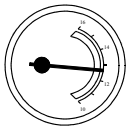
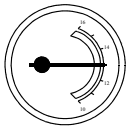
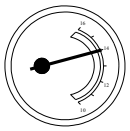
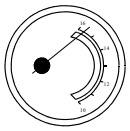
Engine not Running or Running at Idle		Engine Running Fast Enough to Make Alternator Produce
1—Dead or disconnected battery. Disconnected or badly connected meter.	A915 	1—Disconnected meter. Engine could not run with dead or disconnected battery unless circuit was completed around battery.
2—Very low battery charge. Engine might not start.		2 and 3—When pointer stays below 13.3 V with engine running fast enough to operate alternator, it shows that alternator is not operating, voltage regulator is out of adjustment, or current being drawn from battery by lights, heater, fan, or other load exceeds alternator output.
3—Low battery charge. Constant reading in this area indicates need to check alternator and voltage regulator.		
4—Well-charged battery. Indicates a good battery and that alternator and voltage regulator are operating properly.		4 and 5—When engine is started, pointer might stay in this area temporarily, but it should gradually rise above 13.3 V as alternator reaches normal output.
5—Pointer might remain in this position temporarily when engine has been stopped after considerable use, due to a “surface charge” in battery. To get a correct reading, turn on wipers or heater for a few minutes.		
6 and 7—Under normal conditions, a 12 V battery is fully charged at 12.8 V. A slightly higher reading might occur under conditions outlined in number 5. Generally speaking, however, any reading above 12.8 V when engine is stopped is not a true reading.		6—This is the area where pointer should be when alternator, voltage regulator, and battery are all in good condition and working properly.
		7—When pointer goes above 15.2 V, voltage regulator is set too high or jammed. Continued operation of engine will burn out battery.

FIGURE 3-7

D5—Battery Voltage Gauge

This shows the condition of the battery charging system. For a complete description of gauge readings, see Figure 3-7.

D6—Air Pressure Gauge

This shows pressure in the air system for the load drum brakes and clutches. The gauge should read 8.3 to 9.1 bar (120 to 132 psi) with the engine running.

E—Special Controls and Indicators

See Figure 3-4 for the following components and see Figure 3-8 for drum identification.

E1—Drum 1 Free Fall Light
E2—Drum 2 Free Fall Light
E3—Drum 3 Free Fall Light

These lights glow yellow when Free Fall is on for the corresponding load drum.

E4—Crane Mode Selector

WARNING

Moving Load Hazard!

Avoid the possibility of death or serious injury. Unexpected drum motion or improper limit responses can result if the wrong mode is selected.

The operator shall select the proper operating mode prior to operating.

Insert and turn the key clockwise and hold it to select the desired crane mode. The crane mode appears on the first line of the digital display. Available crane modes will then scroll by (one to two seconds apart) on the second line of the display.

Turn the key counterclockwise to confirm the desired crane mode when it appears on the digital display.

Release the key to center. Remove the key to prevent unauthorized operation.

NOTE: To check the crane mode in effect, turn the key to the CONFIRM position. The present mode will appear on the digital display.

The crane mode in effect when the engine is stopped remains in memory. At each startup, the crane mode in effect must be confirmed or another mode must be selected and confirmed. The load drums and boom hoist are not operable until this step is performed (the operating limit alert will come on and CONFIRM MODE will appear on the digital display if operation is attempted).

The crane can be operated in one of several modes. If the Free Fall option is not selected, the corresponding drum operates in full power.

Main Modes

See the description below for the available crane modes.

Standard

Use this mode for all normal load handling operations. This mode allows full power or free fall operation of only one drum at a time.

Clamshell

This mode allows two load drums (holding and closing) to be operated at the same time and turns on the Clamshell Power Down and Closing features.

Drum 5 (Luff Jib)

This is the same as Standard mode except the boom hoist is parked and inoperable. Drum 5 is operable and the luffing jib limits are turned on. See the Luffing Jib Operator Manual for raising and lowering instructions when equipped with the luffing jib attachment.

When it is necessary to operate the boom hoist, select and confirm Standard mode. Drum 5 is then parked and inoperable.

Drum 5 (AUX HST)

This is the same as Standard mode, except drum 5 is also operable (Figure 3-8).

Tandem Drum

This is the same as Standard mode, except that two load drums operate at the same time with the left handle (Figure 3-8).

Crane Setup

WARNING

Boom Hazard!

A falling boom can result in the possibility of death or serious injury. Crane Setup mode is provided for crane assembly and disassembly purposes only.

Do not use this mode for normal load handling operations. The Boom Up limit is inoperable, which could allow the boom to be pulled over backward.

This is the same as Standard mode except for the following:

- The operating limit fault is turned on.
- The boom hoist handle controls drum 4 regardless of the auxiliary mode.

- The drum 1 and drum 2 control handles control the main and auxiliary drums regardless of the auxiliary mode.
- The Boom Max Up and Mast 80° operating limit faults are disabled.
- The Luffing Jib Angle Sender fault is disabled.
- The Boom Too High and Jib Too Low portions of the RCL/RCI Operating Limit fault are disabled.
- MAX-ER 2000 drum 9 is disabled.
- On CE cranes, lowering speed limitations for drums 2 and 5 are disabled (if applicable).

Luffing Jib Setup

The Luffing Jib Setup mode allows the limits listed in Table 3-2 to be bypassed with the limit bypass switch (E5).

Auxiliary Modes

FFALL

This allows the desired load drum (1, 2, or 3) to be operated in Free Fall.

When selecting Free Fall, drum numbers appear on the digital display as follows:

- DRUM 1 FFALL
- DRUM 2 FFALL
- DRUM 3 FFALL

For MAX-ER 2000, drum 2 (boom hoist) cannot be operated in Free Fall.

DANGER

Falling Boom Hazard!

Avoid death or serious injury.The boom will fall uncontrolled if the following precaution is not followed. For the MAX-ER 2000, do not switch drum 2 (boom hoist) to Free Fall.

To turn on Free Fall for the desired load drum, proceed as follows.

NOTE: The following example is for drum 1. The process is the same for the other drums.

1. Bring drum 1 to a complete stop.
2. Press the drum working brake pedal fully. Free Fall cannot be turned on until this step is performed.
3. Turn the mode selector key clockwise and hold it until DRUM 1 FFALL OFF appears on the digital display.
4. Turn the mode selector key counterclockwise to confirm Free Fall.
5. DRUM 1 FFALL ON will appear on the digital display, and the Drum 1 Free Fall light will glow yellow.

To turn off Free Fall for the desired load drum, proceed as follows.

NOTE: The following example is for drum 1. The process is the same for the other drums.

1. Press the drum working brake pedal fully to bring drum 1 to a complete stop.
2. Turn the mode selector key clockwise and hold it until DRUM 1 FFALL ON appears on the digital display.
3. Turn the mode selector key counterclockwise to confirm Free Fall.
4. DRUM 1 FFALL will appear on the digital display (ON will disappear), and the Drum 1 Free Fall light will turn off.

NOTE: When Free Fall is off, the corresponding load drum operates in full power. See G—Load Drum Controls on page 3-26 for a description of full power operation.

MAX-ER

See MAX-ER Operation Guide for operating instructions when equipped with the MAX-ER attachment.

Table 3-2. Limit Bypass Identification

Limit	Limit Bypass Switch (E5) (momentary key switch)		Limit Bypass Switch (E5) (momentary key switch) Luffing Jib Setup Mode On[1]		External Override Switch[2]
	non-CE[3]	CE	non-CE	CE	CE
Boom Up Limit	No	No	No	No	No
Boom Down Limit	Yes	Yes	No	No	No
Block-Up Limit (each drum)	Yes	Yes	Yes	Yes	No
Bail Limits—Max and Min (each drum)	Yes	Yes	No	No	No
Rated Capacity Indicator/Limiter	Yes	Yes[4]	No	No	Yes[5]
Hoist Limit (equalizer and boom stop)	Yes	Yes	No	No	No
Luffing Jib Maximum Up1	Yes	No	Yes	Yes	No
Luffing Jib Maximum Up 2	Yes[6]	No	Yes[6]	Yes[6]	No
Luffing Jib Maximum Down 1	Yes	No	Yes	Yes	No
Luffing Jib Maximum Down 2	Yes	No	Yes	No	No

1 Use only for rigging. See E5—Limit Bypass Switch on page 3-22.

2 See Rated Capacity Indicator/Limiter Operation Manual.

3 CE = Cranes that comply with 2010 European Requirements.

4 Only while operating between 100% and 110% rated capacity. The speed of the crane functions is limited to 15% of their maximum speed for movements that increase load.

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

6 Only when the boom is below 50°.

E5—Limit Bypass Switch

WARNING

Falling Boom or Load Hazard!

Avoid the possibility of death or serious injury from a falling boom or load.

When bypassing a limit, carefully follow the instructions under Limit Devices on page 3-29.

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

Insert and turn the key clockwise to bypass the reached operating limits. This position allows the functions to be operated beyond the limits.

Release the key to activate the limits. This position allows the limits to stop the functions in the normal manner. The key must be in this position for all normal operation. Otherwise, structural damage can occur.

Remove the key to prevent unauthorized operation.

NOTE: To bypass the limits listed in Table 3-2 for luffing jib setup, proceed as follows:

- Select and confirm Luffing Jib Setup mode.
- Rotate the limit bypass switch (E5) clockwise and release. The limits will remain bypassed for 10 seconds.
- Move the desired control handle (luffing hoist, boom hoist, load drum)—one control handle at a time—in the required direction. The limits will remain bypassed for as long as the handle is moved in either direction.
- The limits will remain bypassed for 10 seconds after the control handle(s) is returned to OFF.

E6—Drum Selector

Press the front end of the rocker switch to operate the drum 2 load drum.

Press the rear end of the rocker switch to operate the drum 3 load drum.

NOTE: The drum selector is provided only when the crane has a front drum and a split-rear drum.

The drum clutch releases and the drum park brake applies to prevent the unused drum from turning.

E7—Load Drum Indicator Lights

The corresponding indicator lights glow green to indicate which handles and drums are active (operable) for the selected operating mode. See Figure 3-8 for drum and handle identification.

E8—Seat Switch

This prevents the crane from being operated until the operator is seated. When the operator is not seated, all control handles are inoperable, all park brakes are applied, Free Fall is turned off, and the travel detent is turned off.

E9—MAX-ER Controls

Controls vary by model. See the MAX-ER Operator Manual for identification and operation of the MAX-ER controls.

E10—Aircraft Warning Beacon (optional)

Press the top of the rocker switch to turn on the red aircraft warning beacon on the boom or jib top.

Press the bottom of the rocker switch to turn off the aircraft warning beacon.

E11—Dome Light (optional)

Press the top of the rocker switch to turn on the dome light.

Press the bottom of the rocker switch to turn off the dome light.

E12—Dome Light Dimmer Control (optional)

Turn the dimmer control clockwise to increase cab brightness when the dome light is selected on the front console.

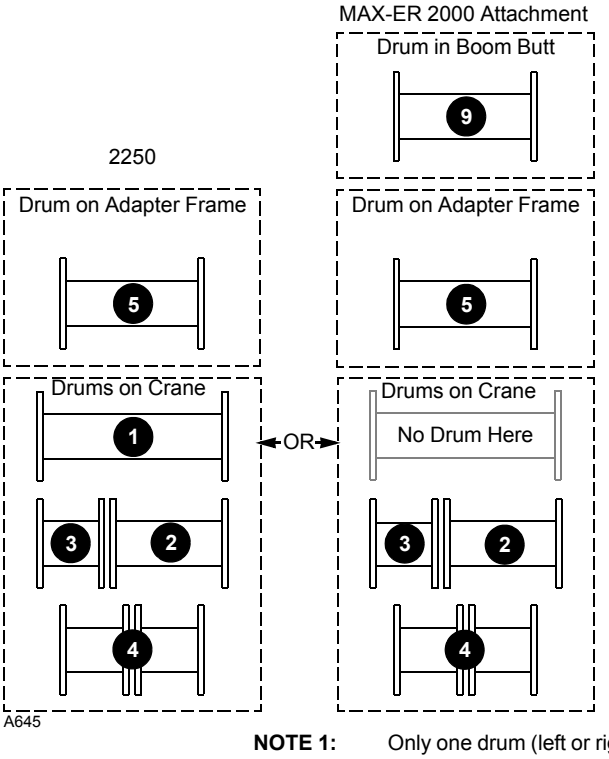
E13—Clam Closing Control and Air Pressure Gauge

See Clamshell Operation—Standard on page 3-39 for detailed operating instructions.

E14—APU Cab Key Switch (optional)

Turn the key clockwise and hold it to start the engine. Release the key as soon as the engine starts.

Drum Identification



Drum Number	2250	MAX-ER 2000
1	Front Load Drum	No Drum Available
2	Rear or Right Rear Load Drum	Boom Hoist
3	Left Rear Load Drum or Mast Hoist	Rear Load Drum with Luffing Hoist
4	Boom Hoist	Mast Hoist
5	Luffing Hoist or Auxiliary Hoist (Load Drum)	Luffing Hoist or Rear Load Drum or Auxiliary Drum without Luffing Hoist
9	—	Front Load Drum

NOTE 1: Only one drum (left or right) can be operated at a time. The desired drum must be selected with the drum selector.

NOTE 2: Only one drum (boom or luffing) can be operated at a time. To operate the boom hoist, select Standard mode. To operate the luffing hoist, select drum 5 (luffing hoist). The drum not in use must be parked before the other drum can be used.

NOTE 3: If the auxiliary hoist is powered by the boom hoist circuit, only one drum (boom or auxiliary) can be operated at a time. The drum not in use must be parked before the other drum can be used.

If the auxiliary hoist is powered by the travel circuit, the auxiliary drum and travel cannot be operated at the same time. The function not in use must be parked before the other function can be used.

The auxiliary drum is always controlled by Handle C. All other drums that could be controlled by Handle C are parked and inoperable.

Drum 5 (auxiliary hoist) mode is not available for the clamshell attachment.

WARNING

Falling Boom and Jib Hazard!

Avoid serious personnel injury and equipment damage. The boom and luffing jib could be pulled over backward if the luffing jib limits are turned off.

Do not use drum 5 (auxiliary hoist) to operate the luffing hoist when equipped with the MAX-ER 2000 attachment. To operate the luffing jib on a MAX-ER 2000, always select drum 5 (luffing hoist).

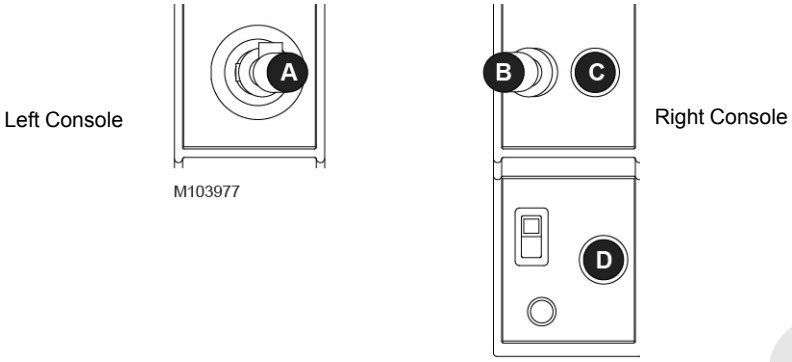
NOTE 4: Tandem drum mode is not available for MAX-ER or clamshell attachments.

NOTE 5: With MAX-ER mode ON, only one drum (boom or left rear) can be operated at a time.

Use Standard or Setup mode to raise and lower the MAX-ER 2000 mast with drum 4. See the MAX-ER Assembly and Disassembly Guide.

FIGURE 3-8

Handle-to-Drum Identification



Mode/Drum Options	Handle A Controls	Handle B Controls	Handle C Controls	Handle D Controls
Standard or Setup Mode				
Split Rear Drums (2-drum crane)	4—Boom Hoist	2—Right Rear	3—Left Rear	
Front and Rear Drums (2-drum crane)	4—Boom Hoist	1—Front	2—Rear	
Front and Rear Drums (3-drum crane)	4—Boom Hoist	1—Front	2—Right Rear or 3—Left Rear (NOTE 1)	
Drum 5 (Luffing Jib) Mode—Standard Crane (NOTE 2)				
	4—Boom Hoist or 5—Luffing Hoist	Same as Standard Mode		
Drum 5 (Luffing Jib) Mode—MAX-ER 2000 (NOTE 2)				
	4—Boom Hoist or 5—Luffing Hoist	9—Boom Butt Drum	3—Left Rear	
Drum 5 (Auxiliary Hoist) Mode—Standard Crane (NOTE 3)				
	4— Boom Hoist	Same as Standard Mode		5—Auxiliary
Drum 5 (Auxiliary Hoist) Mode—MAX-ER 2000 (NOTE 3)				
	2—Boom Hoist	9— Boom Butt	5—Auxiliary	
Tandem Drum Mode (NOTE 4)				
Split Rear Drums (2-drum crane)	4—Boom Hoist	2—Right Rear and 3—Left Rear		
Front and Rear Drums (2-drum crane)	4—Boom Hoist	1—Front and 2—Rear		
Front and Rear Drums (3-drum crane)	4—Boom Hoist	1—Front and 2—Right Rear		
Clamshell Mode				
Split Rear Drums (2-drum crane)	4—Boom Hoist	2—Right Rear	2—Right Rear and 3—Left Rear	
Front and Rear Drums (2-drum crane)	4—Boom Hoist	1—Front	1— Front and 2—Rear	
Front and Rear Drums (3-drum crane)	4—Boom Hoist	1—Front	1— Front and 2—Right Rear	
MAX-ER Mode (M*) (2000) (5)				
	2—Boom Hoist	9—Boom Butt	3—Left Rear	

FIGURE 3-8 continued

F—Boom/Luffing Hoist Controls

See Figure 3-4 for the following components.

NOTE: Drum 5 can also be used as an auxiliary hoist (load drum). See Drum 5 Operation—Boom Hoist Diverted on page 3-47 and Drum 5 Operation—Travel diverted on page 3-48.

F1—Boom Hoist Handle

Both hoists—boom (drum 4) and luffing (drum 5)—have a spring-applied, hydraulically released disc brake. The brake will be spring-applied to stop the hoist if power is lost.

The boom/luffing hoist is controlled by a dual-axis control handle. The dual-axis control handle allows the boom/luffing hoist and swing to be operated at the same time with one handle.

Move the handle to REAR to raise the boom or luffing jib. The brake releases and the speed increases in relation to handle movement.

Release the handle to CENTER to stop the boom or luffing jib. Speed decreases until motionless, and the brake applies to stop the boom or luffing jib and to hold the boom or jib in position.

Move the handle to FRONT to lower the boom or luffing jib. The brake releases and the speed increases in relation to handle movement.

F2—Drum 4 Park Switch

The drum 4 park switch enables and disables boom hoist operation. With the boom hoist park on, the boom hoist handle is inoperable, and the boom hoist brake is applied to hold the boom in position. The drum pawl is also engaged.

Press the top of the rocker switch to turn on the boom hoist park and engage the drum pawl.

Press the bottom of the rocker switch to turn off the boom hoist park (allowing the boom hoist to be operated) and disengage the drum pawl.

F3—Drum 5 Park Switch

The drum 5 park switch enables and disables luffing hoist operation. With the luffing hoist park ON, the luffing hoist handle is inoperable and the luffing hoist brake is applied to hold the luffing jib in position. The drum pawl is also engaged.

Press the top of the rocker switch to turn on the luffing hoist park and engage the drum pawl.

Press the bottom of the rocker switch to turn off the luffing hoist park (allowing the luffing hoist to be operated) and disengage the drum pawl.

G—Load Drum Controls

See Figure 3-4 for the following components.

Each load drum has a spring-applied, air-released, band-type park brake. The brake will apply by spring force to stop the load drum if power is lost.

Each load drum also has an air-applied, spring-released, band-type working brake. The working brake can be applied at any time to stop the load drum.

Full Power Mode (either load drum)

- The drum park brake applies when the drum handle is released to OFF.
- The drum park brake releases when the drum handle is moved in either direction from OFF.
- The drum clutch remains applied at all times to provide Full Power operation.

Free Fall Mode (either load drum)

- The drum park brake remains released at all times.
- The drum clutch releases when the drum handle is moved to OFF. Use the drum working brake to control the load.
- The drum clutch applies when the drum handle is moved in either direction from OFF to provide full power operation (hoist and lower).

WARNING

Falling Load Hazard!

When operating in Free Fall, the load will lower uncontrolled if the drum brake is not applied with the brake pedal when the load drum handle is moved to OFF.

Be ready to apply the drum brake with the brake pedal so lowering speed can be controlled and the load can be stopped immediately when necessary.

CAUTION

Avoid Clutch/Motor Damage!

Do not move the load drum handle in either direction from OFF while free falling a load. Serious damage to the drum clutch and motor could result. Stop the load with the drum working brake before moving the load drum handle in either direction from OFF.

For the same reason, do not turn off Free Fall or turn on the drum park while free falling a load. Stop the load with the brake pedal. Then turn off Free Fall or turn on the drum park.

G1—Left Handle
G2—Right Handle

NOTE: The corresponding load drum indicator lights glow green to indicate which handles and drums are active (operable) for the selected operating mode. See Figure 3-8 for drum and handle identification.

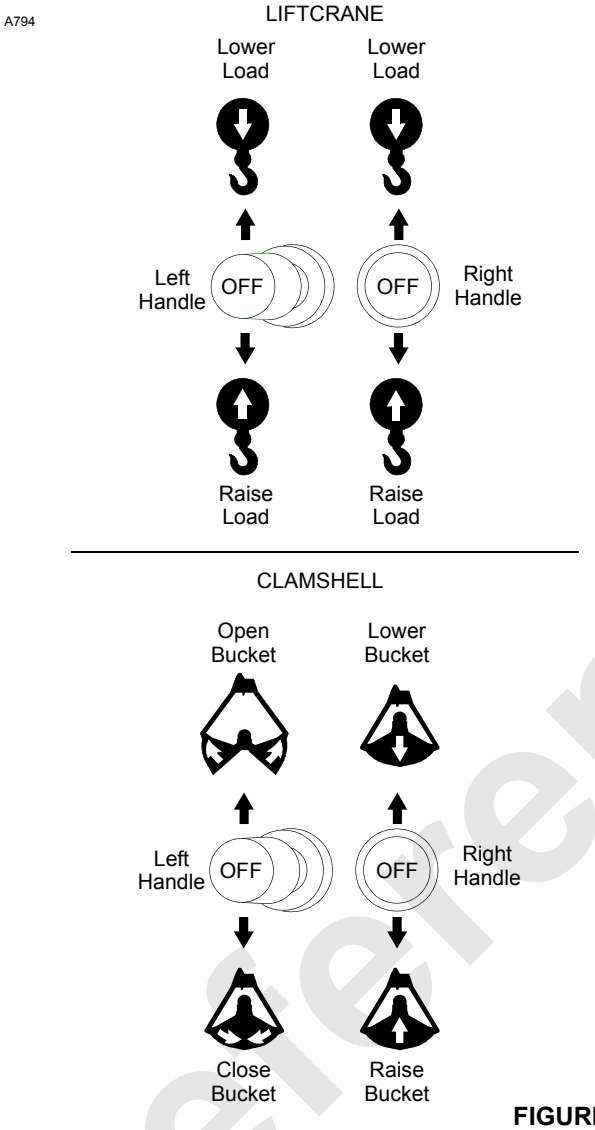


FIGURE 3-9

See Figure 3-9 for the following procedure.

1. Move the handle forward to lower the load.
2. Release the handle to the middle to stop the load and hold it in position.

NOTE: In Free Fall mode, the drum brake must be applied with the brake pedal to stop and hold a load. See Figure 3-10.

3. Move the handle rearward to raise the load.

G3—Drum 1 Park Switch
G4—Drum 2 Park Switch
G5—Drum 3 Park Switch

The drum park switches enable and disable load drum operation. With the drum park on, the corresponding drum handle is inoperable and the park brake is applied.

Pawl operation is controlled with the selected drum park switch. When the drum park switch is on, the pawl is engaged.

Press the top of the rocker switch to turn on the corresponding drum park brake.

Press the bottom of the rocker switch to turn off the corresponding drum park brake (allowing the drum to be operated).

G6—Left Working Brake Pedal
G7—Right Working Brake Pedal

Each load drum has a brake pedal that can be pressed down at any time to stop the drum.

NOTE: The left working brake pedal is used only with the left handle. The right working brake pedal is used only with the right handle.

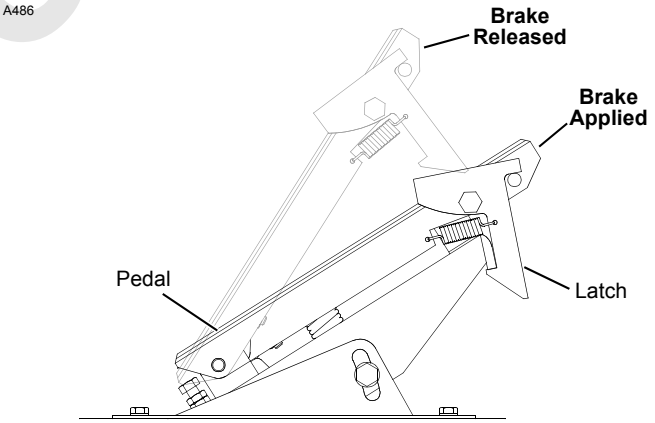


FIGURE 3-10

See Figure 3-10 for the following procedure.

1. Press the pedal to apply the working brake in relation to pedal movement.
2. Fully press and latch the pedal to fully apply the brake.
3. Release the pedal to release the working brake gradually as the pedal is eased up.
4. Press the heel of the latch to unlatch the pedal.

G8—Drum 9 Park Switch

The drum 9 park switch enables and disables load drum operation. With the drum 9 park on, the corresponding drum handle is inoperable. The park brake is applied and the pawl is engaged.

Press the top of the rocker switch to turn on the corresponding drum park and engage the drum pawl.

Press the bottom of the rocker switch to turn off the corresponding drum park switch and disengage the drum pawl to allow drum operation.

G9—Auxiliary Drum 5 Handle (optional)

See Drum 5 (luffing or auxiliary hoist) on page 3-63 for identification and operation of the drum 5 auxiliary hoist controls.

H—Swing Controls

See Figure 3-4 for the following components.

H1—Swing Handle

The dual-axis handle allows the swing and boom/luffing hoist to be operated at the same time with one handle.

Move the handle to the left to swing left. Swing speed increases in relation to handle movement.

Release the handle to the center to stop. Swing speed decreases to off, and the rotating bed slows to a stop. Move the swing handle in the opposite direction to stop the swing motion quicker.

Press the swing holding brake switch to hold the stopped rotating bed in position.

Move the handle to the right to swing right. Swing speed increases in relation to handle movement.

NOTE: If equipped, the optional swing alarm will beep to warn personnel when the rotating bed is swung in either direction.

H2—Swing Holding Brake Switch

Use the swing holding brake switch (on the side of the swing/boom hoist handle) to hold the rotating bed in position for short periods of time during the operating cycle. The swing brake will apply, and the swing handle will be inoperable while the switch is pressed.

Press the button to apply the swing holding brake.

Release the button to release the swing holding brake.

CAUTION

Avoid Swing Drive or Boom 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 from side loading or damage to the swing drive from shock loading. Bring the rotating bed to a smooth stop with the swing handle and then apply the swing holding brake or turn on the swing park switch.

H3—Swing Brake Switch

The swing is equipped with a spring-applied, hydraulically released disc brake.

Press the front of the rocker switch to turn on the swing brake.

Press the rear of the rocker switch to turn off the swing brake.

J—Travel Controls

See Figure 3-4 for the following components.

The crawlers are equipped with spring-applied, hydraulically released disc brakes, which function as follows:

- Both crawler brakes release when either crawler handle is moved from OFF.
- Both crawler brakes apply when both crawler handles are moved to OFF.
- Both crawler brakes apply to hold the crane in position if power is lost for any reason.

J1—Left Crawler Handle
J2—Right Crawler Handle

NOTE: The following directions of travel are with the crawler drive shafts to the rear of the operator.

Move the handle to the front to travel forward. Speed increases in relation to handle movement.

Release the handle to the center to stop traveling.

Move the handle to the rear to travel in reverse. Speed increases in relation to handle movement.

NOTE: If equipped, the optional travel alarm will beep to warn personnel when the crane is traveled in either direction.

J3—Travel Detent Selector

NOTE: The travel detent selector allows the crawlers to be operated in either direction at a selected speed without the operator's hand on the crawler handles.

Move both crawler handles in either direction from OFF to select the desired speed and direction of travel. Pull up and release the knob on the right crawler handle to turn on the

travel detent. Release the handles to OFF. The crawlers will continue to travel at the selected speed and direction.

Slightly move either crawler handle in the opposite direction or pull up and release the knob on the right handle to turn off the travel detent.

J4—Travel Park Switch

The travel park switch enables and disables travel operation. With travel park on, the travel handles are inoperable and the travel brakes are applied.

Press the top of the rocker switch to turn on travel park.

Press the bottom of the rocker switch to turn off travel park (allowing travel to be operated).

J5—Travel Speed Selector

Press the top end of the rocker switch to operate the travel motors in high speed. High-speed operation provides the maximum available travel speed for traveling long distances.

Press the bottom end of the rocker switch to operate the travel motors in low speed. Low-speed operation provides smoother starts and stops and more precise control of the travel motors than high speed.

In low speed, the travel motors operate at approximately 1/3 the speed of high speed.

NOTE: It is okay to change travel speed while traveling.

The travel motors will shift immediately from high to low when low speed is selected.

The travel motors will not shift from low to high when high speed is selected until the following occur:

- Engine speed is at high idle.
- Hydraulic pressure is low enough to allow the motors to shift from low to high speed.

WARNING

Avoid Death or Serious Injury!

Read and understand instructions in the crane assembly procedures in Section 4 before selecting the Setup mode or using setup controls.

LIMIT DEVICES

See Table 3-2 for the limits that can be bypassed.

Boom Up Limit

This limit automatically stops the boom when it is raised to a preset maximum angle, as follows:

- 83° Boom without luffing jib
- 88° Boom with luffing jib when the Boom Up limit can be bypassed
- 89° Boom with luffing jib when the Boom Up limit cannot be bypassed

The boom can be lowered after the limit is contacted.

NOTE: For MAX-ER 2000 boom angles, refer to the Operator Manual supplied with the MAX-ER.

WARNING

Falling Boom/Jib Hazard!

Avoid serious injury or equipment damage. The boom and jib could fall over backward if you bypass the Boom Up limit for any reason. DO NOT allow the physical boom stops to bottom out. The boom butt could be damaged.

Crush Hazard!

Avoid serious injury. Stay clear of moving parts. Maintain constant communication between the operator and assistants during the following steps.

Boom Up Limit Bypass Test

Perform the following test to determine if the Boom Up limit on your crane can be bypassed or not:

1. Lower the boom onto blocking at ground level.
2. Have an assistant push the Boom Up limit switch plunger in to trip the limit switch open.
3. Rotate the limit bypass switch (E5) to the BYPASS position and hold.
4. Try to boom up slowly. Do not raise the boom any higher than necessary to perform the test and observe the following:
   - If the boom rises, the Boom Up limit can be bypassed.
   - If the boom does not rise, the Boom Up limit cannot be bypassed.
5. Release the limit bypass key and the boom stop rod to the normal operating positions.

Boom Down Limit (if equipped)

WARNING

Falling Boom Hazard!

Avoid serious injury and equipment damage from a falling boom.The wire rope could be pulled out of the drums, allowing the boom to fall.

When lowering the boom below the Boom Down limit, do so slowly with extreme caution. Do not lower the boom to the point where less than three full wraps of wire rope are on boom hoist drums.

This limit automatically stops the boom when it is lowered to a preset minimum angle (usually 0°).

The boom can be raised after the limit is contacted.

The limit bypass switch must be turned to the BYPASS position before the boom can be lowered below the limit.

Block-Up Limit

WARNING

Two-Blocking Hazard!

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

Do not hoist the load above the minimum block clearance given on the Range Diagram in the Capacity Chart Manual.

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

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

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

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

Luffing Jib Up Limits

Two luffing jib up limits are provided:

- **Luffing Jib Maximum Up 1**—This limit automatically stops the luffing hoist when the boom-to-luffing jib angle is 168°.

  The limit bypass switch must be turned to the BYPASS position to allow the jib to be raised an additional 2° to the Luffing Jib Maximum Up 2 limit.

- **Luffing Jib Maximum Up 2**—This limit automatically stops the luffing hoist when the boom-to-luffing jib angle is 170°.

This limit can be bypassed only when the attachment is lowered to the ground (boom below 50°). Turn the limit bypass switch to the BYPASS position to bypass the limit.

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

LUFFING JIB MAX UP 2
CONFIRM TO RESET

FIGURE 3-11

NOTE: For cranes meeting 2010 European Requirements, the luffing jib cannot be lowered after the Luffing Jib Maximum Up 2 limit is contacted, until the limit switch is reset. When the limit is contacted, the screen shown in Figure 3-11 will appear on the digital display.

Once the screen appears, confirm it to reset the limit switch. The luffing jib can then be lowered.

WARNING

Falling Boom/Jib Hazard!

Avoid serious injury or equipment damage. Raising the luffing jib above the Luffing Jib Maximum Up 2 limit will cause structural damage and possibly cause the boom and luffing jib to be pulled over backward.

Proceed slowly when operating the luffing jib above the Luffing Jib Maximum Up 1 limit.

Luffing Jib Down Limits

WARNING

Falling Boom/Jib Hazard!

Avoid serious injury or equipment damage. The boom and luffing jib could collapse if the luffing jib is lowered below the minimum angle.

Follow the Luffing Jib Raising Procedure in the Capacity Chart Manual.

Two luffing jib down limits are provided. Both limits can be bypassed as indicated in Table 3-2.

- **Luffing Jib Maximum Down 1**—This limit automatically stops the luffing hoist when the boom-to-luffing jib angle is the following:
  - 73° if equipped with a MAX-ER 2000 attachment
  - 63° for all other attachments
- **Luffing Jib Maximum Down 2**—This limit automatically stops the luffing hoist when the boom-to-luffing jib angle is the following:
  - 70° if equipped with a MAX-ER 2000 attachment
  - 60° for all other attachments

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

LUFFING JIB MAX DN 2
CONFIRM TO RESET

FIGURE 3-12

NOTE: For cranes meeting 2010 European Requirements, the luffing jib cannot be raised after the Luffing Jib Maximum Down 2 limit is contacted, until the limit switch is reset. When the limit is contacted, the screen shown in Figure 3-12 will appear on the digital display.

Once the screen appears, confirm it to reset the limit switch. The luffing jib can then be raised.

Maximum Bail Limit

WARNING

Falling Load Hazard!

Avoid serious injury. The wire rope could jump off the drum, allowing the load to fall if the maximum allowable spooling capacity given in the Wire Rope Specifications Chart in the Capacity Chart Manual is exceeded.

This limit automatically stops the corresponding load drum from hoisting when there is a preset maximum number of wire rope layers on the drum.

The load can be lowered after the limit is contacted.

The limit bypass switch must be turned to the BYPASS position before the boom can be hoisted above the limit.

Minimum Bail Limit

WARNING

Falling Load Hazard!

Avoid serious injury. If 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.

When lowering a load below the minimum bail limit, do so slowly with extreme caution.

This limit automatically stops the corresponding load drum when there are three wraps of wire rope remaining on the drum.

The load can be raised after the limit is contacted.

The limit bypass switch must be turned to the BYPASS position before the load can be lowered below the limit.

Load Indicator

WARNING

Overload Hazard!

Avoid serious injury or equipment damage. Never overload the capacity of the crane. A crane load indicator is installed on the crane to aid the operator.

The presence of the load indicator on the crane in no way substitutes for or lessens the requirement that the operator's knowledge, experience, and judgment are required to ensure safe operation of the crane.

Before using the load indicator, the operator shall verify that it is properly calibrated. See the instructions in the RCL Manual.

See the RCL Manual for operating instructions.

Mast Up Limit

WARNING

Falling Mast Hazard!

Avoid serious injury or equipment damage. To prevent the mast from falling over backward, make sure the proper size hold-back is used when raising the mast to its operating position. Do not raise the mast above 80° except when raising the mast to its operating position.

See the MAX-ER Operator Manual for detailed mast raising and lowering instructions.

For the MAX-ER 2000, this limit automatically stops the mast when it is raised to 80° in Standard mode (MAX-ER mode OFF). This limit is provided to stop the mast when it is used as a boom during assembly and disassembly.

To bypass the limit when raising the mast to its operating position, switch to Standard Setup mode (MAX-ER mode OFF).

SEAT CONTROLS

CAUTION

Avoid Damage!

Disconnect the electric cord from the rear of the right console before removing the seat from the operator's cab.

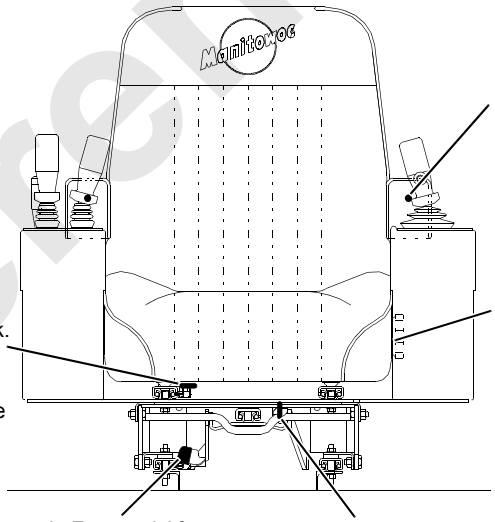


FIGURE 3-13

PREPARING CRANE FOR OPERATION

WARNING

Read Capacity Charts!

Avoid serious injury or equipment damage. Failing to comply with the capacity charts can result in tipping or structural failure of the boom/luffing jib.

Do not attempt to operate the crane without first reading and understanding the capacity charts.

The crane must be rigged and operated according to the instructions given in the capacity charts and rigging guides.

Unless otherwise specified in the capacity charts, all crane operations must be performed with the crane level to within one percent of grade. Otherwise, the crane could tip.

Observe the minimum block weight requirement given on the capacity charts.

Be aware when operating in those areas of the capacity chart marked b, the weight of the backstay pendants can pull the jib against the physical stops if the load block or hook-and-weight ball is not heavy enough. This action will result in sudden unexpected movement of the load.

Make sure the crawlers are blocked, if required per the capacity chart, prior to raising and lowering the attachment. Read and comply with the instructions in the Crawler Blocking Diagram.

Do not operate the crane, which includes raising the boom from ground level, if the wind exceeds the limits given in the capacity charts. Contact your local weather station for wind velocity.

Moving Load Hazard!

Avoid injuring personnel in the operating area! Sound the horn to alert personnel that operation is about to begin.

The operator shall select the proper operating mode prior to operation. Unexpected drum motion or improper limit responses can result if the wrong mode is selected.

The limit bypass switch must be in the ACTIVATE position, and all limits with which the crane is equipped must be operational before operating the crane. See the Service Manual for adjustment procedures.

CAUTION

Machinery Damage!

Before operating the crane at the start of each shift, perform preventive maintenance checks and lubrication services listed in your Operator Manual. Adjust the operator's seat (Figure 3-13).

OPERATION

Engine Startup

WARNING

Running Engine Hazard!

Avoid injuring personnel or equipment damage. A running engine has the potential to sever limbs. Do not start the engine until the following precautions are observed.

- Do not start the engine if a warning or out-of-order sign is present at the start controls.
- Make sure all controls are off so the crane and load do not move when the engine is started.
- Make sure all personnel are clear of the crane before starting the engine. Sound the horn to alert personnel that operation is about to begin.

See the Engine Manual for additional startup instructions and precautions.

1. Unplug or turn off the engine block heater and any other tank heaters that the crane is equipped with.

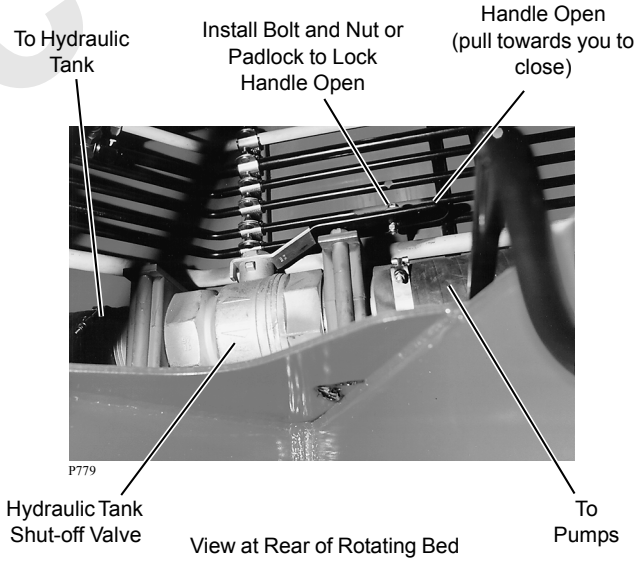


FIGURE 3-14

CAUTION

Pump Damage!

Avoid damaging the pumps. The pumps could cavitate and be damaged if the engine is started with the hydraulic shut-off valves closed.

2. Open the hydraulic shut-off valve (Figure 3-14).

3. Turn the Engine Run/Stop/Run key switch to RUN.

NOTE: The operating limit alert and the system fault alert (lights, buzzer, beeper) should come on for three seconds when the Engine Run/Stop/Run key switch is moved to the proper RUN position. If not, replace worn parts.

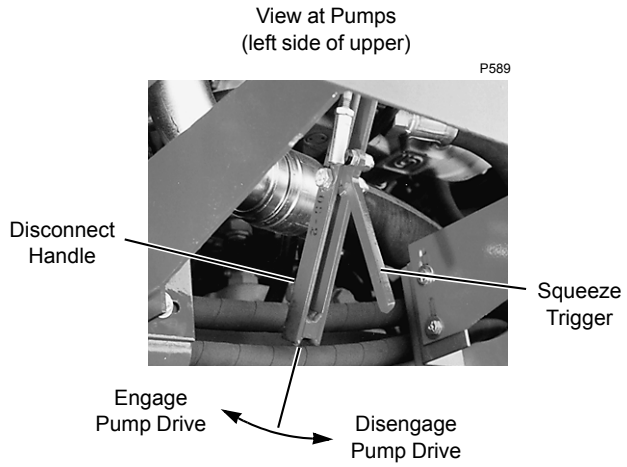


FIGURE 3-15

4. If required, disengage the pump drive (Figure 3-15). This step will disconnect the pumps from the engine and aid in cold weather startup.

CAUTION

Avoid Pump Drive Damage!

Observe the following precautions when equipped with a pump drive disconnect:

- Use the pump drive disconnect only as a starting aid during cold weather (0°C [32°F] or below).
- Stop the engine before engaging or disengaging the pump drive.
- Do not run the engine longer than two minutes with the pump drive disconnected.

5. Turn the Engine Start switch to start the engine.

CAUTION

Avoid Starter Motor Damage!

Do not crank the starter motor for more than 30 seconds.

If the engine does not start after 30 seconds of cranking, wait a few minutes for the starter motor to cool.

NOTE: The engine has an ether starting aid, which the engine's computer activates automatically when needed. There is no need to manually spray ether into the engine during cold weather starts.

6. Increase the engine speed as necessary to keep the engine running after it starts.

7. If disengaged, engage the pump drive within two minutes after starting the engine.

8. Run the engine at low idle until the hydraulic oil temperature is at least 16°C (60°F).

NOTE: It is normal for the System Fault alert to remain on after the engine is started. The alert should go off as soon as engine oil pressure and hydraulic oil temperature rise to normal (if no other faults exist).

CAUTION

Avoid Machinery Damage!

Do not operate the crane when the System Fault alert is on. If the alert does not go off soon after the engine is started or comes on during operation, immediately proceed as follows:

- Determine the fault on the digital display.
- Land loads if possible. Otherwise, turn on the drum park to apply the drum brake and engage the drum pawl (if equipped).
- Move all control handles to OFF.
- Stop the engine.
- Correct the cause of the fault.

9. Confirm the crane mode in effect or select and confirm another crane mode. The drums and boom hoist are inoperable until this step is performed (the operating limit alert will come on, and CONFIRM MODE will appear on the digital display if operation is attempted).

CAUTION

Avoid Machinery Damage!

Continuous operation with hydraulic oil temperature above 82°C (180°F) can result in damage to hydraulic components. Troubleshoot the hydraulic system if the oil temperature exceeds 82°C (180°F).

Boom/Luffing Hoist Operation

WARNING

Falling Boom/Jib Hazard!

Avoid severe injury or equipment damage. Failing to comply with the instructions can result in tipping or structural failure of the boom/luffing jib.If equipped with a luffing jib, raise and lower the boom and luffing jib according to the instructions in the Luffing Jib Attachment Manual.

CAUTION

Rigging Damage!

Avoid damage to the boom or luffing jib rigging. Verify that the boom and luffing hoist wire rope is reeved through all sheaves and spooled properly onto the hoist drums before raising the boom or luffing jib from the ground.

See the appropriate rigging drawings for wire rope and reeving specifications. See Wire Rope Installation in Section 4 for instructions on attaching wire rope to drums.

1. Select and confirm the desired crane mode—Standard to operate the boom hoist or Luffing Jib to operate the luffing jib.
2. To operate the desired hoist, turn off the drum park to release the drum brake and disengage the drum pawl (if equipped).
3. Turn on the drum park to apply the drum brake and engage the drum pawl (if equipped) for each load drum.

NOTE: The boom or luffing jib will not lower until the corresponding pawl is disengaged. It may be necessary to raise the boom or luffing jib slightly before the pawl will disengage.

The boom or luffing jib will stop if the corresponding pawl is engaged while lowering.

For the MAX-ER 2000, drum 2 (boom hoist) cannot be operated until drum 3 (load hoist) is parked, and vice versa.

4. Increase engine speed to the desired rpm with the hand throttle. Press the foot throttle to momentarily increase engine speed when power is required.

WARNING

Two-Blocking Hazard!

Avoid severe injury or equipment damage. Wire rope or other parts could break, allowing the load to fall. Pay out the load lines while lowering the boom or luffing jib. The load may contact the boom or jib point sheaves if this step is not taken.

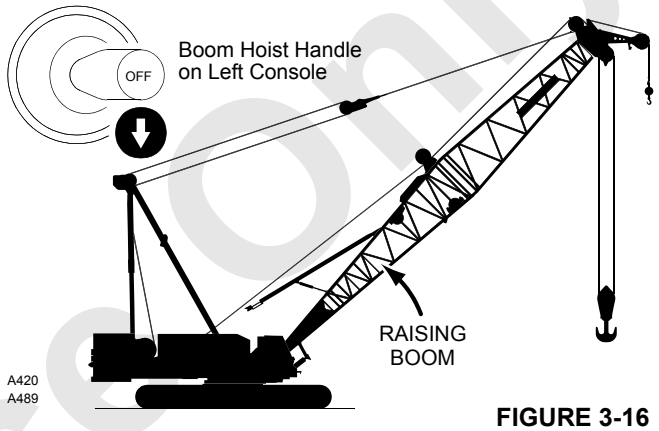


FIGURE 3-16

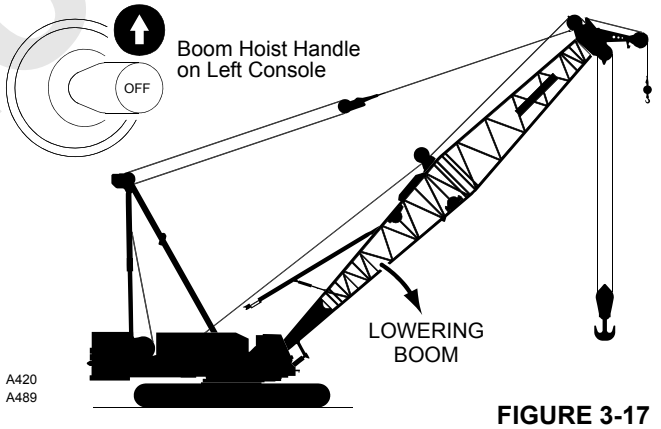


FIGURE 3-17

5. Move the handle to the rear to raise the boom or luffing jib (Figure 3-16). Move the handle to the front to lower the boom or luffing jib (Figure 3-17).
6. As the boom or luffing jib nears the desired angle, slowly move the control handle toward OFF to decrease speed. Then move the handle to OFF to stop the boom or luffing jib and hold it in position (brake will spring apply).

NOTE: Besides being equipped with a Boom Up limit, a physical boom stop is provided. The physical boom stop cushions boom raising between approximately 80° and the Boom Up limit. The boom stop also provides a physical stop at 90°.

WARNING

Falling Boom/Jib Hazard!

Avoid severe injury or equipment damage. The boom or luffing jib could be pulled over backward. Operating with the boom or luffing jib above the Boom Up limit is neither intended nor approved.

7. Once the boom or luffing jib is positioned at the desired angle, turn on the drum park and engage the pawl switch (if equipped).

Swing Operation

WARNING

Tipping Hazard!

Avoid severe injury or equipment damage. Prevent the crane from tipping. Adhere to the swing limitations given in the capacity charts.

DANGER

Moving Crane Hazard!

Avoid death or serious injury. 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.

1. Turn off the swing brake.

CAUTION

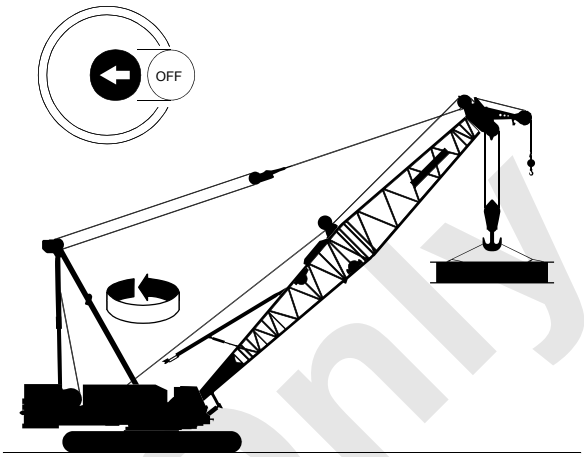
Avoid Swing Lock Damage!

Swing slightly in either direction so the swing lock completely disengages the ring gear before applying full swing power.

Do not engage the swing lock while swinging. Bring the rotating bed to a complete stop first.

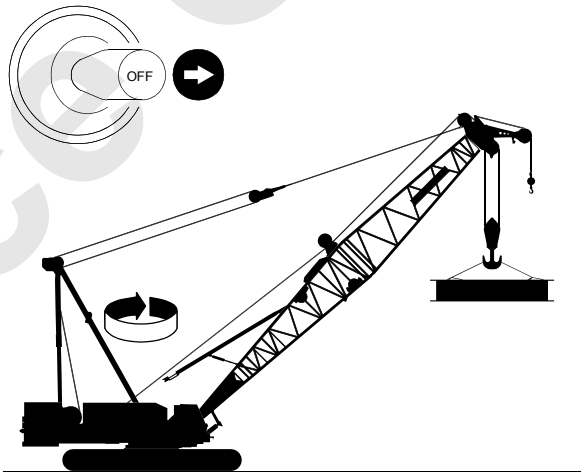
2. Increase engine speed to the desired rpm with the hand throttle. Press the foot throttle to momentarily increase engine speed when more power is required.

A420 Swing Control Handle on Left Console



A489 SWING LEFT **FIGURE 3-18**

A420 Swing Control Handle on Left Console



A489 SWING RIGHT **FIGURE 3-19**

3. Move the swing handle to the left to swing left (Figure 3-18) or to the right to swing right (Figure 3-19).
4. Start the swing motion with a smooth acceleration. Continue the handle motion to swing at the desired speed.
5. Stop swinging by releasing the swing handle to OFF. The swing speed decreases to off, and the rotating bed coasts to a stop. If a faster stop is desired, move the handle slightly past OFF to the opposite swing direction.

CAUTION

Avoid Boom and Swing Drive Damage!

Do not apply the swing holding brake or turn on the brake while swinging. The brake brings the rotating bed to an abrupt stop. This can damage the boom from side loading or damage the swing drive from shock loading. Bring the rotating bed to a smooth stop with the handle and then apply the swing holding brake or turn on the swing brake.

6. Once the rotating bed is stopped, apply the swing holding brake to hold the rotating bed in position for short periods during the operating cycle.
7. To hold the rotating bed in position for long periods, turn on the swing brake and engage the swing lock.

Load Drum Operation

The corresponding indicator lights glow green to indicate which handles and drums are active (operable) for the selected operating mode. See Figure 3-8 and the Drum and Lagging Charts in the Capacity Chart Manual for drum and handle identification.

For the MAX-ER 2000, drum 9 (load drum) cannot be operated until Travel is parked, and vice versa. Also, drum 5 (load drum) cannot be operated until drum 4 (mast hoist) is parked, and vice versa.

WARNING

Falling Load Hazard!

Avoid severe injury or equipment damage. Prevent the load on the unused drum from falling. Apply the drum brake with the brake pedal, and turn on the drum park for any drum not in use.

Liftcrane Operation—Full Power

NOTE: When a drum is not in the Free Fall mode, it operates in Full Power.

In all crane modes except tandem drum, only one drum is powered at a time. While one drum is powered, however, the load can be lowered in Free Fall on another drum (use the drum working brake to control the lowering speed).

If tandem drum mode is selected, two load drums are operated at the same time with the left handle (Figure 3-8). The programmable controller automatically parks any unused drums.

If equipped with the drum interlock option, see Drum Interlock on page 3-71 for installation and operation instructions.

1. Turn off Free Fall for the drum to be operated.
2. Select and confirm the desired crane mode.
3. If equipped with a split drum, switch the drum selector to the desired position. The drum park brake will apply and the clutch will release for the drum not in use (both drums cannot be operated at the same time).
4. Turn off the drum park switch to release the drum brake and disengage the drum pawl (if equipped) for each load drum.

NOTE: The load will not lower until the corresponding drum pawl is disengaged. It may be necessary to raise the load slightly before the pawl will disengage.

CAUTION

Avoid Machinery Damage!

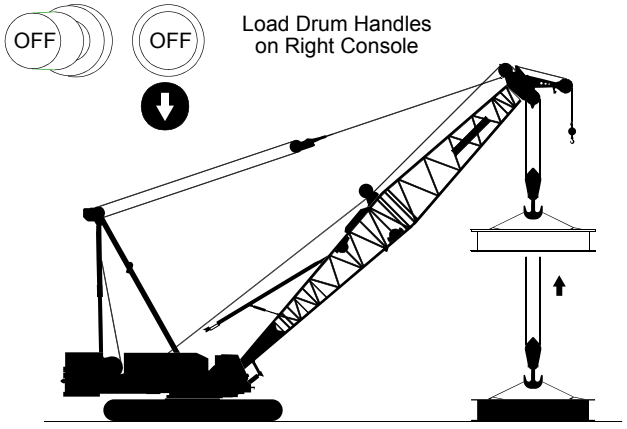
Do not turn on the park brake while lowering a load. Damage to the pawl or drum may result.

Stop the drum with the control handle or brake pedal (if equipped) and then turn on the park brake.

5. Release the drum working brake with the brake pedal for the drum to be operated.

NOTE: The brake pedal can be pressed down at any time to slow down or to stop the load.

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



A489
A420

HOISTING LOAD

FIGURE 3-20

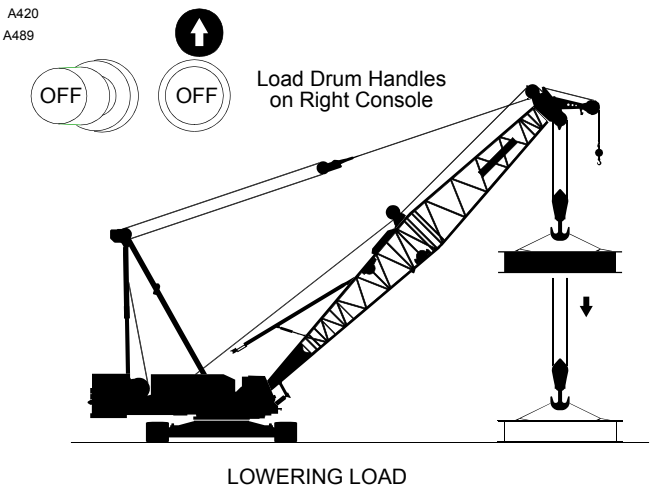


FIGURE 3-21

7. Move the drum handle to the rear to raise the load (Figure 3-20) or to the front to lower the load (Figure 3-21).

8. As the load nears the desired position, slowly move the drum handle toward OFF to slow down the load. Then release the handle to OFF to stop the load and hold it in position (the drum brake will apply).

NOTE: For the MAX-ER 2000, drum 2 (boom hoist) cannot be operated in Free Fall.

DANGER

Falling Boom Hazard!

Avoid death or severe injury. The boom will fall uncontrolled for the MAX-ER 2000, if drum 2 (boom hoist) is switched to Free Fall.

Liftcrane Operation—Free Fall

1. Fully apply the drum working brake for the drum to be operated in Free Fall.

2. Turn off the drum park switch to release the drum brake, and disengage the drum pawl (if equipped) for each load drum.

3. Select and confirm FFALL ON for the drum to be operated.

NOTE: The load drum will not switch to Free Fall until the drum park is off and the selection and confirmation steps have been performed. See E—Special Controls and Indicators on page 3-20.

The load will not lower until the corresponding drum pawl is disengaged. It may be necessary to hoist the load slightly before the pawl will disengage.

CAUTION

Avoid Machinery Damage!

Do not turn on the park brake while lowering a load. Damage to the pawl or drum may result.

Stop the drum with the brake pedal and then turn on the park brake.

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

5. Move the drum handle to the rear and release the drum brake with the brake pedal to raise the load (Figure 3-20).

6. As the load nears the desired position, slowly move the drum handle toward OFF to slow down the load. Then fully apply the drum brake with the brake pedal to stop the load and release the drum handle to OFF.

WARNING

Falling Load Hazard!

Avoid severe injury or equipment damage. When operating in Free Fall, the load will lower uncontrolled if the drum working brake is not applied with the brake pedal when the drum handle is released to OFF.

Be ready to apply the drum brake to control the lowering speed and stop the load immediately when necessary.

7. The load can be lowered in one of two ways—with the drum working brake or with hydraulic power.

   a. To lower the load with the drum brake, leave the drum handle in OFF and release the drum brake with the pedal to lower the load at the desired speed.

   As the load nears the desired position, slowly apply the drum brake to slow down the load. Then, fully apply the brake to stop the load and hold it in position.

   b. To lower the load with hydraulic power, move the drum handle to the front and release the drum brake with the pedal. The lowering speed is controlled by handle movement.

   As the load nears the desired position, slowly move the drum handle toward OFF to slow down the load.

Then, fully apply the drum working brake with the pedal to stop the load and hold it in position.

CAUTION

Avoid Clutch or Motor Damage!

Do not move the drum handle in either direction from OFF while free falling a load. Serious damage to the drum clutch and motor could result. Stop the load with the drum working brake and then move the drum handle in the desired direction.

For the same reason, do not turn off Free Fall or turn on the drum park while free falling a load. Stop the load with the drum brake and then turn off Free Fall or turn on the drum park.

8. If the load will be suspended for any length of time, press down and latch the brake pedal in the APPLIED position, turn on the drum park to apply the drum brake, and engage the drum pawl (if equipped) for each load drum.

Clamshell Operation—Standard

See Figure 3-9 for identification of handle motions in Clamshell mode. See E4—Crane Mode Selector on page 3-20 for clam closing control mode operation.

Selecting Clamshell Mode

1. If equipped with three drums, switch the drum selector to the drum 2 position.
2. Select and confirm Free Fall mode for both drums.
3. Select and confirm Clamshell mode.
4. Clam closing pressure is set with the clam closing control at the rear of the right side console in the operator's cab.

NOTE: The clam closing pressure remains in computer memory even after the engine is stopped.

5. Turn off the drum park switch to release the drum brake, and disengage the drum pawl (if equipped) for each load drum.

NOTE: The bucket will not lower until the drum pawls are disengaged. It may be necessary to hoist the bucket slightly before the pawls will disengage.

The load drums will stop if either pawl is engaged while lowering the bucket.

6. Set engine speed at the desired rpm.

Closing Bucket (Digging)

1. Lower an open bucket into the digging area.
2. Fully release the closing and holding line brakes and pull back the closing line handle to close the bucket.
3. Use the holding line brake to control the digging depth. Use more brake to dig shallower and less brake to dig deeper.
4. Fully apply the closing and holding line brakes and release the closing line handle to OFF when the bucket is closed.

NOTE: Watch the closing line when digging in a blind area. The bucket is closed when the closing line stops moving.

Hoisting Bucket

1. Pull the holding line handle back and fully release the holding and closing line brakes to hoist the bucket.
2. Swing to the dumping area as the bucket is hoisted.
3. Fully apply the closing and holding line brakes and release the holding line handle to OFF when the bucket is hoisted to the desired height.
4. Stop swinging when the bucket is over the dumping area.

Dumping Bucket

NOTE: The bucket can be powered open by moving the closing line handle forward. This is a very slow process, however. To open (dump) the bucket fast, release the closing line brake.

1. Release the closing line brake to dump the bucket (keep the holding line brake applied).
2. Use care not to slacken the closing line while dumping. Any slack in the closing line will need to be taken out while digging. This action will slow down the clam cycle.
3. Fully apply the closing line brake once the bucket is empty.

Lowering Bucket

CAUTION

Drum Clutch Damage!

The drum clutch can be damaged. Do not apply the closing line brake to slow down the bucket lowering speed.

1. Push the holding line handle forward and release the closing and holding line brakes to lower the bucket.
2. Control the lowering speed by slowly moving the holding line handle toward OFF.

NOTE: The lowering speed is controlled by handle movement. It should not be necessary to apply the brakes to slow down the bucket. If desired, the holding line brake can be applied to slow down the bucket.

3. Swing back to the digging area as the bucket lowers.
4. Stop swinging when the bucket lands in the digging area.
5. Fully apply the holding and closing line brakes and release the holding line handle to OFF when the bucket contacts the digging area.
6. Repeat the cycle.

Travel Operation

WARNING

Tipping Hazard!

Avoid severe injury or equipment damage. Failing to comply with the following specifications can result in tipping.

The travel surface must be firm and uniformly supporting.

When traveling with a load, the grade must not exceed 1% in any direction.

When traveling without a load, the grade in direction of travel must not exceed 30%. The grade from side to side must not exceed 2%, measured at the boom hinge pins. For all travel on grades, see the Maximum Allowable Travel Specifications chart.

NOTE: For the MAX-ER 2000, the crane cannot be traveled until drum 9 is parked.

1. Perform the following before traveling:
   - Plan the travel route. It must be free of ground and overhead obstructions.
   - Check the crawlers for proper adjustment.
   - Warn personnel to stand clear of the travel area. Do not travel without a signal person.
2. Position the boom at or above the boom angle given on the capacity chart when traveling with a load.
3. Travel with the boom in line with the crawlers except when swinging is necessary while traveling. Travel with the boom facing the direction of travel.
4. When traveling with a load, carry the load as close to the ground as possible. Stabilize the load with taglines.

   When traveling without a load, carry the load block and 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.
5. Increase engine speed to the desired rpm with the hand throttle. Press the foot throttle to momentarily increase engine speed when more power is required.
6. Select the desired travel speed, low or high.

WARNING

Moving Crane Hazard!

Avoid severe injury. An accident can result if the crane travels opposite of the intended direction. Know the position of the crawler drive shafts before traveling.

Flying Object Hazard!

Avoid severe injury. The tread connectors can break if overtensioned, causing the treads to fly apart unexpectedly with dangerous force. Excessive dirt buildup at the tumbler and front roller ends of the crawlers can result in excessive tension in the tread connectors.

CAUTION

Avoid Shock Load Damage to Boom and Rigging!

Perform all travel functions—starting, turning, and stopping—slowly and smoothly.

Avoid Crawler Damage!

Avoid damage to the crawler components (treads, rollers, frames)!

Use care to prevent dirt from piling up at the tumbler and front roller ends of the crawlers when turning on soft surfaces:

- Bring the crawlers to a complete stop before changing travel direction.
- Turn a few degrees, then slowly travel forward or in reverse so the dirt falls away from the crawlers. Continue this procedure until the desired turn has been made.
- Avoid sharp turns if possible (Figure 3-23).
- Make gradual turns (Figure 3-24) or counter-rotate (Figure 3-25) whenever possible so both crawlers are always powered.
- Clean the crawlers often.
- Keep the crawler treads properly adjusted.

NOTE: The following directions of travel are with the crawler drive shafts to the rear of the operator. If the motors are to the front, the crane will travel in the direction opposite of handle movement.

M104007

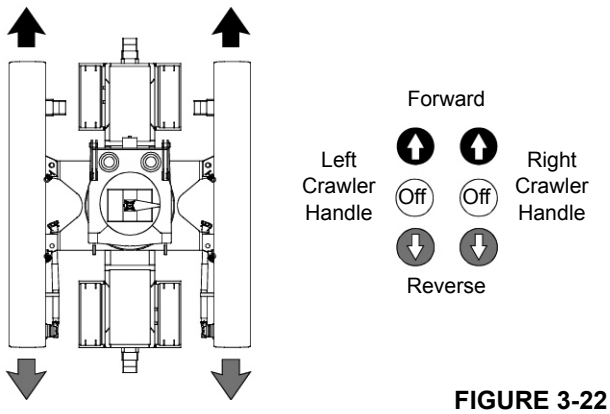


FIGURE 3-22

7. To travel straight, move both crawler handles the same amount in the desired direction from OFF (Figure 3-22).

M104008

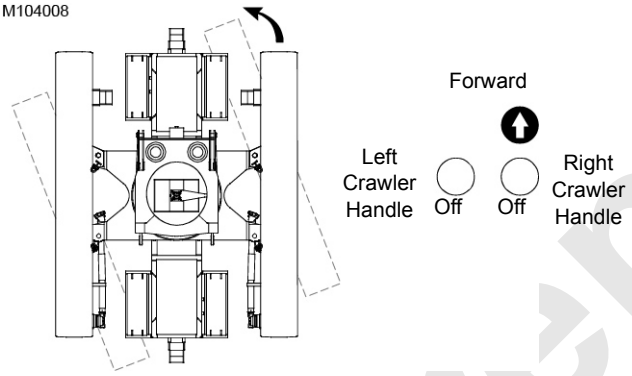


FIGURE 3-23

8. To make a sharp left turn, move the right crawler handle to the front and leave the left crawler handle off. The crane will pivot about the left crawler (Figure 3-23).
9. To make a sharp right turn, reverse step 8.

M104009

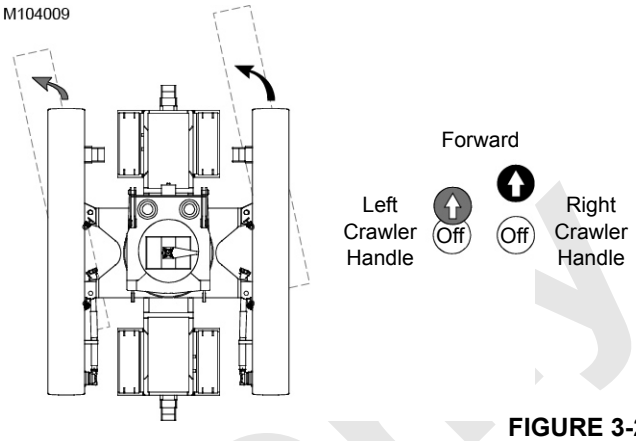


FIGURE 3-24

10. To make a gradual left turn, move both crawler handles to the front, but move the right crawler handle farther to the front than the left crawler handle. The right crawler will turn faster than the left crawler (Figure 3-24).
11. To make a gradual right turn, reverse step 10.

M104010

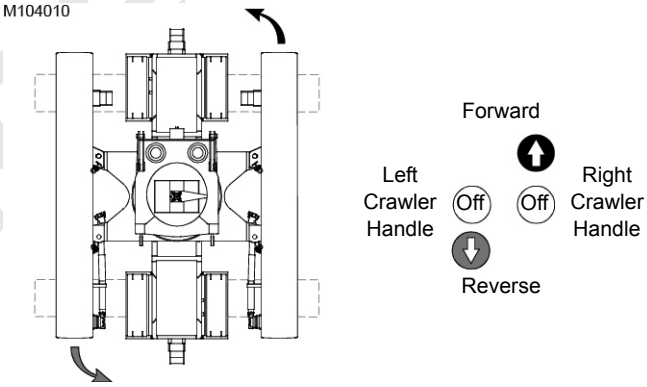


FIGURE 3-25

12. To counter-rotate left, move the right crawler handle to the front and move the left crawler handle to the rear. (Figure 3-25).
13. To counter-rotate right, reverse step 12.
14. Slowly move both crawler handles to OFF to stop traveling and to hold the crane in position.
15. Turn on the Travel Park switch.

STOPPING ENGINE/LEAVING CRANE UNATTENDED

WARNING

Moving Load/Tipping Crane Hazard!

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

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

1. Travel the crane onto a level surface. Do not leave the crane unattended on a grade.
2. Turn on the travel park.
3. Swing the rotating bed to the desired position and turn on the swing brake.
4. Lower all loads to the ground and fully apply the drum working brakes with the brake pedals and latch the pedals down.
5. Turn on the drum park to apply the drum brake and engage the drum pawl, if equipped, for each load drum.
6. If possible, lower the boom and luffing jib 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 wind or other outside forces (see Wind Conditions in the Capacity Chart Manual).

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

7. Ensure that all handles are off.
8. Decrease engine speed to idle.
9. Allow the engine to idle for three to five minutes so it cools evenly.
10. Stop the engine.
11. Turn off the cab power switch.
12. Remove all keys (cab power and crane mode) to prevent unauthorized operation.
13. Lock the operator's cab windows and door to prevent unauthorized entry.

SPECIAL CONTROLS

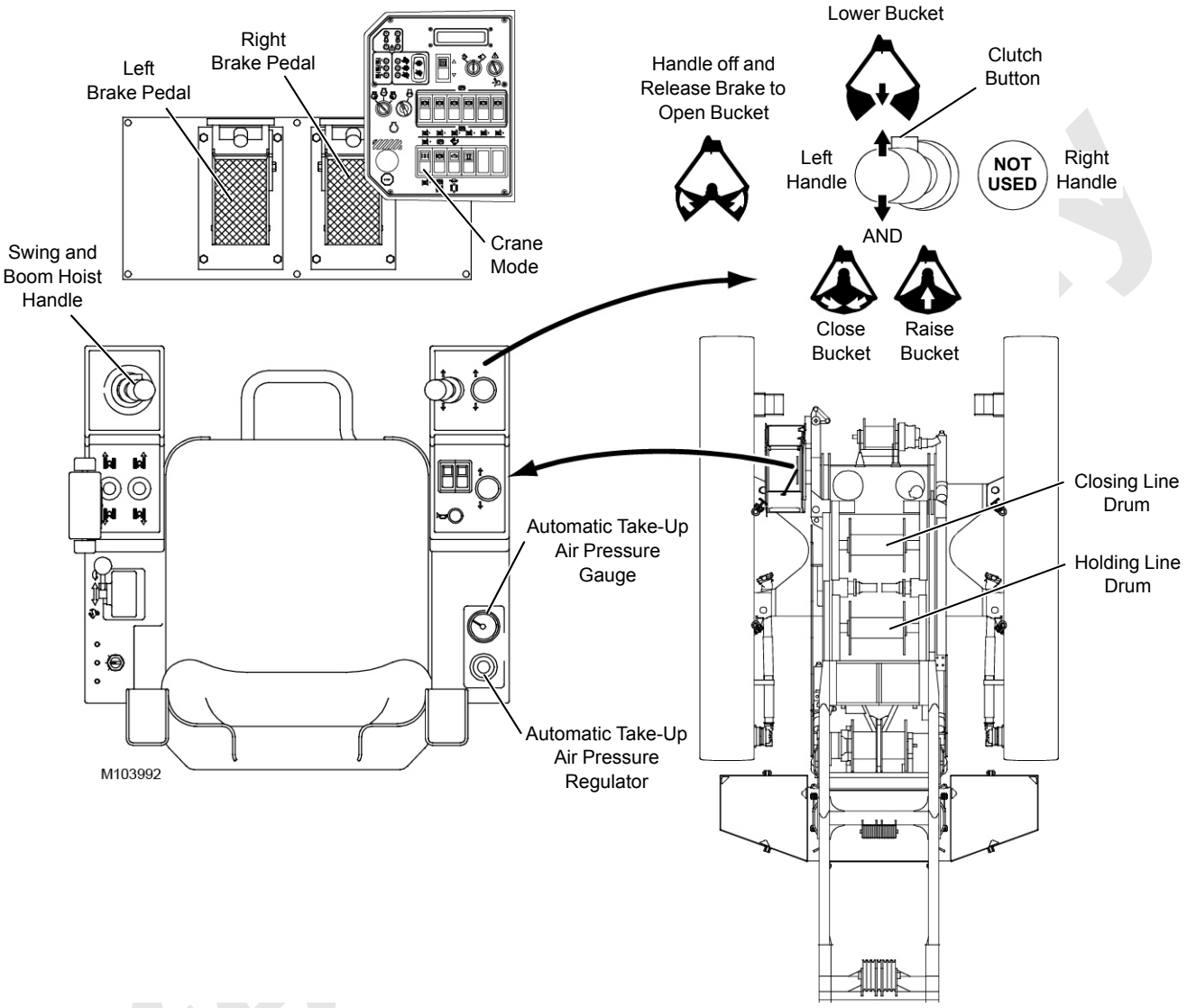


FIGURE 3-26

Clamshell Operation—Manually Operated Clutch

WARNING

Crane Movement Hazard!

Avoid death or serious injury. Movement of any operation of the crane while unattended can lead to a serious accident.

The crane operator shall not leave the operator's cab until the crane, loads, and boom have been secured to prevent movement.

General

This topic describes clamshell operation for cranes with a right rear air-applied drum clutch that is manually controlled with a clutch button on the left control handle. It also describes clamshell operation for cranes equipped with Modification 417332 to Add Clam Control for Right Rear Air-Applied Drum Clutch.

These instructions replace the clamshell instructions in Clamshell Operation—Standard on page 3-39.

See Figure 3-26 for identification of the clam controls and drums.

Manual Clutch Control

CAUTION

Turning Drum Hazard!

Avoid severe injury or equipment damage. In Standard mode, the right rear drum may turn when another drum is operated if the automatic take-up air pressure is on.

Falling Load Hazard!

Avoid severe injury or equipment damage. A falling load can cause a serious situation. Be aware that the right rear drum clutch on this crane is air-released with the air clutch button on the left handle and is spring-applied when the clutch button is released.

Be ready at all times to apply the drum working brake so the drum can be stopped immediately when necessary.

The left drum control handle is used for this clamshell operation. The right drum control handle is not used.

Selecting Clamshell Mode

If equipped with three drums, switch the drum selector to the right rear position.

1. Select and confirm Free Fall mode for both drums.
2. Select and confirm Clamshell mode.

At the automatic take-up air pressure level, the right rear drum clutch is air-released with the air clutch button on the left handle and is spring-applied at full pressure when the clutch button is released.

WARNING

Bucket Falling Hazard!

Avoid severe injury or equipment damage. The clutch will slip, and the bucket will drop suddenly if the air clutch button on the left handle is engaged when the bucket is in the air.

3. Adjust the automatic take-up air pressure as follows:
   a. Push the regulator knob down to unlock it.
   b. Turn the knob clockwise to increase pressure or counterclockwise to decrease pressure.

      Adjust the pressure so the holding line clutch slips while closing the bucket on the closing line. If the setting is too high, the holding line will hoist the bucket. If the setting is too low, the holding line will have excessive slack while hoisting.
   c. Pull the regulator knob up to lock it.
4. Disengage the drum pawls, if equipped.
5. Set the engine speed to the desired rpm.

Closing Bucket (Digging)

1. Lower the open bucket into the digging area. See Lowering Bucket on page 3-45. Press and hold the clutch button on the left handle to take out any slack in the holding line when using the handle.
2. Fully release both brake pedals and pull the left drum handle back to close the bucket.
3. Use the right brake pedal to control the digging depth, if required.

NOTE: Except for when closing a suspended open bucket, this is the only time the right brake pedal needs to be used.

CAUTION

Avoid Drum Clutch Damage!

The holding line clutch is always fully engaged until the drum clutch is air-released with the air clutch button on the left handle.

Do not attempt to close a suspended open bucket without first applying the right brake pedal. Otherwise, the bucket will drop suddenly and slam closed.

Automatic Clutch Control

WARNING

Falling Load Hazard!

Avoid severe injury or equipment damage. The clutch will release, allowing the drum to turn (load will lower) if air pressure to the clutch is lost for any reason. Be aware that the right rear drum clutch on this crane is air-released and spring-applied.

Be ready at all times to apply the drum working brake so the drum can be stopped immediately when necessary.

Selecting Clamshell Mode

1. If equipped with three drums, switch the drum selector to the right rear position.
2. Select and confirm Free Fall mode for both drums.
3. Select and confirm Clamshell mode.
4. Adjust the clam holding pressure as follows.
   a. Unlock and depress the limit bypass switch.
   b. Scroll up or down with the digital display selector to increase or decrease the holding pressure in 6,9 bar (100 psi) increments.

This setting controls the holding line pressure when the programmable controller automatically removes the holding line slack. See Hoisting Bucket on page 3-45. The pressure selected will remain in computer memory even after the engine is stopped.

The bucket size, parts of line, and type of material being handled govern the holding pressure required. It will be necessary to readjust the holding pressure if any of these factors change.

Set the holding pressure high enough to quickly take out the holding line slack when swinging to the dumping area. If the setting is too high, the bucket will hoist slowly by itself when the control handle is centered (off) after digging or hoisting the bucket.

5. Adjust the automatic take-up pressure as follows.
   a. Push the regulator knob down to unlock it.
   b. Turn the knob clockwise to increase pressure or counterclockwise to decrease pressure.

      Adjust the pressure so the holding line clutch slips while closing the bucket on the closing line. If the setting is too high, the holding line will hoist the bucket. If the setting is too low, the holding line will have excessive slack while hoisting.
   c. Pull the regulator knob up to lock it.
6. Disengage the drum pawls, if equipped.
7. Set engine speed to the desired rpm.

Closing Bucket (Digging)

1. Lower the open bucket into the digging area. See Lowering Bucket on page 3-45.
2. Fully release both brake pedals and pull the left drum handle back to close the bucket.
3. Use the right brake pedal to control the digging depth, if required.

NOTE: Except for when closing a suspended open bucket, this is the only time the right brake pedal needs to be used.

Manual and Automatic Clutch Control

Hoisting Bucket

1. Continue to pull the left drum handle back to hoist the bucket.
2. When the bucket has been hoisted to the desired height, release the drum handle to OFF and fully apply the left brake pedal.
3. Swing to the dumping area.
4. When the air clutch button on the left handle is pressed and held, the programmable controller will automatically take out any slack in the holding line swinging the crane.
5. Stop swinging when the bucket is over the dumping area.

Dumping Bucket

1. Release the left brake pedal to dump the bucket.
2. Do not slacken the closing line while dumping. Any slack in the closing line will have to be taken out while digging. This action will slow down the clam cycle.
3. Fully apply the left brake pedal once the bucket is empty.

Lowering Bucket

1. Push the left drum handle forward and fully release both brake pedals to lower the bucket.

CAUTION

Avoid Drum Clutch Damage!

Do not apply the drum brakes to slow down the bucket lowering speed. The drum clutch will chatter and possibly be damaged.

2. Control the lowering speed by slowly moving the left drum handle toward OFF.
3. Swing back to the digging area as the bucket lowers.
4. Stop swinging when the bucket lands in the digging area.
5. Repeat the cycle.

Liftcrane Operation

Before using the crane for liftcrane operation (Standard mode), note the automatic take-up air pressure reading on the gauge in the right rear control console. Then turn off the automatic take-up air pressure regulator (zero pressure reading on gauge).

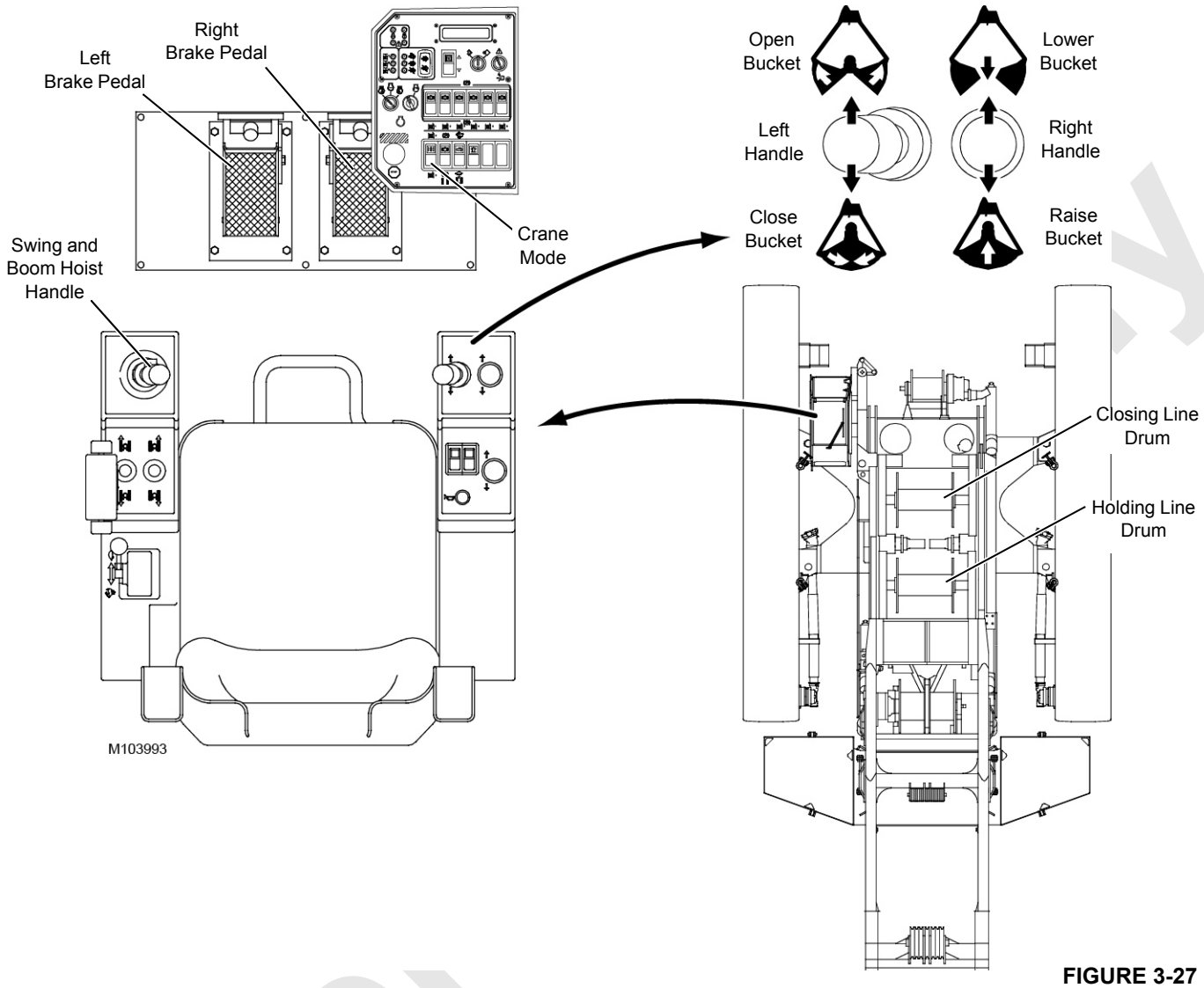


FIGURE 3-27

Clamshell Operation—Independent Drums

General

This topic describes clamshell operation for cranes equipped with independent drums.

These instructions replace the clamshell instructions in Clamshell Operation—Standard on page 3-39.

See Figure 3-27 for identification of the clam controls and drums.

Operating Options

There are only two ways to operate in Clamshell mode. The difference between the two is in how the bucket is opened:

- Confirm Clamshell mode for Option A
- Confirm Clamshell mode and drum 1 Free Fall mode for Option B

NOTE: See the instructions in Clamshell Operation—Standard on page 3-39 for selecting and confirming modes.

The Clamshell mode (and all other modes on cranes with independent drums) will show ON after the name of the mode when confirmed. All inactive modes will show OFF.

Option A—Full Power Open

The bucket is powered open by pushing the left handle forward.

Option B—Free Fall Open

The bucket is allowed to free fall open by pushing the left handle forward. As long as the handle is held forward, the closing drum clutch will remain disengaged. The opening motion can be stopped by centering the handle or by applying the foot brake. The preferred method is to apply the foot brake.

It is not possible to put the holding drum into Free Fall while in Clamshell mode.

Synchronized Control Options

There are only two types of synchronized control actions possible when raising and lowering the bucket with the right handle. Which one is active depends on the hydraulic pressure sensed when the closing drum was last operated.

Equal Line Pull

If the last closing drum pressure sensed was high, the controller will try to maintain approximately equal line pull when hoisting or lowering the bucket with the right handle.

The operator shall close the bucket until the holding line slackens slightly to generate closing pressures high enough to cause the system to operate in this mode.

Equal Line Speed

If the last closing drum pressure sensed was low, the controller will try to maintain equal line speed when hoisting or lowering the bucket with the right handle.

The bucket must be opened until the bucket's weight is fully supported on the holding line to cause the system to operate in this mode.

Digging

The holding line will automatically pay out if the last holding drum pressure sensed by the controller was low. Consequently, the bucket must be lowered onto the material until the holding line slackens, or this feature will not engage.

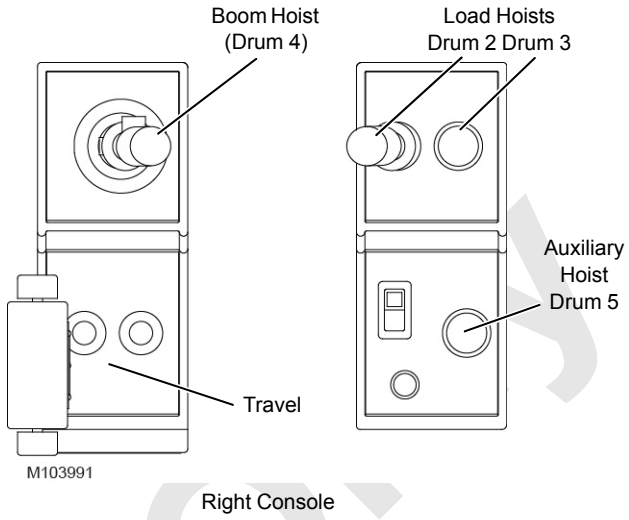


FIGURE 3-28

Drum 5 Operation—Boom Hoist Diverted

General

The following instructions describe the operation of drum 5 when hydraulic oil from the boom hoist circuit is used to power the auxiliary drum. See Figure 3-28 for handle identification.

Load Drum Operation

To operate drum 5 as an auxiliary load drum, proceed as follows.

1. Select and confirm drum 5 [AUX HST] mode.
2. Turn on the drum 4 park. Drum 5 and the boom hoist (drum 4) cannot be operated at the same time.
3. Turn off the drum 5 park.
4. Use the drum 5 handle to raise and lower loads as follows.
   - **a.** Move the handle to the rear to raise the load. The brake releases and the speed increases in relation to handle movement.
   - **b.** Release the handle to the center to stop the drum. Speed decreases to off, and the brake applies to stop the drum and hold it in position.
   - **c.** Move the handle to the front to lower the load. The brake releases and the speed increases in relation to handle movement.
   - **d.** The brake will spring applied to stop the drum if power is lost.

NOTE: Either of the other two load drums—right or left (drum 2 or 3)—can be operated at the same time as drum 5.

5. If it becomes necessary to operate the boom hoist, turn on the drum 5 park and turn off the drum 4 park. Drum 4 can then be operated to raise and lower the boom as required.

Luffing Hoist Operation

The auxiliary drum handle has no function for luffing hoist operation. For luffing hoist operation, the boom hoist (drum 4) and the luffing hoist (drum 5) are both controlled by the handle on the left console.

See Boom/Luffing Hoist Operation on page 3-35 for the procedure on switching between operation of the boom hoist (drum 4) and the luffing hoist (drum 5).

Drum 5 Operation—Travel diverted

General

The following instructions describe operation of drum 5 when hydraulic oil from the travel circuit is used to power the auxiliary drum. See Figure 3-28 for handle identification. If equipped with this option, the crane cannot be used with a MAX-ER attachment.

Load Drum Operation

To operate drum 5 as an auxiliary load drum, proceed as follows.

1. Select and confirm drum 5, [AUX HST] mode.
2. Turn on the travel park. Drum 5 and travel cannot be operated at the same time.
3. Turn off the drum 5 park.
4. Use the drum 5 handle to raise and lower loads as follows.
   a. Move the handle to the rear to raise the load. The brake releases and the speed increases in relation to handle movement.
   b. Release the handle to the center to stop the drum. Speed decreases to off and the brake applies to stop the drum and hold it in position.
   c. Move the handle to the front to lower the load. The brake releases and the speed increases in relation to handle movement.
   d. The brake will spring apply to stop the drum if power is lost.

NOTE 1: Either of the other two load drums—right or left (drum 2 or 3)—can be operated at same time as drum 5.

5. If travel is required, turn on the drum 5 park brake and turn off the travel park. The crane can then be traveled.

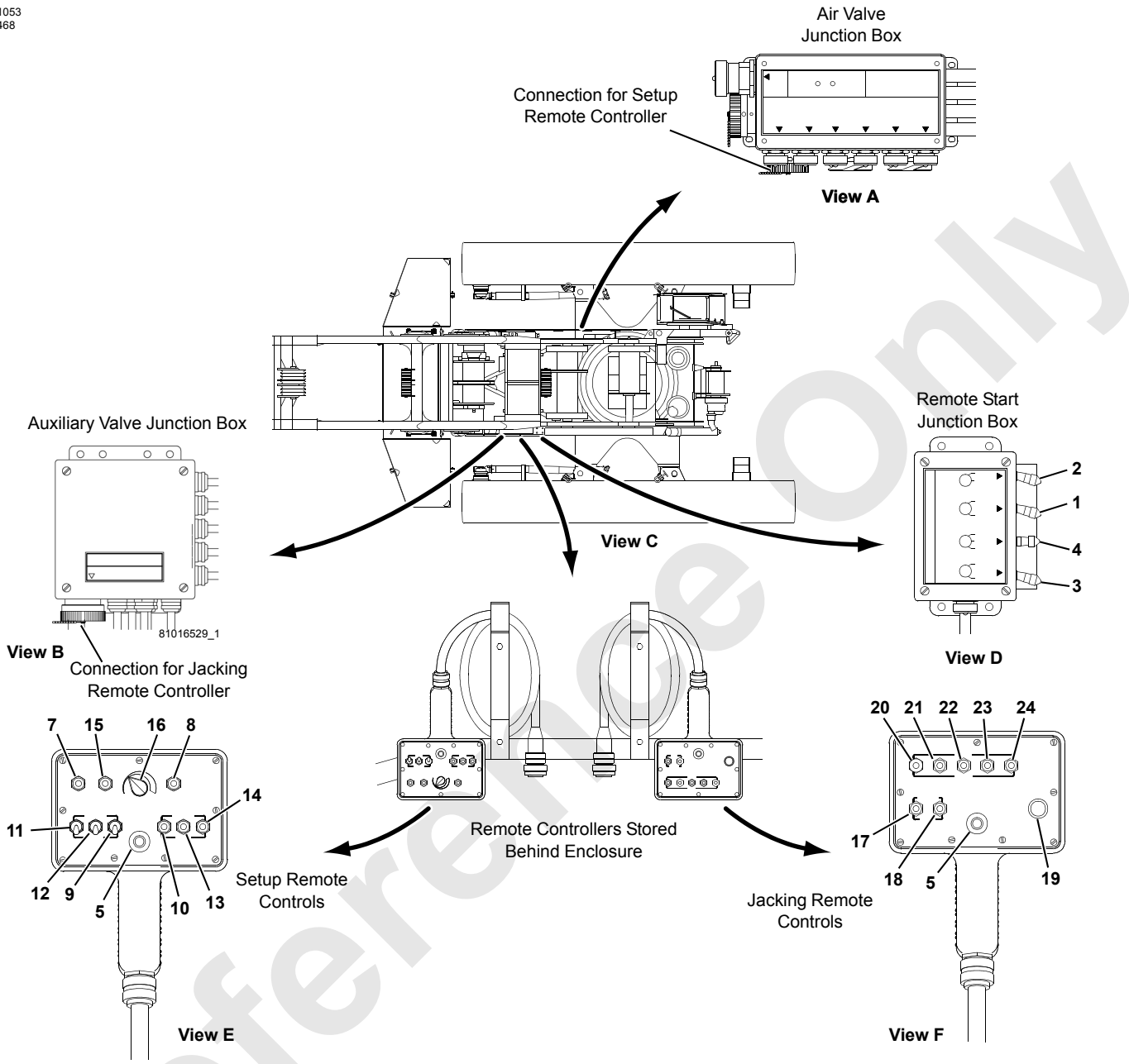
Luffing Hoist Operation

The auxiliary drum handle has no function for luffing hoist operation. For luffing hoist operation, the boom hoist (drum 4) and the luffing hoist (drum 5) are both controlled by the handle on the left console.

See Boom/Luffing Hoist Operation on page 3-35 for the procedure on switching between operation of the boom hoist (drum 4) and the luffing hoist (drum 5).

THIS PAGE INTENTIONALLY LEFT BLANK

A1053
A468



Item	Description
1	Engine Run/Stop Switch
2	Engine Start Switch
3	Engine Speed Switch
4	Hydraulic Disconnect Switch (rotating frame quick-disconnect)
5	Power Switch
6	Not Used
7	Gantry Cylinders Switch
8	Boom Butt Cylinder Switch
9	Backhitch Pins Switch

Item	Description
10	Boom Hinge Pins Switch
11	Upper Counterweight Pins Switch
12	Lower Counterweight Pins Switch
13	Right Crawler Frame Pins Switch
14	Left Crawler Frame Pins Switch
15	Rigging Winch Switch
16	Speed Control Knob
17	Rear Rotating Frame Pins Switch
18	Front Rotating Frame Pins Switch
19	Level Warning Light

Item	Description
20	Right Rear Jacking Cylinder Switch
21	Left Rear Jacking Cylinder Switch
22	Right Front Jacking Cylinder Switch
23	Left Front Jacking Cylinder Switch
24	All Rotating Frame Jacking Cylinders Switch

FIGURE 3-29

REMOTE CONTROLS

General

See Figure 3-29 for more information.

WARNING

Read Instructions!

Avoid serious injury or death to personnel and damage to the crane! Read the crane assembly procedures in Section 4 of this manual before operating remote controls.

Crush Hazard!

To prevent personnel from being crushed by moving parts, observe the following:

- Keep unauthorized personnel clear of the crane while operating remote controls.
- Use a signal person to warn personnel to stay clear of the crane while remote controls are being operated.

This topic identifies and describes operation of the remote controls used for crane setup, jacking, and remote engine start. Disregard any control your crane is not equipped with.

The setup and jacking remote controls are stored on brackets behind the enclosure on the right side of the crane (see View C). The remote start controls are located on the junction box near the batteries on the right side of the crane (see View D).

To use the remote controls (setup, jacking, and engine start), the cab power switch must be turned on in the operator's cab. The electric cord from the setup and jacking remote controls must be connected to the junction boxes (see Views A and B).

NOTE: The swing and travel alarm will sound continuously when a function is being operated with any of the following remote controls:

- Setup
- Jacking
- MAX-ER

The controls in the operator's cab cannot be operated when a remote control is being used, except that the rigging winch can be operated using the remote while the drum is operated from the cab.

Controls Identification and Operation

See Figure 3-29 for the following controls.

1—Engine Run/Stop Switch

Toggle the Engine Run/Stop switch (1) up or down to start and run the engine.

Toggle the switch to the opposite position while the engine is running to stop the engine.

2—Engine Start Switch

Move the Engine Start switch (2) up to start the engine. Release the switch as soon as the engine starts.

CAUTION

Starter Motor Damage!

If the engine does not start after 30 seconds of cranking, wait a few minutes for the starter motor to cool before trying again.

If the engine does not crank, move the Engine Run/Stop switch (1) to the opposite position.

Increase engine speed with the Engine Speed switch (3) while cranking the engine. After the engine starts, release the Engine Speed switch and allow the engine to idle until it warms up.

3—Engine Speed Switch

Move the Engine Speed switch (3) up and hold it to increase engine speed to 1,500 rpm during startup.

Move the Engine Speed switch down (spring returns to this position) to decrease engine speed to idle (or to the speed setting of the throttle in the cab or on the remote controls, whichever is greater).

4—Hydraulic Disconnect Switch (rotating frame quick-disconnect)

NOTE: The knob on the Hydraulic Disconnect switch (4) must be pulled out before the switch can be moved in either direction from OFF.

Move the switch up to engage the hydraulic disconnect.

Center the switch (spring returns to this position) to turn off (stop engaging or disengaging) the hydraulic disconnect.

Move the switch down to disengage the hydraulic disconnect.

CAUTION

Seal Damage!

Prevent damage to hydraulic disconnect seals during operation.

Do not engage or disengage the hydraulic disconnect until the crane is in the following configuration:

- The counterweights are removed.
- The boom is lowered onto blocking so the boom hoist rigging is slack.

5—Power Switch

Press the Power switch (5) button to turn on power to the remote control switches.

Release this button to turn off power to the remote control switches.

6—Not Used

7—Gantry Cylinders Switch

Hold the Gantry Cylinders switch (7) up to extend the gantry cylinders to raise the gantry.

Center the switch (spring returns to this position) to turn off (stop extending or retracting) the gantry cylinders.

Hold the switch down to retract the gantry cylinders to lower the gantry.

8—Boom Butt Cylinder Switch

Hold the Boom Butt Cylinder switch (8) up to extend the boom butt cylinder to raise the butt.

Center the switch (spring returns to this position) to turn off (stop extending or retracting) the boom butt cylinder.

Hold the switch down to retract the boom butt cylinder to lower the butt.

9—Backhitch Pins Switch

Hold the Backhitch Pins switch (9) up to disengage the backhitch pins.

Hold the switch down (spring returns to this position) to engage the backhitch pins.

10—Boom Hinge Pins Switch

Hold the Boom Hinge Pins switch (10) up to disengage the boom hinge pins.

Center the switch (spring returns to this position) to stop engaging or disengaging the boom hinge pins.

Hold the switch down to engage the boom hinge pins.

11—Upper Counterweight Pins Switch
12—Lower Counterweight Pins Switch

Hold the appropriate counterweight pins switch (11 or 12) up to disengage the counterweight pins.

Move the switch down (spring returns to this position) to engage the counterweight pins.

13—Right Crawler Frame Pins Switch
14—Left Crawler Frame Pins Switch

Hold the appropriate crawler frame pins switch (13 or 14) up to disengage the crawler frame pins.

Center the switch (spring returns to this position) to stop engaging or disengaging the crawler frame pins.

Hold the switch down to engage the crawler frame pins.

15—Rigging Winch Switch

Hold the Rigging Winch switch (15) up to pay out wire rope from the rigging winch.

Center the switch (spring returns to this position) to turn off (stop) the rigging winch.

Hold the switch down to haul in wire rope to the rigging winch.

16—Speed Control Knob

Turn the Speed Control knob (16) clockwise and pull the handle down to increase the speed of all items controlled by the setup remote.

Turn the knob counterclockwise and push the handle up to decrease the speed of all items controlled by the setup remote.

17—Rear Rotating Frame Pins Switch
18—Front Rotating Frame Pins Switch

Hold the appropriate rotating frame pins switch (17 or 18) up to disengage the rotating frame pins.

Center the switch (spring returns to this position) to stop engaging or disengaging the rotating frame pins.

Hold the switch down to engage the rotating frame pins.

19—Level Warning Light

The Level Warning light (19) illuminates red and a beeper comes on when the rotating frame is 3° out of level.

WARNING

Collapsing Hazard!

Avoid serious injury or death to personnel and damage to the crane!

Operating the jacking cylinders with the rotating frame more than 3° out of level can result in structural damage to the jacking cylinders and possible collapse of the rotating frame.

Keep the rotating frame as level as possible while jacking. The jacking cylinders are not self-leveling. The operator shall keep the carbody level while jacking.

20—Right Rear Jacking Cylinder Switch
21—Left Rear Jacking Cylinder Switch
22—Right Front Jacking Cylinder Switch
23—Left Front Jacking Cylinder Switch

Hold the appropriate jacking cylinder switch (20, 21, 22, or 23) up to extend the rotating frame jacking cylinder to raise the corresponding corner of the rotating frame.

Center the switch (spring returns to this position) to turn off (stop extending or retracting) the rotating frame jacking cylinder.

Hold the switch down to retract the rotating frame jacking cylinder to lower the corresponding corner of the rotating frame.

24—All Rotating Frame Jacking Cylinders Switch

Hold the All Rotating Frame Jacking Cylinders switch (24) up to extend all jacking cylinders at the same time.

Center the switch (spring returns to this position) to turn off (stop extending or retracting) the rotating frame jacking cylinders.

Hold the switch down to retract all jacking cylinders at the same time.

PROGRAMMABLE CONTROLLER CALIBRATION PROCEDURES

General

To ensure proper operation of the crane functions, the pressure senders and controls must be properly calibrated.

Calibrating the Pressure Sender

When the Pressure Sender Calibration screen is accessed and calibration is started, the crane's programmable controller zeros the pressure senders to ensure accurate pressure signals.

The pressure transducers must be calibrated at the following intervals:

- When a new programmable controller is installed
- When a new CPU board is installed
- When a new controller chip is installed
- When a pressure sender is replaced
- Every six months
- When the displayed pressure is wrong

Be aware that if there is any residual pressure in the system during the calibration process, the display pressure reading in the cab may not reflect the actual system pressure. See the note at the end of this procedure regarding replacing a pressure sender.

To calibrate pressure senders, proceed as follows.

1. Access the diagnostic screens by pressing the limit bypass switch while scrolling up with the scroll switch.

PRESS SENDER CAL BYPASS TO START

FIGURE 3-30

2. Scroll until the Control Calibration screen appears (Figure 3-30).

PRESS SENDER CAL ENGINE MUST BE OFF

FIGURE 3-31

3. Stop the engine (leave ignition and cab power switches on), turn the limit bypass key clockwise, and hold. It is normal for the yellow operating limits light to come on during this procedure.

   Calibration will not start if the engine is running, and the screen in Figure 3-31 appears. Likewise, calibration stops if the engine is started during calibration.

PRESS SENDER CAL ___% COMPLETE

FIGURE 3-32

4. Repeat step 2 if the engine is running or if the engine is started.

   When calibration starts, the Percentage of Completion screen appears (Figure 3-32). It takes approximately one minute to complete the process.

   When calibration is complete, the Control Calibration screen reappears (Figure 3-30).

5. Check the data bank in the upper right corner of the screen. If a pressure sender/pump fails the test, the binary number(s) of the failed item(s) is displayed (Table 3-3).

Table 3-3. Pressure Sender Binary Numbers

Binary No.	Pump No.	Description
1	1	System Pressure (main hoist)
2	3	System Pressure (swing left)
4	3	System Pressure (swing right)
8	1	Charge Pressure (main hoist)
16	2	System Pressure (boom and luffing drums)
32	4	System Pressure (travel/drum 9 on MAX-ER)
64	5	System Pressure (left travel)
128	0	System Pressure (independent luffing)

6. Before replacing a pressure sender, bleed the pressure on the corresponding pump.

NOTE: The cause of a failed calibration or faulty display pressure reading in the cab may not be the pressure sender. The cause of the fault could be trapped air or hydraulic pressure in the system.

   a. Attach an accurate hydraulic pressure gauge to the quick-coupler at the suspect pressure transducer (see Section 2 of the Service Manual).

   b. If pressure appears on the gauge, bleed the corresponding system so the gauge reads zero pressure.

   c. Repeat the calibration steps and check the pressure on the display in the cab with the engine running at idle. The display reading and the gauge reading should be the same.

   d. Before replacing a pressure sender, check the signal voltage at the sender. It should be 1.0 volt against ground at 0 psi.

Controls Calibration

The controls must be calibrated at the following intervals:

- When a pump is replaced
- When a pump control (EDC or PCP) is replaced
- When a new programmable controller is installed
- When a new CPU board is installed
- When a new controller chip is installed
- When there is a noticeable increase in the time it takes a crane function to engage when the handle is pulled back from OFF
- Every six months

To calibrate the controls, proceed as follows:

1. Access the diagnostic screens by pressing the limit bypass switch while scrolling up with the scroll switch.

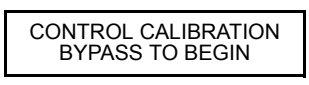


FIGURE 3-33

2. Scroll until the Control Calibration screen in Figure 3-33 appears.

3. Increase engine speed to high idle and press the limit bypass switch.

NOTE: It is normal for the yellow operating limits light to come on during this procedure.

FIGURE 3-34

4. Calibration will not start if the engine is not at high idle. Calibration will stop if engine speed is decreased during calibration. In either case, the screen in Figure 3-34 appears.

5. Repeat step 3.

FIGURE 3-35

6. When calibration starts, the Percentage of Completion screen appears (Figure 3-35). It takes approximately two minutes to complete the process.

   When calibration is complete, the Control Calibration screen in Figure 3-33 reappears.

7. Check the data bank in the upper right corner of the screen. If a control/pump fails the test, the binary number(s) of the failed item(s) is displayed.

Table 3-4. Controls Binary Numbers

Binary No.	Pump No.	Description
1	1	Main Hoist
2	2	Boom and Luffing Drums
4	3	Swing Right
8	3	Swing Left
16	4	Drum 9 on MAX-ER

DIGITAL DISPLAY READINGS

General

See C4—Digital Display on page 3-18 for the following information.

The digital display and selector allow the operator to monitor the following three groups of crane information:

- Operating conditions
- Operating limits
- System faults

Press the top or bottom of the selector to scroll up and down through the display readings. Release the selector when the desired information is displayed.

To display the diagnostic operating conditions listed in Table 3-5, press the limit bypass switch while scrolling up with the selector. To turn off the diagnostic operating conditions, press the limit bypass switch while scrolling down with the selector or turn off the cab power.

See Table 3-8 for a list of abbreviations and notes used in the tables. See Drum Identification on page 3-61 for identification of the drums.

NOTE: This topic identifies display readings for all modes and configurations for the 2250 (to include MAX-ER). Some of the readings will not appear until the corresponding mode or configuration is selected.

Some readings may appear even though the crane is not equipped with the corresponding attachment. In these cases, the reading is meaningless.

Readings for optional items are marked with an asterisk (*).

Selecting Display Language

The display can be viewed in English or one of several other languages. Once the desired language is selected, it will remain in memory until another language is selected.

To select a different display language, perform both of the following steps at the same time:

- Press the limit bypass switch.
- Turn the crane mode selector key to confirm.

Repeat the steps until the screen displays the desired language.

Operating Conditions

Table 3-5 lists the operating conditions that can be displayed and the normal operating range of each.

FIGURE 3-36

When an operating condition is selected (such as engine speed), the current status of the condition appears on the display (Figure 3-36).

Operating Limits

Table 3-6 lists the operating limits that can be displayed.

FIGURE 3-37

When one or more operating limits are reached, the operating limit alert (yellow light and buzzer in cab) turns on to warn the operator. At the same time, the Operating Limit screen immediately appears and automatically scrolls through the names of the limits, stopping at each for approximately three second (Figure 3-37).

The operating limit alert turns off when the cause of each limit is corrected. The name of each limit reached during operation is retained in memory, however, until the following two things happen:

- The name of the limit appears on the display at least once.
- The cause of the limit is corrected.

For this reason, it is normal for the names of limits to appear when you scroll to the operating limit group, even when the operating limit alert is off.

To erase the names of inactive limits, scroll to the operating limit group. Wait until the display scrolls through the name of each limit. The names of inactive limits will be erased automatically. If the alert is on, only the names of active limits will remain.

FIGURE 3-38

NO FAULT appears on the display when there are no limits (Figure 3-38).

System Faults

Table 3-7 lists the system faults that can be displayed.

FIGURE 3-39

When one or more system faults occur, the system fault alert (red light and beeper in cab) turns on to warn the operator (Figure 3-39). At the same time, the system fault display immediately appears and automatically scrolls through the names of the faults, stopping at each for approximately three seconds.

The system fault alert turns off when the cause of each fault is corrected. The name of each fault that has occurred during operation is retained in memory, however, until the following two things happen:

- The name of the fault appears on the display at least once.
- The cause of the fault is corrected.

For this reason, it is normal for the names of faults to appear when you scroll to the system fault group, even when the system fault alert is off.

To erase the names of inactive faults, scroll to the system fault group. Wait until the display scrolls through the name of each fault. The names of inactive faults will be erased automatically. If the alert is on, only the names of active faults will remain.

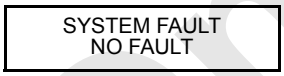


FIGURE 3-40

NO FAULT appears on the display when there are no faults (Figure 3-40).

Table 3-5. Operating Conditions

Listed below are the operating conditions that can be viewed on the digital display.

	Display Reading	Unit of Measure	Operating Range
	Normal Operating Conditions The operating conditions listed below are displayed by scrolling up or down with the digital display selector.		
	ENGINE OIL PRESSURE	PSI	See Engine Manual for specifications.
	ENGINE SPEED	RPM	Low idle to high idle in revolutions per minute
	AIR PRESSURE	PSI	8 to 9 bar (120 to 132 psi)
	ENGINE TEMPERATURE	DEG F	See Engine Manual for specifications.
*	AUX ENGINE TEMP		
	MACHINE LEVEL FRONT	DEG IN	Each screen displays two numbers. The first number is angle (+ or - degrees) that the crane is out of level in indicated direction from horizontal. The second number is the approximate amount (inch) of blocking needed to level the crane in required direction.
	MACHINE LEVEL RIGHT		
	BOOM ANGLE	DEG	Degrees that the boom is positioned above horizontal.
*	LUFF ANGLE	DEG	Degrees that the luffing jib is positioned above horizontal.
*	BOOM TO LUFF JIB ANG	DEG	Degrees between the centerline of the boom and the centerline of the luffing jib.
*	CTWT UP BHITCH DOWN XX.X	—	Indicates the position of the counterweight (UP, DOWN) and the backhitch loading during the MAX-ER 225, 400, or 2000 operation.
	CLAM CLOSING PRESS	PSI	See Selecting Clamshell Mode on page 3-44 for the procedure to adjust the pressure.
	CRANE MODE (Name of Mode)	—	See E4—Crane Mode Selector on page 3-20 for the procedure to select and confirm the desired crane mode.
	Diagnostic Operating Conditions The operating conditions listed below are displayed only by first depressing the limit bypass switch and then scrolling up with the digital display selector. To turn off the diagnostic screens, depress the limit bypass switch and scroll down or stop and restart the engine.		
	HYDRAULIC TANK TEMP	DEG F	Oil temperature varies depending on the load and ambient temperature. Temperature will not accurately read less than approximately 32°C (90°F).
*	AUX HYD TANK TEMP		
	HYDRAULIC TANK PRESSURE	PSIA	0,5 to 1,2 bar absolute (7 to 18 psia) depending on filter condition and oil temperature

Display Reading	Unit of Measure	Operating Range
HYDRAULIC TANK LEVEL	%	75 to 100% of oil remaining in tank
DRUM (10 screens) SWING AUX SWING TRACKS A1, A2, A3 D1, D2, D3	2 Rows of Numbers in Multiple Display Screens	Numbers are used to monitor the operation of the programmable controller and system functions. See Diagnostic Display on page 3-62 for a detailed explanation of these screens. The Manitowoc Crane Care Lattice Team will request these numbers when troubleshooting crane problems.
MXR	2 Rows of Numbers	Numbers are used to monitor the operation of the programmable controller and system functions for MAX-ER 2000 only. See Diagnostic Display on page 3-62 for a detailed explanation of the screen.
PROG M000000.0DP	—	Computer Program Version. The Manitowoc Crane Care Lattice Team will request these numbers when troubleshooting crane problems.
CON 00000000000	—	Computer and Crane Configuration Code. The Manitowoc Crane Care Lattice Team will request these numbers when troubleshooting crane problems.

* = Optional

Table 3-6. Operating Limits

Listed below are the limits that turn on the operating limit alert (yellow light and continuous buzzer) in the operator's cab. When the alert comes on, scroll to the Operating Limit group of the digital display to determine which limit has been reached. Take corrective action.

Display Reading	Function Response	Corrective Action
FUNCTION PARKED	Function inoperable because it is parked.	Turn corresponding park switch off or sit down in operator's seat.
BLOCK UP	Load drum stops hoisting and boom hoist stops lowering.	Lower load or raise boom.
* MAXIMUM BAIL	Load on corresponding drum stops hoisting.	Lower load.
* MINIMUM BAIL	Load on corresponding drum stops lowering.	Hoist load.
FUNCTION NOT PARKED	For standard crane equipped with luffing jib (drum 5), boom hoist (drum 4) cannot be operated until luffing hoist pawl is engaged or luffing hoist is parked, and vice versa.	Engage corresponding pawl or park corresponding drum.
FUNCTION NOT PARKED	For MAX-ER 2000: Drum 2 cannot be operated until drum 3 is parked, and vice versa. Drum 9 cannot be operated until Travel is parked, and vice versa. Drum 4 cannot be operated until drum 5 is parked, and vice versa.	Park corresponding drum.
BOOM MAXIMUM UP [1]	Boom stops hoisting when maximum limit is reached.	Lower boom.
BOOM MAXIMUM DOWN	Boom stops lowering (limit usually set at 0°).	Raise boom.
* MAST MAXIMUM UP	Mast stops hoisting at 80°. Operable only in standard mode. (MAX-ER 2000 only.)	Lower boom. To raise mast above limit, switch to Standard Setup mode to bypass limit.

Display Reading	Function Response	Corrective Action
* RATED CAPACITY LIMIT	If equipped with shutdown option, corresponding load drum stops hoisting and boom hoist stops lowering. Other load drums are inoperable. If not equipped with shutdown option, operating limit light and buzzer will come on to alert operator to overload condition.	Land load on corresponding load drum or raise boom.
CRANE OUT OF LEVEL	All functions operable. Crane 3° out of level.	Level crane.
* LUFFING JIB MAX UP 1	Luffing jib stops rising when boom-to-jib angle is 168°. This angle can be bypassed to allow luffing jib to be raised to LUFFING JIB MAX UP 2.	Lower luffing jib.
* LUFFING JIB MAX UP 2	Luffing jib stops rising when boom-to-luffing jib angle is 170° on #133 or #133A luffing jib (169.2° on #44 luffing jib). This limit can be bypassed only when boom is below 50°.	Lower luffing jib.
* LUFFING JIB MAX DOWN	Luffing jib stops lowering when boom-to-jib angle is 60° on #133 or #133A luffing jib (70° on #44 luffing jib).	Raise luffing jib.
* LUFFING JIB MAX DOWN 1	Luffing jib stops lowering when boom-to-jib angle is 63° on #133 or #133A luffing jib (73° on #44 luffing jib).	Raise luffing jib.
* LUFFING JIB MAX DOWN 2	Luffing jib stops lowering when boom-to-jib angle is 60° on #133 or #133A luffing jib (70° on #44 luffing jib).	Raise luffing jib.
EQUALIZER BOOM STOP	Boom hoist stops hoisting when equalizer is pulled back against stops on gantry and when physical boom stops are within 25 mm (1 in) of bottoming out.	Pay out (lower) boom hoist wire rope.
SETUP MODE ENGAGED	All functions operable. For crane setup only, travel operates at 1/2 speed, and automatic boom stop is disabled.	Turn off setup selector. (Select and confirm desired operating mode.)
* JIB BELOW HORIZONTAL	Luffing jib is operable. See capacity chart for luffing jib minimum operating angles.	Raise luffing jib above horizontal.
* CTWT OFF RING	Alert only. Does not stop boom hoist or load drum operation.	Crane's capacity has been exceeded. Stop lowering boom or hoisting load immediately. Land the load slowly.
CONFIRM MODE	Load drums inoperable until mode in effect is confirmed or another mode is selected and confirmed.	Confirm mode in effect or select and confirm a different mode.
RCL OVERRIDE	Alert only. Does not stop operation. Indicates that external override switch is on for rated capacity limiter (RCL) (crane meeting CE requirements).	Turn off external override switch as soon as possible.
DRUM AIR VALVES	Selected drum air pressure switch is open for more than four seconds.	Brakes and clutches of all drums on main shaft are applied. Fault cannot be cleared until crane is shut down and restarted.

* = Optional

Table 3-7. System Faults

Listed below are the faults that turn on the system fault alert (red light and beeper) in the operator's cab. When the alert comes on, scroll to the SYSTEM FAULT group of the digital display to determine which fault has been reached. Take corrective action.

Display Reading	Cause of Fault	Function Response
* AUX SYS HYD FILTER [2]	Plugged filter. Filter differential pressure above 2,8 bar (40 psi).	Does not affect operation. Replace filter elements as soon as possible.
PUMP 1 CHARGE PRESS	Low charge pressure at load drum pump.	Load drum brake applies and pump strokes to neutral to stop load drum. If drop in charge pressure is intermittent, operation may be resumed once load drum control handle is returned to off. Verify that cause of fault is low pressure and correct cause as soon as possible. If pressure is correct, replace pressure sender.
BOOM ANGLE SENDER * LUFF JIB ANGLE SENDER	Sender output voltage 0.0 V or above 9.7 V.	All functions operable. Machine level or boom and luffing jib angle displays will not be correct. Correct cause of sender fault as soon as possible. Neither fault is active when crane is operated in Setup mode.
LOW AIR PRESSURE	Manifold air pressure below 6,2 bar (90 psi).	If air pressure continues to drop, load drum park brakes will apply.
HYD TANK LEVEL	Less than 75% level.	Stop and check oil level in tank (reservoir).
LOAD PIN	Zero (0) output voltage from pin.	MAX-ER counterweight stops and remains in last position and boom hoist stops and is inoperable in up direction.
MOTION	Deselected drum turns.	If a deselected load drum moves (except in Free Fall), all drum brakes and clutches apply and pumps shift to neutral to stop all load drums. If a selected load drum rotates down when handle is in UP or NEUTRAL position, all drum brakes and clutches apply and pumps shift to neutral to stop all load drums. If a deselected boom or luffing hoist drum moves, brakes apply and pumps shift to neutral to stop both hoists. Stop and restart engine to correct fault (reboot programmable controller).
* MAX-ER SYSTEM	One of three MAX-ER transducers not in operating range of 0.6 to 9 V. Differential pressure between left/right side strap cylinders is 83 bar (1,200 psi). Counterweight tray level is over 3° in right or left direction.	MAX-ER counterweight stops and remains in last position. Check and replace faulty transducer(s). Check hydraulic system and repair. Level counterweight tray.
MAST ACCUMULATOR	Mast stop cylinders, MAX-ER luffing jib stop cylinders, or accessory system pressure is not in range.	See ACCUM screen to determine cause of fault and correct problem as soon as possible.

Display Reading	Cause of Fault	Function Response
BATTERY VOLTAGE LOW	System voltage below 11 V.	Handle commands disabled.
I/O BOARD FAULT *n*	CPU not communicating with I/O board *n,* where: 1—first I/O board after the CPU 2—second I/O board after the CPU 4—third I/O board after the CPU 8—fourth I/O board after the CPU Failure of more than one board is indicated by an *n* value that is the sum of the *n* values associated with each board (for example, if *n*=6, the second and third I/O boards after the CPU may have failed).	Check for a loose or damaged I/O board. Reposition and reconnect the boards in the circuit to see if the problem moves with the location. If the indicated fault code *n* does not change, the problem is most likely in the motherboard or the CPU board. Reference troubleshooting procedures in Folio 2238.

* = Optional

Table 3-8. Additional Notes

Table Notes		Abbreviation	Definition
[1]	The maximum angle at which the boom will stop varies with each attachment. See Boom Stop Adjustment in Section 4 of the Crane Service Manual for the maximum angle at which the boom stops.	+	Plus
		-	Minus
		%	Percent
		A1	Handle Inputs
		A2	Pump Control Outputs
[2]	It is normal for the AUX SYS HYD FILTER fault to come on at startup when the oil in the auxiliary hydraulic tank is cold. The alert should turn off as the oil temperature rises to normal.	A3	Programmer's Screen
		ANG	Angle
		AUX	Auxiliary
		BHITCH	Backhitch
		CLAM	Clamshell
		CTWT	Counterweight (MAX-ER)
		D1	On-Off Inputs
		D2	Digital Inputs
		D3	Digital Inputs or Outputs
		DEG F	Degrees Fahrenheit
		HYD	Hydraulic
		LUFF	Luffing
		MIN	Minimum
		MAX	Maximum
		MXR	MAX-ER 2000
		PRESS	Pressure
		PSI	Pounds Per Square Inch
		PSIA	Pounds Per Square Inch Absolute
		RPM	Revolutions Per Minute
		SYS	System
		TEMP	Temperature

Drum Identification

Drum Number	2250	MAX-ER 2000	14 514 kg (32,000 lb) Option 1 Clamshell	14 514 kg (32,000 lb) Option 2 Clamshell
1	Front Load Drum	No Drum Available	Front Load Drum	
2	Rear or Right Rear Split Load Drum	Boom Hoist	Full Width Rear Load Drum	Right Rear Split Load Drum
3	Left Rear Split Load Drum or Mast Hoist (MAX-ER)	Rear Split Load Drum with Luffing Hoist	—	Left Rear Split Load Drum
4	Boom Hoist	Mast Hoist	Boom Hoist	Boom Hoist
5	Luffing Hoist	Luffing Hoist or Rear Load Drum or Auxiliary Drum without Luffing Hoist	Tagline	Tagline
9	—	Front Load Drum	—	—

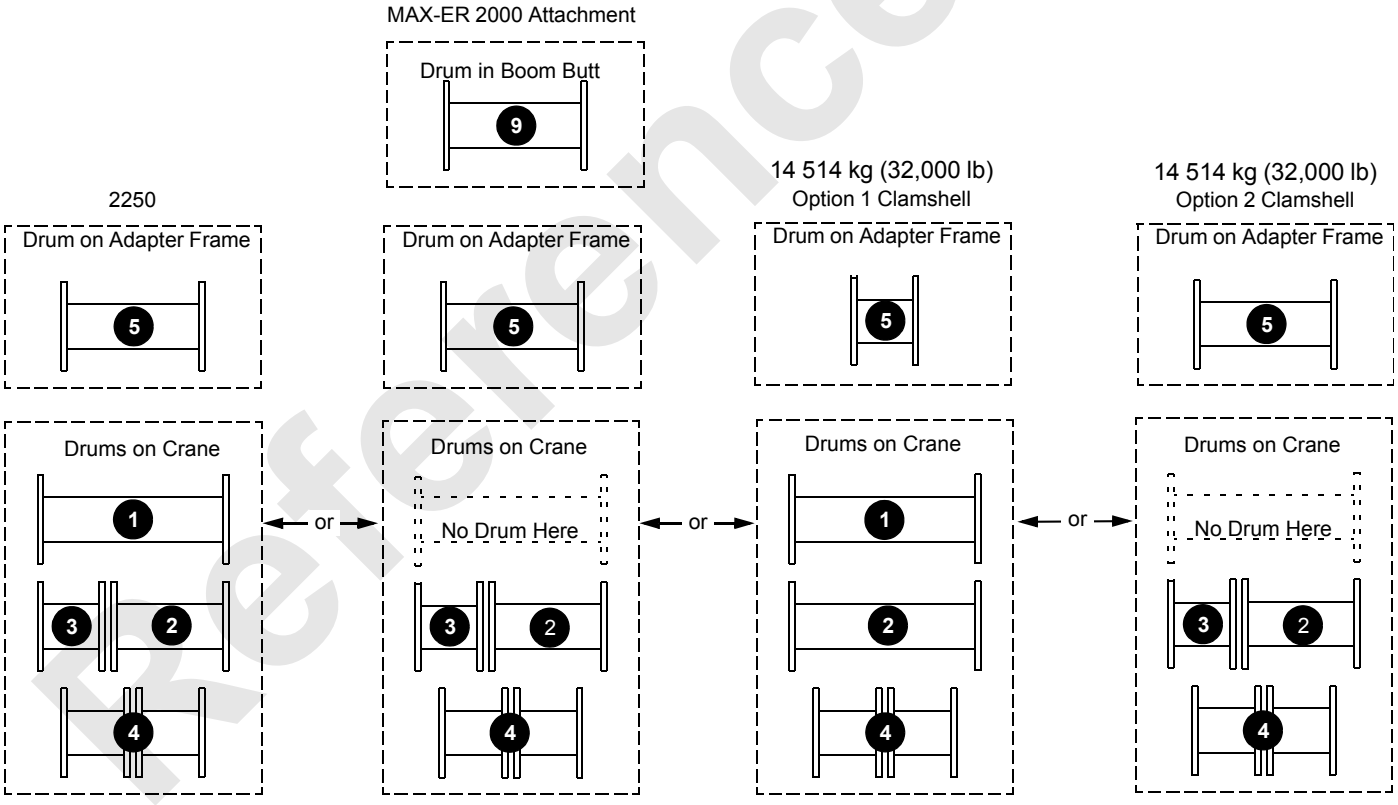


FIGURE 3-41

DIAGNOSTIC DISPLAY

General

To activate the diagnostic display screens, turn the limit bypass switch clockwise and scroll up at least one screen. Once this step is performed, you can scroll up and down through the diagnostic display screens in addition to the normal operating screens. To deactivate the diagnostic display screens, turn the limit bypass switch clockwise and scroll down at least one screen. The normal operating screens will remain active.

The diagnostic display screens provide information about the status of all main crane components as well as the controller inputs and outputs during operation. The diagnostic display screens contain the following:

- Information about a particular crane function (drums 1 through 9, Crane Swing, Track, Accumulator, and MAX-ER 2000)
- Digital outputs (D1) from the controller, digital inputs (D2) to the controller, control handle inputs (A1) to the controller, and the programmer's screen (A2)

NOTE: See Figure 3-41 for drum identification and Figure 3-53 for drum and pump identification.

Drums 1, 2, and 3 (crane load drums)

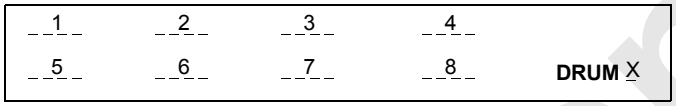


FIGURE 3-42

1. Handle command in percent from neutral—For certain operating conditions, this is set to neutral by the controller even if the handle is not in neutral:

   \+ = Raise

   \- = Lower
2. Pump command in percent from neutral:

   \+ = Raise

   \- = Lower
3. Motor command in percent:

   0% = Maximum displacement

   100% = Minimum displacement
4. Measured drum speed in rpm:

   \+ = Raise

   \- = Lower
5. Command to park brake:

   1 = Release

   0 = Apply
6. Command to clutch:

   1 = Disengage

   0 = Engage
7. Measured pump system pressure (port A) in psi
8. Measured pump charge pressure in psi

NOTE: X = Corresponding drum number.

Drum 4 (boom hoist)

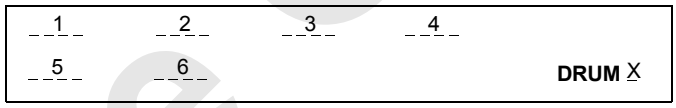


FIGURE 3-43

1. Handle command in percent from neutral—For certain operating conditions, this is set to neutral by the controller even if the handle is not in neutral:

   \+ = Raise

   \- = Lower
2. Pump command in percent from neutral:

   \+ = Raise

   \- = Lower
3. Motor command in percent:

   0% = Maximum displacement

   100% = Minimum displacement
4. Measured drum speed in rpm:

   \+ = Raise

   \- = Lower
5. Command to park brake:

   1 = Release

   0 = Apply
6. Measured pump system pressure (port B) in psi

NOTE: X = Corresponding drum number

Drum 5 (luffing or auxiliary hoist)

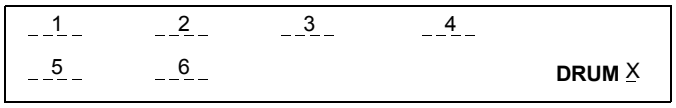


FIGURE 3-44

1. Handle command in percent from neutral—For certain operating conditions, this is set to neutral by the controller even if the handle is not in neutral:

   + = Raise

   - = Lower

2. Pump command in percent from neutral:

   + = Raise

   - = Lower

3. Motor command in percent:

   0% = Maximum displacement

   100% = Minimum displacement

4. Measured drum speed in rpm:

   + = Raise

   - = Lower

5. Command to park brake:

   1 = Release

   0 = Apply

6. Measured pump system pressure (port B) in psi

NOTE: X = Corresponding drum number

Drum 9 (MAX-ER 2000 load drum)

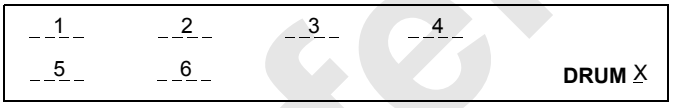


FIGURE 3-45

1. Handle command in percent from neutral—For certain operating conditions, the handle command is set to neutral by the controller even if the handle is not in neutral:

   + = Raise

   - = Lower

2. Pump command in percent from neutral:

   + = Raise

   - = Lower

3. Motor command in percent:

   0% = Maximum displacement

   100% = Minimum displacement

4. Measured drum speed in rpm:

   + = Raise

   - = Lower

5. Command to park brake:

   1 = Release

   0 = Apply

6. Measured pump system pressure (port B) in psi

NOTE: X = Corresponding drum number

Swing (crane)

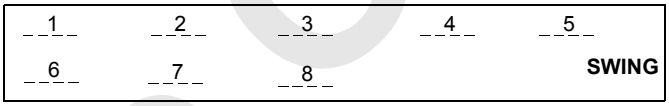


FIGURE 3-46

1. Handle command in percent from neutral—For certain operating conditions, this is set to neutral by the controller even if the handle is not in neutral:

   + = Right

   - = Left

2. Crane swing pump command in percent from neutral:

   + = Right

   - = Left

3. Measured pump pressure swing right (port B) in psi

4. Measured pump pressure swing left (port A) in psi

5. Measured swing brake pressure 0 to 51.71 bar (0 to 750 psi)

6. MAX-ER 2000 shorting plug status:

   0 = MAX-ER 2000 enabled

   1 = MAX-ER 2000 shorting plug installed

   2 = 2250 enabled

   4 = 2250 shorting plug installed

7. MAX-ER 2000 travel status:

   0 = Travel disabled

   1 = Travel enabled

   MAX-ER 2000 travel status is determined by swing brake pressure and MAX-ER shorting plug status. If swing pressure is less than 10.34 bar (150 psi) and MAX-ER shorting plug is absent, travel is disabled.

8. Swing limiter sensor status (appears only if equipped with swing limiter):

   + = Swing right

   - = Swing left

Track (crane crawlers)

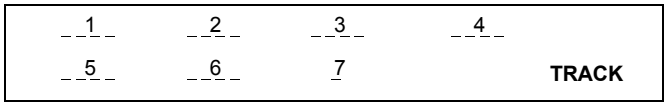


FIGURE 3-47

1. Right handle command in percent from neutral—For certain operating conditions, this is set to neutral by the controller even if the handle is not in neutral:

   + = Forward

   - = Backward

2. Right pump command in percent from neutral:

   + = Forward

   - = Backward

3. Left handle command in percent from neutral—For certain operating conditions, this is set to neutral by the controller even if the handle is not in neutral:

   + = Forward

   - = Backward

4. Left pump command in percent from neutral:

   + = Forward

   - = Backward

5. Measured system pressure right track in psi
6. Measured system pressure left track in psi
7. Command to park brake:

   1 = Release

   0 = Engage

Mast Accumulator

FIGURE 3-48

1. Accessory disable valve stroke (0 to 100%)
2. Control requirement:

   0 = No demand

   1 = Accessory disable valve enable input

   2 = MAX-ER wagon controls

   3 = MAX-ER luffing jib stop cylinders

   4 = Mast stop cylinders

3. Accumulator pressure (psi)

MXR (MAX-ER 2000)

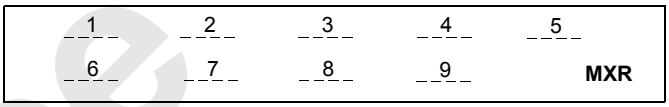


FIGURE 3-49

1. Tray level indicator:

   + = Degrees high on right side

   - = Degrees low on left side

2. Backhitch load (US tons):

   + = Tension

   - = Compression

3. MAX-ER switches (see Table 3-9)

Table 3-9. MAX-ER Switch Definitions

MAX-ER Switches	0	1	2	3	4	5	6	7
Left strap cylinder limit switch (normally closed)		■		■		■		■
Counterweight raise remote control switch (normally open)			■	■			■	■
Counterweight lower remote control switch (normally open)					■	■	■	■
Dark shaded boxes indicate ON, white boxes OFF.								

4. MAX-ER State/Faults (total of number(s) listed):

   1 = Tray high on left side (CWT level is more than 3.0 degrees)

   2 = Tray high on right side (CWT level is less than -3.0 degrees)

   4 = Derived that strap cylinder loads are both 9 071,9 kg (20,000 lb). Value 4 does not trigger a MAX-ER fault.

   8 = Not used

   16 = Left rod side pressure transducer out of range (below 0.6 or above 9.0 V)

   32 = Right rod side pressure transducer out of range (below 0.6 or above 9.0 V)

   64 = Differential pressure (one side taking 144.8 bar [2100 psi] more than other side)

   128 = Piston pressure transducer out of range (below 0.6 or above 9.0 VV)

5. MAX-ER controller communication status: 0 = Good. Any other number indicates a problem with MAX-ER controller communication to the crane controller. Contact the Manitowoc Crane Care Lattice Team.
6. Right strap cylinder rod side pressure (0 to 207 bar [0 to 3,000 psi])
7. Left strap cylinder rod side pressure (0 to 207 bar [0 to 3,000 psi])
8. Strap cylinder piston side pressure (0 to 207 bar [0 to 3,000 psi])
9. Strap cylinder command:

   0 = Idle

   1 = Raise tray

   2 = Lower tray

A1 (handles)

The variable control handle output voltage is represented in the controller by a number between 0 (0 V) and 255 (10 V). The diagnostic screen A1 displays this number for each of the control handles/pedals. The normal operating outputs of the handles range from the following:

- Approximately 38 (1.5 V) to 120 (4.7 V) for lower/reverse/right. Some dual-axis handles (joysticks) are internally limited and will not put out the full range stated.
- Approximately 136 (5.3 V) to 215 (8.5 V) for raise/forward/left. Some dual-axis handles (joysticks) are internally limited and will not put out the full range stated.
- A switch opens when the handle is in the neutral range (4.7 to 5.3 Vs). In the neutral range, the screen reads 0.

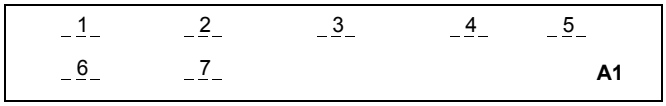


FIGURE 3-50

Banks:

1. Handle 1—Right rear or front load drum
2. Handle 2—Left rear or rear load drum
3. Handle 3—Boom/luffing/mast hoist
4. Handle 5—Right track
5. Handle 6—Left track
6. Handle 4—Swing
7. Handle 7—Auxiliary load drum or luffing hoist with independent pump

A2 (programmer's screen)

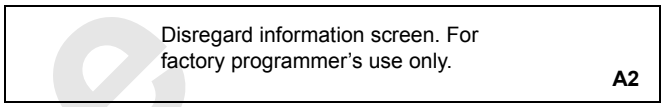


FIGURE 3-51

D1 and D2 (digital outputs and inputs)

The status of the digital outputs from the controller and the inputs to the controller are displayed in several banks in screens D1 and D2. Each bank can indicate the state of up to eight individual digital inputs or outputs.

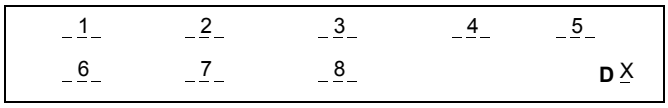


FIGURE 3-52

NOTE: 1 through 8 = Bank number

X = Corresponding digital screen number (1 or 2)

Each individual input/output is assigned a number (identifier) in the binary system (powers of two). The identifiers of all inputs/outputs that are on (active) are added to a total in each bank. Thus, the number displayed for each bank is the sum of all identifiers of the inputs/outputs that are on (0 through 255). With this system, each possible on/off combination per bank has a unique total.

For identification of the digital outputs and inputs (and the crane components connected to them), see Table 3-10 and Table 3-11.

To determine the state of the individual inputs/outputs in a bank, find the number displayed for the bank in the first column in Table 3-12. In the corresponding row, the identifier

numbers that are on (active) in the bank are shaded black. Use Table 3-10 and Table 3-11 to identify the crane components associated with the identifiers for the corresponding bank.

Example 1: If the number displayed in Bank 3 of screen D2 is 41, go to row number 41 in Table 3-12. The boxes for identifiers 1, 8, and 32 are shaded black in this row, indicating that the corresponding inputs are active. Find the component description for the identifiers in Table 3-11, Bank 3. The inputs for High Speed Travel (Identifier 1), Drum 1 Brake (Identifier 8) and Low Air Pressure (Identifier 32) are active.

Example 2: You want to know if the controller output for the drum 2 clutch is on. In Table 3-10 you will find drum 2 Clutch in Bank 1 (Identifier 64). Look up the current number for Bank 1 in screen D1 (for example 152). Then go to the corresponding row number (152) in Table 3-12. Identifier 64 box is not shaded black in this row, indicating that the controller output to the rear drum clutch is off.

All numbers in screen D1 and the pump/motor command values in screens Drum, Swing, and Track represent controller commands to the corresponding output devices only. The state of a certain output port on the controller may not necessarily correspond to the actual state of the associated crane component (brake valve, clutch valve, or other components), since the connection between the controller and the component may be faulty due to loose connections, corroded terminals, broken wiring, or improperly operating components.

Table 3-10. D1 (Digital Outputs)

Binary Identifier	Component
Bank 1	
1	Drum 1 Brake
2	Drum 2 Brake
4	Drum 4 Brake
8	Travel Brake
16	Comm Output to Right Side Console Control Board
32	Drum 1 Clutch/Drum 5 Diverting Valve
64	Drum 2 Clutch
128	Drum 3 Clutch
Bank 2	
1	Drum 3 Brake
2	Spare
Bank 3	
1	Drum 5 Brake
2	Handle 1 Drum Rotation Indicator
4	Auxiliary System Disable Valve
8	Handle 7 Drum Rotation Indicator
16	Independent Luffing Hoist Pump
32	Travel 2-Speed Valve
64	Handle 2 Drum Rotation Indicator
128	System Fault Alarm
Bank 4	
1	Operating Limit Alarm
2	Out-of-Level Alarm (Crane Remote Control)
Bank 5	
1	Drum 1 Free Fall Front Console LED
2	Handle 3 Drum Rotation Indicator
4	Pulse Width Modulation Engine RPM
8	Spare
16	Counterweight Down Valve (MAX-ER 2000)
32	Counterweight Up Valve (MAX-ER 2000)
64	Proportional Valve (MAX-ER and Setup Modes)
128	Drum 1 Pawl In
Bank 6	
1	Pulse Width Modulation to Split Drum 2/3 Hoist Motor
2	Swing/Travel Alarm
Bank 7	
1	Drum 2 Free Fall Front Console LED
2	Drum 3 Free Fall Front Console LED
4	MAX-ER Programmable Controller Relay
8	Swing Brake
16	Drum 1 Pawl Out
32	Spare
64	Spare
128	Spare
Bank 8	Not Used
Bank 9	
1	Drum 9 (MAX-ER 2000)/Drum 5 Diverting Valve
2	Counterweight Strap Cylinder Extend (MAX-ER 2000)
4	Counterweight Strap Cylinder Lower (MAX-ER 2000)
8	Spare
16	Spare
32	Drum 9 Brake (MAX-ER 2000)
64	Drum 9 Pawl In (MAX-ER 2000)
128	Drum 9 Pawl Out (MAX-ER 2000)
Bank 10	
1	Drum 2 Pawl In (MAX-ER 2000)
2	Drum 2 Pawl Out (MAX-ER 2000)

Table 3-11. D2 (Digital Inputs)

Binary Identifier	Component
Bank 1	
1	Travel Detent
2	Drum 1 Max Air Pressure/Swing Right Limit Switch
4	Drum 1 Minimum Bail Limit or Swing Left Limit Switch
8	Drum 3 Minimum Bail Limit
16	Drum 3 Maximum Bail Limit/Maximum Air Pressure
32	Block-Up Limit
64	Drum 2 Max Bail Limit or Drum Air Pressure Switch
128	Drum 2 Minimum Bail Limit
Bank 2	
1	COMM Input From Right Side Console Control Board
2	Seat Switch
4	Auxiliary System Enable
8	Remote Jacking Enable Input
16	Drum 9 Brake
32	Boom Maximum Up
Bank 3	
1	High Speed Travel
2	Luffing Maximum Down
4	Luffing Maximum Up
8	Drum 1 Brake
16	Travel Brake
32	Low Air Pressure
64	Spare
128	Drum Selector Switch (Drum 2 and 3)
Bank 4	
1	Drum 1 or 2 Free Fall Pressure Switch
2	Crane Mode (Select)
4	Limit Bypass Switch
8	Digital Display Selector (Scroll Up)
16	Drum 2 Brake
32	Drum 3 Brake
Bank 5	
1	Drum 4 Brake
2	Drum 5 Brake
4	Spare
8	Pendant Cylinder Limit Switch (MAX-ER 225 and 400)
16	Digital Display Selector (Scroll Down)
32	Spare
64	Counterweight Lower
128	MAX-ER 225 Removed
Bank 6	
1	Engine Oil Pressure Low Limit
2	Engine Temperature High Limit
4	Rated Capacity Indicator/Limiter
8	Crane Mode (Confirm)
16	Swing Park Brake On
32	Equalizer/Boom Stop Limit
Bank 7	
1	Remote Throttle
2	Drum 2 or 3 Free Fall Pressure
4	Spare
8	Maximum Boom/Luffing Angle Bypass
16	Drum 1 Pawl Limit
32	Drum 2 Pawl Limit
64	Spare
128	Spare
Bank 8	
1	Spare
2	RCI External Bypass (CE Option Only)
4	Spare
8	MAX-ER 225 Enabled
16	Mast Maximum Up Limit
32	Rigging Winch Enable Input

Table 3-12. 8-Bit Binary System

	1	2	4	8	16	32	64	128
1	■							
2		■						
3	■	■						
4			■					
5	■		■					
6		■	■					
7	■	■	■					
8				■				
9	■			■				
10		■		■				
11	■	■		■				
12			■	■				
13	■		■	■				
14		■	■	■				
15	■	■	■	■				
16					■			
17	■				■			
18		■			■			
19	■	■			■			
20			■		■			
21	■		■		■			
22		■	■		■			
23	■	■	■		■			
24				■	■			
25	■			■	■			
26		■		■	■			
27	■	■		■	■			
28			■	■	■			
29	■		■	■	■			
30		■	■	■	■			
31	■	■	■	■	■			
32						■		
33	■					■		
34		■				■		
35	■	■				■		
36			■			■		
37	■		■			■		
38		■	■			■		
39	■	■	■			■		
40				■		■		
41	■			■		■		
42		■		■		■		
43	■	■		■		■		

	1	2	4	8	16	32	64	128
44			■	■		■		
45	■		■	■		■		
46		■	■	■		■		
47	■	■	■	■		■		
48					■	■		
49	■				■	■		
50		■			■	■		
51	■	■			■	■		
52			■		■	■		
53	■		■		■	■		
54		■	■		■	■		
55	■	■	■		■	■		
56				■	■	■		
57	■			■	■	■		
58		■		■	■	■		
59	■	■		■	■	■		
60			■	■	■	■		
61	■		■	■	■	■		
62		■	■	■	■	■		
63	■	■	■	■	■	■		
64							■	
65	■						■	
66		■					■	
67	■	■					■	
68			■				■	
69	■		■				■	
70		■	■				■	
71	■	■	■				■	
72				■			■	
73	■			■			■	
74		■		■			■	
75	■	■		■			■	
76			■	■			■	
77	■		■	■			■	
78		■	■	■			■	
79	■	■	■	■			■	
80					■		■	
81	■				■		■	
82		■			■		■	
83	■	■			■		■	
84			■		■		■	
85	■		■		■		■	
86		■	■		■		■	

	1	2	4	8	16	32	64	128
87	■	■	■		■		■	
88				■	■		■	
89	■			■	■		■	
90		■		■	■		■	
91	■	■		■	■		■	
92			■	■	■		■	
93	■		■	■	■		■	
94		■	■	■	■		■	
95	■	■	■	■	■		■	
96						■	■	
97	■					■	■	
98		■				■	■	
99	■	■				■	■	
100			■			■	■	
101	■		■			■	■	
102		■	■			■	■	
103	■	■	■			■	■	
104				■		■	■	
105	■			■		■	■	
106		■		■		■	■	
107	■	■		■		■	■	
108			■	■		■	■	
109	■		■	■		■	■	
110		■	■	■		■	■	
111	■	■	■	■		■	■	
112					■	■	■	
113	■				■	■	■	
114		■			■	■	■	
115	■	■			■	■	■	
116			■		■	■	■	
117	■		■		■	■	■	
118		■	■		■	■	■	
119	■	■	■		■	■	■	
120				■	■	■	■	
121	■			■	■	■	■	
122		■		■	■	■	■	
123	■	■		■	■	■	■	
124			■	■	■	■	■	
125	■		■	■	■	■	■	
126		■	■	■	■	■	■	
127	■	■	■	■	■	■	■	
128								■
129	■							■

Dark shaded boxes indicate ON. White boxes indicate OFF.

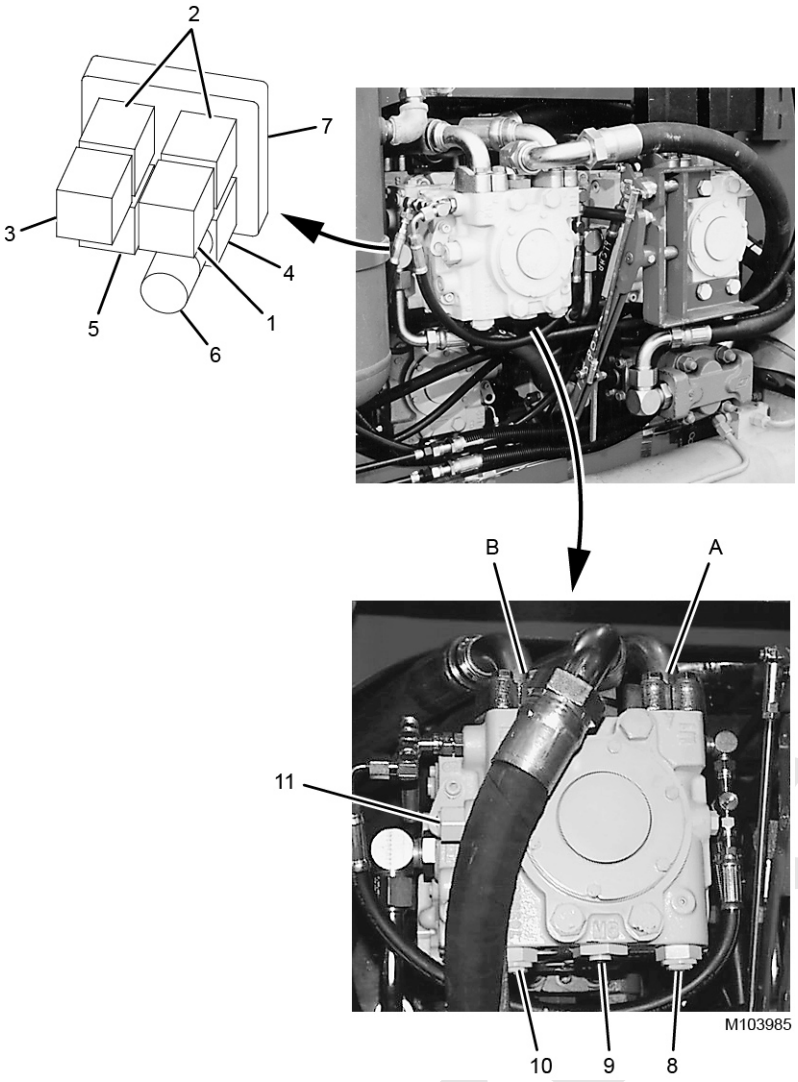
Table 3-12. 8-Bit Binary System (continued)

	1	2	4	8	16	32	64	128
130		■						■
131	■	■						■
132			■					■
133	■		■					■
134		■	■					■
135	■	■	■					■
136				■				■
137	■			■				■
138		■		■				■
139	■	■		■				■
140			■	■				■
141	■		■	■				■
142		■	■	■				■
143	■	■	■	■				■
144					■			■
145	■				■			■
146		■			■			■
147	■	■			■			■
148			■		■			■
149	■		■		■			■
150		■	■		■			■
151	■	■	■		■			■
152				■	■			■
153	■			■	■			■
154		■		■	■			■
155	■	■		■	■			■
156			■	■	■			■
157	■		■	■	■			■
158		■	■	■	■			■
159	■	■	■	■	■			■
160						■		■
161	■					■		■
162		■				■		■
163	■	■				■		■
164			■			■		■
165	■		■			■		■
166		■	■			■		■
167	■	■	■			■		■
168				■		■		■
169	■			■		■		■
170		■		■		■		■
171	■	■		■		■		■
172			■	■		■		■

	1	2	4	8	16	32	64	128
173	■		■	■		■		■
174		■	■	■		■		■
175	■	■	■	■		■		■
176					■	■		■
177	■				■	■		■
178		■			■	■		■
179	■	■			■	■		■
180			■		■	■		■
181	■		■		■	■		■
182		■	■		■	■		■
183	■	■	■		■	■		■
184				■	■	■		■
185	■			■	■	■		■
186		■		■	■	■		■
187	■	■		■	■	■		■
188			■	■	■	■		■
189	■		■	■	■	■		■
190		■	■	■	■	■		■
191	■	■	■	■	■	■		■
192						■	■	■
193	■					■	■	■
194		■				■	■	■
195	■	■				■	■	■
196			■			■	■	■
197	■		■			■	■	■
198		■	■			■	■	■
199	■	■	■			■	■	■
200				■		■	■	■
201	■			■		■	■	■
202		■		■		■	■	■
203	■	■		■		■	■	■
204			■	■		■	■	■
205	■		■	■		■	■	■
206		■	■	■		■	■	■
207	■	■	■	■		■	■	■
208					■		■	■
209	■				■		■	■
210		■			■		■	■
211	■	■			■		■	■
212			■		■		■	■
213	■		■		■		■	■
214		■	■		■		■	■
215	■	■	■		■		■	■

	1	2	4	8	16	32	64	128
216				■	■		■	■
217	■			■	■		■	■
218		■		■	■		■	■
219	■	■		■	■		■	■
220			■	■	■		■	■
221	■		■	■	■		■	■
222		■	■	■	■		■	■
223	■	■	■	■	■		■	■
224						■	■	■
225	■					■	■	■
226		■				■	■	■
227	■	■				■	■	■
228			■			■	■	■
229	■		■			■	■	■
230		■	■			■	■	■
231	■	■	■			■	■	■
232				■		■	■	■
233	■			■		■	■	■
234		■		■		■	■	■
235	■	■		■		■	■	■
236			■	■		■	■	■
237	■		■	■		■	■	■
238		■	■	■		■	■	■
239	■	■	■	■		■	■	■
240					■	■	■	■
241	■				■	■	■	■
242		■			■	■	■	■
243	■	■			■	■	■	■
244			■		■	■	■	■
245	■		■		■	■	■	■
246		■	■		■	■	■	■
247	■	■	■		■	■	■	■
248				■	■	■	■	■
249	■			■	■	■	■	■
250		■		■	■	■	■	■
251	■	■		■	■	■	■	■
252			■	■	■	■	■	■
253	■		■	■	■	■	■	■
254		■	■	■	■	■	■	■
255	■	■	■	■	■	■	■	■

Dark shaded boxes indicate ON. White boxes indicate OFF.



Pump Identification

Pump Number	Description
1	Boom Hoist
2	Load Drum (qty 2)
3	Swing
4	Right Crawler
5	Left Crawler
6	Fan (outboard) and Accessory (inboard) Pump
7	Pump Drive

Pump Port Identification

Pump	Port A	Port B
8	Lower	Hoist
9	Hoist	Lower
10	Left	Right
11	Reverse	Forward

FIGURE 3-53

ENGINE DIAGNOSTICS

General

The Cummins QSX15 engine has two types of fault codes, as follows:

- Engine electronic fuel system fault codes
- Engine protection system fault codes

All fault codes are either active or inactive. Active faults can be read with the red Engine Stop light and amber Engine Warning light on the front console. Inactive faults can only be read with the electronic service tool supplied by the engine manufacturer.

Diagnostic Lights

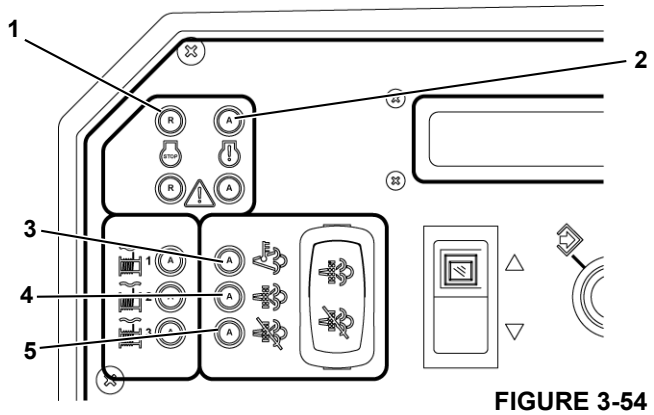


FIGURE 3-54

The engine diagnostic lights are mounted on the front console in the operator's cab (Figure 3-54).

1—Engine Stop Light

The red Engine Stop light indicates the need to stop the engine as soon as safely possible and correct the fault.

CAUTION

Engine Damage!

Permanent damage can occur if the engine is run while the red Engine Stop light is on. Do not run the engine until the fault is corrected. If possible, lower the lifted loads and then stop the engine as soon as possible when the red Engine Stop light comes on.

2—Engine Warning Light

The amber Engine Warning light indicates that the engine can be run but the fault should be corrected as soon as possible.

3—High Exhaust System Temperature

See A4—Exhaust System Lights on page 3-14 for details.

4—DPF Regeneration Active

See A4—Exhaust System Lights on page 3-14 for details.

5—DPF Regeneration Inhibited

See A4—Exhaust System Lights on page 3-14 for details.

Engine Diagnostics

The engine has two diagnostic modes, as follows:

- Off-board diagnostics—This mode requires special hardware and software from the engine manufacturer.
- On-board diagnostics—This mode has warning lights to alert the operator to engine problems during operation (engine running) and has fault codes to identify specific engine problems (Figure 3-54).

To identify active faults, proceed as follows:

1. Stop the engine.
2. Move the ignition switch to the RUN position.
3. Move the hand throttle from LOW speed to HIGH speed and back to LOW speed three times within five seconds.

   If no active faults exist, the amber Engine Warning light and red Engine Stop light come on but do not flash.

   If there is an active fault, the amber Engine Warning light flashes to indicate that a fault code will be flashed.

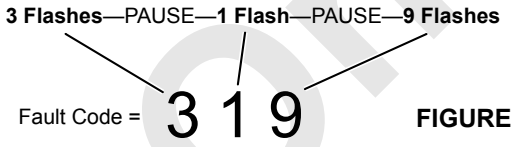


FIGURE 3-55

4. After another two-second pause, the red diagnostic light flashes the fault code.

   After a two-second pause, the same fault code flashes a second time before advancing to the next fault code.

NOTE: To decipher the fault code, see Figure 3-55.

5. See the engine manufacturer's manual for a list of fault codes.

DRUM INTERLOCK

General

The drum interlock physically connects both load drums on a split drum shaft to allow single load line operation with dual brakes either in the Free Fall or the Full Power mode.

With drum interlock, both drums are controlled by one load drum control handle and one drum working brake pedal.

NOTE: Drum interlock cannot be used on three-drum cranes.

Free Fall Mode

Dual working brakes, in effect, double the braking surface, which results in less brake heat and wear.

Use drum interlock in the Free Fall mode for a concrete bucket and similar operations where the load is continually lowered long distances on the drum working brake.

Drum interlock in the Free Fall mode requires installing a drive lug between the drums and rerouting the drum working brake air lines. See Installing Drum Interlock on page 3-72.

For drum interlock operation in the Free Fall mode, reroute the drum working brake air lines (Figure 3-58).

Operate the drums in Free Fall mode as follows:

- Use the left pedal (right rear drum) to apply the drum working brakes.
- Use the control handle corresponding to the drum that has the load line installed on it. This will reduce torque on the drive lug.

Full Power Mode

Use the drum interlock in the Full Power mode when the added security of a dual park brake and clutch application is desired during critical lifts.

Drum interlock in the Full Power mode only requires installing a drive lug between the drums. It is not necessary to modify or reroute the drum working brake air lines, because in the Full Power mode, the drum park brake stops the drum. The drum working brake is used only when necessary to stop the drum. One working brake has sufficient torque to perform this function.

Drum interlock in the Full Power mode requires the drums to be operated in the tandem drum mode. In Tandem mode, the crane's programmable control automatically selects the left side control handle (right drum) as the active handle. The other handle is inoperable.

Installing Drum Interlock

WARNING

Falling Load Hazard!

Avoid the possibility of death or serious injury. The load will fall if the load lines are not slack. Land all loads so the load lines are slack before installing the drive lug or disconnecting the air lines.

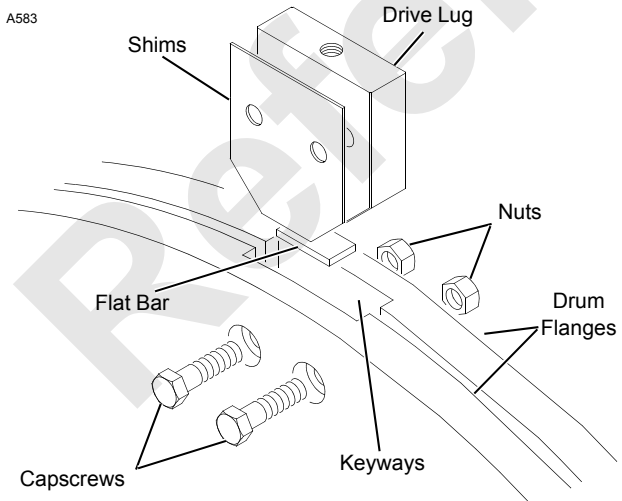


FIGURE 3-56

See Figure 3-56 for the following procedure.

1. Land the load on both drums so the wire rope is slack.
2. Remove the load line from the drum not to be used.
3. Operate the drums to align the keyways in the drum flanges as shown.
4. Install the flat bar and drive lug in the keyways as shown. Use shims so the drive lug is snug in the keyways.
5. Apply thread-locking compound to the screw threads, fasten the nuts to the screws, and securely tighten the nuts so they cannot loosen.
6. Modify the drum working brake air lines to allow drum interlock operation (Figure 3-58, View B).

   This modification is not required for operation in the Full Power mode, but it can be made if dual working brake operation is desired.

   a. Fully release both drum working brake pedals to exhaust air from the air lines between the brake chambers and the treadle valves.

   b. Install a tee (1) in air line B with nuts (3) and ferrules (2).

   c. Connect jumper air line C to the tee (1) with a nut (3) and ferrule (2).

   d. Securely fasten the female connector (4) and plug (5) to the free end of air line A with a nut (3) and ferrule (2).

   e. Make sure all fittings are tight to prevent air leaks.

WARNING

Falling Load Hazard!

Death or serious injury to personnel can result. The working brake must be applied to stop the load when the drum control handle is released to OFF. Otherwise, the load will lower uncontrolled.

Be aware of which working brake pedal is active when operating with drum interlock in Free Fall mode.

Removing Drum Interlock

1. Land the load on both drums so the wire rope is slack.
2. Fully release both drum working brake pedals to exhaust the air from the air lines between the brake chambers and treadle valves.
3. Remove the drive lug, shims, and flat bar from the keyways (Figure 3-56). Store all parts.
4. If the drive lug is seized to the keyways, use a bar and bolt to jack the drive lug out of the keyways (Figure 3-57).

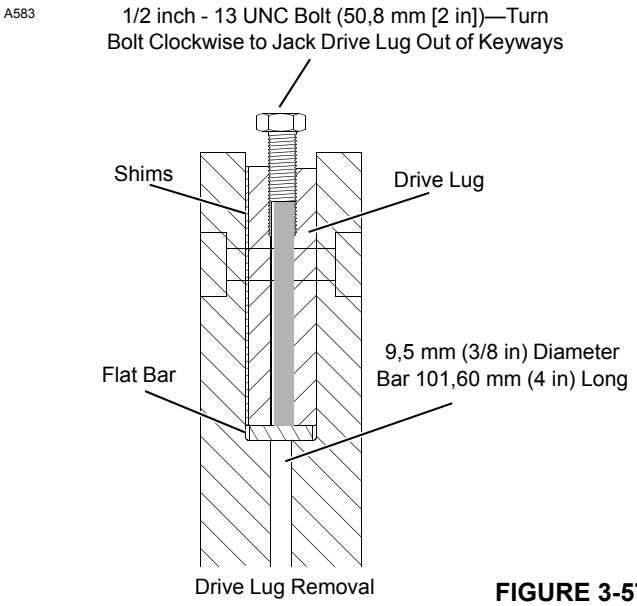
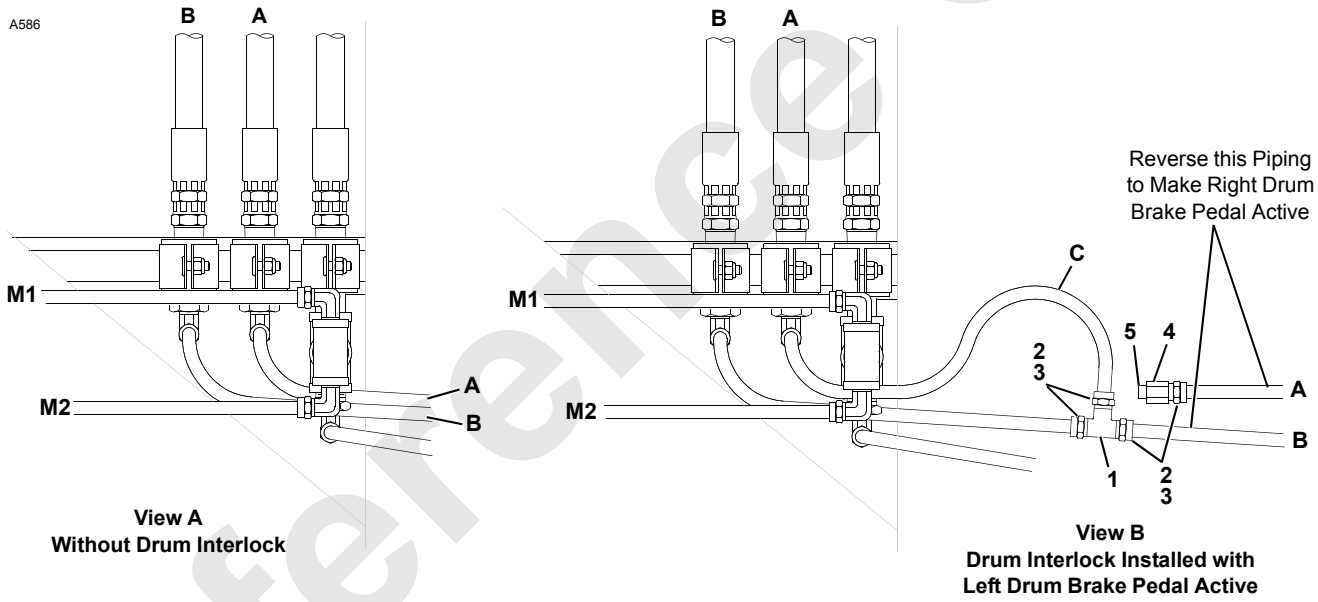


FIGURE 3-57



Air Line Identification

Air Line	Identification
A	Delivery Air to Right Drum Working Brake Chamber
B	Delivery Air to Left Drum Working Brake Chamber
C	Jumper
M1	Supply Air to Right Drum Working Brake Treadle Valve
M2	Supply Air to Left Drum Working Brake Treadle Valve

Fitting Identification for 3/8 inch O.D. Air Line

Item	Description	MCC Number	Quantity
1	Tee	429629	1
2	Ferrule	429627	4
3	Nut	429628	4
4	Female Connector	429820	1
5	Plug	571721	1
C	Air Line	486056	As Required

DRUM WORKING BRAKE AIR PIPING

FIGURE 3-58

5. Remove the air fittings and reroute the air lines so they are connected (Figure 3-58, View A).
6. Make sure all fittings are tight to prevent air leaks.
7. Install the load line on another drum if necessary.

SWING SPEED/TORQUE ADJUSTMENT

General

Swing speed and torque can be adjusted to suit the operator's needs.

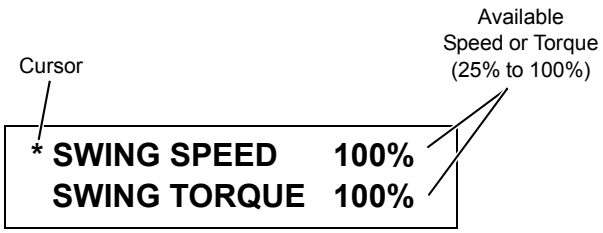


FIGURE 3-59

Adjustment

See Figure 3-59 for the following procedure.

1. Stop swinging and apply the swing park brake (park upper with the rocker switch on the control console).
2. Access the diagnostic screens as follows:
   a. Depress the limit bypass button or turn the limit bypass switch clockwise and scroll up (with the selector next to the display screen).
   b. Once step 2a is performed, scroll up at least one screen, release the button or key, and scroll up or down through the diagnostic screens until the Swing Speed/Swing Torque screen appears.
3. Rotate the crane mode selector back and forth from the CENTER position to the SELECT position until the cursor (*) appears next to SWING SPEED.
4. Scroll up and down to change the swing speed to the desired percentage between 25% and 100%.
5. Repeat step 3 and step 4 for swing torque.
6. Rotate the crane mode selector back and forth from the CENTER position to the SELECT position until the cursor (*) disappears.

   The adjustment is complete. The selected swing speed and torque will remain in computer memory, even after the engine is stopped.
7. If desired, turn off the diagnostic screens:
   a. Depress the limit bypass button or turn the limit bypass switch clockwise.
   b. Scroll down at least one screen and release the button or switch.

   Stopping the engine will also turn off the diagnostic screens.

SWING LIMITER OPERATION

General

The swing limiter system is a safety device that allows the operator to program how far the rotating bed can be swung to the right and left. When the programmed limit is reached in either direction, the programmable controller automatically stops the rotating bed and prevents swinging past the programmed limit. The operator can swing in the opposite direction.

The system consists of the following components (Figure 3-62).

- Swing Sensor—This electronically monitors swing speed and direction and sends corresponding electric signals to the crane's programmable controller.
- Crane Mode Selector—This is used to turn the swing limits on and off.
- Digital Display—This contains the swing limiter programming screens.
- Programmable Controller—This receives input signals from the swing sensor and crane mode selector, and controls the swing pump to stop the rotating bed and hold it in position at the programmed swing limits.
- Limit Switch and Actuators—These apply the swing park brake to stop the rotating bed if the programmed swing limits fail for any reason.

CAUTION

Operator Aid!

The swing limiter is a safety device designed to stop the rotating bed (prevent boom or rotating bed from swinging into jobsite obstructions) in the event that the operator fails to stop the rotating bed from swinging in a normal manner. Any other use of the swing limiter is neither intended nor approved.

Programming Swing Limits

Check the programmed swing limits daily at the start of operation by swinging slowly to each limit. The rotating bed should stop smoothly when either swing limit is reached.

1. Access the diagnostic screens on the digital display by depressing the scroll up and limit bypass buttons at the same time.
2. Scroll through the diagnostic screens until either of the screens in Figure 3-60 appears.

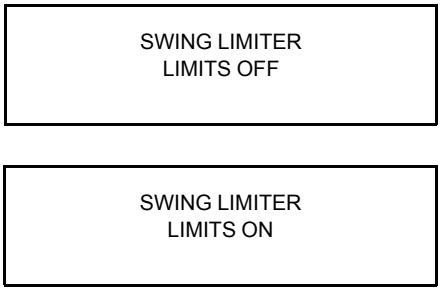


FIGURE 3-60

3. To turn off the swing limits, perform the following.
   - **a.** Turn the crane mode selector to the SELECT position. An asterisk (*) will appear to the left of the SWING LIMITER line.
   - **b.** Scroll up or down to LIMITS OFF.
   - **c.** Turn the crane mode selector to the SELECT position. Swing limits will be turned off, and the asterisk will disappear.
   - **d.** Remove the limit switch actuators.

CAUTION

Shock Load Damage to Boom and Jib!

Remove the limit switch actuators before operating the crane with the swing limiter system turned OFF.

The limit switch will apply the swing park brake when either actuator is contacted if this step is not performed. The crane rotating bed will stop abruptly, possibly causing shock load damage to the boom and jib.

4. To set the swing limits, perform the following.
   - **a.** Remove the limit switch actuators if they will interfere with the desired programmed limits.
   - **b.** Make sure the crane's swing motion is stopped at a position between the desired swing limits.
   - **c.** Turn the crane mode selector to the SELECT position. An asterisk (*) will appear to the left of the SWING LIMITER line.
   - **d.** Scroll up or down to SET LIMITS (Figure 3-61).

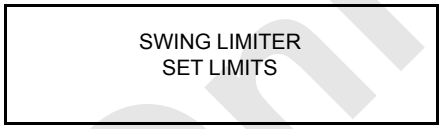


FIGURE 3-61

NOTE: The programmed swing limits have an accuracy of ±1.5 degrees of rotation (approximately ±0.5 ring gear tooth).

   - **e.** Swing the rotating bed to the desired right or left position and bring the rotating bed to a smooth stop. Do not swing beyond the desired limit.
   - **f.** Swing the rotating bed in the opposite direction and bring the rotating bed to a smooth stop at the desired position. Do not swing beyond the desired limit.
   - **g.** Scroll up to LIMITS ON to activate the selected limits.
   - **h.** Turn the crane mode selector to the SELECT position. SWING LIMITER will remain on, and the asterisk will disappear.
   - **i.** Install and adjust the limit switch actuators.

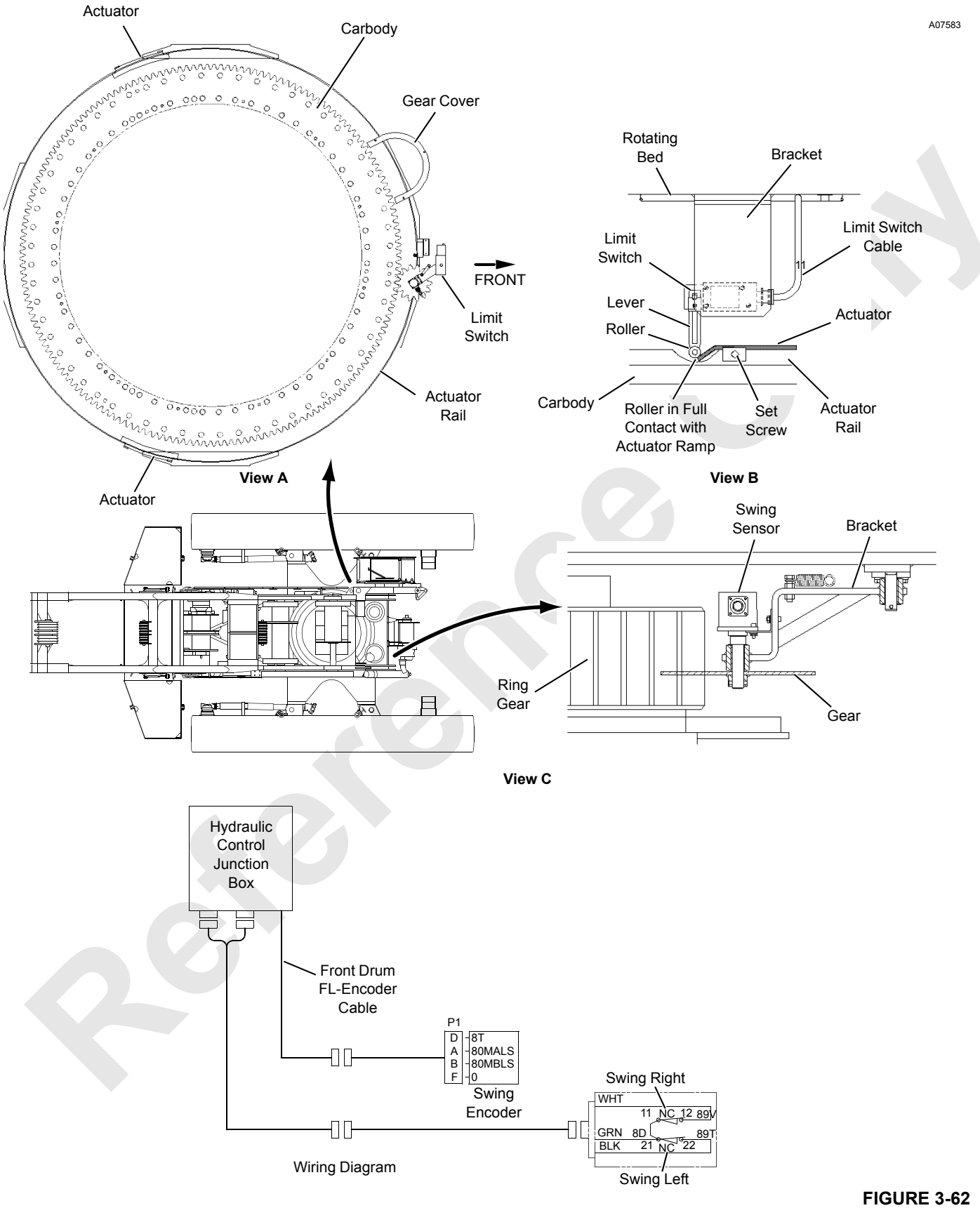


FIGURE 3-62

Swing Limit Switch Adjustment

See Figure 3-62 for the following procedure.

The physical limits defined by the position of the limit switch actuators cannot be bypassed. If either actuator is contacted, the swing pump shifts to neutral and the swing brake applies.

1. At initial setup only, adjust the limit switch lever so the roller is in full contact with the actuator ramp (see View B).
2. Remove both limit switch actuators from the actuator rail.
3. Program the swing limits. See Programming Swing Limits on page 3-74.
4. Swing the rotating bed in either direction to the programmed right or left swing limit.
5. Engage the swing lock.
6. Place the actuator on the rail (see View B)—to the right of the limit switch for the swing right limit or to the left of the limit switch for the swing left limit—so the actuator just lightly contacts the limit switch roller. Do not trip the limit switch open while performing this step.
7. Securely tighten the setscrews to secure the actuator.
8. Swing the rotating bed to the programmed swing limit in the opposite direction and repeat step 3 through step 7.

NOTE: The operator can swing away from either actuator by moving the swing handle in the opposite direction and building a pressure in that direction. If the pump control is stuck in the wrong direction, pressure will not build up in the safe direction and the brake will never release.

If for any reason the crane swings in the wrong direction after the brake has been released (due to crane being out of level or excessive side wind) the brake will reapply. The operator is free to attempt to swing away from the actuator again or stop and investigate. After several attempts, it is possible to ratchet well beyond the limit.

If the operator is unable to swing away from the actuators in two to three attempts, stop and move the crane away from any dangerous areas before trying to swing again.

SWING DRIVE DISCONNECT OPERATION

General

The crane has either one or two swing drives. Disconnecting the swing drives may be necessary to prevent equipment damage in high wind conditions by allowing the boom to weather vane. Before disconnecting the swing drives, perform the following steps.

1. Swing the crane so that the rear faces the wind direction.
2. Compare expected wind velocities to the wind limits indicated in Wind Conditions on page 3-82.

CAUTION

Equipment Damage!

To prevent equipment damage, sufficient clear area must be available for the crane to weather vane.

Before disconnecting the swing drives, make sure the boom will not strike power lines, buildings, or other stationary objects while the crane is weather vaning.

3. Lower the boom to the angle indicated or to the ground as required to prevent equipment damage.
4. Make sure there is sufficient clearance for the boom to swing without striking other objects.

Disconnecting Crane Swing Drive

See Figure 3-63 for the following procedure.

1. Pull out the locking pin knob.
2. Rotate the handle fully to the left (when facing the handle).
3. Release the locking pin knob.
4. Ensure that the handle is locked in position.
5. Repeat this procedure for the second swing drive.

Connecting Crane Swing Drive

See Figure 3-63 for the following procedure.

1. Pull out the locking pin knob.
2. Rotate the handle fully to the right (when facing the handle).
3. Release the locking pin knob.
4. Ensure that the handle is locked in position.
5. Repeat this procedure for the second swing drive.

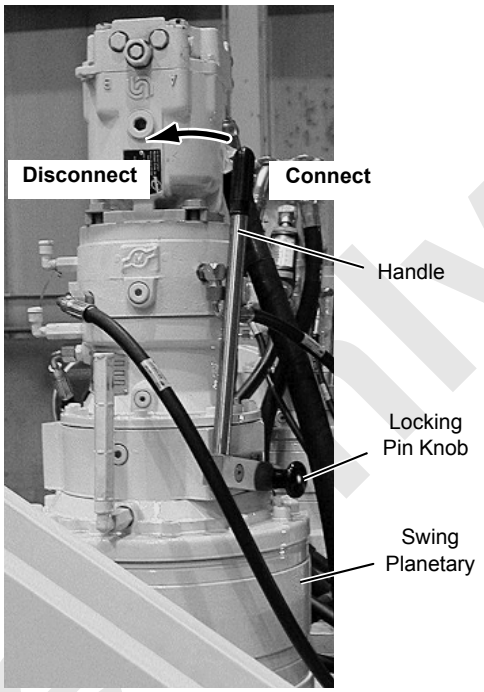
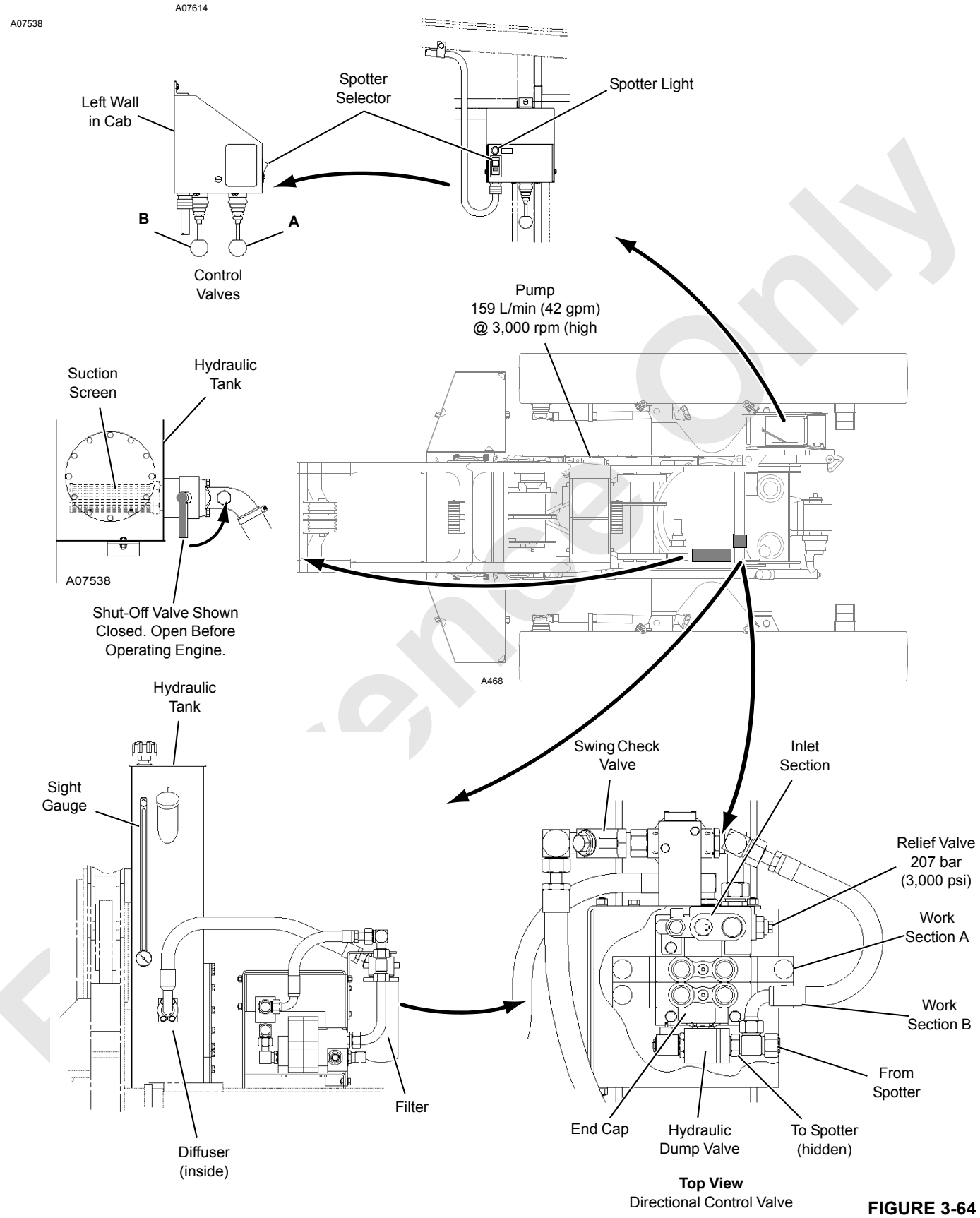


FIGURE 3-63



Top View
Directional Control Valve

FIGURE 3-64

PILE DRIVING SYSTEM CONTROLS

General

See Figure 3-64 for the location of the following components.

The following identifies the location and function of the hydraulic components that Manitowoc Cranes has provided for the customer-supplied pile driving system.

Components Function

Hydraulic Tank

The hydraulic tank is mounted on the right front corner of rotating bed. It houses the hydraulic oil for the system. The tank's capacity is approximately 246 L (65 gal).

CAUTION

Pump Damage!

The hydraulic tank shut-off valve must be open when the engine is operating to prevent spotter system pump cavitation.

A hydraulic tank shut-off valve is located at the bottom rear of the tank where the suction hose exits. The valve handle must be opened (in line with hose) before operating the engine.

A sight gauge and level decal are provided on the outside of the tank.

The tank contains a 100-mesh filter strainer that prevents large pieces of foreign matter from entering the pump.

Hydraulic Pump

The hydraulic pump is mounted on and driven by the 2250 swing pump.

The pump is a gear type with a flow rating of 159 L/min (42 gpm) at 3,000 rpm when the engine is operated at high idle.

Hydraulic Filter

The hydraulic filter is mounted near the directional control valve in the return oil line from the spotter.

The filter has a 10-micron, spin-on type of element with a visual service indicator.

Directional Control Valve

The directional control valve is mounted on the front of the rotating bed. The valve has the following four sections:

- Inlet Section
  - The inlet section routes oil from the pump to the two work sections (A and B) of the valve and routes return oil flow from the work sections through the filter back to the tank.
  - The inlet section has a relief valve that limits system pressure to 207 bar (3,000 psi).
- Two Work Sections (A and B)
  - Two electrically controlled work sections are spring-returned to neutral. The work sections direct oil flow to the customer-supplied cylinders in response to the controls in the operator's cab.
  - Work sections A and B have a 4-way, 3-position spool for controlling a cylinder. When in neutral, work section valves A and B lock the cylinders in position and allow oil flow to the customer-supplied spotter system control valve. When enabled, work sections valves A or B direct oil flow to the customer-supplied cylinders. Return oil from the cylinders flows through the system filter and back to the tank.
- End Cap
  - The end cap routes return oil back to the inlet section or to the spotter system.

Spotter System Dump Valve

The spotter switch is a two-position on/off switch, mounted on the left wall of the cab. The spotter switch controls the operation of the two-position dump valve. When the spotter switch is on, the green spotter light comes on. The dump valve closes to allow oil flow from the directional control valve to the spotter system control valve. When the switch is placed in the OFF position, the green spotter light goes off. The dump valve opens to allow oil to flow through the system filter and back to the tank.

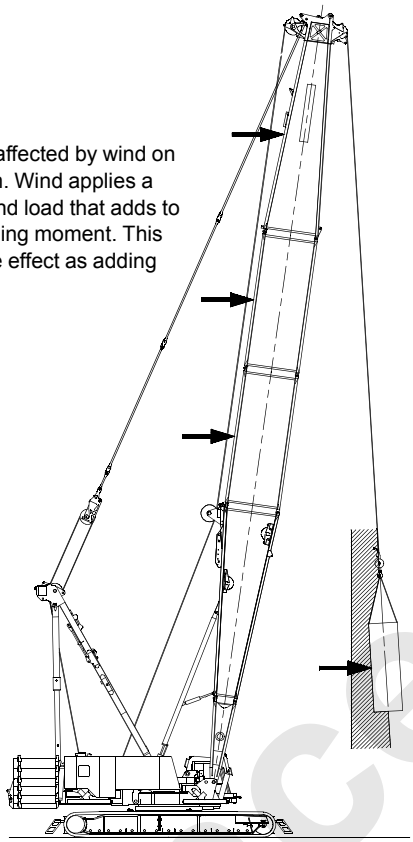
NOTE: When one or both directional control valves are operating, oil available to operate the spotter system is greatly reduced.

Cylinder Operating Controls

The controls are three-position, handle-operated electrical valves that provide variable control of the customer-supplied cylinders.

Handle A controls forward and reverse operation of work section A of the directional control valve. Handle B controls forward and reverse operation of work section B of the directional control valve. Exact operation of the controls depends upon how the customer connects the hydraulic hoses to the cylinders.

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

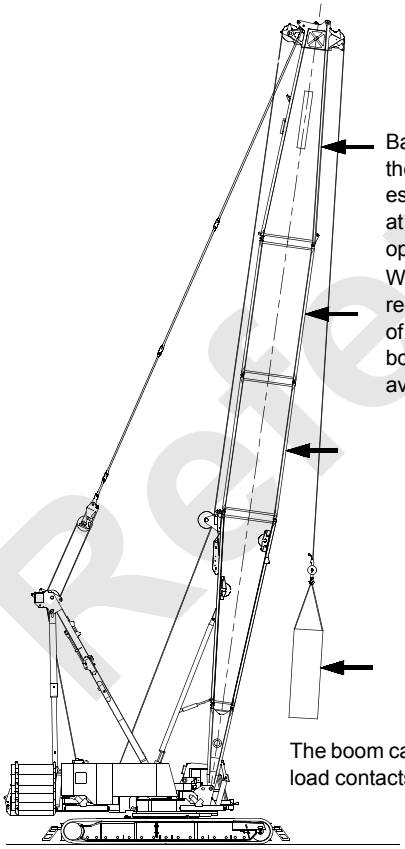


The wind's effect on the rear of the load increases the load radius. This condition can result in an overload hazard, possibly causing the crane to tip or the boom to collapse.

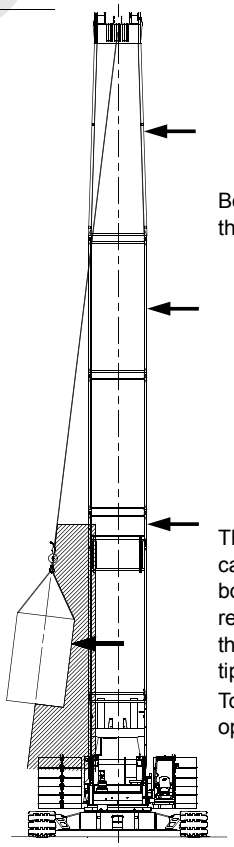
To avoid this hazard, reduce the operating speeds and load.

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

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



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



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

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

To avoid this hazard, reduce the operating speeds and load.

FIGURE 3-65

WIND CONDITIONS

General

See Figure 3-65 for more information.

WARNING

Tipping Crane Hazard!

Avoid the possibility of death or serious injury. Failing to observe this precaution can cause the crane to tip or the boom and/or jib to collapse.

Qualified operators, job planners, and supervisors shall evaluate the effect of wind on lifting and boom operations and continually monitor the wind speeds and gusts. These persons shall use their experience and judgment by reducing the ratings or operating speeds, or a combination of both.

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

The capacity of the crane is derated beginning at a wind speed as low as 7 m/s (15 mph), depending on boom height. For complete wind derate specifications, refer to the Wind Conditions document, which is supplied at the end of this section and in the Capacity Chart Manual.

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

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

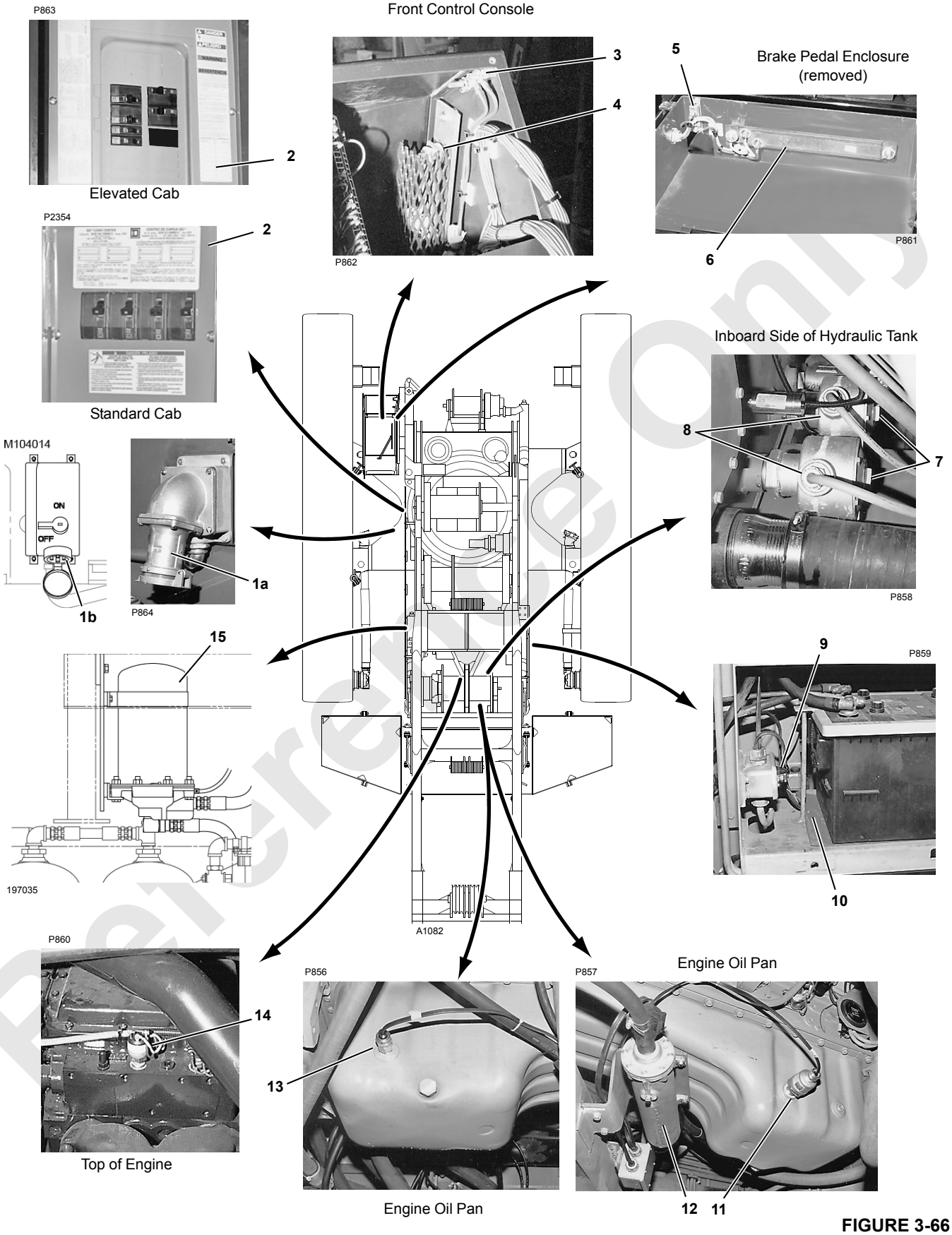


FIGURE 3-66

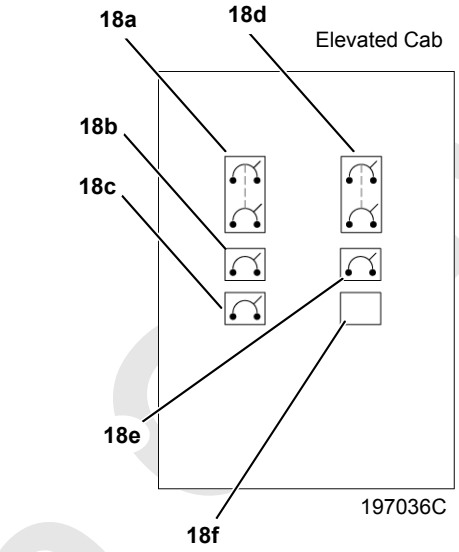
Component Identification for Figure 3-66:

Item	Description
Elevated Cab	
1a	Power Supply Receptacle—4P3W 100A, 250VDC
2	Circuit Breaker Load Center
18a	Main Breaker (50 amp)
18b	Control Console Heater Breaker (15 amp)
18c	Battery Pad Heaters Breaker (15 amp)
18d	Engine Coolant, and Oil Heater Breaker (20 amp)
18e	Hydraulic Reservoir Heaters Breaker (15 amp)
18f	Spare
Standard Cab	
1b	Power Supply Receptacle—3P4W 50A, 125/250 VDC
2	Circuit Breaker Load Center
19a	Main Breaker (50 amp)
19b	Engine Coolant Heater Breaker (20 amp)
19c	Treadle Valve Heater, and Front Control Console Heater Breaker (15 amp)
19d	Hydraulic Reservoir Heaters, Engine Oil Heater, and Battery Pad Heaters Breaker (15 amp)
Standard and Elevated Cabs	
3	Thermostat Controls
4	Heater Controls
5	Brake Pedal Valve Thermostat
6	Brake Pedal Valve Heater [1] (15 amp)
7	Hydraulic Oil Thermostat (under cover)
8	Hydraulic Oil Heaters
9	Battery Thermostat
10	Battery Heater (two places)
11	Engine Oil Heater
12	Engine Coolant Heater [2]
13	Engine Oil Thermostat
14	Radiator Fan Switch
15	Air Dryer

[1] Not provided on some cranes

[2] Heater has built-in thermostat

Breaker Arrangements



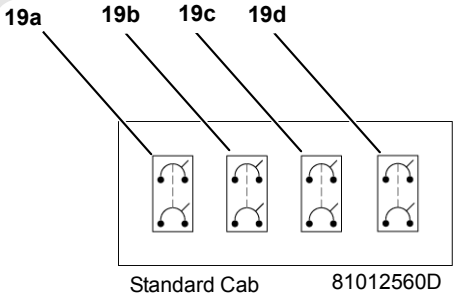


FIGURE 3-66 continued

COLD WEATHER HEATER PACKAGE

General

The optional cold weather heater package preheats critical machinery and lubricant sumps during cold weather shutdown. See Figure 3-66 for heater components.

CAUTION

Machine Damage!

Operating in an arctic climate without heaters can damage the machine during cold weather startup due to lack of lubrication.

The heater package may not provide adequate protection when operating below -34°C (-30°F). Contact the Manitowoc Crane Care Lattice Team for recommendations.

CAUTION

Hydraulic Pump Damage!

To prevent damage to pumps, warm the hydraulic oil to 16°C (60°F) minimum before operating the crane in an arctic climate.

When operating in arctic climates, with the outside temperatures continuously between -18°C (0°F) and -34°C (-30°F)—the crane should be equipped with the following heaters, and lubricated with the lubricants listed in Section 5.

Heaters

The heaters operate on 240 V_{AC} (single phase) electrical power supplied through an external power supply. The heater package includes the following:

Qty	Description	Voltage
1	Engine Coolant, 4000 watt	240 V
1	Engine Oil Sump, 300 watt	240 V
2	Hydraulic Oil Tank, 500 watt	240 V
2	Battery Pads, 75 watt	240 V
1	Control Console, 150 watt	240 V
1	Brake Pedal, 250 watt	240 V

NOTE: Cranes with an elevated cab are not equipped with a brake pedal heater.

In addition to heaters, the following items are provided:

Air dryer (see the Vendor Manual provided with crane)

- Thermostatically controlled radiator fans. Fans are off until the coolant temperature is at least 77°C (170°F). The thermostat turns on the fans at 82°C (180°F).

Thermostats

Thermostats turn the heaters on and off at the temperatures listed below.

Heater	Heater On	Heater Off
Hydraulic Oil Reservoir	16°C (60°F)	27°C (80°F)
Control Console	16°C (59°F)	27°C (77°F)
Battery Pads	10°C (50°F)	16°C (60°F)
Controls and Brakes	10°C (50°F)	16°C (60°F)

Turning Heaters On

If the power supply is disconnected, proceed as follows.

1. Make sure the main circuit breaker and each heater circuit breaker is off.
2. Make sure the external power supply is off.

WARNING

Electrocution Hazard!

Severe electric shock can cause death or serious injury. The crane owner/user shall make provisions for turning off the electrical power supply before connecting a power supply cord to the crane.

3. Connect an external power supply cord to the crane.
4. Turn on the external power supply.
5. Turn on the main circuit breaker.
6. Turn on each heater circuit breaker.

Turning Heaters Off

1. Turn off each heater circuit breaker.
2. Perform the remaining steps only if the power supply cord will be disconnected or if the electrical system is being serviced.
   a. Turn off the main circuit breaker.
   b. Turn off the external power supply.
   c. Unplug the power supply cord from the crane.

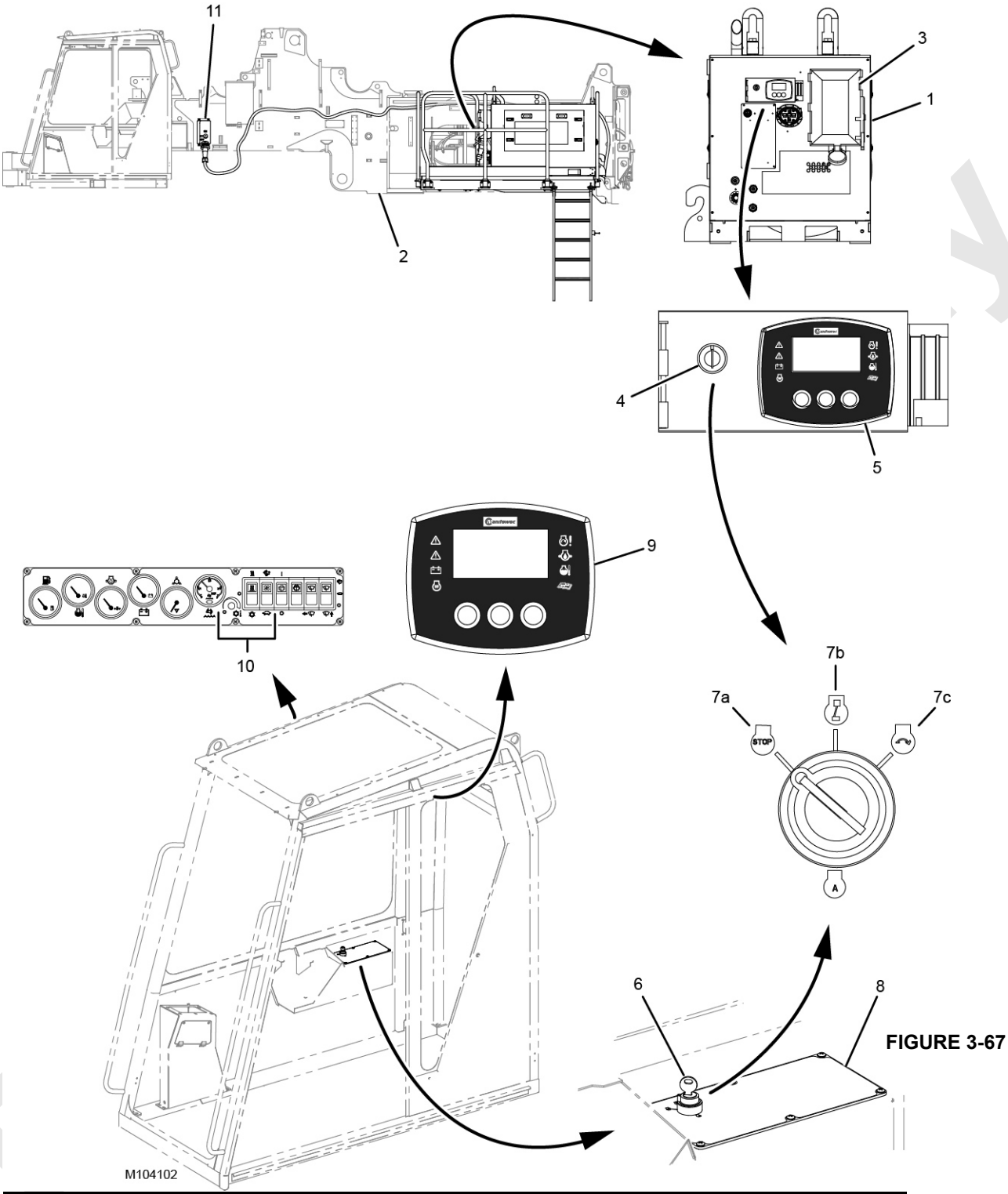


FIGURE 3-67

Item	Description	Item	Description	Item	Description
1	Auxiliary Power Unit (APU)	6	APU Cab Key Switch	9	APU Cab Control Panel
2	Rotating Bed	7a	STOP Position	10	HVAC Controls
3	APU Interlock Switch	7b	RUN Position	11	Rotating Bed Interlock Switch
4	APU Key Switch	7c	START Position		
5	APU Control Panel	8	Right Side Control Panel		

AUXILIARY POWER UNIT (APU)

General

See Figure 3-67 for the following information.

The optional auxiliary power unit (APU) (1) is a self-contained, stand-alone system. The APU can be equipped to power the cab HVAC and electrical system while the crane engine is off during downtime. The APU can also be used to power optional lighting systems and cold weather packages. If the crane engine and the APU engine are running at the same time and the A/C toggle switch is activated in the cab, the crane engine A/C compressor will shut off.

Engine

The APU is powered by a Caterpillar C1.5 diesel engine and is equipped with a 12 V_{DC} (65 A @ 3034 rpm) alternator and an additional 28SI 12 V_{DC} (160 A @ 3888 rpm) alternator.

Generator and Interlock Switch

The A/C power is supplied by a Marathon MagnaPLUS generator located at the rear of the engine assembly. The generator provides a continuous 120 V_{AC} (10 kW @ 60 Hz) output. The APU interlock switch (3) is protected by three fuses rated at 60 A. There is also a rotating bed interlock switch (11) located on the left side of the crane.

Key Switches

The APU is controlled by a three-position key switch with the following positions: STOP (7a), RUN (7b), and START (7c). The key switches are located either in the cab or on the APU.

The APU key switch (4) and the APU control panel (5) are located on the APU, which is located on the left side of the rotating bed (2).

The APU cab key switch (6) is located within the cab on the right side control panel (8). The APU cab key switch enables the operator to start or stop the APU as well as send the APU status to the APU cab control panel (9). The RUN signal from the key switch provides power to the control panel and runs to the APU to bring it out of STANDBY mode. When the APU engine is running, the HVAC controls (10) will function the same as if the crane engine was running.

Safety Switches

General

Prior to performing any service, maintenance, or repairs, the auxiliary power unit (APU) must be disconnected from its battery source located within the APU control panel. Follow all established and acceptable safety practices while inspecting, servicing, or repairing the APU.

The safety systems on the auxiliary power unit (APU) should be examined/tested whenever maintenance is performed on the APU to ensure that they are in good condition and proper working order.

Side Access Panel Safety Switches

It is critical that the side access panel safety switches on the auxiliary power unit (APU) are never deactivated or bypassed. Failure to comply may result in serious injury.

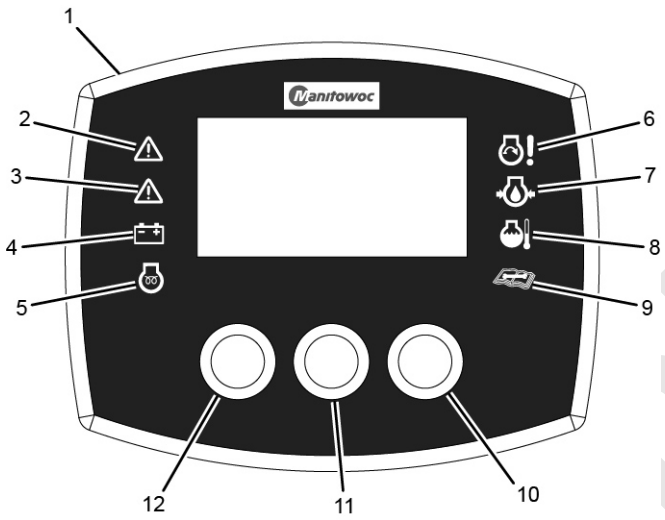
The side access panel safety switches are designed to prevent the APU from starting when the side access panel is loose or has been opened. When the switch is open, the access panel has been opened or is loose. When the switch is closed, the access panel is latched down. The switch is located at the left side of each side access panel.

Starting with the Side Access Panel Opened

Some repair or diagnosis procedures may require the auxiliary power unit (APU) to be started with the side access panel opened. Never deactivate or bypass the safety cover switch.

Starting Aids

Do not use aerosol starting aids such as ether. Use of any starting aids can result in an explosion and personal injury and will render the warranty null and void due to internal engine damage.



Item	Description
1	Control Panel
2	Warning Symbol (Red)
3	Warning Symbol (Amber)
4	Battery Symbol (Red)
5	Glow Plug Symbol (Amber)
6	Engine Failure Symbol (Red)
7	Engine Oil Pressure Symbol (Red)
8	Engine Coolant Temperature Symbol (Red)
9	Maintenance Reminder Symbol (Amber)
10	Right Button
11	Center Button
12	Left Button
13	APU Monitor Screen
14	APU Output Screen
15	Fault Screen
16	Software Version/Display Setting Screen

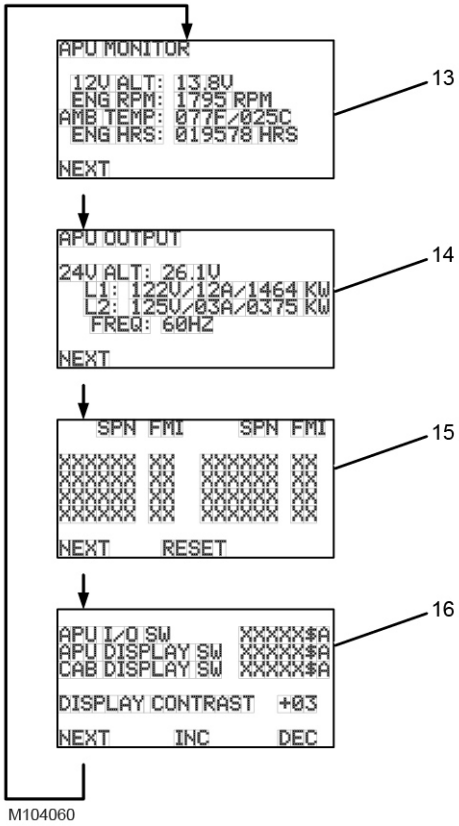


FIGURE 3-68

Control Panel

See Figure 3-68 for the following information.

The control panel (1) can be used to display the status and diagnostic information of the APU to the user. On each side of the display there are four back-lit symbols—all eight are illuminated for one second at startup.

- **Warning Symbol (red) (2)**—This warning symbol is illuminated when faults are present that prevent the APU from starting.
- **Warning Symbol (amber) (3)**—This warning symbol is illuminated when faults are present that prevent the APU from being fully functional.
- **Battery Symbol (red) (4)**—The battery symbol is illuminated when the charging system is not operational.

- **Glow Plug Symbol (amber) (5)**—The glow plug symbol is illuminated when the glow plugs are energized.
- **Engine Failure Symbol (red) (6)**—The engine failure symbol is illuminated when the engine fails to start or when the engine stalls.
- **Engine Oil Pressure Symbol (red) (7)**—The engine oil pressure symbol illuminates steadily when the engine oil pressure is low, and it blinks when failure of the engine oil pressure switch is detected.
- **Engine Coolant Temperature Symbol (red) (8)**—The engine coolant temperature symbol illuminates steadily when the engine is overheating.
- **Maintenance Reminder Symbol (amber) (9)—**The maintenance reminder symbol illuminates when the engine run time reaches 500 hours. Holding the reset button for five seconds will reset the 500-hour maintenance reminder.

Control Panel Screens

See Figure 3-68 for the following information.

There are four different screens that can be viewed on the control panel display. The left button (12) is used for scrolling through the different screens. The center button (11) and the right button (10) are used for accepting the text above the button. The screens will show up in the following order.

1. **APU Monitor Screen (13)—**The APU monitor screen is the default screen. After 10 seconds of inactivity, the display will return to this page. This screen will display the following:
   - Alternator voltage
   - Engine rpm
   - Ambient temperature
   - Engine hours
2. **APU Output Screen (14)—**The APU output screen will display the following:
   - Alternator voltage
   - Generator output, Leg1,V/A/KW
   - Generator output, Leg2,V/A/KW
   - Generator frequency
3. **Fault Screen (15)—**The fault screen displays the fault codes in J1939 SPN-FMI format. The user can reset any non-active faults by pressing the reset button. Hold the reset button for five seconds to reset the 500-hour maintenance reminder.
4. **Software Version/Display Setting Screen (16)—**The software version/display setting screen is used to adjust the display contrast as well as software revisions.

Control Module

The auxiliary power unit (APU) control module's inputs will provide initial power to the micro-controller and allow exit from standby mode when run signals are provided. This allows very low current draw while in standby mode. The APU control module features a J1939 port, which allows communication with the display in the APU control panel and the crane control panel.

Fault Codes

The APU control module supports J1939 DM1 diagnostic trouble codes (DTC). DTCs used in the APU system are expressed below in SPN-FMI format (see Table 3-13).

Table 3-13. DTCs

Code	Description
100-0	APU engine oil pressure fault, signal above normal (defective oil pressure switch)
100-1	APU engine oil pressure fault, signal below normal (low oil pressure while running)
110-0	APU coolant temperature fault (coolant over temperature)
171-0	Ambient air temperature higher than
171-1	Ambient air temperature lower than expected
190-0	Engine speed higher than expected
190-1	Engine speed lower than expected
632-5	Fuel relay current lower than expected
632-6	Fuel relay current higher than expected
676-5	Glow plug relay current low
676-6	Glow plug relay current high
677-5	Starter relay current lower than expected
677-6	Starter relay current higher than expected
2436-1	Generator frequency lower than expected
2436-0	Generator frequency higher than expected
3353-1	12 V alternator output fault (not producing power while engine is running)
3354-1	12 V alternator output fault (not producing power while engine is running)
520220-31	Interlock input fault (start attempted while access doors are not closed)
520221-5	Display power supply output current lower than expected
520221-6	Display power supply output current higher than expected

Starting the Auxiliary Power Unit (APU)

See Figure 3-67 for the following procedure.

1. Stop the crane engine and turn the key switch to the OFF position.

WARNING

Personal Injury Hazard!

Avoid death or serious injury. Accidental starting could occur. Never deactivate or bypass the safety switches.

The side access panels are equipped with safety switches.

2. Make sure the side access panels on the auxiliary power unit (APU) (1) are closed and latched. The APU will not start with the panels open.

CAUTION

Starter Motor Damage!

The starter motor could overheat, causing damage.

Do not crank the engine for more than 30 seconds. Allow the starter motor to cool before cranking the engine again.

CAUTION

Engine Damage!

Use of any starting aids can result in an explosion and personal injury.

Do not use aerosol starting aids such as ether.

3. Turn the APU key or cab key switch (4 or 6) to the RUN position (7b). This activates the control panel and is confirmed when the control panel displays all active systems.

NOTE: The APU can be started using the switch in the operator cab or on the APU. If the switch in the cab is used, the crane engine ignition switch must be in the RUN position.

Glow plug warm-up is controlled by an external ambient temperature probe. Confirmation of glow plug engagement is displayed by the glow plug icon being active. After the glow plug light turns off, the engine can be started.

4. Turn the key switch to the START position (7c) and release the key when the engine starts.
5. Make sure the rotating bed interlock switch (11) and APU interlock switch (3) are in the ON position.
6. Turn on the circuit breakers in the load center.

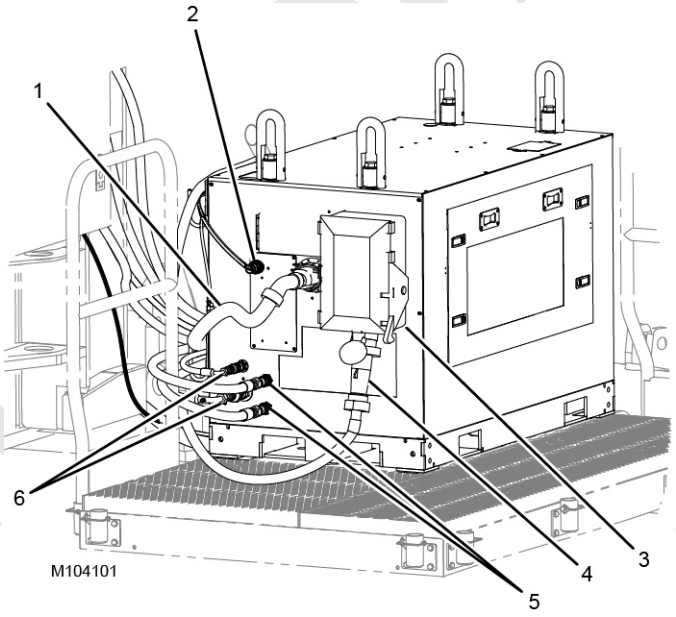
Stopping the Auxiliary Power Unit (APU)

1. Turn off the circuit breakers in the load center.
2. Stop the auxiliary power unit (APU) engine using the key switch in the operator cab or on the APU.

NOTE: Turning off the interlock switches is only required when servicing or removing the APU.

If the APU is to be shut down for an extended period of time, it is recommended to turn both ignition keys to the OFF position to avoid draining the batteries.

Identifying the Connectors



Item	Description
1	Electrical Cable (DC, WAD1)
2	Electrical Cable (DC, WAC1)
3	APU Interlock Switch
4	Power Supply Cable (AC, WAA1)
5	Fuel Line (qty 2)
6	A/C Line (qty 2)

FIGURE 3-69

PREPARATION FOR COLD WEATHER

Crane Limitations

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

In cold weather, dynamic loads (impact and shock) can affect the steels used in Manitowoc cranes. Dynamic loads are created by traveling, sudden application and release of load, and duty-cycle operations (dragline, clamshell, magnet, container handling, concrete bucket placement).

To prevent possible damage to the crane and its attachment when operating during cold weather, Manitowoc Cranes recommends the following:

- -21°C (-5°F) to -30°C (-22°F)—Avoid impact or shock loading of crane and attachment. Operations involving hydraulic cranes should be conducted with due regard to potential failure of hydraulic components. For critical lifts, the crane should be derated 25%.
- -31°C (-23°F) to -40°C (-40°F)—Derate the 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 derated the crane accordingly.

Wire Rope

The wire rope manufacturers indicate that wire rope will not become brittle in temperatures down to -34°C (-30°F). Lubrication may be a problem, however. During extremely cold weather, normal wire rope lubricants may harden and chip off, leaving the rope unlubricated. Consult your wire rope supplier for recommended cold–weather lubricants.

Cold Weather Starting Aid

Engine startup at temperatures below 4°C (40°F) requires the use of a cold-weather starting aid.

DANGER

Engine Explosion Hazard!

Avoid the possibility of death or serious injury.

The crane engine has an air intake pre-heater. The pre-heater will ignite a combustible starting aid (ether) if used, resulting in a severe explosion and/or burns.

Do not spray any combustible starting aid (ether) into the air intake.

Coolant and Oil Pan Heaters

240 V coolant and oil pan heaters can be installed in the engine. The heaters utilize an electric heating element to heat the coolant and oil inside the engine when the crane is idle. Each heater is equipped with an extension cord for connection to an owner-furnished electric power supply. The coolant heater must be capable of maintaining the engine's coolant and oil temperatures between 4°C and 10°C (40°F and 50°F). Contact the nearest engine dealer for availability and installation of the heaters.

NOTE: Engine heaters must be unplugged when the engine is running to prevent the cooling system from overheating.

Cooling System

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

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

Battery

To provide maximum cranking power and to prevent the battery from freezing, it must be kept fully charged (1.26 to 1.28 specific gravity) and warm when the crane is idle during cold weather.

It is recommended that the battery be stored indoors or heated with a battery heater when the crane is idle.

NOTE: The battery box is equipped with two 75 W heated battery pads to keep the batteries 17°C (30°F) warmer than the ambient air temperature.

Be aware of the following:

- 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

See the engine manufacturer's manual for more information and recommendations.

Fuel Oil

See the engine manufacturer's manual for more information and recommendations.

Gear Oil

Hydraulic Cranes

Use a gear oil that meets MIL-L-2105C specification or API-GL-5 classification. Change to one of the following viscosities when the corresponding temperature range will be encountered:

- Below -23°C (-10°F)—75W-90
- Above -23°C to 38°C (-10°F to 100°F)—80W-90
- Above 38°C (100°F)—85W-140

Hydraulic Oil

General

Optional thermostatically controlled heaters (120 V or 240 V) can be installed in the hydraulic tank to aid in cold weather startup.

The heaters are designed to keep the oil temperature 17°C (30°F) warmer than ambient air temperature. Each heater is equipped with an extension cord for connection to an owner-furnished electric power supply.

NOTE: Hydraulic tank heaters must be unplugged when the engine is running to prevent the hydraulic system from overheating.

Change the oil in the hydraulic system to ISO Grade 15 when the expected ambient temperature will remain at 0°C (32°F) or below.

Change the oil in the hydraulic system to ISO Grade 46 when the expected ambient temperature will remain above 0°C (32°F).

Air System

Install the optional air dryer available from Manitowoc Cranes.

Frequently inspect the moisture ejector at the air tanks for proper operation. The moisture ejector has a heater that prevents water from freezing in the ejector when the engine is running.

Manually drain any moisture from the air tanks after the engine is stopped before an idle period.

CIRCUIT BREAKERS

See Section 3 in the Service Manual for identification and location of the circuit breakers used to protect the crane's electric circuits.

SECTION 4
SET-UP AND INSTALLATION

TABLE OF CONTENTS

Published 06-24-16, Control # 241-01

Published 06-24-16, Control # 241-01

SECTION 4
SETUP AND INSTALLATION

RIGGING DRAWINGS

See the boom and jib rigging drawings that apply to your crane.

OPTIONAL ATTACHMENTS

If applicable, see instructions for optional attachments that apply to your crane.

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.

The terms “right,” “left,” “front,” and “rear” refer to the operator’s right, left, front, and rear sides when seated in the operator’s cab looking forward with the crawler motors to the rear.

WARNING

Assemble or Disassemble Hazard!

Death or serious injury can occur if the assembly and disassembly instructions are not followed.

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

WARNING

Tipping/Overload Hazard!

Avoid tipping the crane over or collapsing the mast:

- Assemble and disassemble the crane on a firm, level, uniformly supporting surface.
- Do not exceed swing limits given in Table 4-3.
- Keep the crane level when operating carbody jacks.

WARNING

Falling Hazard!

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

Avoid falling off crane and boom! Use sturdy owner-furnished ladders or aerial work platforms to gain access to areas that cannot be reached from ladders or steps provided with the crane.

WARNING

Moving Parts/Pinch Point Hazard!

Avoid death or crushing injury during crane assembly and disassembly:

- Assembly personnel shall take every precaution to prevent injury when working near moving parts.
- Maintain communication between the operator and assemblers to avoid accidents.
- Do not raise or lower the gantry and 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 falling and the load from dropping, the crane owner/user shall verify the following prior to each lift:

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

SELF-ERECTING EQUIPMENT

See Figure 4-1 for assembly and disassembly.

The 2250 with self-erect is a self-erecting crane equipped with the following components:

- Rotating bed jacking system with pads for lifting the crane onto and off the trailer. The jacks are also used to raise the crane during the crawler repositioning of the carbody support pedestal.
- Hydraulically actuated pins for connecting and disconnecting the crawlers to and from the carbody
- Hydraulic cylinders for raising and lowering the gantry
- Hydraulically actuated pins for connecting the crane counterweight to the rear of the crane
- 27 t (30 USt) load block and 3-leg chain sling with hooks for handling components

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 and with the rigging drawings before attempting to assemble or disassemble the crane, boom, or jib.

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

ASSEMBLY AND DISASSEMBLY AREA

Select an assembly/disassembly area that has a firm, level, uniformly supporting surface. Make sure the area is large enough to accommodate the crane, the selected boom and jib length, movement of trucks with trailers, and movement of the 2250 (or assist crane).

Set the carbody jack pads on a flat, firm foundation that will support the load placed on them. The maximum load on each jack is 40 824 kg (90,000 lb).

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

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

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

NOTE: Contact the Crane Care Lattice Team at Manitowoc Cranes for ground bearing information.

ACCESSING PARTS

Some parts of the crane, boom, and jib cannot be reached from the ground. Take necessary precautions to prevent slipping and/or falling off the crane and attachment during installation and removal.

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

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

Optional boom ladders (stored in boom butt) are available from Manitowoc Cranes. If your crane has ladders, see the appropriate instructions.

Do not use the top of the boom or jib as walkways.

CRANE WEIGHTS

See Crane Weights on page 1-9 in Section 1 for the overall weight of the crane and for the individual weights of the components.

RETAINING CONNECTING PINS

Connecting pins are retained in various ways:

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

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

MISCELLANEOUS LOOSE PARTS BOX

See Figure 4-2 for more information.

Miscellaneous loose parts are shipped in a job box with the crane. The box contains standard items that are part of every crane (for example, crawler shim kit, touch-up paint, and spacers) as well as optional items (for example, wind speed assembly, warning light assembly, aircraft warning light, cold weather cap and receptacle, and mirror assemblies). A decal on the inside of the box lid indicates the parts that should be included in the parts box.

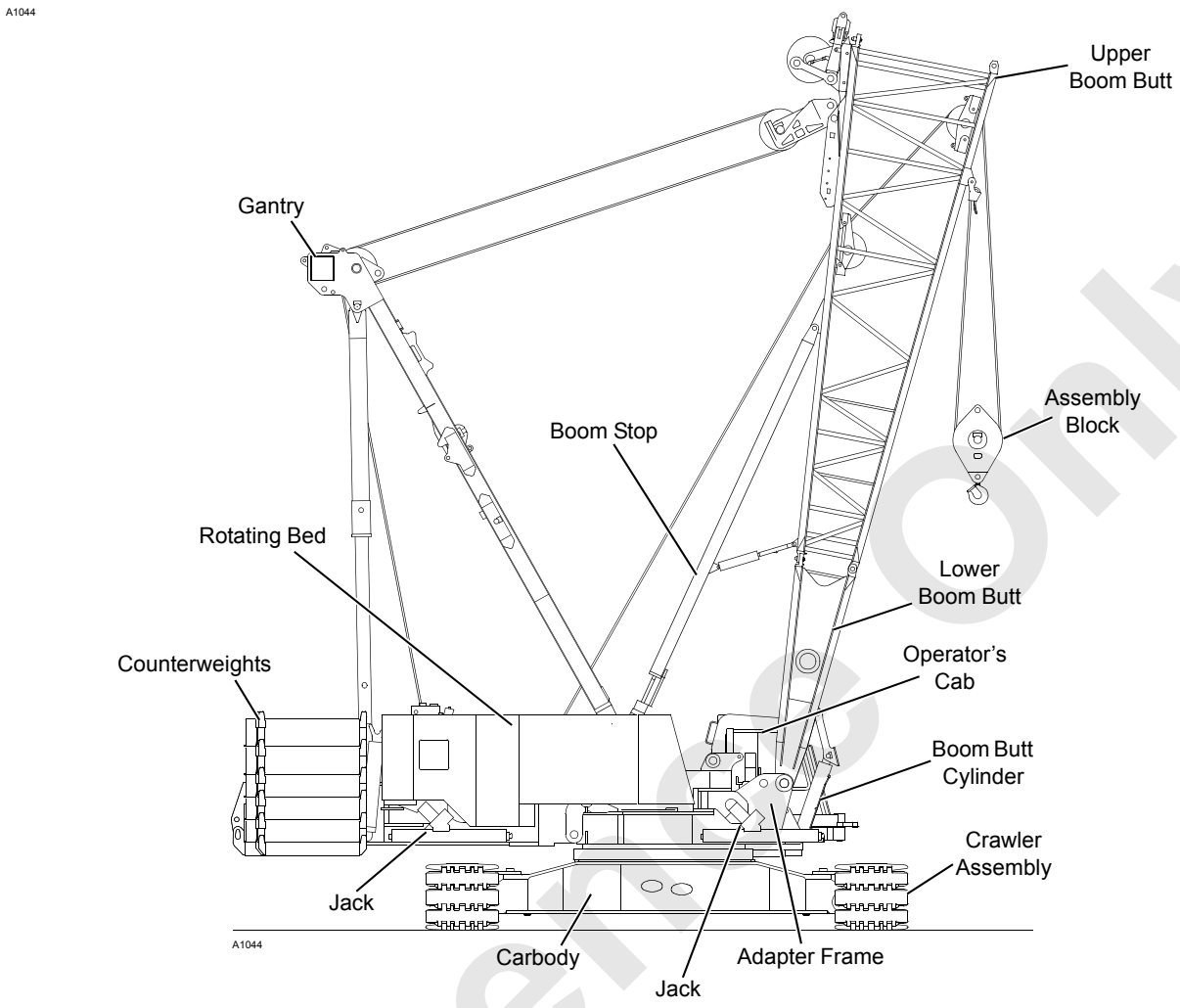


FIGURE 4-1

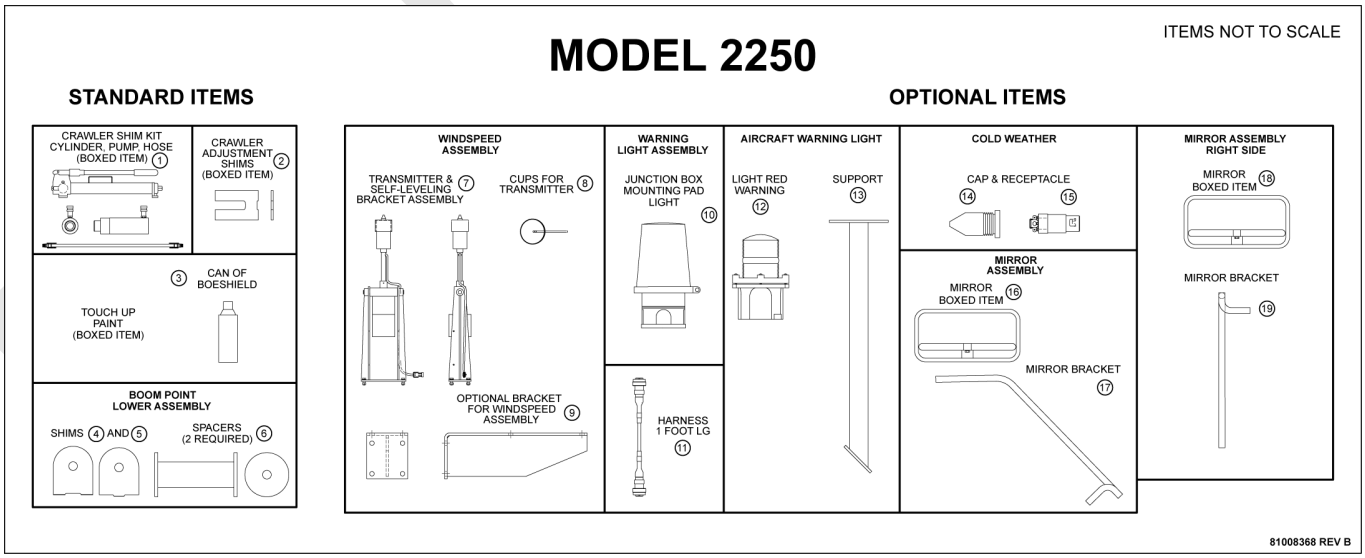


FIGURE 4-2

SHIPPING CRANE COMPONENTS

This section contains outline dimensions and weights for the major components of the crane. For weights of other components, see Crane Weights on page 1-9 in Section 1. For the dimensions of the boom and jib sections, see the Range Diagram in your Capacity Chart Manual.

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

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

- All trailer loads comply with local, state, and federal transportation requirements.
- All crane components are properly blocked and secured so they cannot fall off the trailers.
- Avoid damage to components. See Figure 4-3 for the following:
  - Use nylon tie-downs to secure the components (see 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 (see View B).
  - When securing the boom sections, wrap tie-downs over the chords, never over the lacings. Keep the tie-downs as close to the blocking as possible to prevent bending the chords (see View A).

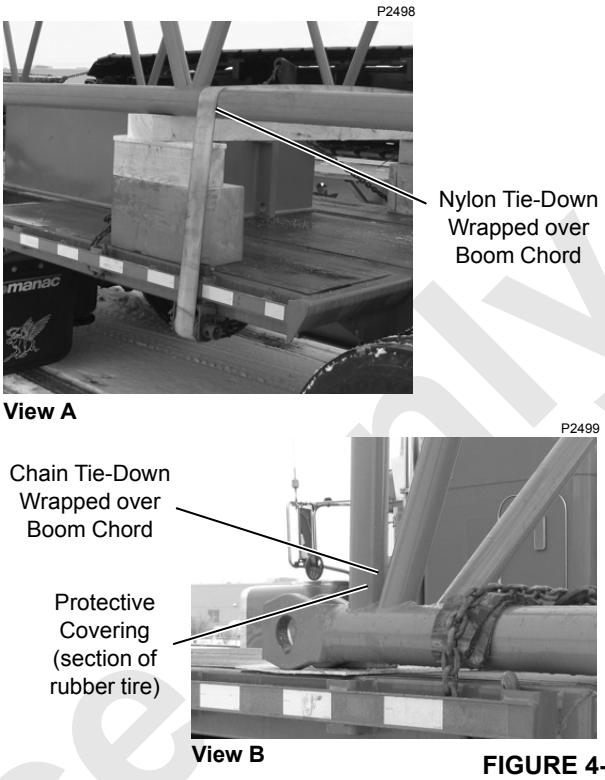
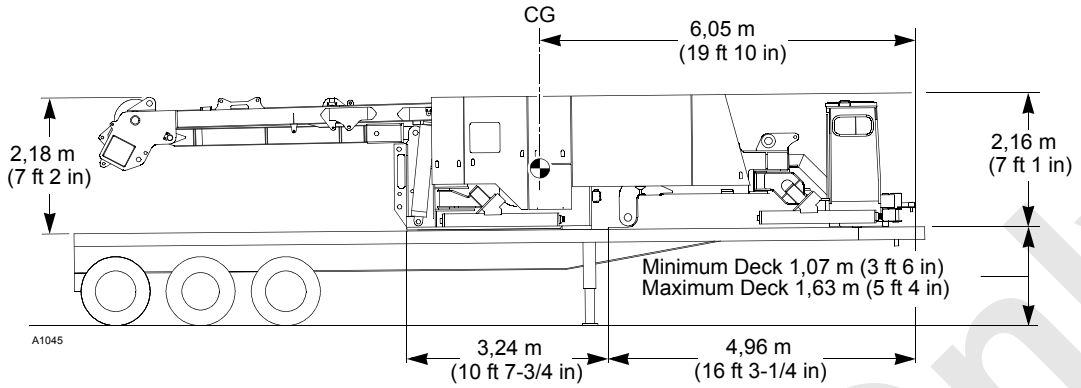


FIGURE 4-3

COMPONENT WEIGHTS

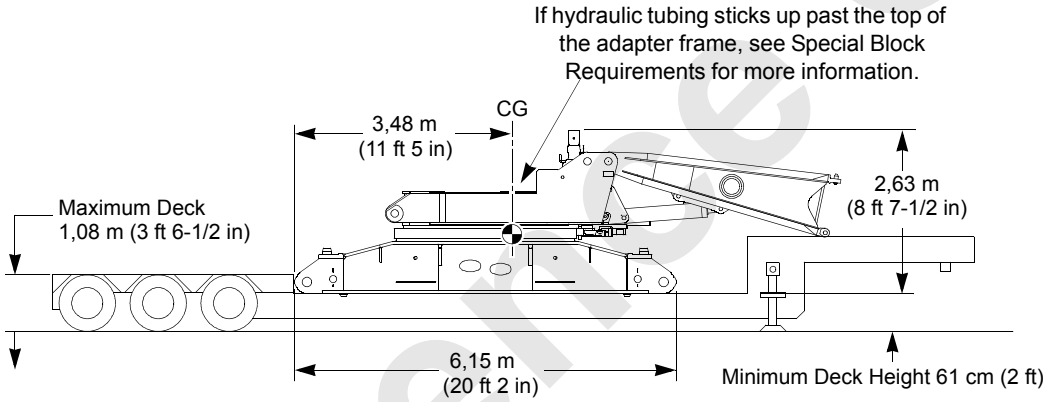
Table 4-1. Trailer Arrangements and Component Weights

Trailer Arrangement	Component	Weight kg (lb)
A	Rotating Bed with Operator's Cab, Gantry, Equalizer, Self-Erecting Jacks, and Unequal Split Rear Drums Without Lagging and Wire Rope	36 287 (80,000)
	Optional Items	
	Front Drum Without Lagging or Wire Rope **ADD**	2 812 (6,200)
	Ringer Prep with Two-Full Width Drums and Lagging Without Wire Rope **ADD**	4 309 (9,500)
B	Undercarriage with Carbody and Adapter Frame, Turntable Bearing, One Swing Drive, 3,66 m (12 ft) Lower Boom Butt, and Boom Butt Handling Cylinder	29 211 (64,400)
	Optional Items	
	Luffing Hoist with Wire Rope **ADD**	2 177 (4,800)
	Ringer or MAX-ER Prep Second Swing Drive **ADD**	816 (1,800)
C	Crawler Assembly with 1,22 m (48 in) Treads **EACH**	25 265 (55,700)
D	9,14 m (30 ft) Boom Top with 9-Sheave Lower Boom Point, Wire Rope Guide, and Basic Straps	5 761 (12,700)
	Additional Items	
	Two Counterweight Side Boxes **ADD FOR EACH**	7 031 (15,500)
	One Counterweight Side Box **ADD**	9 072 (20,000)
E	8,53 m (28 ft) Upper Boom Butt with Wire Rope Guide, and Boom Stop	5 194 (11,450)
	Additional Items	
	Two Counterweight Side Boxes **ADD FOR EACH**	7 031 (15,500)
	27,22 t (30 USt) Assembly Block **ADD**	907 (2,000)



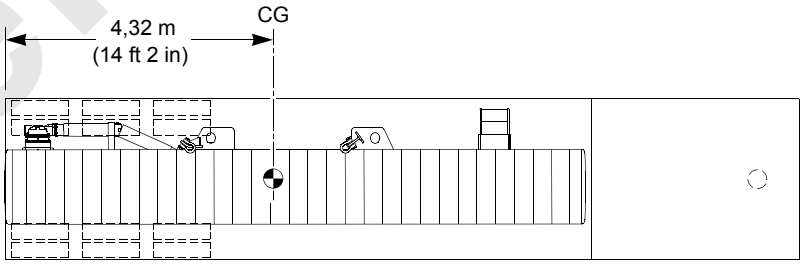
Load 13,16 m (43 ft 2 in) Long x 3,00 m (9 ft 10 in) Wide x 2,13 m (7 ft) High

View A



Load 8,81 m (28 ft 11 in) Long x 2,95 m (9 ft 8 in) Wide X 2,63 m (8 ft 7-1/2 in) High

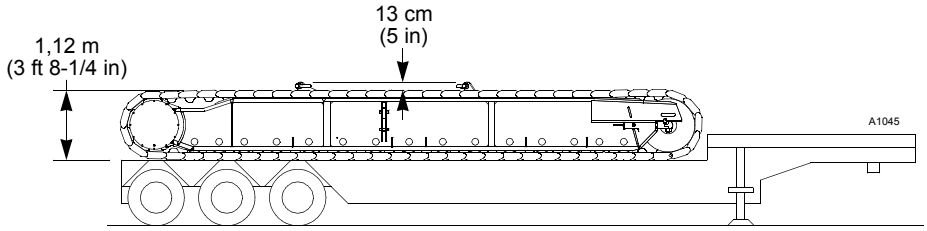
View B



Load: 9,37 m (30 ft 9 in) Long x 2,21 m (7 ft 3 in) Wide x 1,26 m (4 ft 1-1/2 in) High

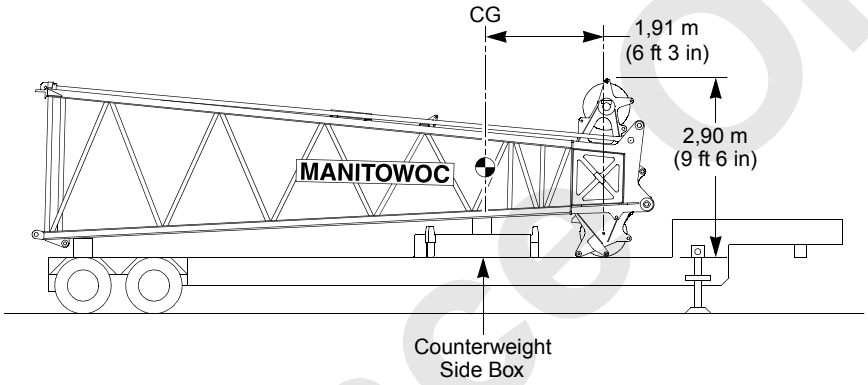
View C_1

FIGURE 4-4



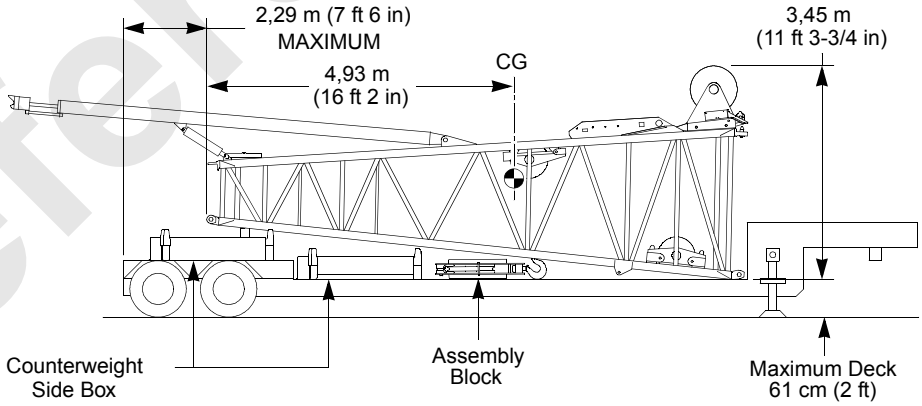
Load: 9,37 m (30 ft 9 in) Long x 2,21 m (7 ft 3 in) Wide x 1,26 m (4 ft 1-1/2 in) High

View C_2



Load: 10,06 m (33 ft) Long x 2,59 m (8 ft 6 in) Wide X 2,90 m (9 ft 6 in) High

View D



Load: 11,94 m (39 ft 2 in) Long x 2,59 m (8 ft 6 in) Wide x 3,45 m (11 ft 4 in) High

View E

FIGURE 4-4 continued

SPECIAL BLOCKING REQUIREMENTS

General

CAUTION

Avoid Equipment Damage!

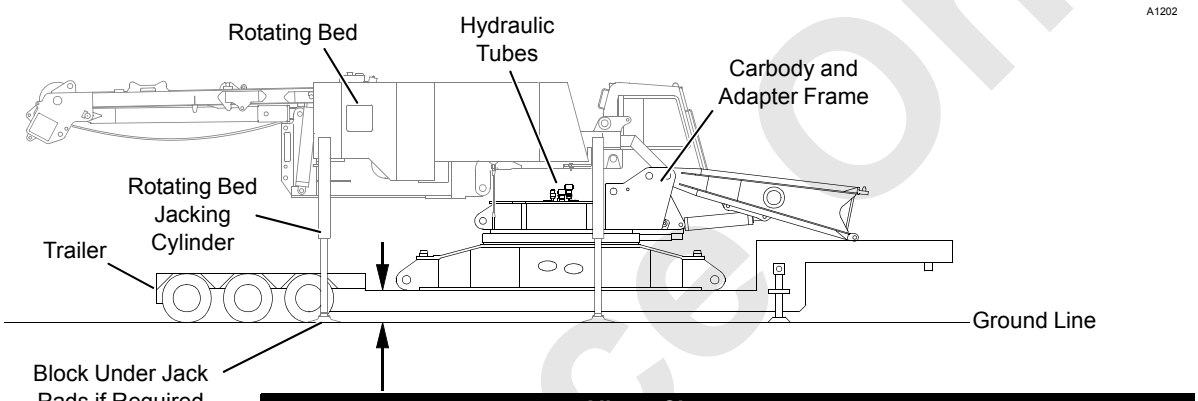
Failing to observe the precautions will result in damage to hydraulic tubes extending out of the rotating bed adapter frame.

The control system on some MAX-ER–prepared cranes has been modified to allow simultaneous operation of the boom hoist, travel, and drum 9 when operating in the MAX-ER mode. To accommodate this modification, it was necessary to extend the hydraulic tubing in the center of the adapter frame approximately 152 mm (6 in) higher than normal.

Blocking

See Figure 4-5 for more information.

During crane assembly and disassembly, it may be necessary to block under the jack pads of the rotating bed jacking cylinders to provide sufficient clearance between the rotating bed and the tubing in the adapter frame. The amount of blocking required depends on the height of your trailer deck above ground level.



Trailer Deck Height	Allows Clearance Above Hydraulic Tubes	
0,8 m (2 ft 9 in)	51 mm (2 in)	No Blocking Required Under Jack Pads
0,6 m (2 ft)—Minimum	279 mm (11 in)	No Blocking Required Under Jack Pads
1,1 m (3 ft 6 in)—Maximum	114 mm (4-1/2 in)	0,3 m (1 ft) Minimum Blocking Required Under Jack Pads

FIGURE 4-5

UNDERCARRIAGE LUBRICATION AT ASSEMBLY

Each time the crawlers are assembled to the carbody, thoroughly clean and grease all machined surfaces on the carbody and the crawlers (surfaces marked with * in Figure 4-6).

Failing to perform this step will cause loud noises to come from the undercarriage when turning (cutting) the crawlers or swinging the rotating bed over the corner of the crawlers.

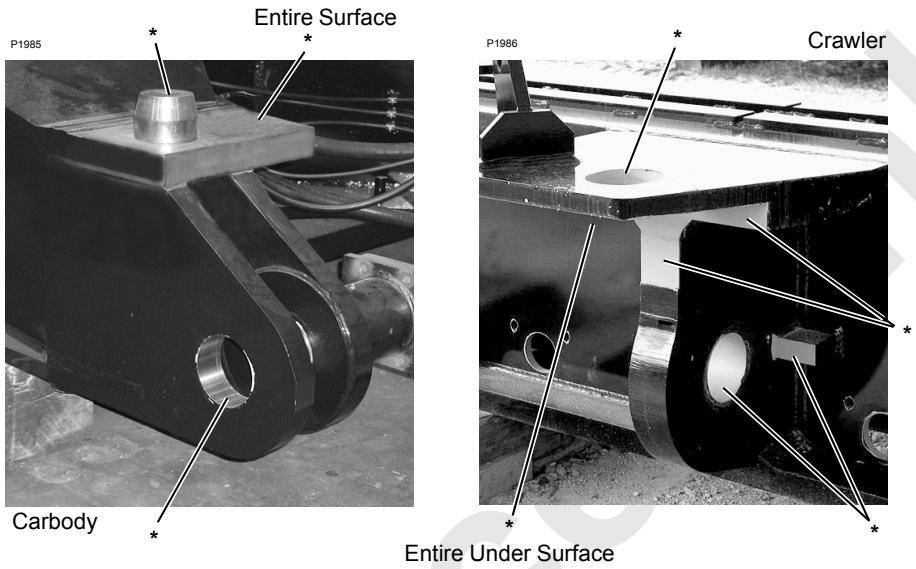


FIGURE 4-6

4

CRANE ASSEMBLY WITH SELF-ERECT

Operating Controls

In order to assemble and disassemble the crane with the self-erecting system, the engine must be running and crane Setup mode must be selected and confirmed.

The jacking cylinders, boom butt cylinder, gantry cylinders, hydraulic disconnect, rotating frame pins, and crawler pins are controlled by switches on the jacking and setup remote controls.

See Section 3 for identification and operation of all controls.

Pre-Start Checks

WARNING

Burn and Inhalation Hazards!

Avoid possible injury. The temperature of exhaust and exhaust components for a Tier 4F engine can be higher than other engines and can cause serious burns.

Avoid physical contact with the exhaust gases and the exhaust system components. Exhaust gases are harmful to your health.

Keep all flammable materials away from the exhaust system to prevent fire.

If it is necessary to service the crane while the engine is running, inhibit (turn off) SCR regeneration using the switch in the cab to prevent a higher exhaust temperature.

Make the following checks before starting the engine upon arrival at the assembly site. See Section 3 for starting instructions.

Engine

- Check for leaks
- Check fuel, oil, diesel exhaust fluid (DEF), and coolant levels
- Repair or refill as required

Gear Boxes

- Check for leaks
- Check fluid levels
- Repair or refill as required

Hydraulic System

- Check for leaks
- Check level
- Repair or refill as required
- Make sure hydraulic shut-off valve is open

Table 4-2. Load Data

Jack and Pedestal Load Data	
Maximum load on jack	40 824 kg (90,000 lb)
Jack pad size	610 mm (24 in) diameter
Jack pad weight	27 kg (60 lb)
Maximum load on carbody pedestals	54 432 kg (120,000 lb)
Carbody pedestal size	762 mm (30 in) diameter
Carbody pedestal assembly weight	58 kg (128 lb)

Table 4-3. Swing Limits

Crane Without Counterweight and Carbody on Pedestals				
Gantry	Crawlers	Boom Butt	Safe to Swing Yes	Safe to Swing No
Down	Both Off	3,7 m (12 ft)		X[1]
Up or Down	Both Off	12,2 m (40 ft)—two-piece 0° to 45°	X[2]	
Up or Down	Both Off	12,2 m (40 ft)—two-piece above 45°		X
Up	One or Two On	12,2 m (40 ft)—two-piece at any Angle	X[2]	
Crane with Counterweight and Crawlers on Ground				
Up or Down	Both On	12,2 m (40 ft)—two-piece at any Angle	X	

1 Must remain in the shipping position (Figure 4-12).

2 Limit swing to 5° in either direction from the center when lifting the crawler.

THIS PAGE INTENTIONALLY LEFT BLANK

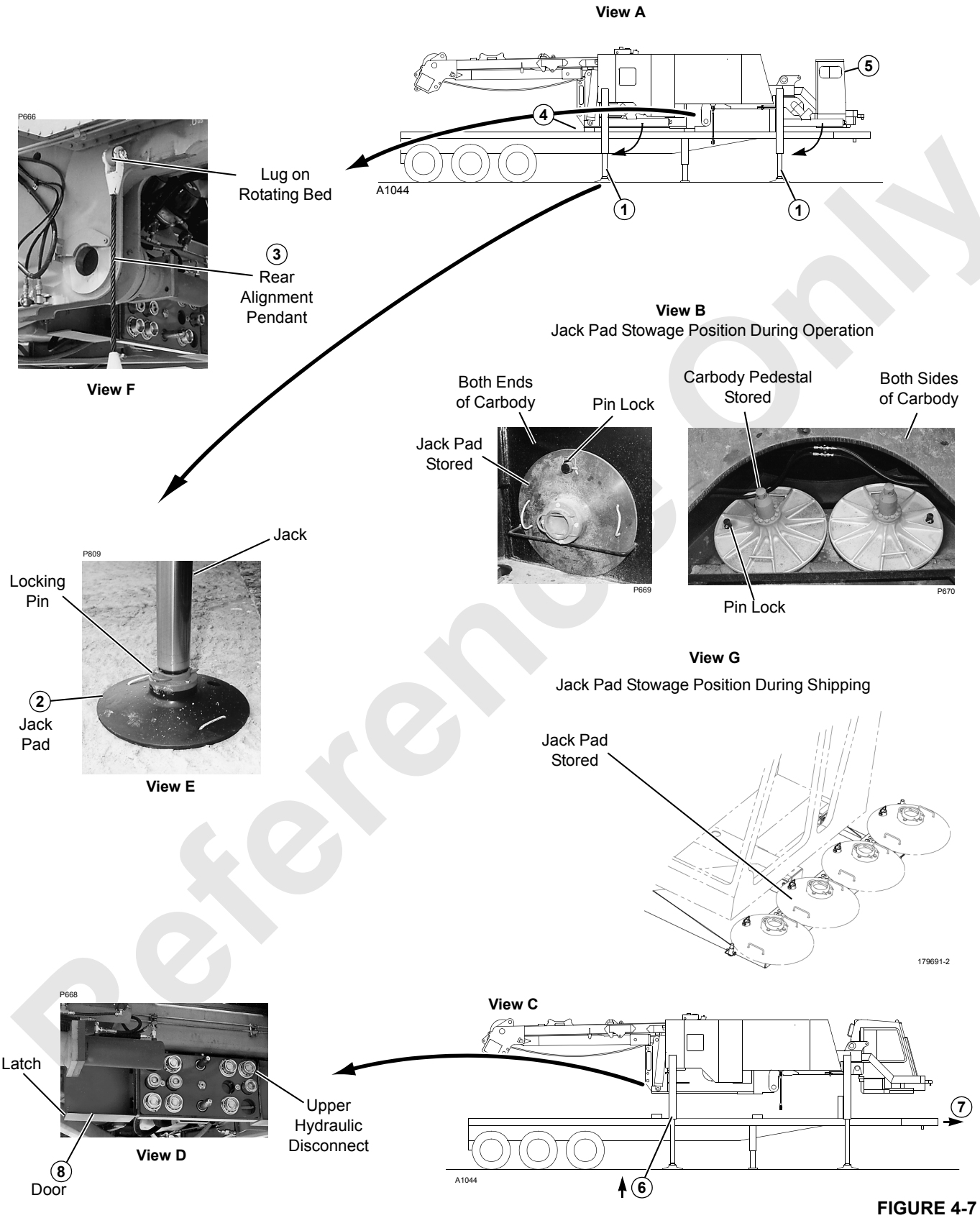


FIGURE 4-7

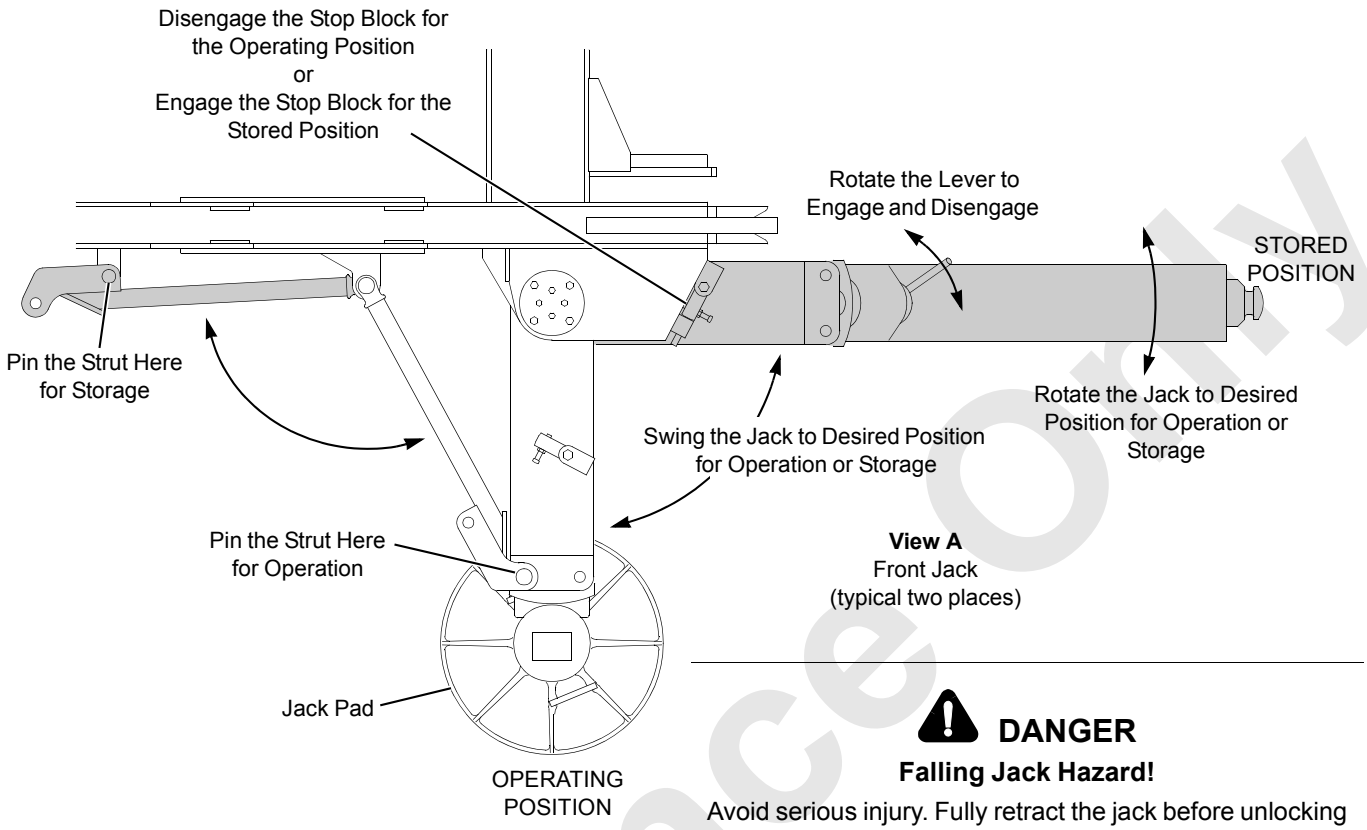
Remove Rotating Bed from Trailer

NOTE: The circled numbers in Figure 4-7 correspond to the numbers of the following steps.

1. Rotate four jacks to the operating position (see also Figure 4-8) and pin the struts to the jacks.
2. Remove the jack pads from storage (Figure 4-7, View B) and fasten them to the jacks (see View E).
3. Pin the rear alignment pendants to the lugs on the rotating bed (Figure 4-7, View F).
4. Start the engine and extend the jacks with the controls on the jacking remote to lift the rotating bed to clear the trailer.
5. Remove the tie-down strap between the lugs on the operator's cab frame and the rotating bed. Unclamp and swing the operator's cab to the intermediate position (Figure 4-9, View A).
6. Fully extend the jacks to lift the rotating bed off the trailer (Figure 4-7, View C).
7. Remove the trailer (Figure 4-7, View C).
8. Unlatch and open the doors covering the upper hydraulic disconnect (Figure 4-7, View D).

A1047

JACK POSITIONS



DANGER

Falling Jack Hazard!

Avoid serious injury. Fully retract the jack before unlocking from stored position.

Failure to do so may cause the jack to rotate down at uncontrolled speed with considerable force.

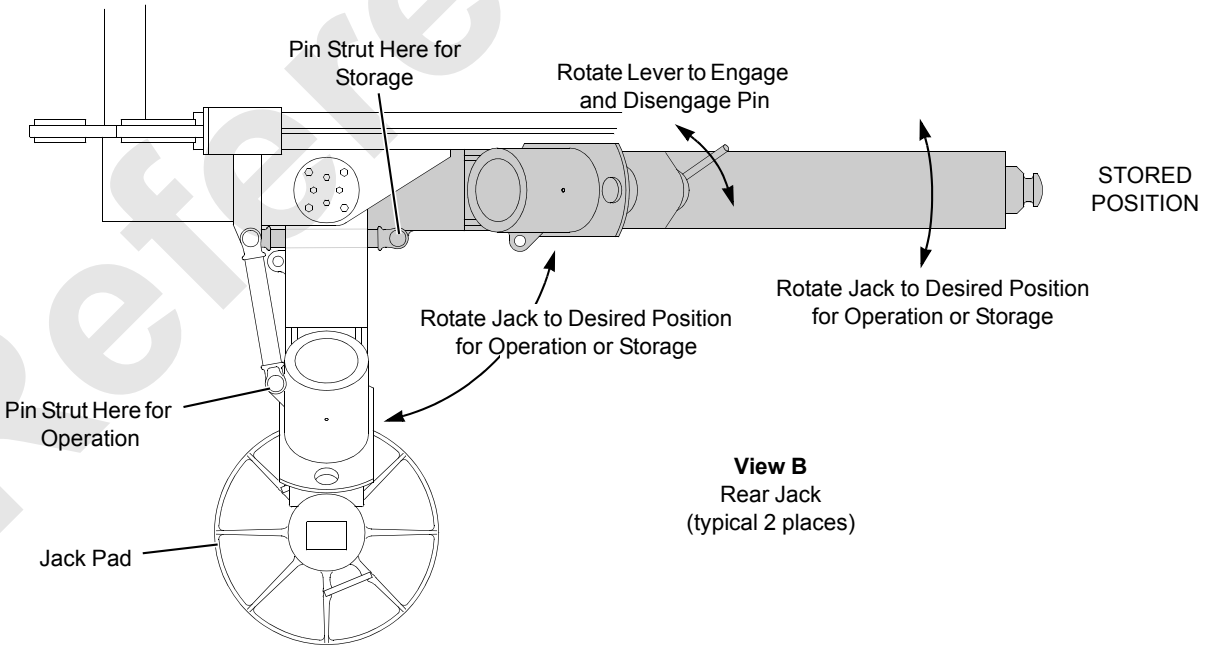


FIGURE 4-8

A445

OPERATOR'S CAB POSITIONS

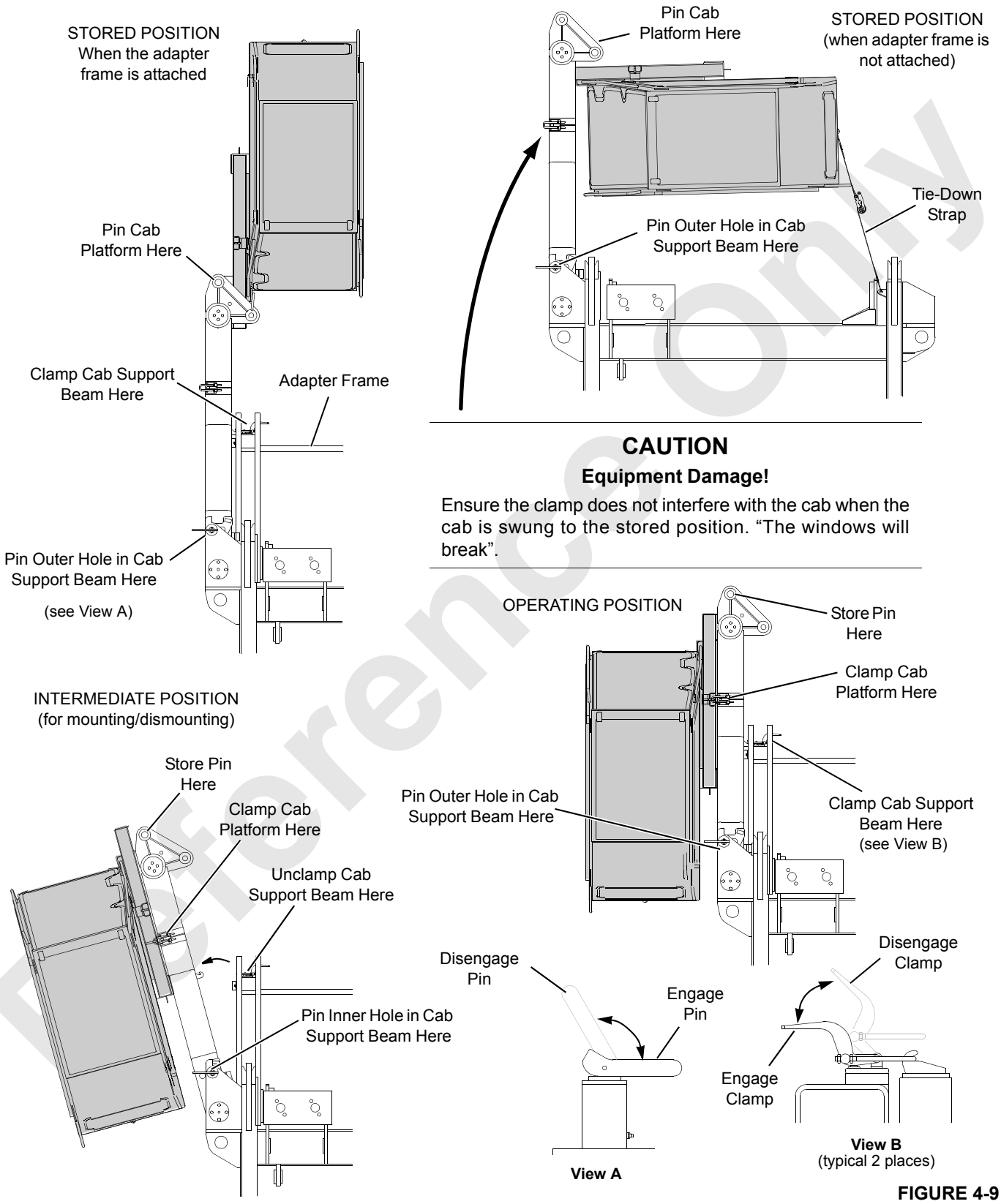


FIGURE 4-9

4

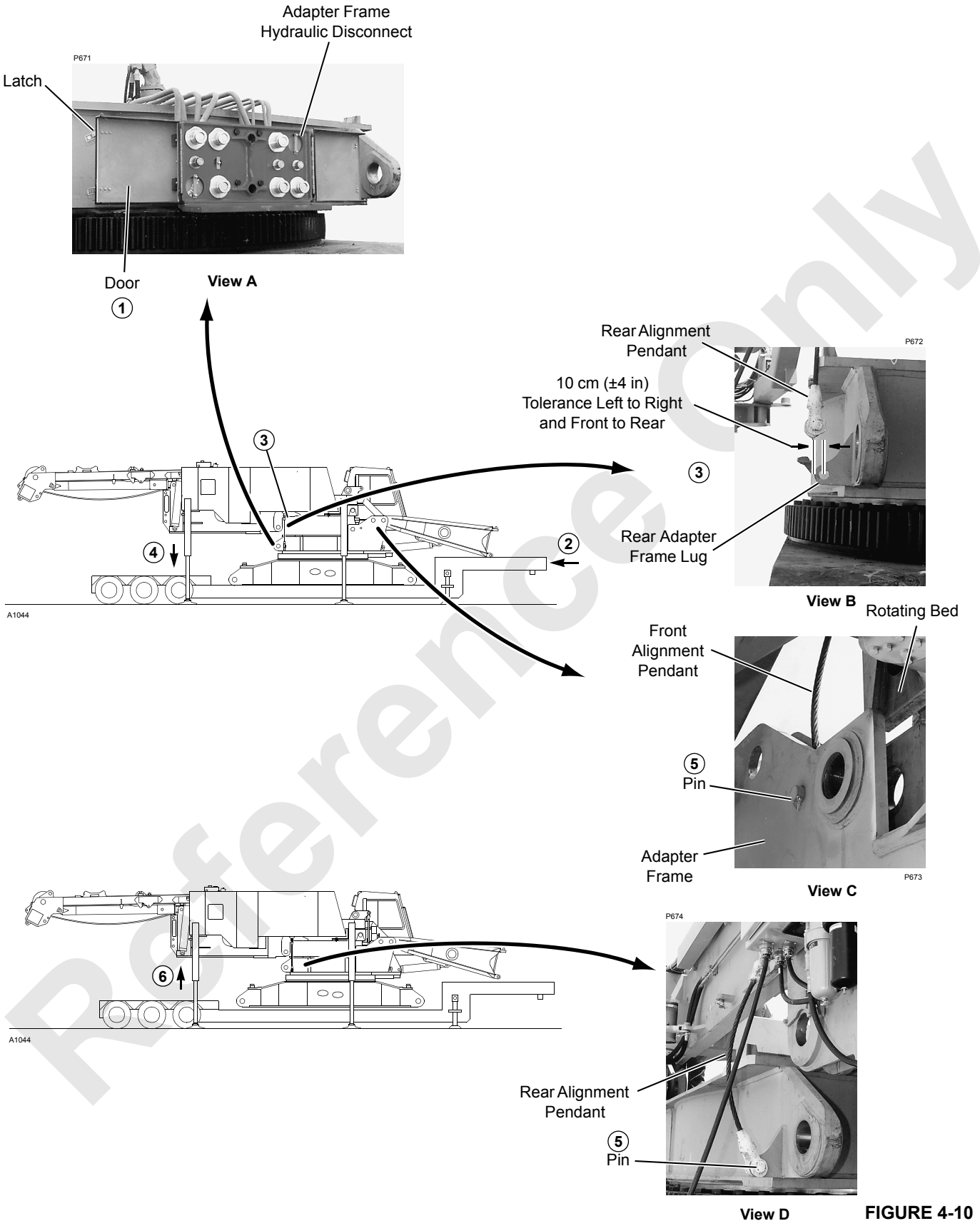


FIGURE 4-10

Remove Adapter Frame and Carbody from Trailer

NOTE: The circled numbers in Figure 4-10 correspond to the numbers of the following steps.

1. Unlatch and open the doors covering the adapter frame hydraulic disconnect (see View A).
2. Position the trailer carrying the adapter frame and carbody under the rotating bed.

CAUTION

Prevent Equipment Damage!

Avoid hitting the swing motor while backing the trailer. The motor, piping, or hoses may be damaged.

3. Use the alignment pendants hanging from the rear of the rotating bed as a guide when positioning the trailer (see View B). Observe the specified alignment tolerance.
4. Retract the jacks only enough for the alignment pendants to be pinned.
5. Pin the front and rear alignment pendants to the adapter frame (see Views C and D).
6. Slowly extend the jacks to lift the adapter frame and the carbody to clear the trailer.

   Alignment pendants will center the adapter frame and carbody under the rotating bed.

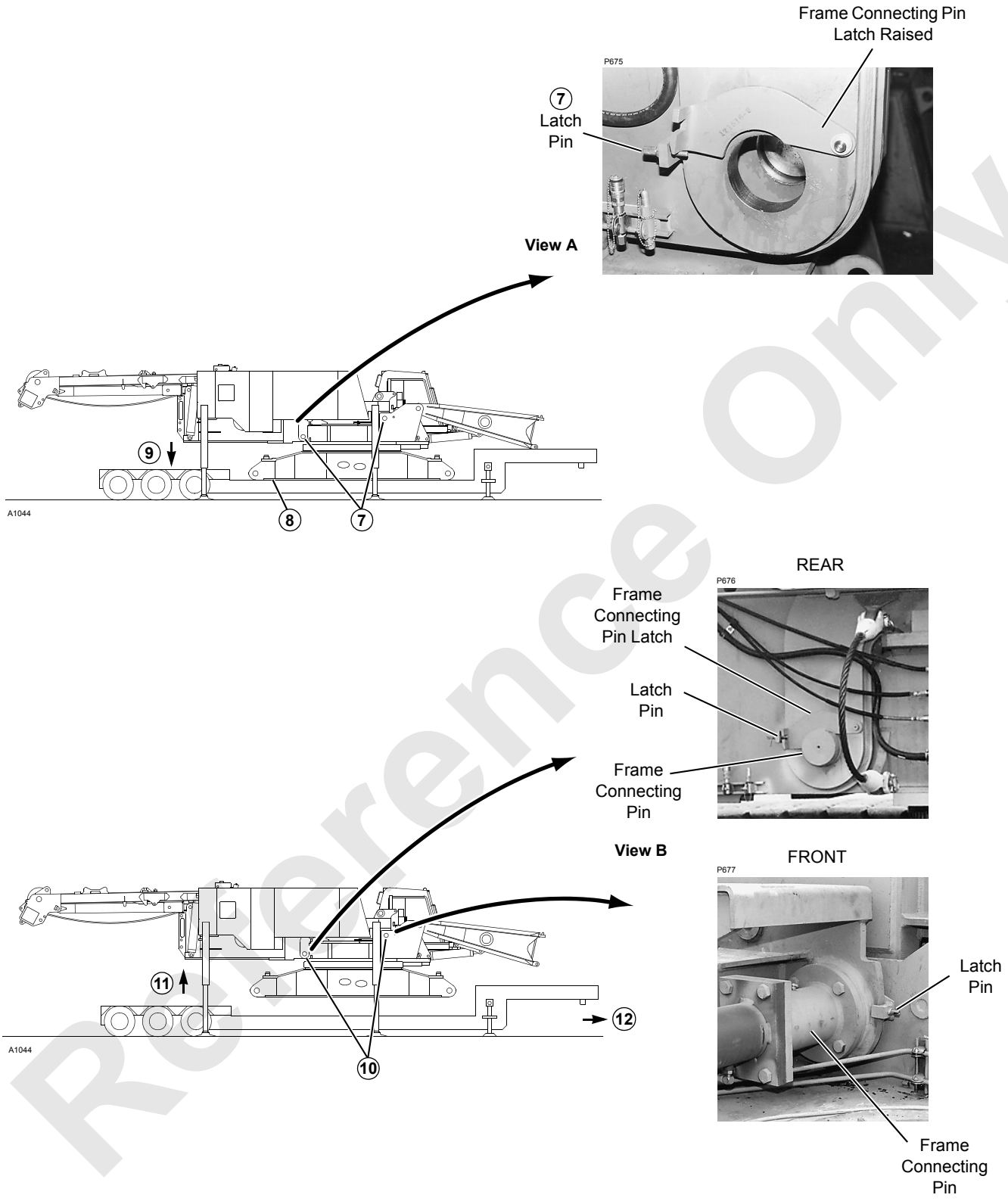


FIGURE 4-11

NOTE: The circled numbers in Figure 4-11 correspond to the numbers of the following steps.

7. Make sure all four frame connecting pin latches are held up with the latch pins (see View A).
8. Slowly retract the jacks to lower the adapter frame and carbody back onto the trailer.

NOTE: Lower the front jacks first.

CAUTION

Avoid Equipment Damage!

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

9. Continue to lower the rotating bed with the front jacks until the front mounting holes line up with and engage the two front frame connecting pins with the control on the jacking remote. Then lower the rear jacks until the rear mounting holes line up with and engage the two rear frame connecting pins.

NOTE: The connecting pin latches should be able to drop into the groove of the connecting pins when fully installed.

10. Retain the frame connecting pins with latches and secure the latches with latch pins (see View B).
11. Fully extend the jacks to lift the rotating bed, adapter frame, and carbody off the trailer.
12. Remove the trailer.

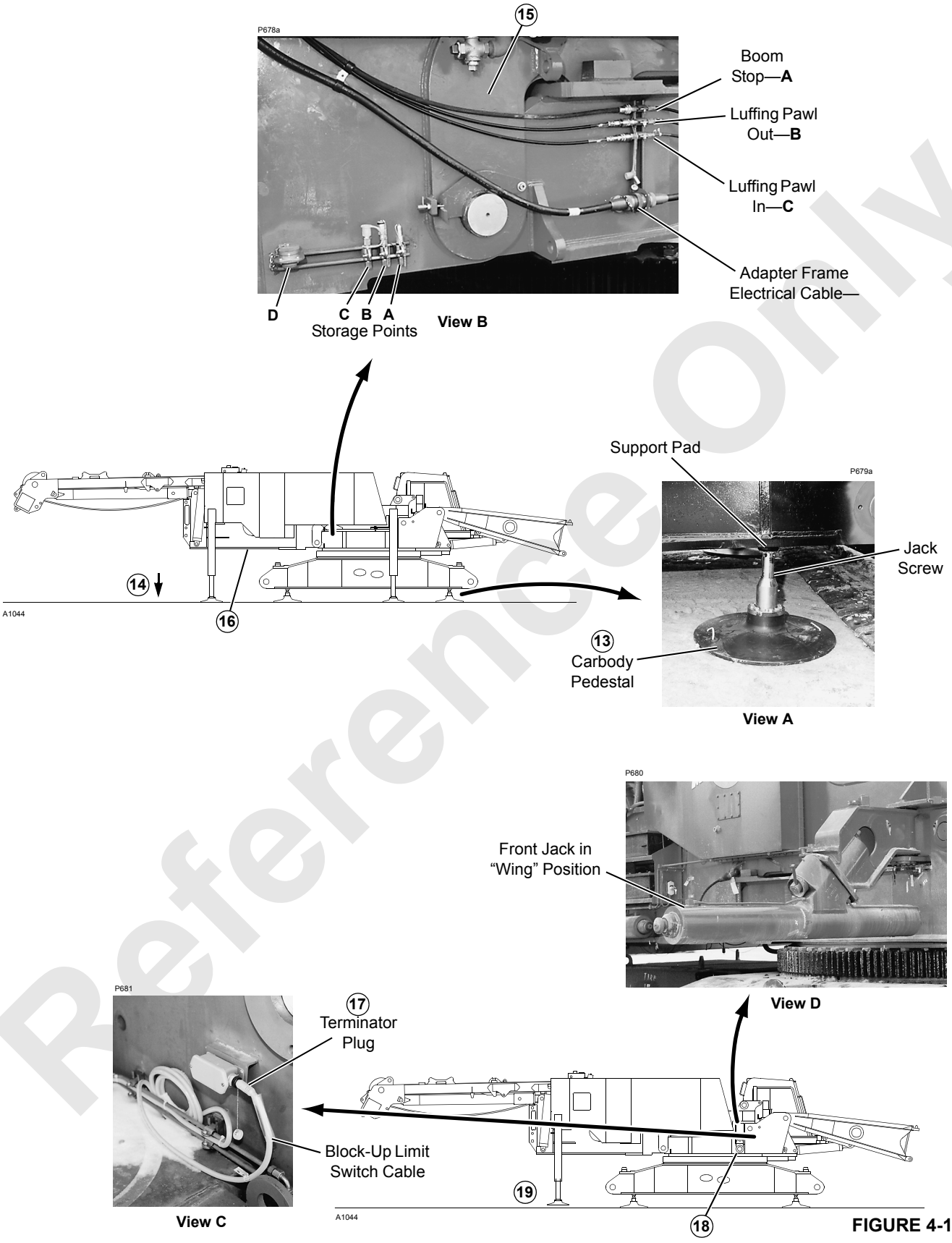


FIGURE 4-12

NOTE: The circled numbers in Figure 4-12 correspond to the numbers of the following steps.

13. Remove the four carbody pedestals from storage (Figure 4-7, View G) and place them under the support pads of the carbody (Figure 4-12, View A).

NOTE: Make sure the pedestals engage the support pads.

14. Retract the jacks to lower the carbody onto the four pedestals. Adjust the pedestal jack screws, as required, to level the carbody (Figure 4-12, View A).

WARNING

Tipping Hazard!

Prevent possible injury. Level the assembly using a carpenter's level to avoid potential tipping.

15. Disconnect the electrical cable and the air lines from the storage points on the right side of the rotating bed and connect them to the plug and quick couplers on the right side of the adapter frame (Figure 4-12, View B).

NOTE: If a swing lock quick coupler won't engage, apply the swing brake and switch the swing lock control in the cab to the other position, then engage the quick coupler.

16. Turn off the engine and engage the hydraulic disconnect with the switch on the right side of the rotating bed.

17. Connect the block-up limit switch cable to the terminator plug (Figure 4-12, View C).

18. Turn on the engine and retract both front jacks, remove and store the jack pads (Figure 4-7, View B), and rotate the jacks to the horizontal "wing" position (Figure 4-12, View D). Do not swing the jack inward.

19. Leave the rear jacks in the operating position and retract the jacks until the pads are 152 mm (6 in) off the ground.

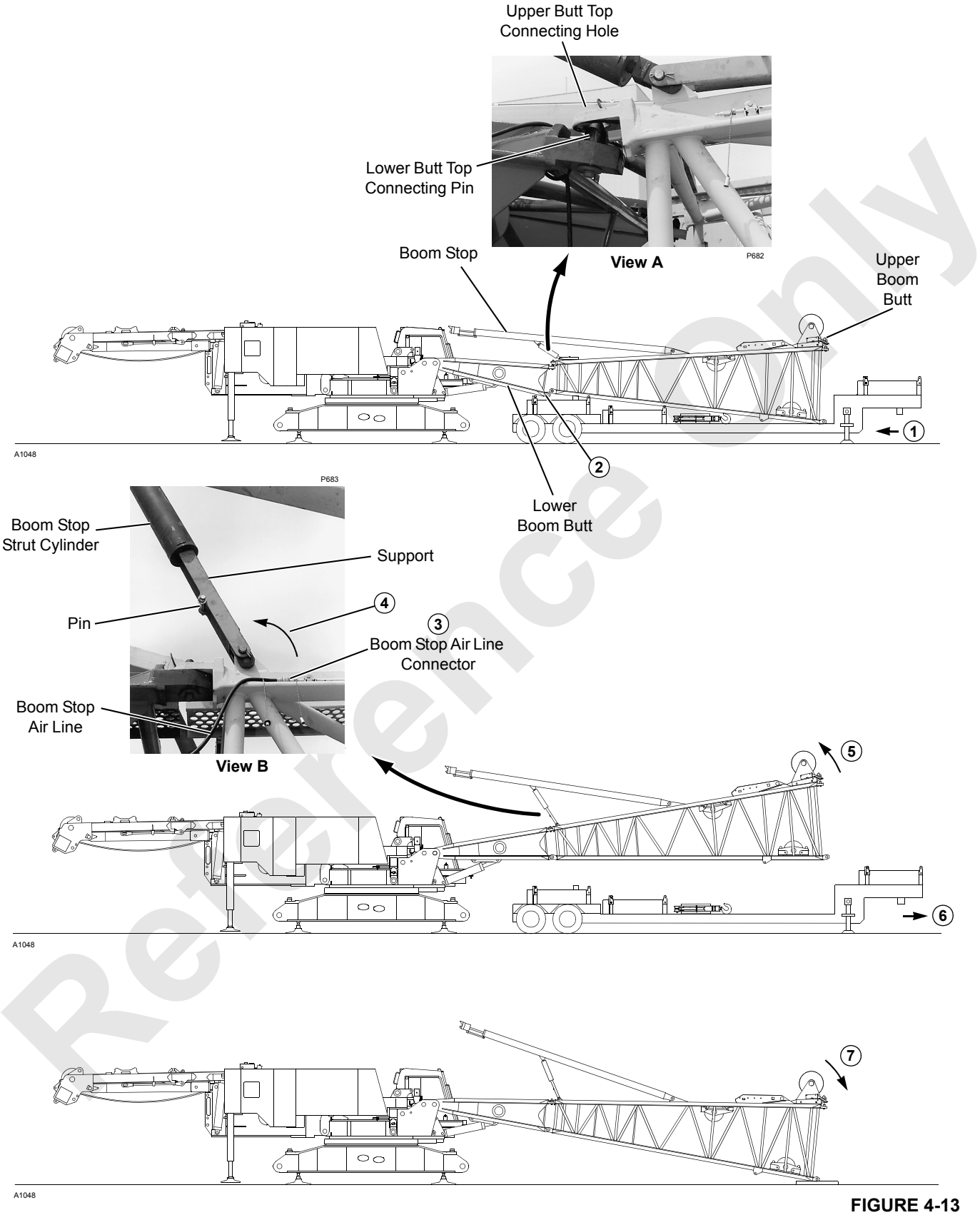


FIGURE 4-13

Connect Upper Boom Butt to Lower Boom Butt

NOTE: The circled numbers in Figure 4-13 correspond to the numbers of the following steps.

1. Position the trailer carrying the upper boom butt in-line with the lower boom butt. Move the trailer and the boom up and down as needed to engage the top connecting pins in the lower boom butt with the top connecting holes in the upper boom butt (see View A).
2. Raise the boom butt using the boom butt cylinder until the bottom connecting holes line up to install the connecting pins.
3. Connect the boom stop air line from the lower butt to the quick-coupler on the right side of the upper butt (see View B). Stand clear as the boom stops rise.
4. Swing the supports for the boom stop strut cylinders up to the operating position and pin them in place (see View B).
5. Raise the boom butt to clear the trailer using the boom butt cylinder.
6. Remove the trailer.
7. Lower the boom butt onto the blocking using the boom butt cylinder.

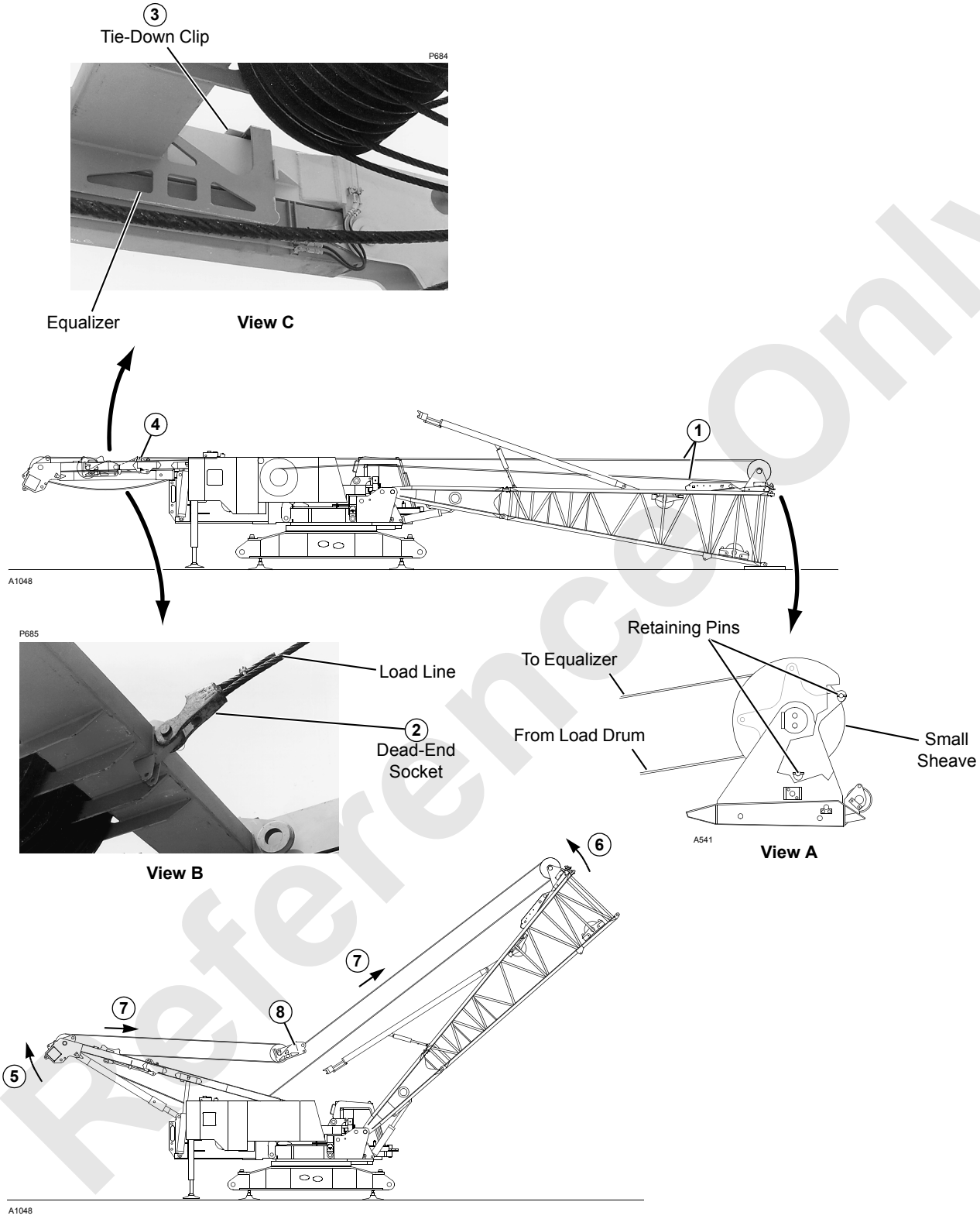


FIGURE 4-14

Connect Equalizer to Boom Butt

NOTE: The circled numbers in Figure 4-14 correspond to the numbers of the following steps.

1. Reeve the load line from the top of the rear or right rear drum under the small sheave on the boom butt. Place the retaining pins into the sheave (see View A).
2. Anchor the load line to the equalizer using a dead-end socket and wedge (see View B).
3. Slowly pay out the boom hoist line and haul in the load line to pull the equalizer out of the tie-down clips on the gantry (see View C).
4. Continue until the equalizer is about 0,3 m (1 ft) out of the clips and is clear of the guide rollers.
5. Raise the gantry to the limit of the gantry cylinders.

NOTE: Make sure the equalizer does not go back into the clips as the gantry rises. Pay out the boom hoist line as needed.

6. Raise the boom butt to the limit of the boom butt cylinder.
7. Haul in the load line to lift the equalizer off the gantry. Pay out the boom hoist line at the same time.
8. Maintain equal haul-in and payout speeds so that the equalizer rises smoothly.
   a. Too much tension in either line will cause the butt to rise off the cylinder and the equalizer to stop.
   b. Too little tension will cause the equalizer to tip.

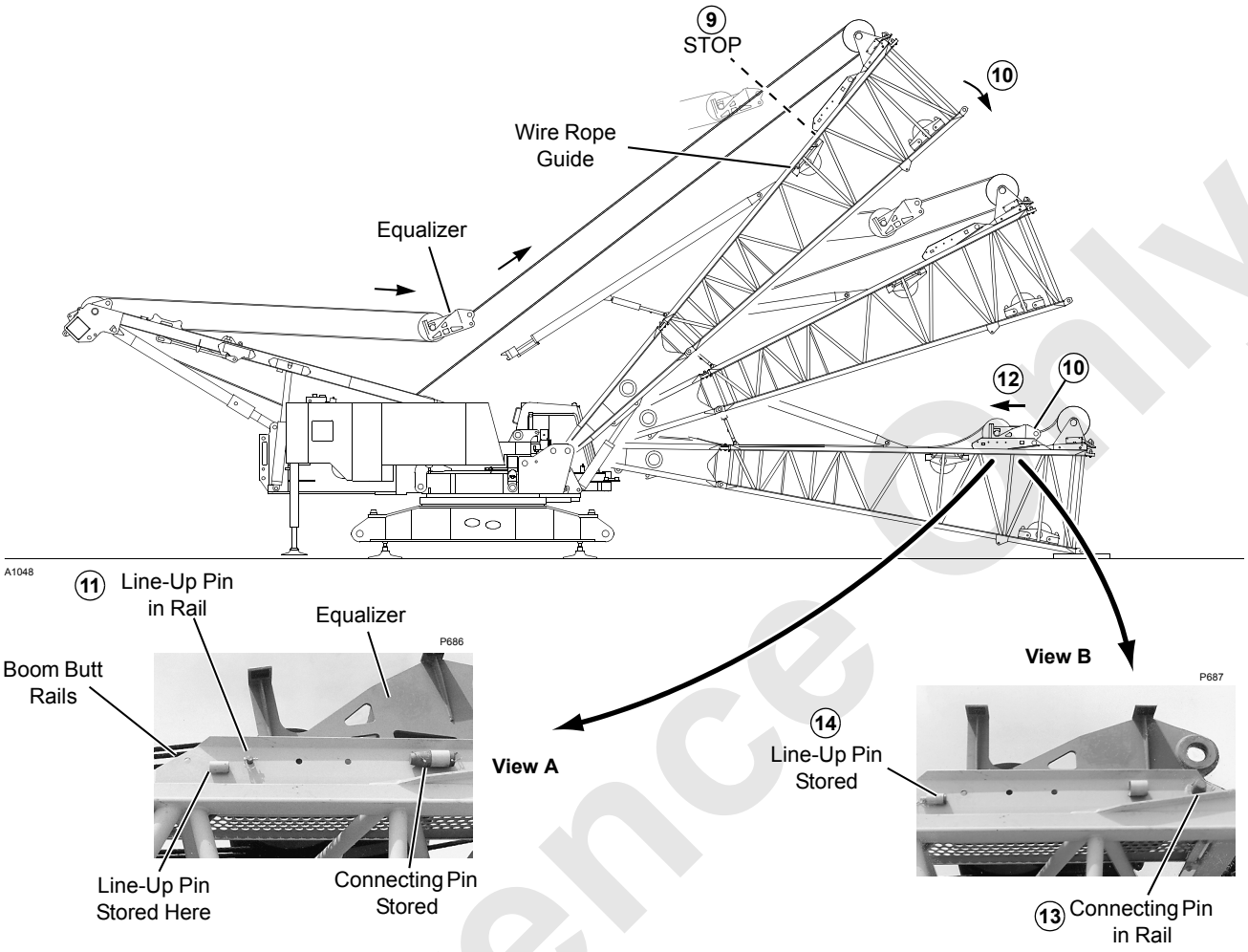


FIGURE 4-15

NOTE: The circled numbers in Figure 4-15 correspond to the numbers of the following steps.

9. Stop paying out the equalizer when it is just past the wire rope guide on the boom butt.

10. Lower the boom butt onto the blocking using the boom butt cylinder.

At the same time, slowly pay out the boom hoist line so the equalizer lands at the front of the boom butt rails.

NOTE: Make sure the load line is kept slack so the equalizer lowers onto the boom butt rails.

CAUTION

Avoid Equipment Damage!

Do not allow the boom butt to lift off the cylinder while lowering the boom butt. Damage to the boom butt may occur.

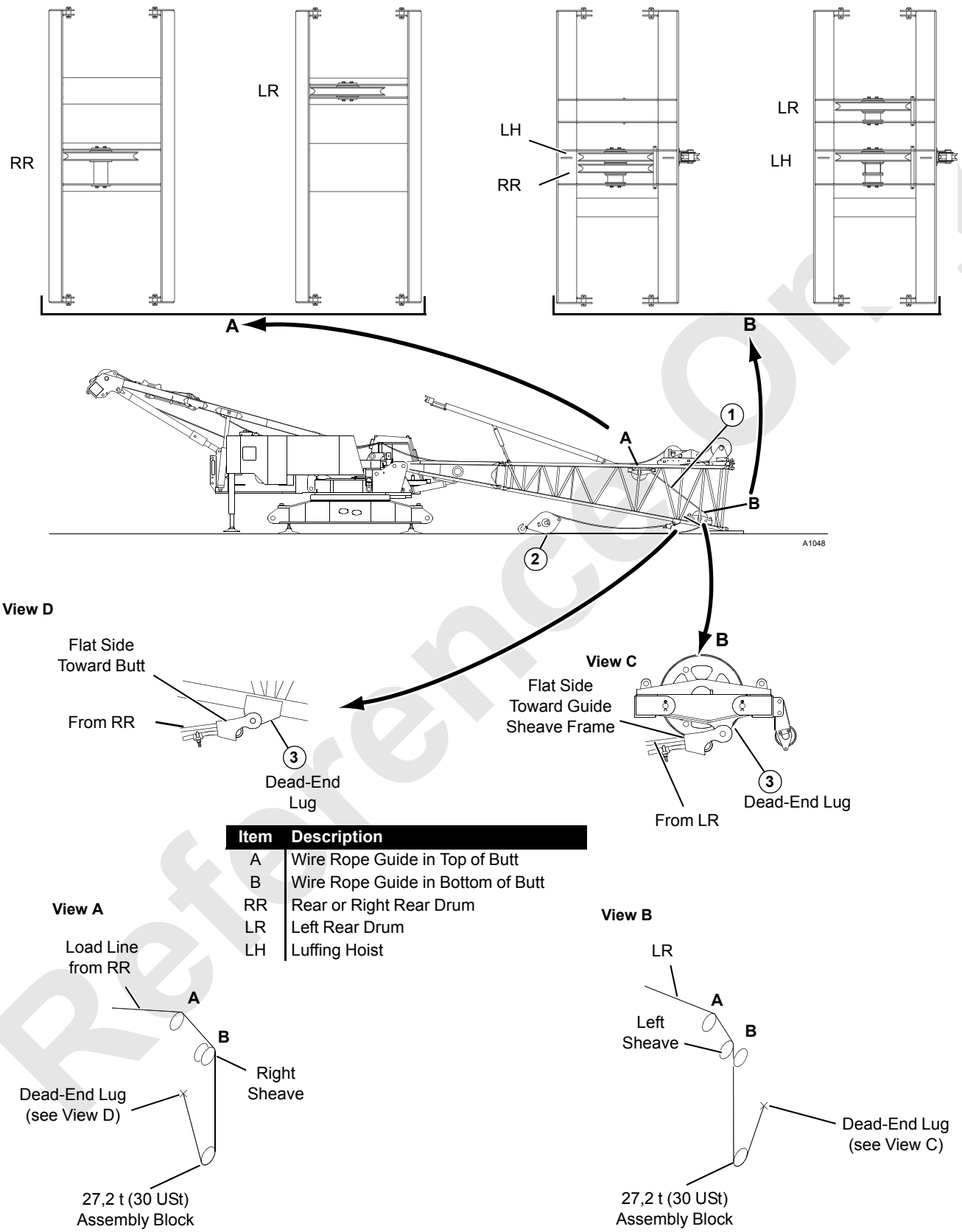
11. Haul in the load line as necessary and insert the line-up pins in the second-to-last holes in the boom butt rails (see View A).

12. Slowly slacken the load line to rest the equalizer against the line-up pins (see View A).

Holes at the front of the equalizer will line up with the holes at the front of the rails.

13. Pin the equalizer to the boom butt rails using the connecting pins (see View B).

14. Remove and store the line-up pins.



Item	Description
A	Wire Rope Guide in Top of Butt
B	Wire Rope Guide in Bottom of Butt
RR	Rear or Right Rear Drum
LR	Left Rear Drum
LH	Luffing Hoist

FIGURE 4-16

Install Assembly Block

NOTE: The circled numbers in Figure 4-16 correspond to the numbers of the following steps.

Letters “A” and “B” indicate the sheave locations. Determine the sheave configuration of your crane at the two locations using the illustrations in Figure 4-16. Then follow the reeving pattern for those configurations.

1. Reeve the load line from the top of rear, right rear, or left rear drum over the proper guide sheave A and proper guide sheave B (see View A or B).
2. Reeve the load line through the assembly block.
3. Anchor the load line to the appropriate dead-end lug (see View C or D). Use the dead-end socket and wedge for a 29 mm (1-1/8 in) load line.

Raise Gantry

See Gantry Raising and Lowering (with Boom Butt Handling Cylinder) on page 4-50 for more information.

NOTE: Fully retract the boom butt cylinder after the gantry is fully raised.

Install Crawlers

See Figure 4-17 for the following procedure.

DANGER

Tipping Hazard!

Avoid death or serious injury. Prevent the crane from tipping over:

- Make sure the crane is level. Adjust the jacks as required.
- Limit the swing to 5° in either direction from center when lifting the crawler.

CAUTION

Parts Damage!

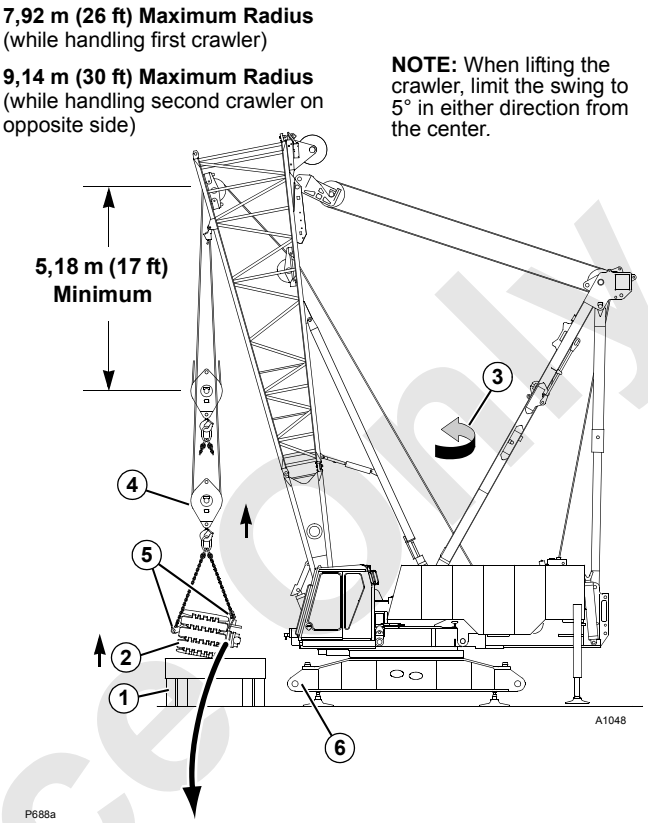
Avoid hitting the carbody jacks with crawlers.

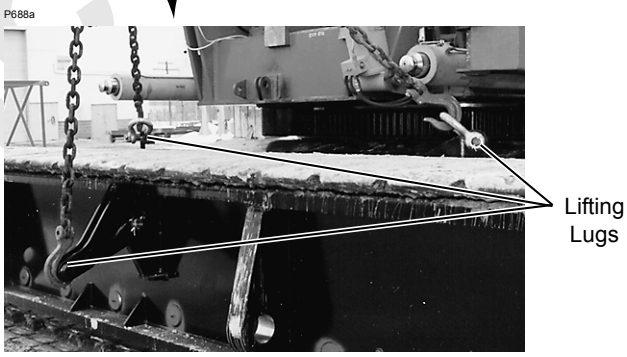
First Crawler Installation

1. Position the trailer (1) carrying the crawler (2) either parallel or perpendicular to the carbody, as long as the maximum radius is not exceeded.
2. Swing the rotating bed (3) so the assembly block (4) is centered over the crawler.
3. Connect the crawler handling chain assembly to the hook of the assembly block.
4. Connect the three legs of the chain assembly to the lifting lugs (5) on the crawler frame (see View A).
5. Lift the crawler clear of the trailer.

NOTE: The crawler will hang at an angle, which allows the top connecting holes in the crawler to easily engage the top pins in the carbody (6).

6. Remove the trailer from the work area.





View A

FIGURE 4-17

THIS PAGE INTENTIONALLY LEFT BLANK

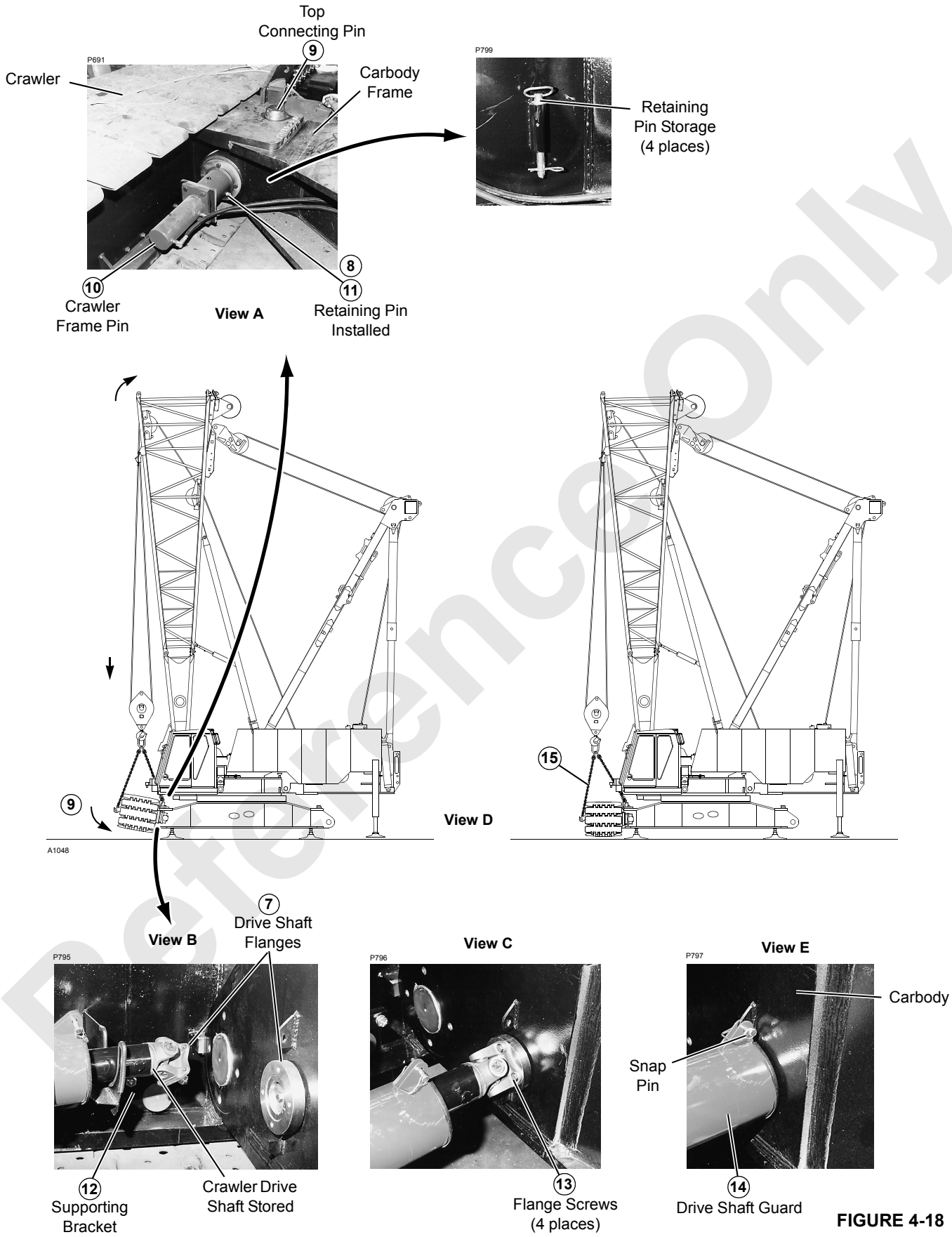


FIGURE 4-18

See Figure 4-18 for the remaining steps.

NOTE: The circled numbers in Figure 4-18 correspond to the numbers of the following steps.

7. Swing the crawler by hand, as required, so the drive shaft is at the rear of the carbody, and the drive shaft flanges are as shown in View B.

8. Fully disengage the crawler frame pins with the control on the setup remote control.

9. Lower the crawler and raise the boom. Swing the boom as needed to engage the top connecting holes in the crawler frame with the top connecting pins in the carbody (see View D).

10. After the top holes engage the pins, continue to lower the crawler until the chains are slack. The bottom connecting holes will be in line with the crawler frame pins.

11. Engage the crawler frame pins and install the retaining pins (see View A).

12. Lift the crawler drive shaft off the supporting bracket (see View B), extend the shaft, and align the holes in the drive shaft flange (see View C).

13. Insert the flange screws and tighten them to 100 Nm (74 ft-lb) (see View C).

DANGER

Rotating Drive Shaft Hazard!

The crawler drive shaft rotates at high speed. Death or serious injury will occur if body parts or clothing come in contact with a rotating drive shaft.

To prevent death or serious injury:

- Make sure the drive shaft is securely attached at both ends.
- 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.

14. Slide the drive shaft guard over the drive shaft (see View E) and pin the guard to the carbody.

15. Unhook the handling chain assembly from the lugs on the crawler frame.

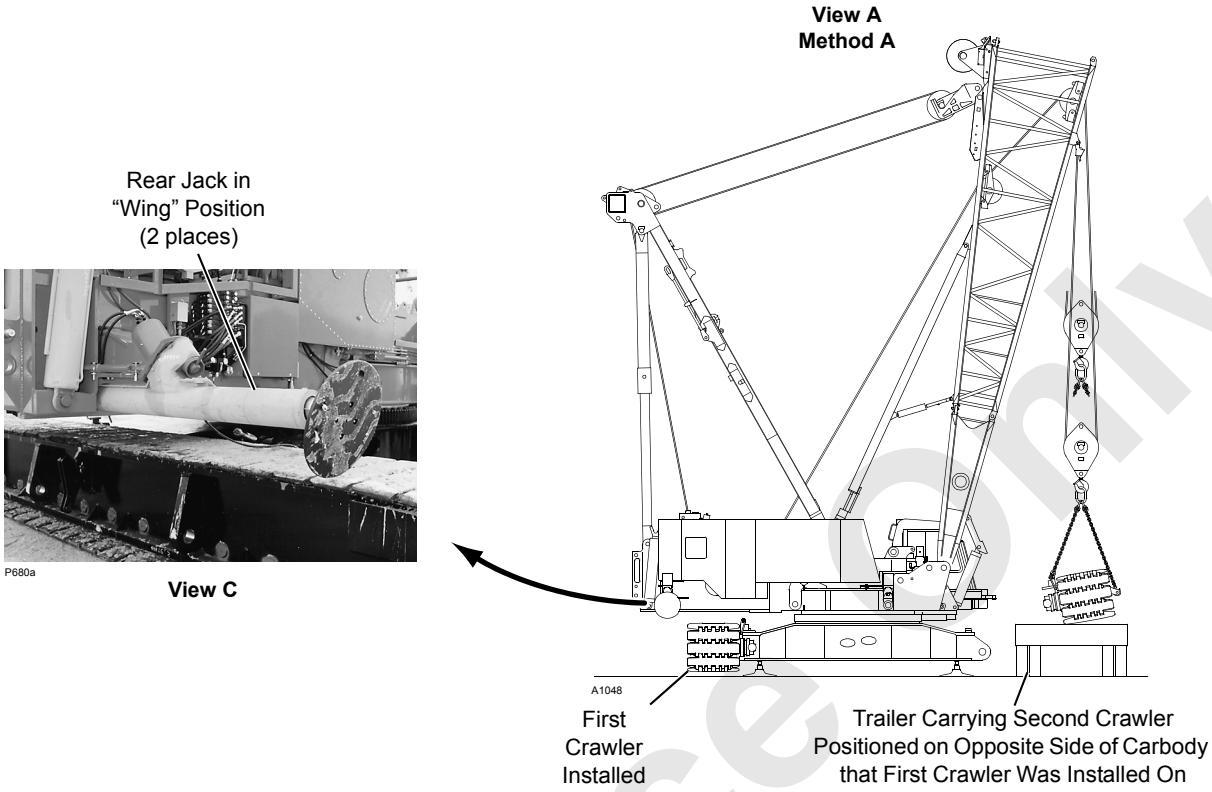


FIGURE 4-19

Second Crawler Installation

See Figure 4-19 for the following procedure.

The second crawler can be installed using either of these methods:

- Method A—when the trailer carrying the second crawler is positioned on the opposite side of the carbody that the first crawler is installed on (see View A)
- Method B—when the trailer carrying the second crawler is positioned on the same side of the carbody that the first crawler is installed on (see View B)

NOTE: For this method, the first crawler must be lowered to the ground to prevent the crane from tipping when the second crawler is swung.

Install the second crawler using Method A.

1. Position the trailer carrying the second crawler along opposite side of the carbody that the first crawler is installed on (Figure 4-19, View A).
2. The crawler can be positioned either parallel or perpendicular to the carbody, as long as the maximum radius is not exceeded.
3. Rotate the rear jacks to the horizontal “wing” position (Figure 4-19, View C). Do not rotate the jacks to the stored position.
4. Repeat step 2 through step 15 in Figure First Crawler Installation on page 4-30.
5. Slowly rotate the crawler treads in either direction with the crawler controls to the center treads on the crawler frame.
6. Remove and store the carbody pedestals. See Remove Carbody Pedestals on page 4-35.

Install the second crawler using Method B.

1. Slowly rotate the crawler treads on the first crawler in either direction with the crawler control to the center treads on crawler frame.
2. Rotate the rear jacks to the horizontal “wing” position (Figure 4-19, View C). Do not rotate the jacks to the stored position.
3. Swing the rear of the rotating bed so that it is positioned over the first crawler (Figure 4-20).
4. Rotate the rear jacks to the operating position and extend the jacks until the carbody is clear of the pedestals next to the first crawler.
5. Remove and store the carbody pedestals (set nearest first crawler).
6. Lower the crawler to the ground.
7. Rotate the rear jacks to the horizontal “wing” position (Figure 4-19, View C). Do not rotate jacks to the stored position.
8. Repeat step 2 through step 6 in Figure First Crawler Installation on page 4-30.
9. Swing 180° and repeat step 2 through step 15 in Figure First Crawler Installation on page 4-30.
10. Slowly rotate the crawler treads in either direction with the crawler control to the center treads on the crawler frame.
11. Remove and store the remaining two carbody pedestals. See Remove Carbody Pedestals on page 4-35.

Remove Carbody Pedestals

NOTE: The circled numbers in Figure 4-20 correspond to the numbers of the following steps.

1. Extend the rear jacks until the carbody is clear of the carbody pedestals.
2. Remove and store the two pedestals (Figure 4-7, View A).
3. Retract the rear jacks until the crawler is on the ground (Figure 4-20).
4. Rotate the rear jacks to the horizontal “wing” position.
5. Swing the rotating bed over the other crawler.
6. Repeat step 1 through step 4 for the remaining two carbody pedestals.
7. Remove and store the jack pads (Figure 4-7, View A).
8. Swing the operator cab clear of the front jacks.

9. Secure all four jacks in the stored position (Figure 4-8).
10. Secure the operator's cab in the operating position (Figure 4-10).

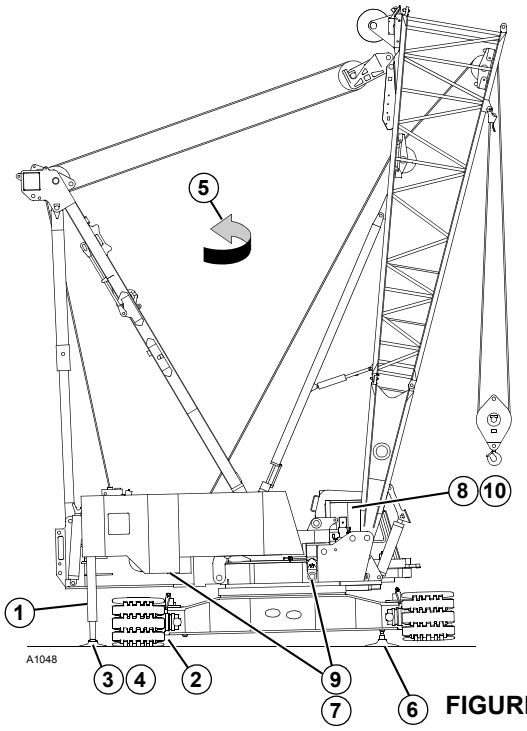


FIGURE 4-20

Install Counterweight and Assemble and Attach Boom

The crane can now be used in the setup configuration. See Figure 4-21.

- Assemble and install the counterweights. For the counterweight assembly and installation instructions, see Counterweight Installation and Removal on page 4-57.
- Assemble the boom and connect it to the boom butt. For boom assembly instructions, see Boom Rigging Guide (#44 HL and LR) on page 4-72.

DANGER

Tipping Hazard!

The crane can tip or the boom butt can collapse if the capacity is exceeded, causing death or serious injury.

Do not exceed the maximum lifting capacity and radius given in Figure 4-21.

CAUTION

Avoid Boom Rigging Damage!

Avoid possible injury. Do not exceed the minimum block distance given in Figure 4-21. Hoisting the block higher than specified can result in damage to the wire rope and sheaves.

View of Crane Handling
Counterweight with 27,2 t (30 USt)
Assembly Block
Maximum Capacity of 27 216 kg
(60,000 lb) at 12 m (40 ft) Radius

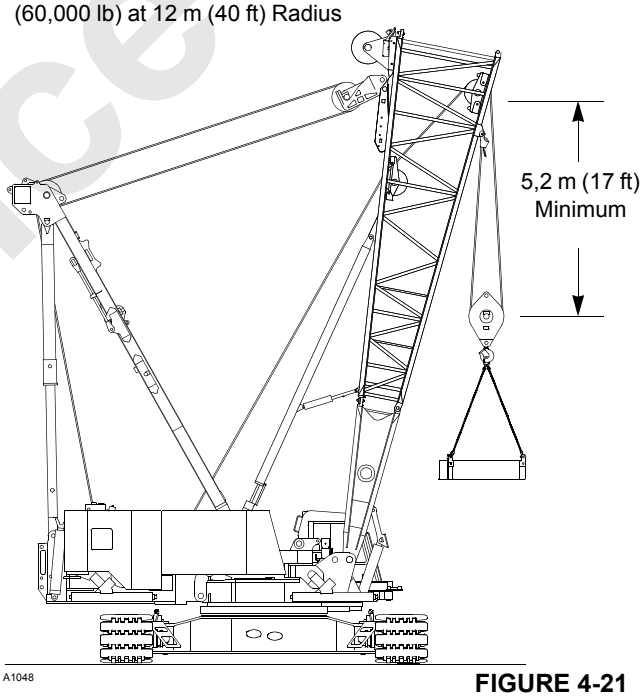


FIGURE 4-21

PRE-RAISING CHECKS

Perform the following checks and correct any defects before raising the boom:

- Crane is on firm, level surface
- All connecting pins are installed and properly retained
- Boom and jib inserts are installed in the proper sequence per the rigging drawing
- Boom and jib straps and pendants are installed in the proper sequence per the rigging drawing
- Intermediate suspension (if required) is installed
- All insert, strap, and pendant connector pins are installed and properly retained
- Load lines are spooled tightly onto the drums and engaged with the proper sheaves. Load lines are securely anchored to the wedge sockets at the boom and jib point or at the load block and weight ball.
- All blocking, tools, and other items are removed from the boom and jib
- Electronic boom angle indicator is properly installed and adjusted
- Automatic boom stop is properly installed and adjusted
- Block-up limit control is properly installed and operational
- Load indicator is properly installed and operational
- Crane and attachment are properly lubricated
- Crawlers are blocked if required per the capacity chart, or the outriggers are extended and the carrier is level
- Wind is within the allowable limits for operation

CRANE DISASSEMBLY WITH SELF-ERECT

It is the crane owner/user's responsibility to ensure that the crane components are properly loaded and secured to the transport trailers. Shipping Crane Components on page 4-4 and Component Weights on page 4-5, for the trailer loading requirements.

Disconnect Boom Butt from Boom

See Boom Rigging Guide (#44 HL and LR) on page 4-72 for the procedure to disconnect the boom from the boom butt.

Install Assembly Block

1. Reeve the load line from the top of the rear, right rear, or left rear drum over the upper guide sheave and appropriate lower guide sheave in the upper boom butt (Figure 4-16, View A or B).
2. Reeve the load line through the assembly block.
3. Anchor the load line to the appropriate dead-end lug (Figure 4-16, View C or D). Use a dead-end socket and wedge for the 29 mm (1-1/8 in) load line.

Remove Counterweight and Disassemble Boom

Once the boom is removed from the boom butt and the assembly block is installed, the crane can be used in the setup configuration. See Figure 4-21 for the following procedures:

- Remove and disassemble the counterweights. See Counterweight Installation and Removal on page 4-57 for counterweight removal and disassembly instructions.
- Disassemble the boom. See Boom Rigging Guide (#44 HL and LR) on page 4-72 for boom disassembly instructions.

DANGER

Tipping Hazard!

The crane can tip or the boom butt can collapse if the capacity is exceeded. Avoid possible injury. Do not exceed the maximum lifting capacity and radius given in Figure 4-21.

WARNING

Equipment Hazard!

Avoid possible death, serious injury, or damage to the boom rigging. Hoisting the block higher than specified can result in damage to the wire rope and sheaves. Do not exceed the minimum block distance given in Figure 4-21.

Install Carbody Pedestals

WARNING

Moving Part Hazard!

Avoid serious crushing injury. Warn all personnel to stand clear of the jacks.

Tipping Hazard!

Avoid tipping the crane over. Keep the crane level while jacking.

NOTE: Only use the rear jacks when installing the pedestals.

1. Swing the rotating bed over the first crawler.
2. Swing the operator's cab away from the front jack (Figure 4-10).

3. Rotate the front jacks to the horizontal “wing” position (Figure 4-12, View D). Pin the struts to the jacks (Figure 4-8, View A).
4. Swing the operator’s cab to the intermediate position and pin in place (Figure 4-10).
5. Rotate the rear jacks to the operating position (Figure 4-8). Pin the struts to jacks.
6. Install the jack pads (Figure 4-7, View E).
7. Extend the rear jacks until the carbody pedestals can be installed.

   Remove two pedestals from storage (Figure 4-7, View B) and install them under the carbody (Figure 4-12, View A).

NOTE: Make sure the pedestals engage the support pads.

8. Retract the rear jacks and rotate to the horizontal “wing” position (Figure 4-19, View C).
9. Swing the rotating bed over the other crawler.
10. Repeat step 5, through step 7 for the remaining two carbody pedestals.
11. Ensure the carbody is level. Adjust the jack screws to the level assembly (Figure 4-12, View A).

WARNING

Tipping Hazard!

Avoid possible injury. Level the assembly using a carpenter’s level to avoid potential tipping.

Remove Crawlers

1. Position an empty trailer along the desired side of the carbody (Figure 4-17).
2. Start the engine. Swing the rotating bed and boom up so that the assembly block is centered over the crawler.
3. Connect the crawler handling chain assembly to the hook of the assembly block.

DANGER

Rotating Drive Shaft Hazard!

The crawler drive shaft rotates at high speeds. To prevent death or serious injury, do not attempt to disconnect the drive shaft until the crane has been parked and the engine has stopped.

4. Unpin the drive shaft guard (Figure 4-18, View D) and slide the guard back.
5. Remove the flange screws from the drive shaft flange (Figure 4-18, View C). Store the screws in the flange.
6. Retract the crawler drive shaft and place the drive shaft on the supporting bracket (Figure 4-18, View B).
7. Connect three legs of the chain assembly to the lugs on the crawler frame (Figure 4-17, View A).
8. Remove and store the retaining pins (Figure 4-18, View A) and disengage the crawler frame pins with the control on the setup remote control. Pins should be fully disengaged within 10 seconds.
9. Visually check that both crawler frame pins are fully disengaged. If either pin fails to disengage, proceed as follows:
   a. Pump grease into the grease fitting on the piston cover plate (Figure 4-22) while holding the crawler frame pin switch at the disengage position for 10 seconds.
   b. If the pin does not disengage, remove the plug from the piston cover plate and measure the position of the piston. When fully retracted, the piston is 25,7 cm (10-1/8 in) from the outside of the cover.
   c. If the dimension is less than 25,7 cm (10-1/8 in) remove the cover plate and, using a bar and hammer, tap the piston until it is fully retracted (check dimension). Replace the piston cover plate.
10. Lift the crawler. The crawler will tilt as it is lifted off the top connecting pins (Figure 4-18, View A).

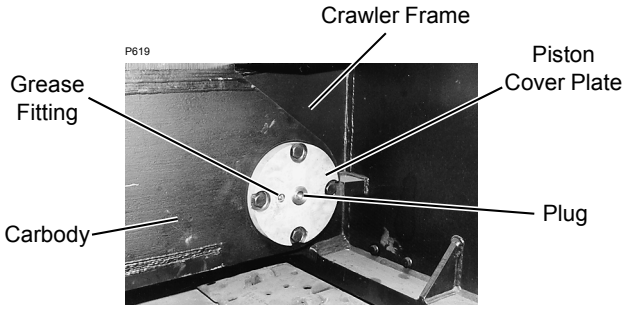


FIGURE 4-22

11. Continue lifting the crawler. Stop before hitting the cab support.

DANGER

Falling Boom Hazard!

Avoid serious injury. The crane boom can collapse if not properly lowered.

Carefully perform the following steps to properly lower the boom and prevent it from falling suddenly.

12. While watching the equalizer, boom down until the equalizer sags a maximum of 15 cm (6 in). The boom will not move.
13. Lower the load to move the boom until the equalizer tightens to the point that the boom stops lowering.
14. Hoist again, stopping before hitting the cab support.
15. Repeat steps step 12 through step 14 until the boom lowers freely and position the crawler on the trailer.

DANGER

Tipping Hazard!

Avoid serious injury. To prevent the crane from tipping while handling the counterweights, do not exceed the maximum swing and capacity limitations given in Figure 4-17.

16. Unhook the handling chain assembly from the lugs on the crawler frame.
17. Engage the crawler frame pins.
18. Rotate the rear jacks to the horizontal “wing” position (Figure 4-19, View C). Do not rotate the jacks to the stored position.
19. Swing the rotating bed to the other side of the carbody and center the assembly block over the crawler.
20. Rotate the rear jacks to the operating position (Figure 4-8).
21. Extend the jacks until the pads are about 15 cm (6 in) off the ground.
22. Repeat step 1 through step 15 for the other crawler.
23. Remove and store the chain assembly.

Connect Equalizer to Gantry

1. Lower the boom butt onto the blocking on the ground.
2. Remove and store the assembly block.
3. Lower the gantry cylinders to the extend position.
4. Reeve the load line under the small sheave on the boom butt, and place the retaining pins into the sheave frame (Figure 4-14, View A).
5. Anchor the load line to the equalizer with a dead-end socket and wedge (Figure 4-14, View B).
6. Insert the equalizer line-up pins in the second-to-last hole in the rails (Figure 4-15, View A).
7. Slowly pay out the load line while hauling in the boom hoist line until the equalizer rests against the line-up pins.
8. With the boom hoist line slack, place tension on the load line just enough to loosen and remove the connecting pins holding the equalizer to the rails (Figure 4-15, View B). Remove and store the pins.
9. Slowly haul in the boom hoist line and pay out the load line to lift the equalizer from the rails on the boom butt.
10. Remove the equalizer line-up pins from the rail and store them (Figure 4-15, View A).
11. Raise the boom butt to the limit of the boom butt cylinder.
12. Maintain equal haul-in and payout speeds so the equalizer rises smoothly.
    a. Too much tension in either line will cause the butt to rise off the cylinder and the equalizer to stop.
    b. Too little tension will cause the equalizer to tip.
13. Continue until the equalizer is just above the guide rollers on the gantry.
14. Fully lower the gantry using the gantry cylinders while paying out the load line and hauling in the boom hoist line so the equalizer lands on the gantry rails.
15. Continue to slowly haul in the boom hoist line and pay out the load line to slide the equalizer under the tie-down clips (Figure 4-14, View C). The equalizer limit switch will stop the boom hoist automatically.
16. Lower the boom butt onto the blocking.
17. Unpin the load line dead-end socket from the equalizer (Figure 4-14, View B) and remove the wedge and socket from the load line.
18. Remove the load line from the guide sheave on the boom butt. Haul in and secure the load line on the load drum for storage.

Disconnect Lower Butt from Upper Butt

See Figure 4-13 for the following procedure.

1. Back up an empty trailer in line with the boom butt.
2. Lower the boom butt with the boom butt cylinder until the upper butt is supported on the trailer.
3. Raise and lower the boom butt using the boom butt cylinder until the bottom connecting pins are loose. Remove and store the pins.
4. Unpin and swing down the supports for the boom stop strut cylinders to the storage position (see View B). Pin in place.
5. Disconnect the boom stop air line from the lower butt at the quick coupler located on the right side of the upper butt (see View B). Stand clear since the boom stops will lower.
6. Lower the butt using the boom butt cylinder to disengage the top connecting pins in the lower butt from the holes in the upper butt (see View A).
7. Secure the upper butt to the trailer and remove the trailer.

Install Adapter Frame and Carbody on Trailer

1. Stop the engine and disengage the hydraulic disconnect with the switch on the right side of the rotating bed.
2. On the right side of the adapter frame, unplug the electrical cable and uncouple the air lines from the quick-couplers (Figure 4-12, View B). Connect the electrical cable and air lines to the storage points.
3. Unpin the front alignment pendants from the rotating bed (Figure 4-10, View C).
4. Unpin the rear alignment pendants from the adapter frame (Figure 4-10, View D).
5. Swing the operator's cab away from the front jack and pin into position (Figure 4-10).
6. Rotate the jacks to the operating position (Figure 4-8). Pin the struts to the jacks.
7. Remove the jack pads from storage and install them (Figure 4-7, View A).
8. Start the engine and fully extend the front and rear jacks to lift the adapter frame and carbody off the four pedestals (Figure 4-12, View A).
9. Remove and store the carbody pedestals (Figure 4-7, View B).
10. Carefully back an empty trailer into position under the carbody. Loosely block the trailer in event of an overload.
11. Slowly retract the jacks to lower the carbody onto the trailer.

NOTE: Lower the rear jacks before the front jacks.

12. At the frame connecting pins (Figure 4-11, View B), pull the latch pins and pivot the latches up. Lock the latches in place with the pins (Figure 4-11, View A).
13. Disengage all four frame connecting pins. Visually ensure that all four pins are fully disengaged**.**
14. Fully extend the jacks to raise the upper butt off the adapter frame and the carbody.
15. Close and latch the doors of the adapter frame hydraulic disconnect (Figure 4-10, View A).
16. Carefully pull the trailer with the carbody out from under the rotating bed.

    Secure the carbody to the trailer.

Install Rotating Bed on Trailer

See Figure 4-7 for the following procedure.

1. Close and latch the doors on the rotating bed hydraulic disconnect (see View C).
2. Carefully back an empty trailer into position under the rotating bed (see View C).
3. Fully retract the jacks to lower the rotating bed onto the trailer (see View A).
4. Remove and store the jack pads (see View A).
5. Rotate the operator's cab to the stored position and secure it.

CAUTION

Avoid Equipment Damage!

Ensure the clamp does not interfere with the cab when the cab is rotated to the stored position.

The window will break if the clamp is engaged.

6. Stop the engine.
7. Store the jacks and struts (Figure 4-8).

THIS PAGE INTENTIONALLY LEFT BLANK

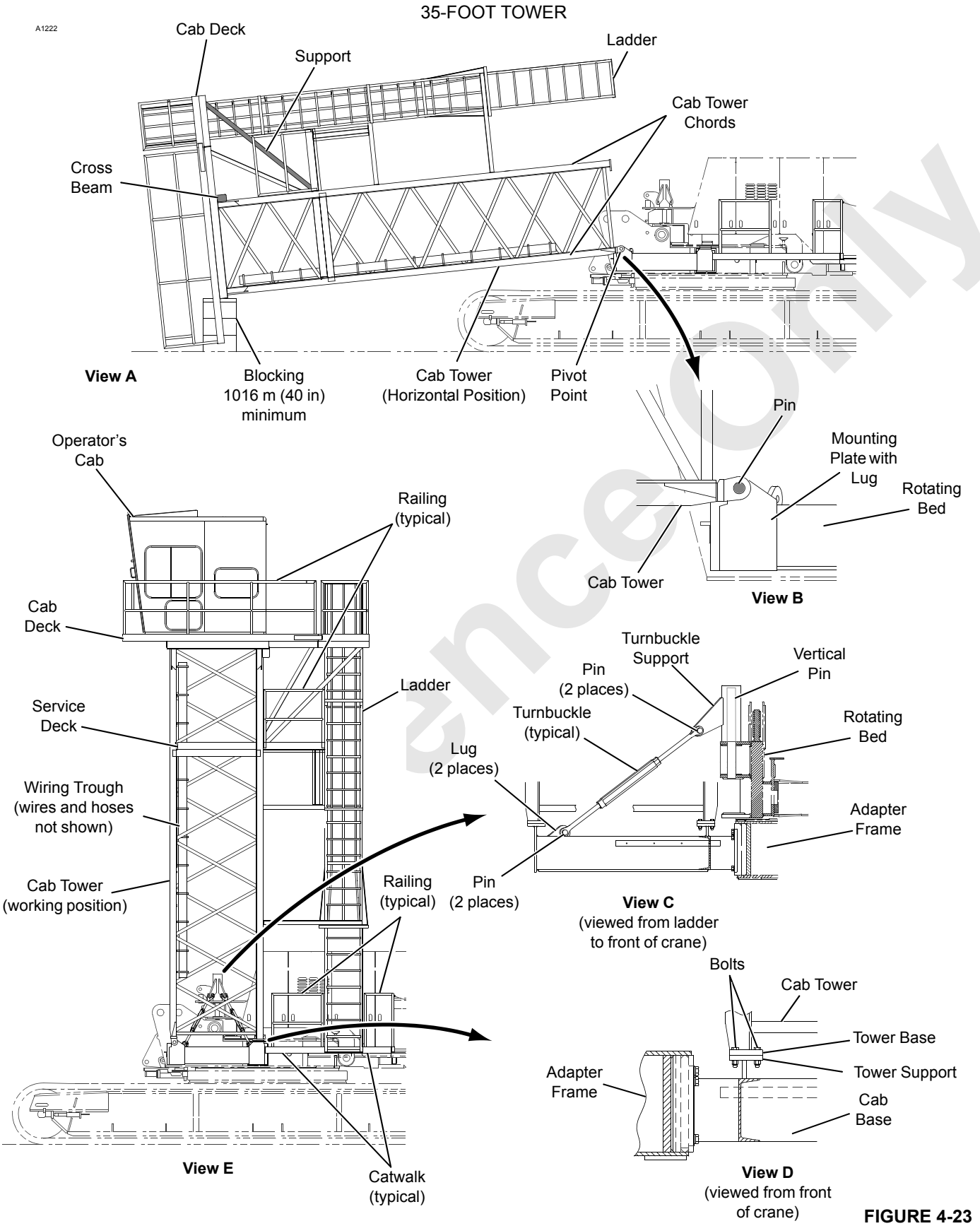

35-FOOT TOWER
A1222
Cab Deck
Support
Ladder
Cab Tower Chords
Cross Beam
View A
Blocking 1016 m (40 in) minimum
Cab Tower (Horizontal Position)
Pivot Point
Pin
Mounting Plate with Lug
Rotating Bed
Cab Tower
View B
Operator's Cab
Railing (typical)
Cab Deck
Ladder
Service Deck
Wiring Trough (wires and hoses not shown)
Cab Tower (working position)
Turnbuckle Support
Vertical Pin
Pin (2 places)
Turnbuckle (typical)
Rotating Bed
Lug (2 places)
Adapter Frame
Railing (typical)
Pin (2 places)
View C
(viewed from ladder to front of crane)
Bolts
Cab Tower
Tower Base
Tower Support
Adapter Frame
Cab Base
View D
(viewed from front of crane)
View E
Catwalk (typical)

FIGURE 4-23

ELEVATED CAB ASSEMBLY (35-FOOT TOWER)

General

This section provides assembly and removal instructions for the elevated cab option.

The elevated cab must be installed and removed by experienced personnel trained in the erection of construction cranes. These personnel shall read and become thoroughly familiar with the instructions section and in the Operator Manual supplied with the crane before attempting to install or remove the cab tower.

The installation and removal area must be firm, level, and free of ground and overhead obstructions. The area selected must be large enough to accommodate the 2250 and cab tower in addition to the movement of an assist crane required to install and remove the parts.

Safety

The crane rotating bed must be properly supported before beginning the installation of the elevated cab. The method of support varies, depending on the application for which the crane was designed.

Some parts of the crane and cab tower cannot be reached from the ground. Take necessary precautions to prevent falling off the crane and cab tower during assembly and disassembly.

Installing Elevated Cab

Attaching Cab Tower to Crane

See Figure 4-23 for the following procedure.

NOTE: Lift on the chords, not the ladder or tower cross members.

1. Using slings, shackles, and other rigging as needed, lift the tower from the trailer.
2. Align the tower base with the mounting plate on the rotating bed (see View B).
3. Insert and retain the pins (see View B).
4. Lower the tower top onto the blocking 1016 m (40 in) minimum (see View A).
5. Bolt the support first to the tower chord and then to the deck (see View A).

NOTE: For the first installation, align the support with the deck and drill holes in the deck to match the location of the bolt holes in the support.

WARNING

Crushing Hazard!

Prevent death or serious injury as the cab tower is raised!

- Stay out from under the cab tower.
- Keep fingers and other body parts away from the tower base and mounting plate.

6. Using slings and shackles attached to the cross beam (see View A), slowly raise the cab tower to the working position, allowing it to pivot on the pins.
7. As the cab tower nears vertical, allow the tower to rest on the cab base mounting plate and align the bolt holes (see View D).
8. Bolt the tower to the mounting plate (see View D).
9. Stiffen the tower with the turnbuckles (see View C).
   a. Slide the turnbuckle support over the vertical pin mounted on the rotating bed.
   b. Pin the turnbuckle to the lugs on the turnbuckle support and the tower.
   c. Tighten the turnbuckles evenly to stiffen the tower.

Installing Catwalks and Railings

Install the catwalks and railings as shown in Figure 4-23 and on the Operator's Cab Assembly drawing:

- Right side of the crane
- Left side of the crane
- Service deck
- Cab deck

Installing Operator's Cab

1. Using the four-point connection, hook the assist crane to the lugs on top of the operator's cab.
2. Lift the operators cab into position on the cab deck.
3. Align the bolt holes in the cab with the bolt holes in the cab deck.
4. Attach the cab to the deck with bolts (12 places).

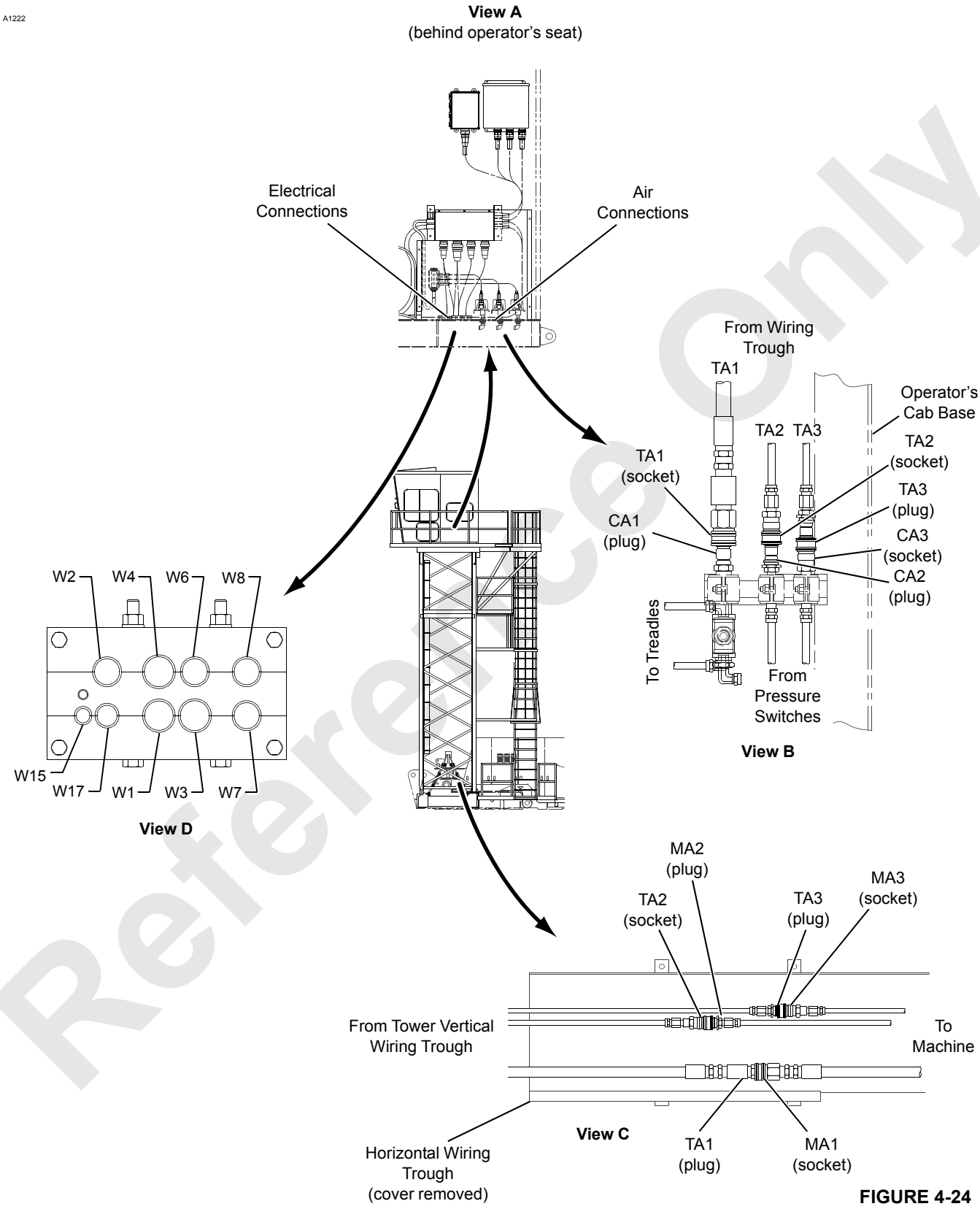


FIGURE 4-24

Make Cab-to-Machine Connections

See Figure 4-24 for the following procedure.

The cab tower is shipped with piping and wiring installed in the vertical wiring trough. Connections to the cab can be made from the service deck. Connections to the machine are made in the horizontal wiring trough at the base of the tower.

1. If necessary, remove the cover from the horizontal wiring trough.
2. Make the air piping connections. All air hoses have quick disconnects.
   a. At the service deck, connect hoses TA1, TA2, and TA3 from the wiring trough to the connectors CA1, CA2, and CA3, respectively, on the air manifold (see View B).
   b. At the horizontal wiring trough, connect the hoses TA1, TA2, and TA3 to connectors MA1, MA2, and MA 3, respectively, on the machine (see View C).
3. Make the electrical connections.
   a. At the service deck, connect the electrical cables from the wiring trough to the terminals at the cable bulkhead (see View D). Cable numbers will match the terminal numbers.
   b. At the horizontal wiring trough, connect the electrical cables from the wiring trough to the cables from the machine. The cables have matching numbers.
4. Connect the cab exterior lighting to the junction boxes (Figure 4-25).
   a. Connect the cable from the wiring trough to junction box A on the back of the cab (see View B).
   b. If necessary, plug the front floodlights and ladder floodlight into junction box A (see View B).
   c. Connect the cable from the wiring trough to junction box B under the catwalk (see View A).
   d. Plug the receptacle and cold-weather package (if provided) into junction box B (see View A).

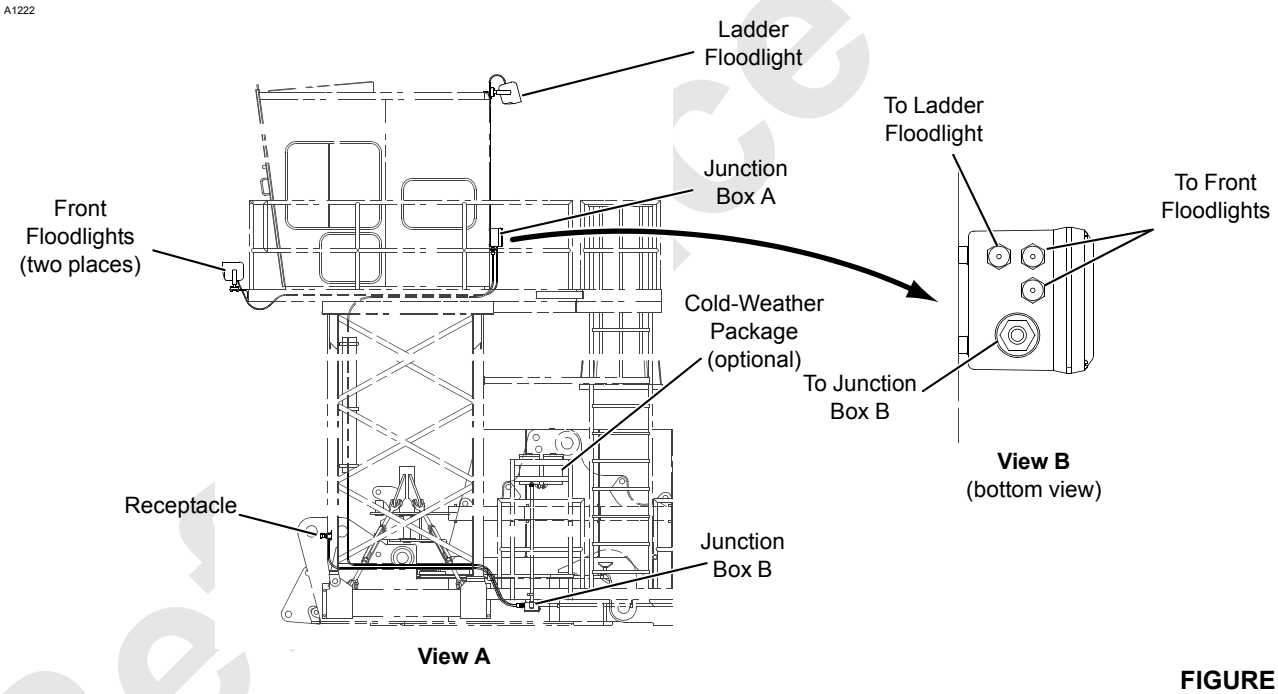


FIGURE 4-25

5. Make the necessary air conditioning system connections (Figure 4-26). The air conditioning hoses have quick disconnects.
   a. At the service deck, connect the heater hoses from the wiring trough to the heater hoses from the cab (see View A).
   b. At the service deck, connect air conditioning hoses 6 and 12 to hoses 6 and 12 from the cab (see View A).
   c. At the base of the tower, connect the air conditioning hoses 8 and 12 to hoses 8 and 12 from the machine (see View C).
   d. At the base of the tower, connect the heater hoses from the tower to the heater hoses from the machine (see View E).
   e. Connect the power cord from the condenser fans (see View B) to the terminal on the air solenoid junction box (see View D).
   f. Charge the air conditioning system according to the instructions in the manual provided by the manufacturer.

Remove Cab Tower

1. Discharge the refrigerant from the air conditioning system according to the instructions in the manual provided by the manufacturer.
2. At the base of the tower, disconnect and stow the following:
   - Power cord from the condenser fans (Figure 4-26, View B) to the terminal on the air solenoid junction box (see View D). Install the dust cap.
   - Heater hoses (Figure 4-26, View E)
   - Air conditioning hoses 8 and 12 (Figure 4-26, View C)
   - Electrical cable, receptacle, and cold-weather package (if provided) from junction box B under the catwalk (Figure 4-25, View A)
   - Electrical cables (tower) from machine cables
   - Tower air hoses from the machine air hoses (Figure 4-24, View C)
3. At the service deck, disconnect and stow the following:
   - Heater hoses (Figure 4-26, View A)
   - Air conditioning hoses 6 and 12 (Figure 4-26, View A)
   - Electrical cable from junction box A on the back of the cab (Figure 4-25, View B)
   - Electrical cables from the terminals on the bulkhead at the cab base (Figure 4-24, View D)
   - Air hoses from the air manifold at the base of the cab (Figure 4-24, View B)
4. Removing the cab:
   a. Remove the bolts holding the cab to the deck (12 places).
   b. Using the four-point connection, hook an assist crane to the lugs on top of the operator's cab.
   c. Lift the cab off the deck and set the cab off to the side.
   d. Remove the railings and catwalks.
5. Using slings and shackles attached to the cross beam (Figure 4-23, View A), support the tower in the working position.
6. Remove the tower turnbuckles (Figure 4-23, View C).
   a. Loosen the turnbuckle nuts.
   b. Unpin the turnbuckles from the lugs.
   c. Slide the turnbuckle support off the vertical pin.
7. Remove the bolts holding the tower to the mounting plate (Figure 4-23, View D).
8. Slowly lower the tower from the working position to the horizontal position, allowing it to pivot forward on the pins. Allow the cab deck to rest on the ground or the blocking (Figure 4-23, View A).
9. Unhook the assist crane from the crossbeam.
10. Using slings, shackles, and other rigging as needed, hook the assist crane to the tower.

NOTE: Lift on the chords, not on the ladder or the tower cross members.

11. Remove the pins from the tower base (Figure 4-23, View B).
12. Lift the tower away from the crane and store the tower.

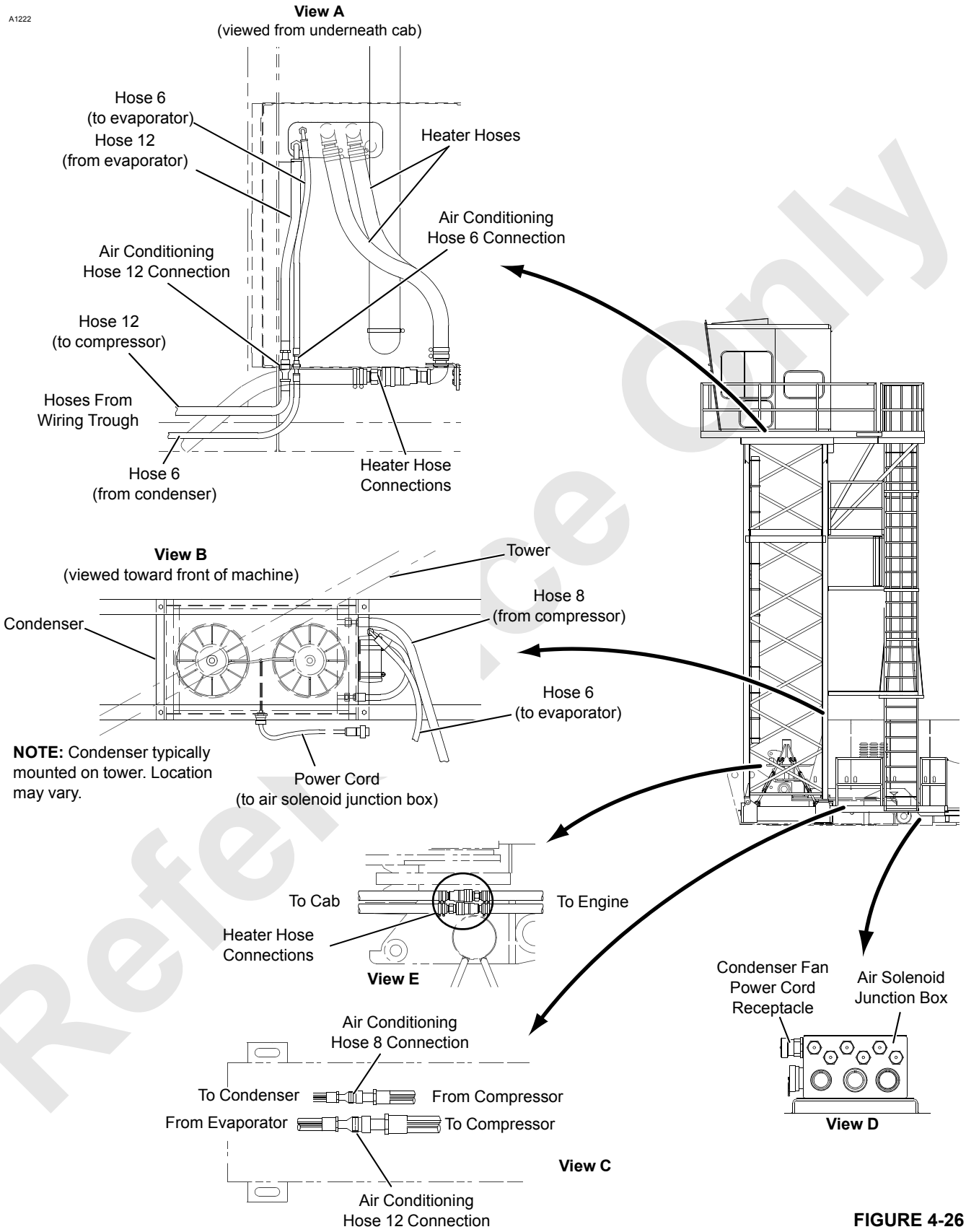


FIGURE 4-26

4

DRUM SPACER/LAGGING INSTALLATION

General

This section identifies the drum spacer and the lagging components available for various crane applications. For specific information about a lagging (part number and rope sizes), see the Drum and Lagging Chart in the Capacity Chart Manual provided with your crane:

- Front Drum (Figure 4-27)
- Unequal Split Rear Drum (Figure 4-28)
- Equal Split Rear Drum (Figure 4-29)

NOTE: All drums are viewed from the rear.

Torque Values

Apply Loctite 243 (or equivalent thread-locking adhesive/sealant) to the threads of Lebus fasteners and tighten to 678 Nm (500 ft-lb).

Tighten the spacer nuts coated with light engine oil to 81 to 102 Nm (60 to 75 ft-lb).

Installation of Mast Self-Erecting Wire Rope

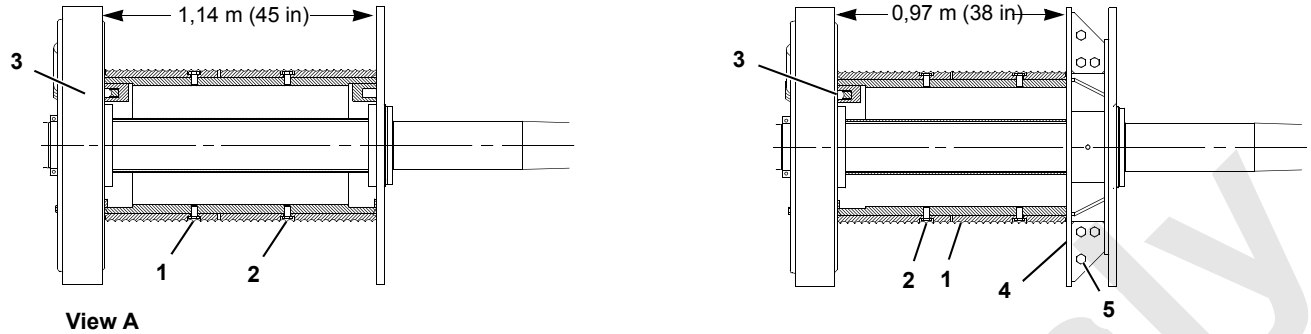
NOTE: See the Wire Rope Installation and Maintenance in Section 5 of the Crane Service Manual for the wire rope anchoring and spooling procedure.

See Figure 4-28 for the following procedure.

1. Anchor the wire rope to the left rear drum.
2. Tightly wrap the first layer of the wire rope onto the left rear drum.
3. Install the drum spacer over the first layer of the wire rope so the spacer is tight against the outboard drum flange.
4. Wrap the wire rope onto the drum until the drum is full.

A792

2250 Front Drum



View A
Clamshell (optional holding)
Bulk Material Handling (closing)

View B
Liftcrane (optional hoist or whip)
Container Handling (auxiliary)

FIGURE 4-27

2250 Unequal Split Rear Drum

Left Rear
Liftcrane (whip)
Mast Self-Erect
Clamshell (holding)

Right Rear
Liftcrane (hoist)
Clamshell (closing)
Bulk Material Handling (holding)

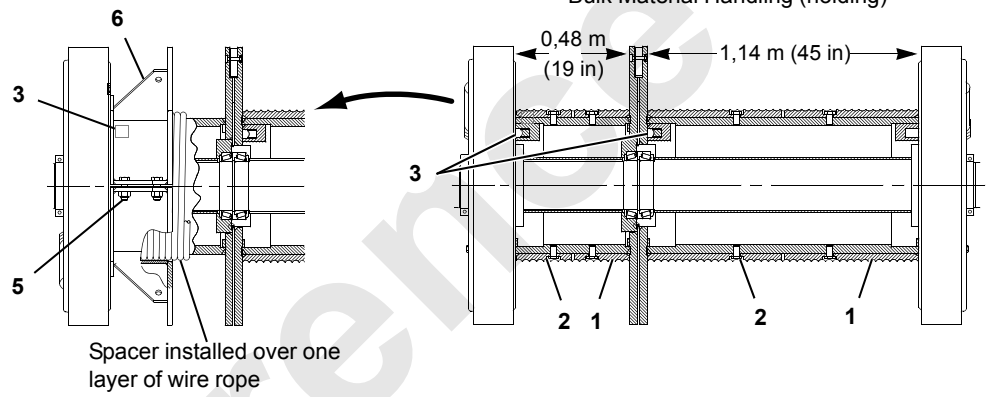
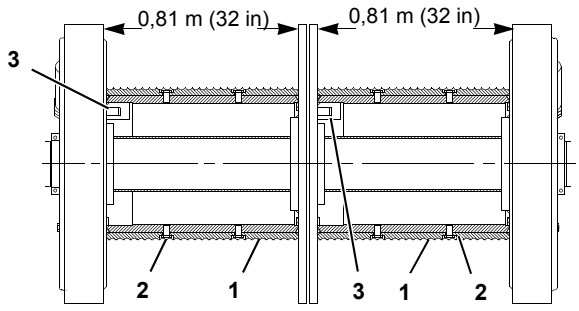


FIGURE 4-28

2250 Equal Split Rear Drum

Item	Description
1	Lagging
2	Lebus Fastener
3	Wire Rope Anchor Wedge
4	Spacer (liftcrane only)[1]
5	Elastic Stop Nuts and Bolt
6	Spacer (MAX-ER Self-Erect Mast)

[1] Required to ensure proper drum spooling. Rope and sheave damage will occur if spacers are not installed.



Left Rear
Container Handling (hoist)
Clamshell (holding)

Right Rear
Container Handling (hoist)
Clamshell Closing

FIGURE 4-29

GANTRY RAISING AND LOWERING (WITH BOOM BUTT HANDLING CYLINDER)

General

This section contains the gantry raising and lowering instructions for cranes equipped with a two-piece boom butt and boom butt handling cylinder.

Figure 4-30 shows a crawler crane. These procedures also apply to truck cranes.

Gantry raising and lowering requires two people:

- One to operate the boom hoist control in the crane cab.
- A second to operate the remote controls from the ground level, to observe the raising or lowering procedure, and to provide the necessary signals to the operator in the cab

These personnel shall read and become thoroughly familiar with the instructions section before attempting any procedure. Contact the Manitowoc Crane Care Lattice Team for assistance if any procedure is not understood.

The gantry assembly has a telescopic backhitch, which provides the following three positions (Figure 4-30):

- FULLY RAISED—position for all the load handling operations
- INTERMEDIATE—fully extended position of the gantry cylinders

  The gantry cylinders must be used to partially raise and fully lower the gantry. The boom hoist rigging is used to raise and lower the gantry from or to the extended position of the cylinders.
- FULLY LOWERED—transporting the crane and for handling some boom lengths (see Boom Rigging Drawing for the boom handling conditions)

The gantry cylinders, backhitch pins, and boom butt handling cylinder are controlled with switches on the crane setup remote control. See Section 3 for the identification and location of all the operating controls.

To raise and lower the gantry, the Setup mode must be selected and confirmed.

In the Setup mode, the crane's normal automatic boom stop is bypassed and the setup boom stop is activated. The setup limit switch (Figure 4-30, View A) stops the boom butt when the boom stop tubes are approximately 25 mm (1 in) from bottoming out (boom butt at approximately 89°).

When the boom stop tubes are approximately 25 mm (1 in) from bottoming out, the gantry should be fully raised and you should be able to engage/disengage the backhitch pins with the corresponding switch on the remote control.

CAUTION

Equipment Damage Hazard!

Do not allow the boom stop tubes to bottom out. Damage to the boom stop tubes and the boom butt will occur.

If for some reason the backhitch pins cannot be engaged/disengaged when the boom stop tubes are approximately 25 mm (1 in) from bottoming out, it will be necessary to bypass the setup boom stop and to boom up slightly.

CAUTION

Crush Hazard!

The gantry can fall onto the personnel. Avoid personal injury. Do not raise or lower the gantry until all personnel are off the top of the crane and counterweights.

Do not lift loads, including the assembly block, when the gantry is in the intermediate position. The gantry will rise, allowing the boom butt and the load to fall violently.

THIS PAGE INTENTIONALLY LEFT BLANK

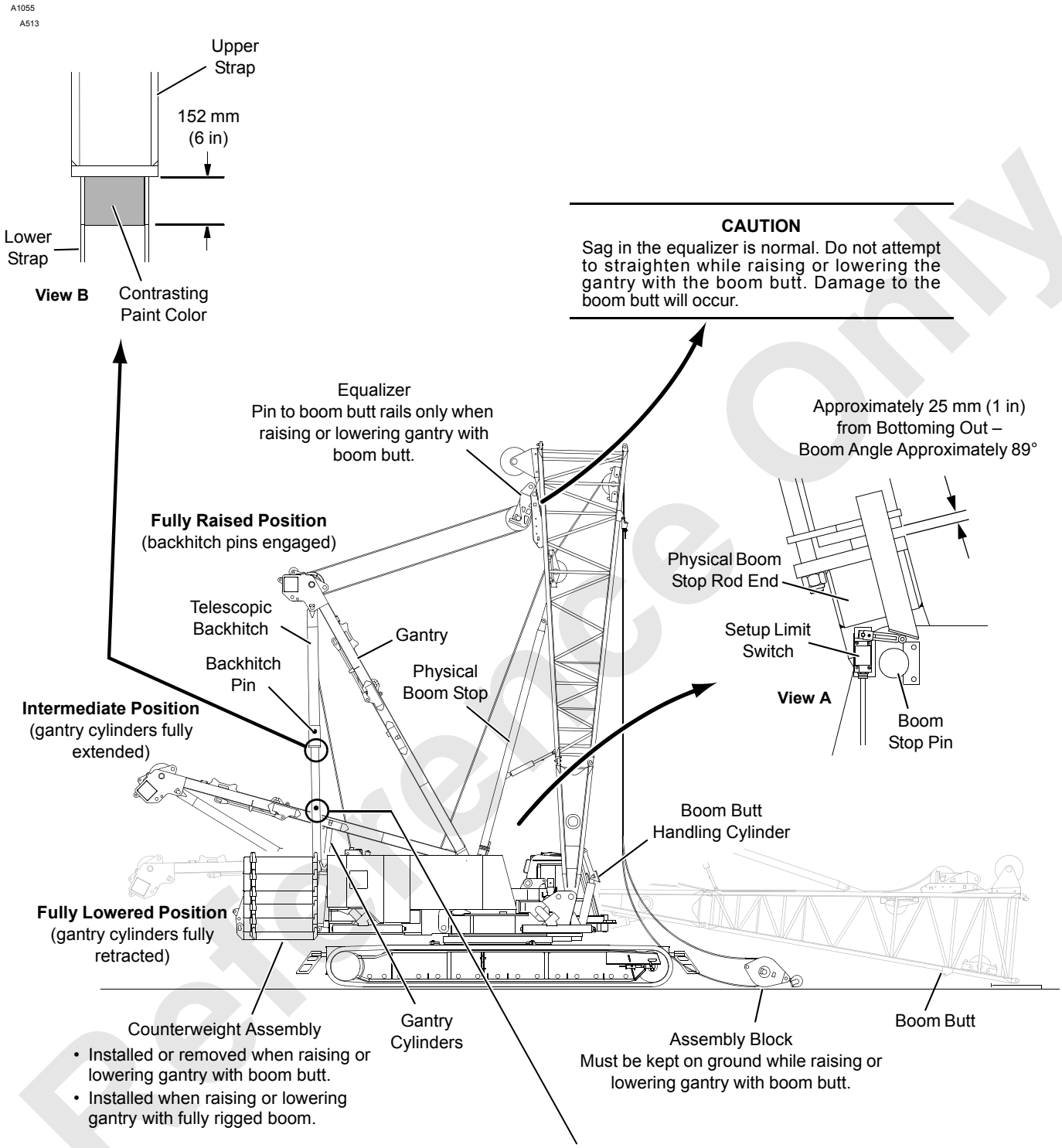


FIGURE 4-30

Raising and Lowering Gantry with Boom Butt

Requirements for Raising and Lowering Gantry with Boom Butt

See Figure 4-30 for more information.

- Crane is on a firm level surface.
- For truck cranes, the rotating bed and carrier is in line with the boom butt and over the rear of the carrier.

DANGER

Tipping Hazard!

Avoid death, serious injury or tipping the crane. For a truck crane, do not swing over the side of carrier rubber when the counterweight is installed or when the gantry is lowered with or without the counterweight installed.

- Boom butt is pinned to the crane as shown on the Boom Rigging Drawing and is resting on the blocking at the ground level.
- Physical boom stops are installed.
- Boom hoist wire rope is reeved properly through the gantry and equalizer sheaves and is anchored to the boom hoist drums as shown on the Boom Rigging Drawing.
- Equalizer is pinned to the boom butt rails.
- Counterweights are either installed or removed.
- Assembly block, if installed, is kept on the ground while raising and lowering the gantry.

Raising Gantry with Boom Butt

See Figure 4-30 for the following procedure.

1. Connect the crane setup remote control to the air valve junction box on the left side of the rotating bed.
2. Turn on the cab power switch and start the crane's engine.
3. Select and confirm the setup mode with the crane mode selector.
4. Fully extend the gantry cylinders with the switch on the remote control to raise the gantry to the intermediate position.

DANGER

Crush Hazard!

Avoid serious injury. Do not attempt to raise the boom butt with the boom hoist control until step 5 has been performed. The boom butt will rise part of the way, and the gantry will rise, then the boom butt and gantry will fall violently.

5. Raise the boom butt to 45° with the boom butt handling cylinder (use the switch on the remote control).
6. Disengage the backhitch pins with the switch on the remote control. Hold the backhitch pin switch in the disengaged position until the contrasting paint color is visible on the lower backhitch straps.

CAUTION

Equipment Damage!

Do not allow the boom stop tubes to bottom out. Damage to the boom stop tubes and the boom butt will occur.

7. Raise the boom butt with the boom hoist control (boom up). The boom butt will stop rising when the physical boom stops are approximately 25 mm (1 in) from bottoming out (see View A), and then the gantry should rise.

NOTE: If the gantry does not rise when the boom butt stops, depress the bypass switch in the crane cab.

Continue to raise the gantry with extreme caution. Watch the boom stop tubes while the gantry rises.

The backhitch lower straps are painted a contrasting color (see View B) to alert the operator when the backhitch is approximately 152 mm (6 in) from being fully extended.

Watch the backhitch while raising the gantry. Slow down the boom hoist speed when the contrasting color is reached.

CAUTION

Boom Butt Damage!

Use care while raising the boom butt. If either backhitch pin fails to engage before the physical boom stops bottom out, stop and correct the problem—damaged pin, or air/electric fault.

Overtensioning the boom rigging can result in structural damage to boom butt.

8. Continue to raise the boom butt (boom up). The backhitch pins will automatically snap into engagement with the upper holes. Stop raising when the backhitch is fully extended.
9. Visually check that both pins are fully engaged. If either pin fails to engage, raise the boom butt slightly with the boom hoist control to engage the pin.

CAUTION

Equipment Damage!

Do not allow the boom stop tubes to bottom out. Damage to the boom stop tubes and boom butt will occur.

10. Fully retract the gantry cylinders and the boom butt handling cylinder with the switches on the remote control.
11. Lower the boom butt to the desired position, with the boom hoist control.
12. Select and confirm the desired operating mode with the crane mode selector.
13. Unplug the crane setup remote control from the junction box and store the remote control.

Lowering Gantry with Boom Butt

See Figure 4-30 for the following procedure.

1. Connect the crane setup remote control to the air valve junction box on the left side of the rotating bed.
2. Turn on the cab power switch and start the crane engine.
3. Select and confirm the Setup mode with the crane mode selector.
4. Fully extend the gantry cylinders with the switch on the remote control.

DANGER

Falling Attachment Hazard!

The gantry and butt can fall violently, causing death or serious injury. Do not disengage the backhitch pins until the backhitch is tensioned.

5. Raise the boom butt with the boom hoist control (boom up) until the physical boom stops are approximately 25 mm (1 in) from bottoming out (see View A).
6. Disengage the backhitch pins with the switch on the remote control. Hold the backhitch pins switch in the disengaged position until the gantry has been lowered onto the gantry cylinders.

CAUTION

Boom Butt Damage!

Use care while raising the boom butt. If either backhitch pin fails to engage before the physical boom stops bottom out, stop and correct the problem—damaged pin or air/electric fault.

Overtensioning the boom rigging can result in structural damage to boom butt.

7. Visually check that both pins are disengaged. If either pin fails to disengage, raise the boom butt slightly with the boom hoist control (boom up) to disengage the pin.

   It may be necessary to depress the bypass switch in the crane cab while performing this step.

CAUTION

Equipment Damage!

- Watch the boom stop tubes while the gantry rises.
- Do not allow the boom stop tubes to bottom out. Damage to the boom stop tubes and boom butt will occur.

8. Boom down to lower the gantry until it comes to rest on the gantry cylinders.
9. Fully extend the boom butt handling cylinder with the switch on the remote control.
10. Lower the boom butt onto the boom butt handling cylinder and lower the boom butt to the ground with the cylinder. Pay out the boom hoist wire to keep the rope slack as the boom butt lowers.

DANGER

Crush Hazard!

Avoid death or serious injury. Do not lower the boom butt to the ground with the boom hoist control. The boom butt will lower partway, the gantry will rise, and the boom butt and gantry will fall violently.

11. Retract the gantry cylinders with the switch on the remote control to lower the gantry until the cylinders are fully retracted. Pay out the boom hoist wire rope to keep the rope slack as the gantry lowers.
12. Select and confirm the desired operating mode with the crane mode selector.
13. Unplug the crane setup remote control from the junction box and store the remote control.

Raising and Lowering Gantry with Fully Rigged Boom

Requirements for Raising and Lowering Gantry with Fully Rigged Boom

See Figure 4-30 for more information.

- The crane is on a firm level surface.
- For truck cranes, carrier is leveled on extended outriggers with tires off the ground.
- Fully rigged boom is resting on blocking at the ground level.

DANGER

Tipping Hazard!

Avoid death, serious injury, and tipping the crane. For truck cranes, do not attempt to the lower boom to the ground or raise the boom from the ground until the outriggers are extended.

- Equalizer is not pinned to the boom butt rails.
- Counterweights are installed.

Raising Gantry with Fully Rigged Boom

See Figure 4-30 for the following procedure.

1. Connect the crane setup remote control to the air valve junction box on the left side of the rotating bed.
2. Turn on the cab power switch and start the crane's engine.
3. Select and confirm the Setup mode with the crane mode selector.
4. Fully extend the gantry cylinders with the switch on the remote control to raise the gantry to the intermediate position.

CAUTION

Gantry or Boom Damage!

Do not attempt to raise the gantry until the gantry cylinders are fully extended. Structural damage to the gantry or boom will occur.

5. Disengage the backhitch pins with the switch on the remote control. Hold the backhitch pins switch in the disengaged position until the contrasting paint color is visible on the lower backhitch straps.
6. Boom up to raise the gantry.

NOTE: The backhitch lower straps are painted a contrasting color (see View B) to alert the operator when the backhitch is approximately 152 mm (6 in) from being fully extended.

Watch the backhitch while raising the gantry. Slow down the boom hoist speed when the contrasting color is reached.

7. Raise the gantry until the boom is 76 to 102 mm (3 to 4 in) off the blocking. Raising the boom off the blocking will ensure that the backhitch is fully extended.
8. Backhitch pins will automatically snap into engagement with the upper holes. Stop raising the gantry when the backhitch is fully extended.
9. Visually check that both pins are fully engaged. If either pin fails to engage, determine the possible cause of the problem:
   - Pin damaged
   - Air/electric fault
10. Lower the boom onto the blocking.
11. Fully retract the gantry cylinders with the switch on the remote control.
12. Select and confirm the desired operating mode with the crane mode selector.
13. Unplug the crane setup remote control from the junction box and store the remote control.

Lowering Gantry with Fully Rigged Boom

See Figure 4-30 for the following procedure.

1. Connect the crane setup remote control to the air valve junction box on the left side of the rotating bed.
2. Turn on the cab power switch and start the crane's engine.
3. Select and confirm the Setup mode with the crane mode selector.
4. Fully extend the gantry cylinders with the switch on the remote control.

CAUTION

Gantry Damage!

Make sure the gantry cylinders are fully extended. Cylinders must be used to fully lower the gantry. Attempting to fully lower the gantry with the boom hoist rigging will cause the gantry to fall violently. Structural damage to the gantry or the boom will occur.

CAUTION

Gantry or Boom Damage!

Do not disengage the backhitch pins until the backhitch is tensioned. The gantry can fall violently. Structural damage to the gantry or boom will occur.

5. Raise the boom 76 to 102 mm (3 to 4 in) off the blocking to ensure that the backhitch is properly tensioned.
6. Disengage the backhitch pins with the switch on the remote control. Hold the backhitch pins switch in the disengaged position until the gantry has been lowered onto the gantry cylinders in step 8.
7. Visually check that both pins are fully engaged. If either pin fails to engage, determine the possible cause of the problem:
   - Pin damaged
   - Air/electric fault
8. Boom down to lower the gantry until it comes to rest on the gantry cylinders (the boom will lower onto the blocking first, then the gantry will lower).
9. Retract the gantry cylinders with the switch on the remote control to lower the gantry until the cylinders are fully retracted. Pay out the boom hoist wire rope to keep the rope slack as the gantry lowers.
10. Select and confirm the desired operating mode with the crane mode selector.
11. Unplug the crane setup remote control from the junction box and store the remote control.

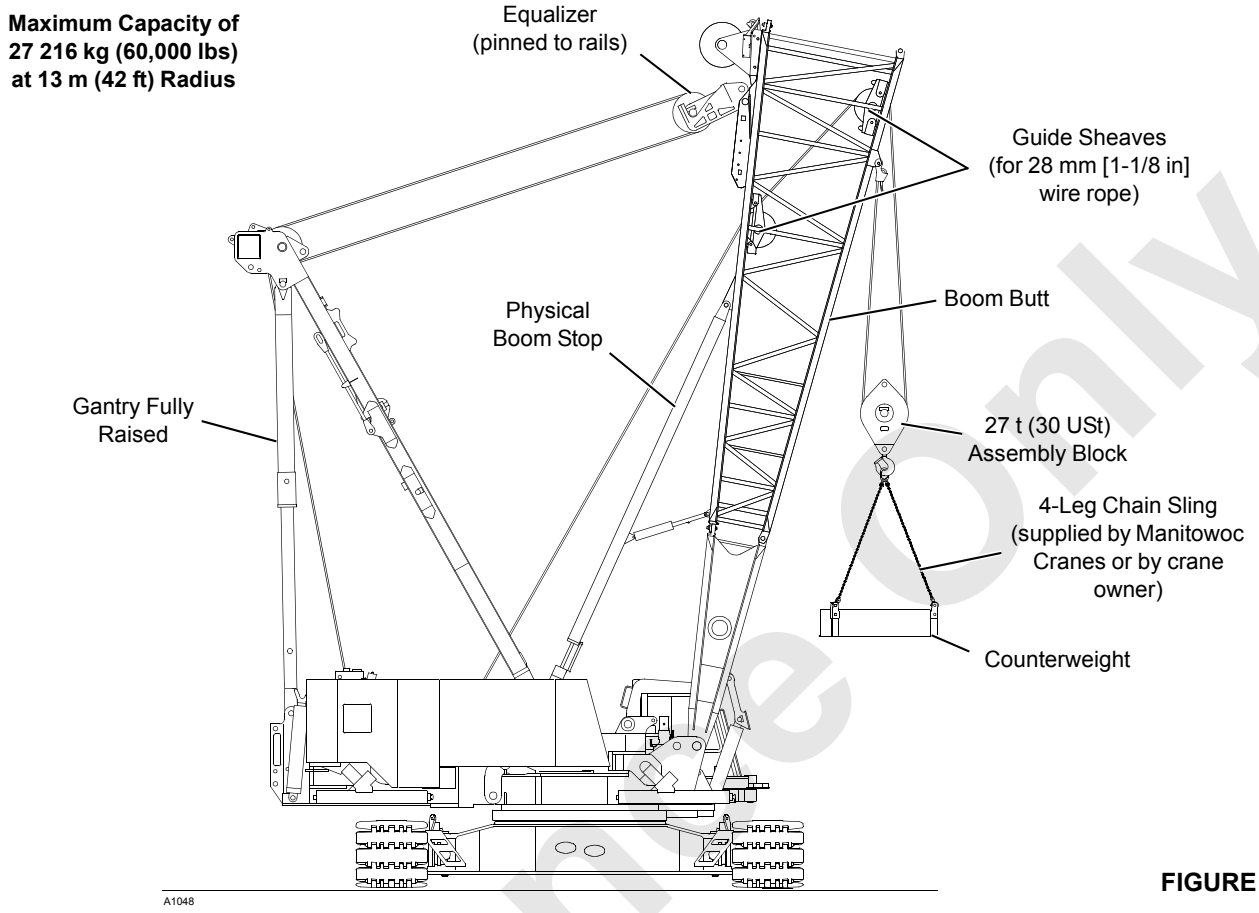


FIGURE 4-31

COUNTERWEIGHT INSTALLATION AND REMOVAL

General

Counterweight installation or removal requires two people:

- One to operate the controls in the operator's cab
- One to operate the remote controls from ground level, to observe the installation or removal procedure, and to provide the necessary signals to the operator in the cab

NOTE: Personnel shall read and become thoroughly familiar with the instructions and the Gantry Raising and Lowering (with Boom Butt Handling Cylinder) on page 4-50 section before attempting any procedure.

Operating Controls

The gantry cylinders and counterweight attaching pins are controlled with switches on the crane setup remote control. See Section 3 for identification and location of all operating controls.

Handling Counterweight

See Figure 4-31 for more information.

The 2250 can handle and assemble its own counterweight using the boom butt when equipped with the optional guide sheaves in the boom butt and the 27 t (30 USt) assembly block. Otherwise, an assist crane is required.

WARNING

Falling Load Hazard!

Avoid serious injury and tipping the crane. Do not exceed 27 216 kg (60,000 lb) capacity at a 13 m (42 ft) radius.

The 2250 must be in the following configuration to handle and assemble its own counterweight:

- Crane (with crawlers installed) is on a firm, level surface.
- Boom butt is pinned to the crane, as shown on the Boom Rigging Drawing.
- Physical boom stop is installed.

- Automatic boom stop is installed and properly adjusted.
- Boom hoist wire rope is reeved properly through the gantry and equalizer sheaves and is anchored to the boom hoist drums as shown on the Boom Rigging Drawing.
- Equalizer is pinned to the boom butt rails.
- Gantry is pinned in the fully raised position.
- Assembly block is installed.
- Capacity is limited to 27 216 kg (60,000 lb) at a 13 m (42 ft) radius for full 360° of rotation.

Lifting Lug Identification

WARNING

Falling Load Hazard!

Avoid death or serious injury. Lifting lugs may break, allowing the counterweight to fall. Do not exceed the capacity of lifting lugs specified.

Lower Tray

See Figure 4-32 for more information.

WARNING

Falling Load Hazard!

Avoid death or serious injury. Do not attempt to lift the lower tray at the lifting lugs when the center box or side boxes are installed. Lifting lugs may break, allowing the counterweight to fall.

Lift the lower tray at the four lifting lugs (L1, View B). The lifting lugs are designed for lifting the lower tray only.

Center Box

See Figure 4-32 for more information.

Lift the center box at two lifting lugs (L2, View C). The lifting lugs are designed for lifting the center box only. Do not attempt to lift the center box with the lower tray attached.

Side Box

See Figure 4-32 for more information.

Lift the side boxes at the two lifting pins (L3, View E). Do not attempt to lift more than two side boxes at a time.

WARNING

Falling Load Hazard!

Avoid death or serious injury. Cracks that develop on the counterweight support lugs, could lead to unexpected structural failure of the center box, allowing the counterweights to fall from the crane. When installing and removing the upper counterweight, inspect the counterweight support lugs on the center box for cracks or other damage (Figure 4-32, View A). The lugs are important structural components that hold the counterweight on the upperworks.

Assembling Upper Counterweight (Series 1 and 2)

See Figure 4-32 for the following procedure.

NOTE: Assemble the complete counterweight assembly on the ground.

1. If lowered, raise the counterweight lifting frame and the pin in the operating position (see View F).
2. Lift the center tray into position on the lower tray and align the connecting holes.
3. Pin the center tray to the lower tray (see View B).

NOTE: Make sure to install the washers and cotter pins.

4. Lift the side boxes into position on the lower tray and align the connecting holes.
5. Pin the side boxes to the lower tray and to each other (see View D).

NOTE: Make sure to install the safety pins.

Assembling Upper Counterweight (Series 3)

See Figure 4-32 for the following procedure.

WARNING

Falling Load Hazard!

Avoid death or serious injury. Do not attempt to install or remove the Series 3 counterweight assembly as a complete unit. The lifting pendants, links, or lugs may break, allowing the counterweight assembly to fall.

The series 3 counterweight assembly must be installed and removed in two stages.

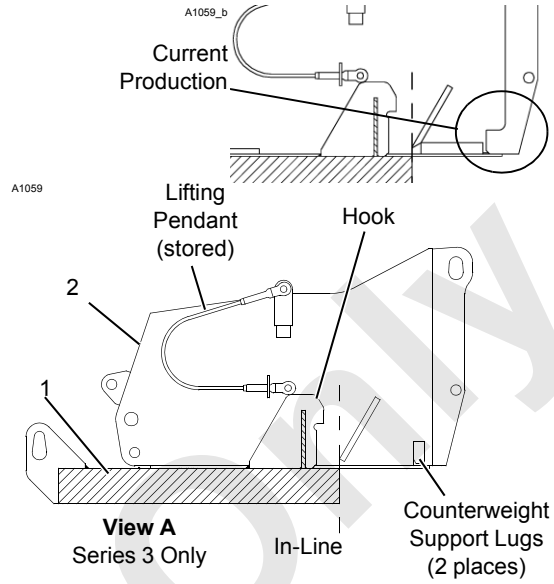
See the detailed Series 3 counterweight installation and removal instructions for more information.

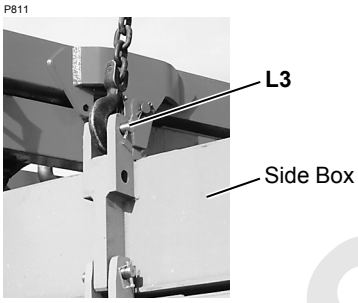
1. If lowered, raise the counterweight lifting frame and pin in the operating position (see View F).
2. Lift the center box into position on the lower tray (see View A). Do not pin the center box to the lower tray.

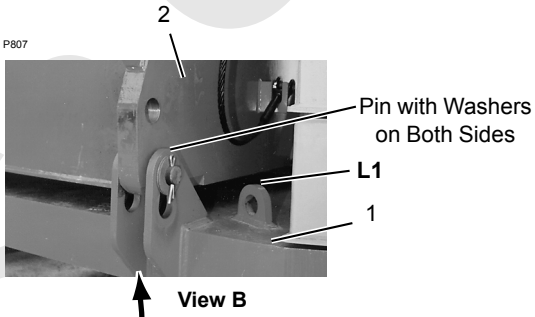
   This step is required to ensure that the counterweight support lugs on the center tray do not contact the hooks on the lower tray when the center box is lifted onto the crane.
3. Lift the side boxes into position on the lower tray and align the connecting holes.
4. Pin the side boxes to the lower tray and to each other (see View D).

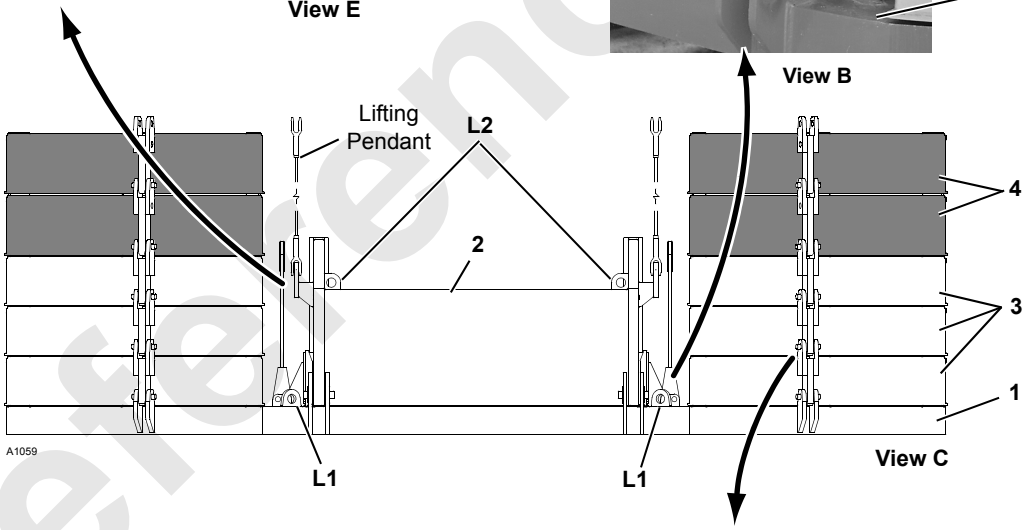
NOTE: Make sure to install the safety pins.

COUNTERWEIGHT REQUIREMENT				
Item	Description	Series 1	Series 2	Series 3
1	Lower Tray 17 588 kg (38,775 lb)	1	1	1
2	Center Box 16 783 kg (37,000 lb)	1	1	1
3	Side Box 7 031 kg (15,500 lb)	3 Both Sides	3 Both Sides	3 Both Sides
4	Side Box 9 072 kg (20,000 lb)	0	1 Both Sides	2 Both Sides
TOTAL WEIGHT		76 748 kg (169,200 lb)	84 898 kg (209,214 lb)	113 064 kg (249,264 lb)

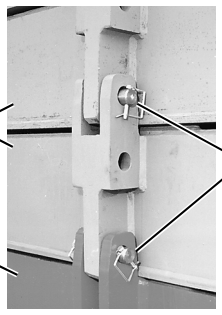






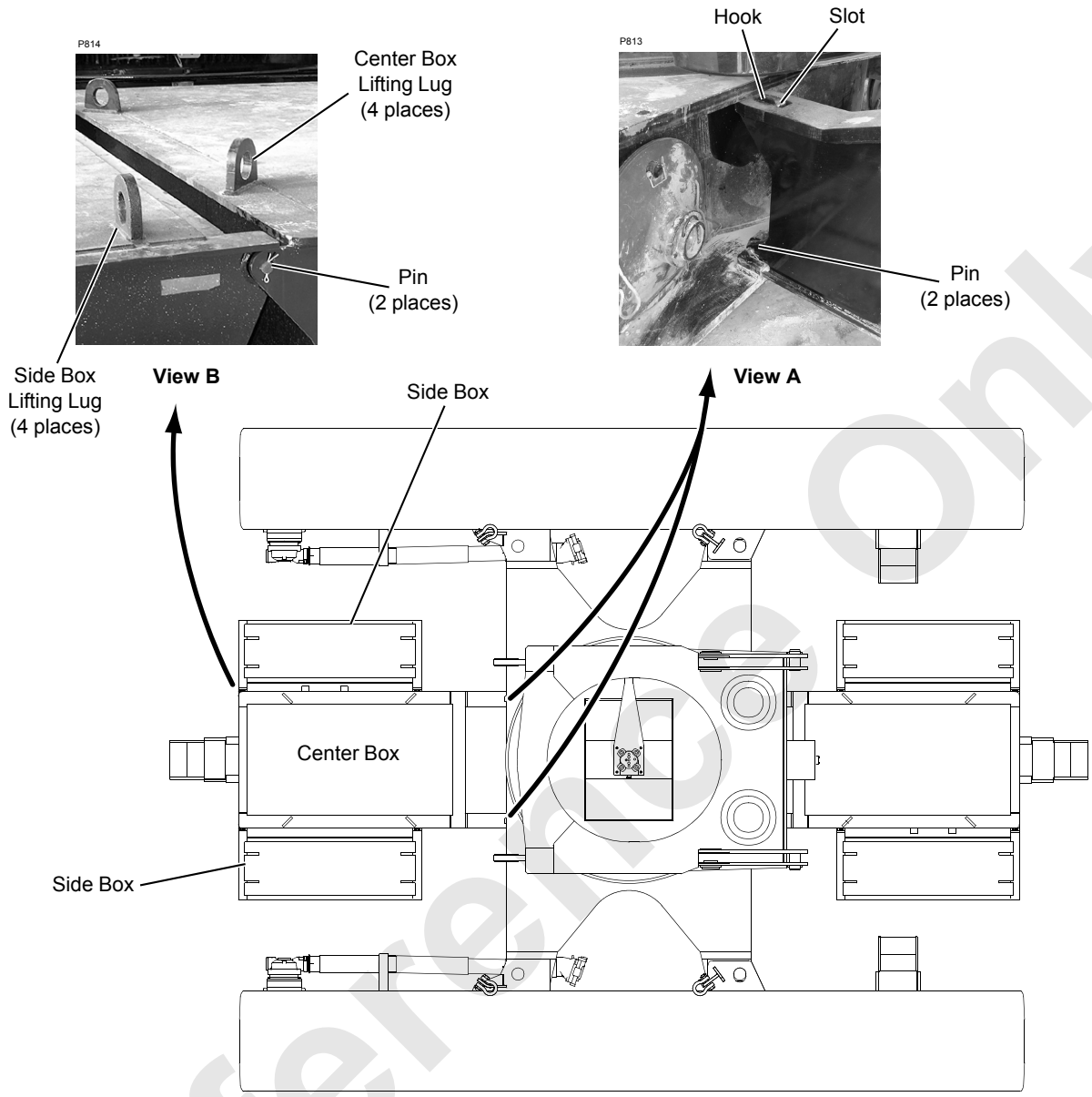


View D



LIFTING POINTS	
Item	Description
L1	Lifting Lug—Lower Tray (qty 4)
L2	Lifting Lug—Center Box (qty 2)
L3	Lifting Pin—Side Box (qty 2)

FIGURE 4-32



	Carbody Counterweights Required	Weight Each kg (lb)	Total Weight kg (lb)
Series 2	2 Center Boxes	13 608 (30,000)	27 216 (60,000)
Series 3	2 Center Boxes	13 608 (30,000)	54 431 (120,000)
	4 Side Boxes	6 804 (15,000)	

FIGURE 4-33

Installing/Removing Counterweight

WARNING

Moving Part Hazard!

Avoid serious injury. It is necessary to stand on the upper counterweight to gain access to the handling links on the gantry. It may be necessary to climb onto the upper counterweight to engage and disengage the handling links.

Stay off the counterweight while the gantry is being raised and lowered. Do not climb onto the counterweight until the gantry is at rest on the gantry cylinders.

Do not stand between the counterweight and the crane while the counterweight is being installed. Never go under the counterweights until they are pinned to the crane.

Requirements

The 2250 can install and remove its own counterweight using the gantry as a lifting device. If equipped with only a boom butt, the 2250 must be in the same configuration as when handling the counterweight (Figure 4-31).

NOTE: The assembly block (if installed) must be kept on the ground while installing and removing the counterweight.

It will be necessary to travel the crane in either direction to align the handling links when installing and removing the counterweight. For this reason, the following steps must be taken if the 2250 is equipped with a fully rigged boom.

1. Lower the boom onto the blocking at least six inches high.
2. Pin the equalizer to the rails on the boom butt.
3. Disconnect the straps from the equalizer. See the Boom Rigging Drawing.
4. Disconnect the boom butt from the boom.
5. Pay out the load lines as the crane is traveled.

Installing Carbody Counterweights (Series 2)

See Figure 4-34 for more information.

Carbody counterweights are required for the Series 2 configuration.

Install the carbody counterweights before installing the upper counterweight as follows.

CAUTION

Boom Butt Damage!

If the boom butt is being used to install the carbody counterweights, do not raise the boom butt to the point that the physical boom stops bottom out. The boom stop tubes and butt will be damaged.

1. Using the assembly block and the 4-leg chain sling from the 2250, lift the center box into position at either end of the carbody.
2. Boom, hoist, and swing as required to engage the slots in the top of the center box with the hooks on the carbody (see View A).
3. Lower the center box until the bottom connecting holes line up.
4. Install the connecting pins (see View A). Make sure to install the cotter pins to retain the connecting pins.
5. Repeat step 1 through step 4 for the other end of the carbody.

Removing Carbody Counterweights (Series 2)

Remove the upper counterweight first. Then remove the carbody counterweights, as follows.

1. Using the assembly block and the 4-leg chain sling from the 2250, attach the chain sling hooks from the assembly block to the lifting lugs on the center box.
2. Remove the connecting pins (see View A).
3. Slowly lift the center box clear off the hooks on the carbody.
4. Lower the center box to the ground or onto the transport vehicle.
5. Repeat step 1 through step 4 for the other end of the carbody.

Installing Upper Counterweight (Series 1 and 2)

See Figure 4-34 for more information.

WARNING

Tipping Hazard!

Avoid possible injury. For Series 1 and 2 configurations, install the carbody counterweights before installing the crane counterweight. Otherwise, the crane could tip. For the same reason, remove the crane counterweight before removing the carbody counterweights.

1. If the crane will be rigged as a Series 2, install the carbody counterweights before installing the upper

counterweight. See Installing Carbody Counterweights (Series 2) on page 4-62 for installation instructions.

2. Position the crane so it is in line and centered with the assembled counterweight (see View B).
3. Fully lower the gantry. See Gantry Raising and Lowering (with Boom Butt Handling Cylinder) on page 4-50.
4. Lower the lifting links from the stored position and pin them to the counterweight lifting frame. Links must be pinned to the rear hole in the lifting frame (see View A).

CAUTION

Link Damage!

Handling links and the lower tray links must be in line and vertical prior to raising the counterweight. Otherwise, the links can be damaged.

5. Disengage the upper and lower counterweight attaching pins (see View A) with the switch on the setup remote control. Switches for the pins must be held in the disengaged position until the counterweight is in position.
6. Raise the gantry and the counterweight assembly with the switch on the setup remote control until the gantry raising cylinders are fully extended (see View D).

   The counterweight will tilt slightly forward with the top attaching holes on the center counterweight box ahead of the lower holes.

NOTE: If the upper counterweight attaching holes are above the mating holes in the rotating bed, lower the gantry cylinders until the holes are aligned.

7. Engage the upper counterweight attaching pins (see View C). Visually check that the pins are engaged.
8. Slowly lower the gantry until the lifting links are loose in their slots.
9. Engage the lower counterweight attaching pins (see View C). Visually check that the pins are engaged.
10. Unpin the lifting links from the lifting frame and store the lifting links on the gantry (see View E).
11. Fully raise the gantry. See Gantry Raising and Lowering (with Boom Butt Handling Cylinder) on page 4-50.
12. The boom butt can now be attached to the boom and the boom assembly.

Removing Upper Counterweight (Series 1 and 2)

See Figure 4-34 for more information.

Remove the upper counterweight before removing the carbody counterweights.

1. Fully lower the gantry and remove the lifting links from the stored position.
2. Pin the lifting links to the counterweight lifting frame. Links must be pinned to the rear hole in the lifting frame (see View A).
3. Disengage the lower counterweight attaching pins (see View C).
4. Raise the gantry and counterweight until the counterweight is supported by the lifting links and the upper attaching pins are loose in the slots.
5. Disengage the upper attaching pins (see View C).

   Keep the pins disengaged until the center box is clear of the rotating bed.
6. Lower the gantry until the counterweight rests on the ground.
7. Continue lowering the gantry until the lifting links are loose in the slots.
8. Unpin the lifting links from the lifting frame. Raise the lifting links and store them on the gantry (see View E).
9. Fully raise the gantry. See Gantry Raising and Lowering (with Boom Butt Handling Cylinder) on page 4-50.

Installing Carbody Counterweights (Series 3)

See Figure 4-33 for the following procedure.

Carbody counterweights are required for the Series 3 configuration. Install the carbody counterweights before installing the crane counterweight.

CAUTION

Boom Butt Damage!

If the boom butt is being used to install carbody counterweights, do not raise the boom butt to the point that the physical boom stops bottom out. The boom stop tubes and butt will be damaged.

1. Using the assembly block and the 4-leg chain sling from the 2250, lift the center box into position at either end of the carbody.
2. Boom, hoist, and swing as required to engage the slots in the top of the center box with the hooks on the carbody (see View A).
3. Lower the center box until the bottom connecting holes line up.
4. Make sure to install the cotter pins to retain the connecting pins.
5. Lift the side box into position (see View B) and pin it to the center box.

6. Repeat step 5 for the other side box.
7. Repeat step 1 through step 6 at the other end of the carbody.

Removing Carbody Counterweights (Series 3)

See Figure 4-33 for the following procedure.

Remove the upper counterweight before removing the carbody counterweights, as follows.

1. Using the assembly block and the 4-leg chain sling from the 2250, attach the chain sling hooks from the assembly block to the lifting lugs on the side box.
2. Remove the side box connecting pins (see View B).
3. Slowly lift the side box clear from the carbody and lower it onto the ground or to a transport vehicle.
4. Repeat step 1 through step 3 for the other side box.
5. Attach the chain sling hooks from the assembly block to the lifting lugs on the center box.
6. Remove the center box connecting pins (see View A).
7. Slowly lift the center box clear from the hooks on the carbody and lower it onto the ground or to a transport vehicle.
8. Repeat step 1 through step 7 for the other end of the carbody.

Series 1 and Series 2 Upper Counterweight
(shading indicates Series 2 configuration)

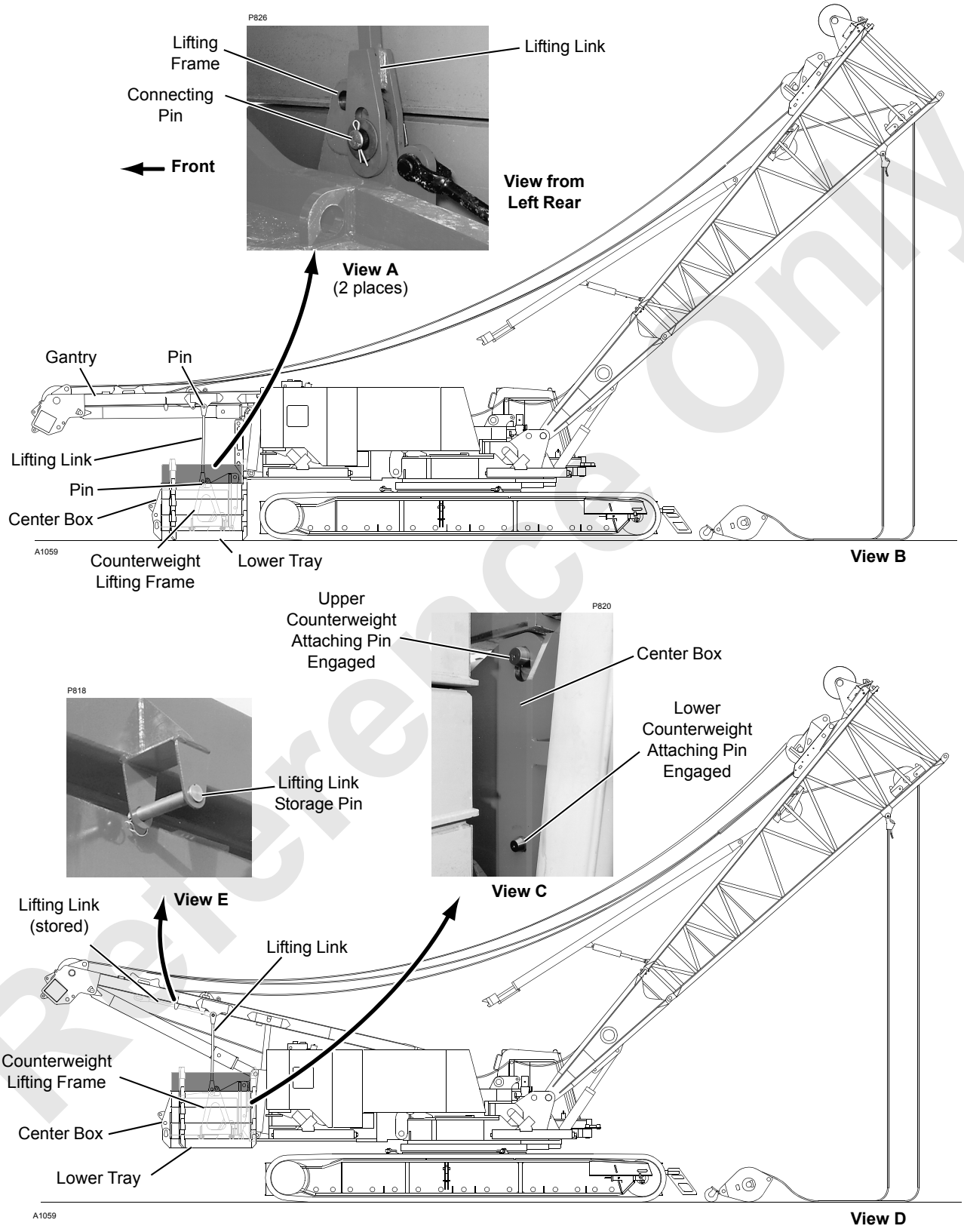
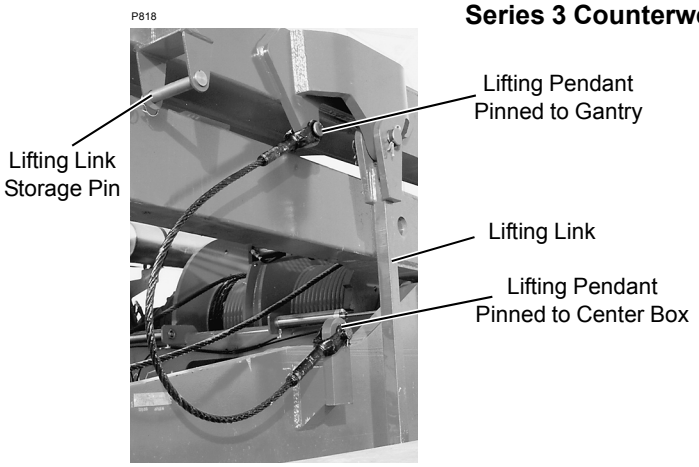
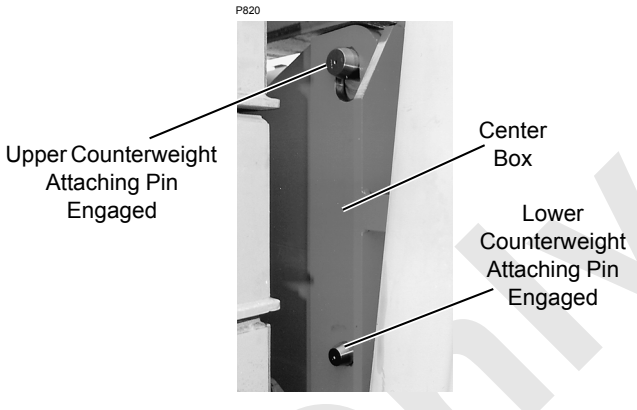
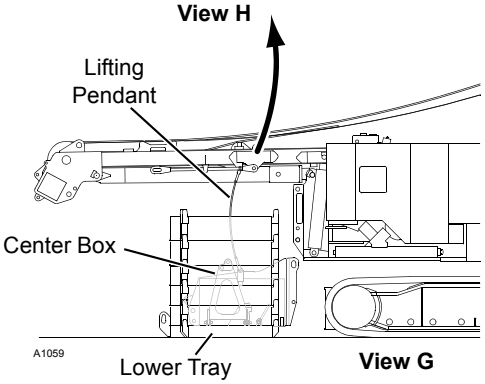


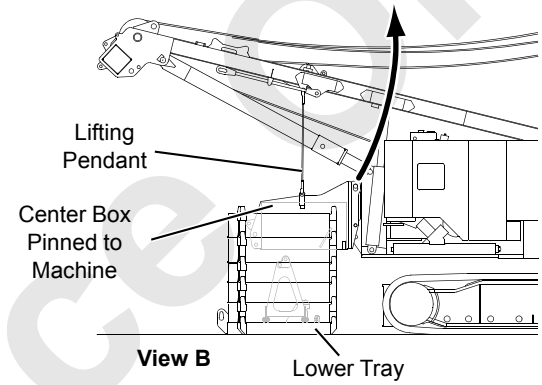
FIGURE 4-34

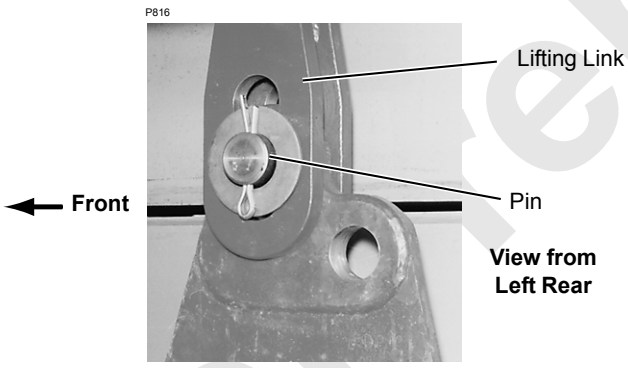
Series 3 Counterweight Installation

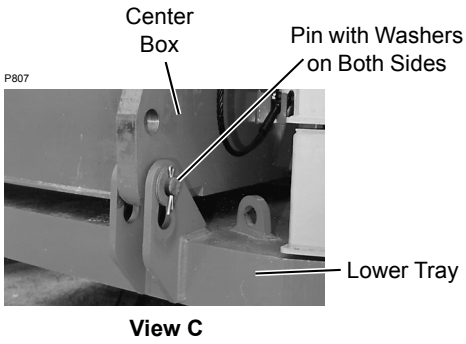


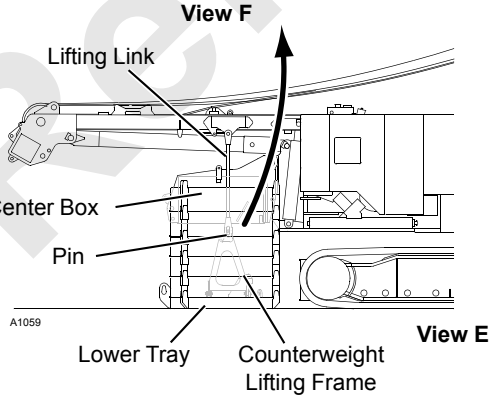












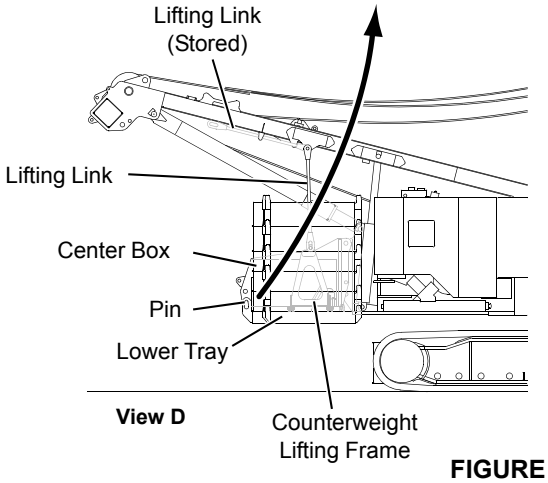


FIGURE 4-35

Installing Upper Counterweight (Series 3)

See Figure 4-35 for more information.

NOTE: Install the carbody counterweights before installing the upper counterweight. See Installing Carbody Counterweights (Series 3) on page 4-63 for installation instructions.

1. Position the crane so it is in line and centered with the assembled counterweight (see View G).
2. Fully lower the gantry. See Gantry Raising and Lowering (with Boom Butt Handling Cylinder) on page 4-50.
3. Lower the lifting links from the stored position (see View H).
4. Attach the lifting pendants (stored on the side of the center box) to the lugs on the gantry (see View H).
5. Disengage the upper and lower counterweight attaching pins (see View A) with the switch on the setup remote control. Switches for the pins must be held in the disengaged position until the counterweight is in position.
6. Raise the gantry and the center box with the switch on the setup remote control until the gantry raising cylinders are fully extended (see View B).

   The center box will tilt slightly forward with the top attaching holes on the center box ahead of the lower holes.

NOTE: If the upper center box attaching holes are above the mating holes in the rotating bed, lower the gantry raising cylinders until the holes are aligned.

7. Engage the upper counterweight attaching pins (see View A). Visually check that the pins are engaged.
8. Slowly lower the gantry until the lifting pendants are slack.

NOTE: Make sure the lifting links do not bind against the counterweight components.

9. Engage the lower counterweight attaching pins (see View A). Visually check that the pins are engaged.
10. Unpin the lifting pendants from the gantry and store them on the center box (Figure 4-32, View A).
11. Lower the gantry until the cylinders are fully retracted.

NOTE: Make sure the lifting links do not bind against the counterweight components.

12. Travel the machine so it is in line and centered with the lifting frames on the lower tray (see View E).
13. Pin the lifting links to the front hole in the lifting frame (see View F).

CAUTION

Link Damage!

The handling links and lower tray links must be in line and vertical prior to raising the counterweight. Otherwise, the links can be damaged.

14. Raise the gantry and remaining counterweight assembly with the switch on the setup remote control until the pin holes in the lower tray line up with the holes in the center box. Install the pins and washers (see View C).
15. Slowly lower the gantry until the lifting links are loose in the slots.

    Hooked lugs on the front of the lower tray will be engaged with the counterweight support lugs on the center box (Figure 4-36).
16. Unpin the lifting links from the lifting frame and store the lifting links on the gantry (see View H).
17. Fully raise the gantry. See Gantry Raising and Lowering (with Boom Butt Handling Cylinder) on page 4-50.
18. The boom butt can now be attached to the boom and the boom assembly.

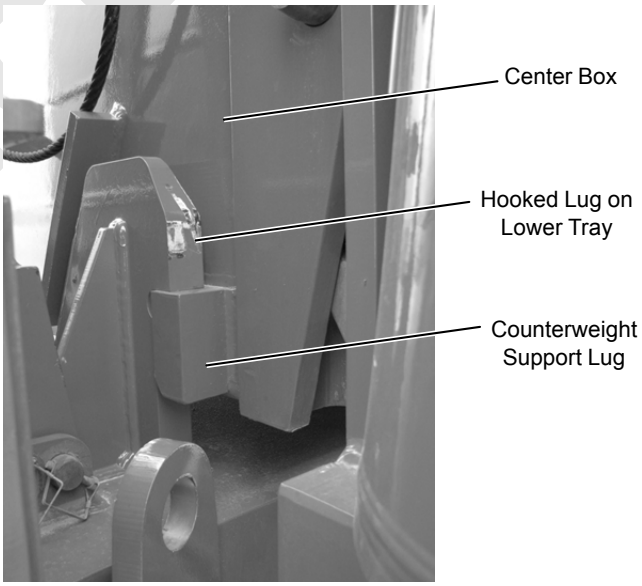


FIGURE 4-36

Removing Upper Counterweight (Series 3)

Remove the upper counterweight before removing the carbody counterweights.

1. Fully lower the gantry and remove the lifting links from the stored position.
2. Pin the lifting links to the counterweight lifting frames. Links must be pinned to the front hole in the lifting frame (Figure 4-35, View F).

3. Slowly raise the gantry until the lower tray contacts the bottom of the center box (Figure 4-32, View A). Remove the pins connecting the center box to the lower tray.
4. Lower the gantry until the counterweight is on the ground and the lifting links are loose in the slots. Unpin the lifting links from the lifting frames (Figure 4-35, View F).
5. Attach the lifting pendants, stored on the side of the center box, to the lugs on the gantry (Figure 4-35, View H).
6. Disengage the lower counterweight attaching the pins (Figure 4-35, View A).
7. Raise the gantry and the center box until the upper counterweight is supported by the lifting links and the upper attaching pins are loose in the slots (Figure 4-35, View A).
8. Disengage the upper attaching pins (Figure 4-35, View A).

   Keep the pins disengaged until the center box is clear from the rotating bed.
9. Lower the gantry until the center box is on the lower tray and the lifting pendants are slack.
10. Unpin the lifting pendants from the gantry and store them on the center box (Figure 4-32, View A).
11. Raise the lifting links and store them on the gantry (Figure 4-35, View H).
12. Fully raise the gantry. See Gantry Raising and Lowering (with Boom Butt Handling Cylinder) on page 4-50.

Counterweight Disassembly

Disassembly is the opposite of assembly.

The lifting frames can be stored for shipping on the lower tray after the side counterweight boxes are removed:

1. Support the lifting frame with an outside assist.
2. Remove the two inside pins from the lifting frame (store the pins in lugs on the lower tray).
3. Lower the lifting frame (toward outside) onto the lower tray.
4. Repeat these steps for the other lifting frame.

DRUM 5 INSTALLATION AND REMOVAL

Drum 5 is used as the luffing hoist or as an auxiliary drum. The drum is mounted on the front of the adapter frame.

Drum 5 Installation

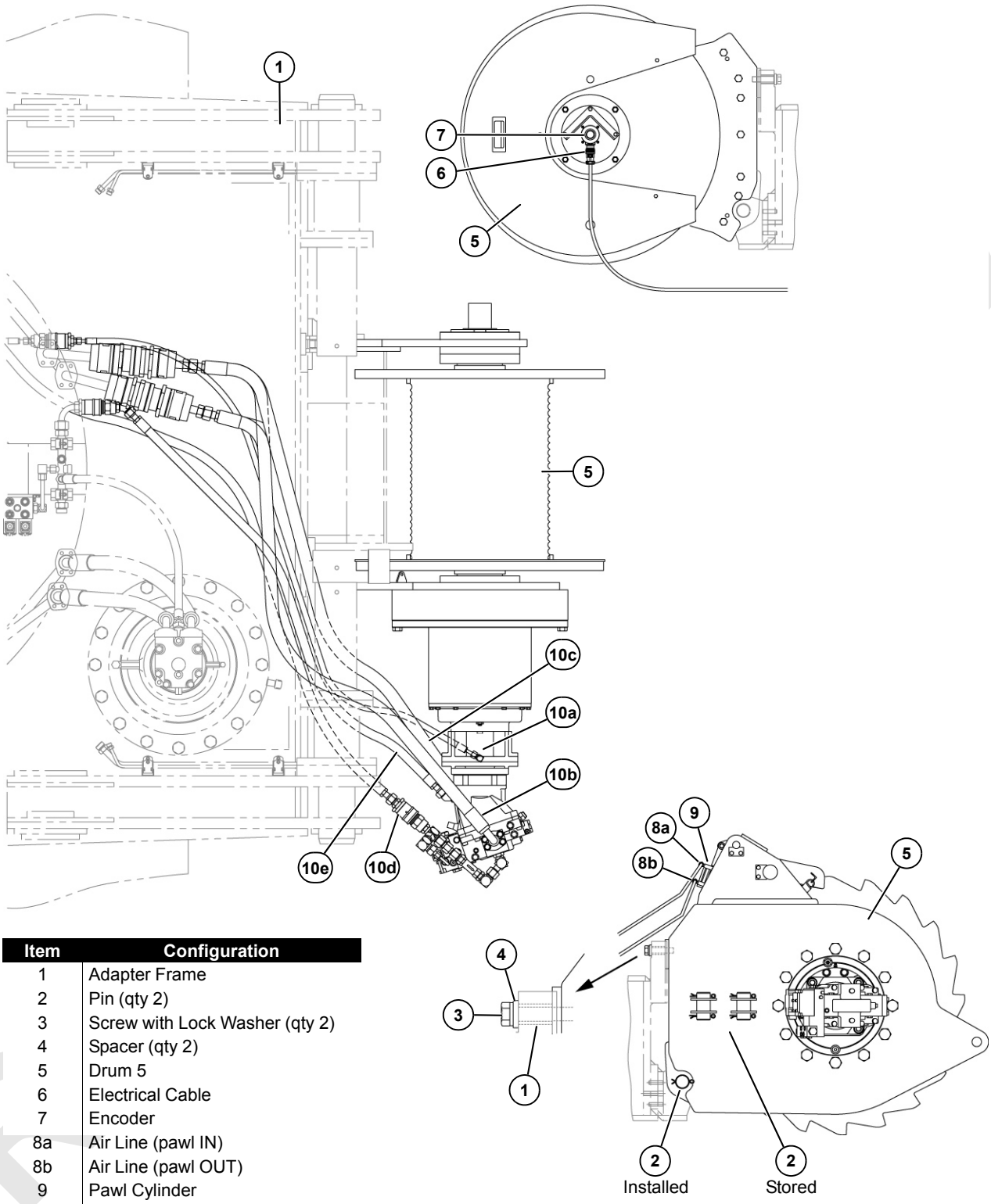
See Figure 4-37 for the following procedure.

1. Attach the owner-furnished nylon lifting slings from an assist crane to drum 5.
2. Lift the drum so it is balanced in the lifting slings.
3. Remove pins (2), screws with lock washers (3), and spacers (4) from storage on the drum.
4. Lift the drum into position at the front of the adapter frame (1).
5. Align the mounting holes and install the pins (2).
6. Install the spacers in the top mounting holes in the adapter frame.
7. Apply Loctite® #271 to the threads of the screws.
8. Install the screws with lockwashers.
9. Tighten the screws to 244 Nm (180 ft-lb).
10. Connect the electrical cable (6) from the adapter frame junction box to the encoder (7) on the left end of the drum.
    - Remove the dust caps from the plug and receptacle.
    - Thoroughly clean all dirt and moisture from the plug and receptacle before connecting.
11. Connect two air lines (8a and 8b) from the adapter frame to the drum pawl cylinder (9).
    - Thoroughly clean all dirt and moisture from the air line fittings before connecting.
    - The top port of the cylinder is pawl IN (engaged).
    - The bottom port of the cylinder is pawl OUT (disengaged).
12. Connect five hydraulic hoses (10a, 10b, 10c, 10d, and 10e) between the adapter frame and the drum.
    - Remove the dust caps from the couplers and nipples.
    - Thoroughly clean all dirt and moisture from the couplers and nipples before connecting.
13. Start the engine and check drum 5 for proper operation. Do not put the drum into service until any faults are corrected.

Drum 5 Removal

See Figure 4-37 for the following procedure.

1. Spool the wire rope onto the drum and secure it.
2. Reverse the installation steps to remove the drum.
3. Store the pins (2) in the brackets on the side of the drum.
4. Store the screws with lockwashers (3) and spacers (4) in the holes in the drum.



Item	Configuration
1	Adapter Frame
2	Pin (qty 2)
3	Screw with Lock Washer (qty 2)
4	Spacer (qty 2)
5	Drum 5
6	Electrical Cable
7	Encoder
8a	Air Line (pawl IN)
8b	Air Line (pawl OUT)
9	Pawl Cylinder
10a	Hydraulic Hose (brake release)
10b	Hydraulic Hose (motor port A)
10c	Hydraulic Hose (motor port B)
10d	Hydraulic Hose (motor control)
10e	Hydraulic Hose (case drain)

FIGURE 4-37

BOOM LADDER ASSEMBLY (#44 BOOM)

WARNING

Equipment Use Hazard!

Observe the following precautions, or serious injury can occur:

- Limit the load on the ladder to 136 kg (300 lb).
- Avoid improper use. This ladder is intended for use only on Manitowoc Cranes #44 boom inserts. Any other use is prohibited.
- Use the ladder for boom assembly/disassembly and maintenance only when the boom is horizontal.
- Make sure the ladder is properly secured to the insert.
- When climbing the ladder, hands must be free of any objects. Objects that cannot be carried in pockets or tool belts must be lifted into place onto the ladder platform prior to climbing the ladder.
- Stand only on the platform. Do not stand on cross braces.

See Figure 4-38 for the following information and procedures.

General

Two ladders are installed inside the boom butt, one on either side. The ladders are designed for use in assembly/disassembly and maintenance of #44 boom sections and components. Each ladder weighs approximately 8 kg (18 lb).

Removal from Boom Butt

It is recommended that two people remove the ladder from the boom butt, one person inside the boom butt to unlatch and lift the ladder and another person outside the boom butt to help guide the ladder out of the boom butt.

1. Lower the boom onto blocking at ground level.

NOTE: Boom sections must be horizontal.

2. Unhook the rubber latches (see View A).
3. Lift the ladder up and out of the hooks.
4. Guide the ladder through the lacings to the outside of the boom butt.

Installation on Boom Inserts

See Figure 4-38, View C for the following procedure.

Lift the ladder to the desired outside location on the insert so that the upper pad is securely hooked over the backside of the upper chord and lower pads rest firmly against the lower chord.

NOTE: The ladder must hang vertically against the boom insert when in use.

Storage in Boom Butt

See Figure 4-38 for the following procedure.

It is recommended that two people store the ladder in the boom butt, one person outside the boom butt to help guide the ladder into the boom butt and another person inside the boom butt to lift the ladder and latch it into position.

WARNING

Falling Load Hazard!

Injury can occur if ladders are not properly stored.

Ladders must be properly stored to prevent them from falling out of the boom butt when the boom is raised.

1. Hang the ladder rails over hooks inside the boom butt (see View B).
2. Pull the rubber latches tightly over the lower rail and latch in the keepers (see View A).
3. Ensure that the ladder cannot move once latched in place.

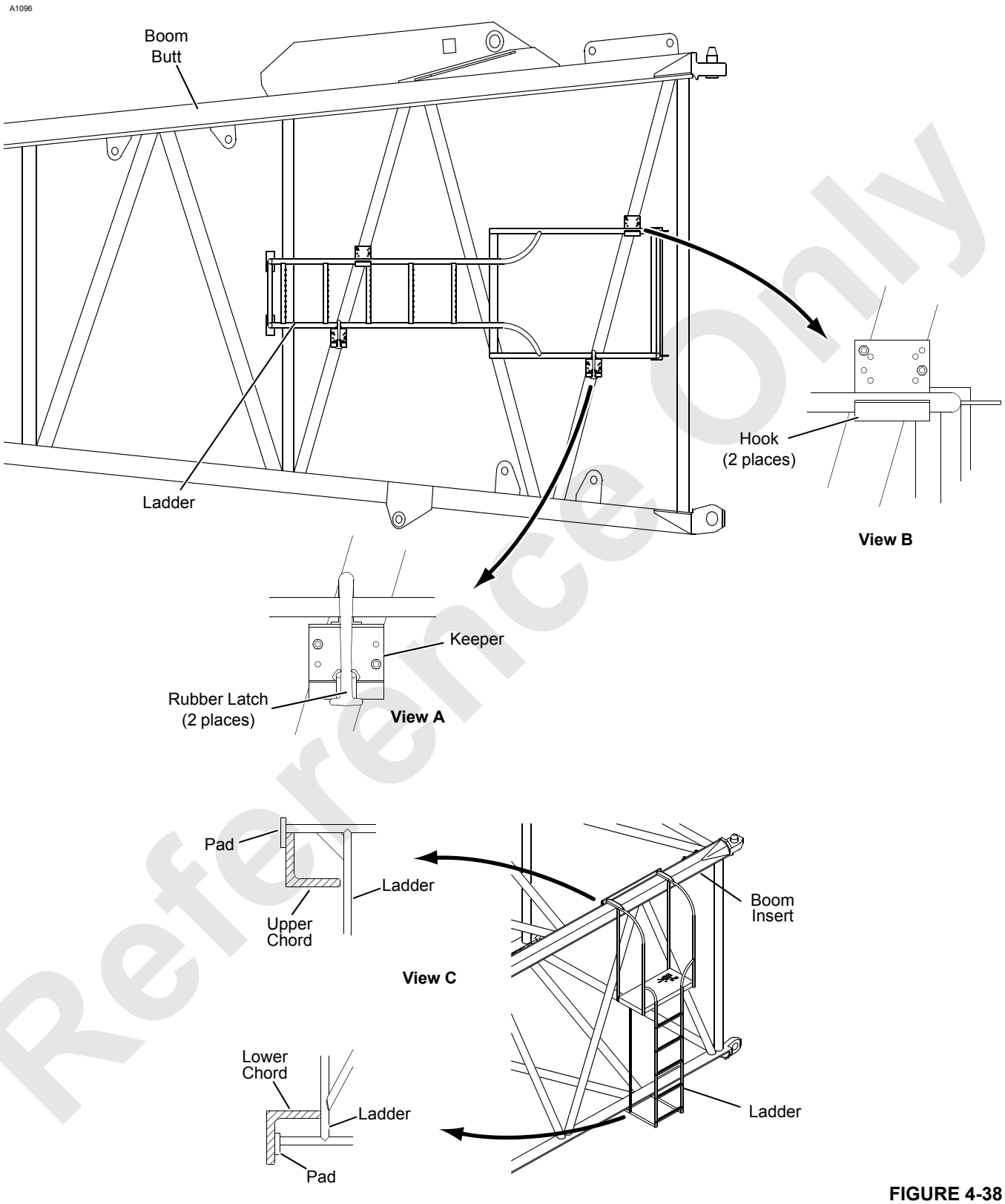


FIGURE 4-38

BOOM RIGGING GUIDE (#44 HL AND LR)

General

This topic contains installation and removal instructions for #44 and #44A Heavy Lift and #44 Long Reach booms equipped with straps.

Assist Crane Requirements

See Figure 4-39 for the following information.

An assist crane is not required to assemble and disassemble the boom sections. The 2250 crawler or truck crane can be used to assemble and disassemble its own boom sections when the crane is equipped with self-erect guide sheaves in the boom butt and is configured as shown.

DANGER

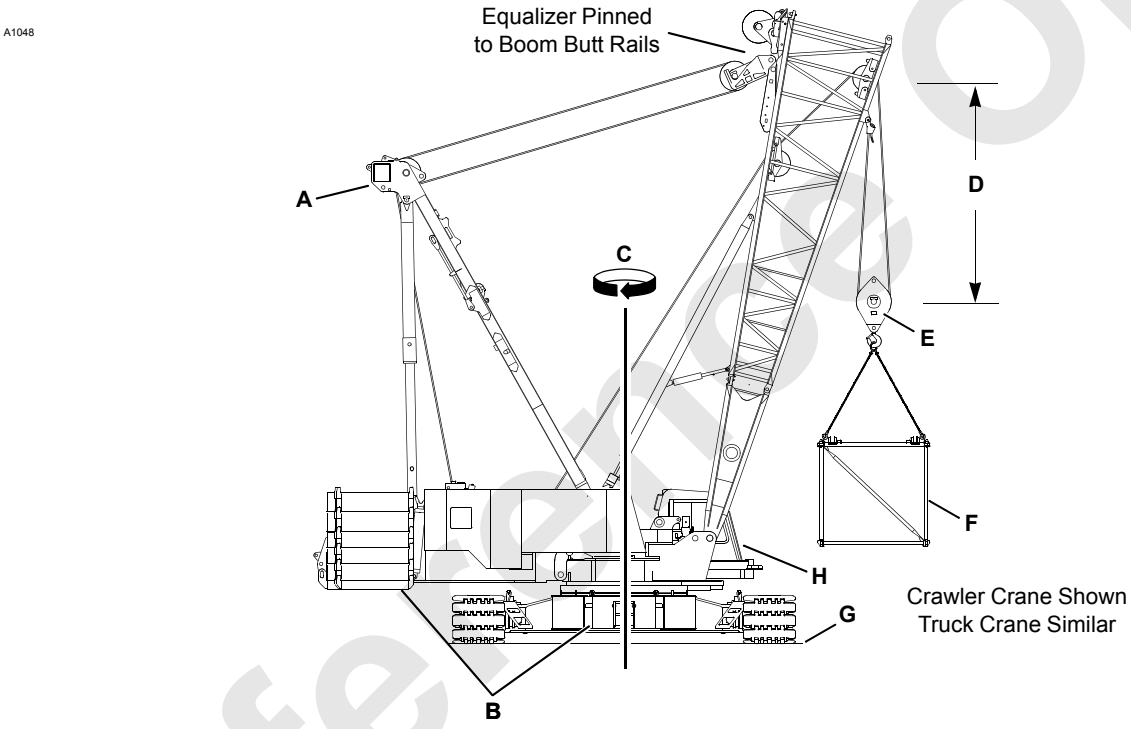
Tipping Hazard!

Avoid serious injury. To prevent the crane from tipping or the boom butt from collapsing, do not exceed the maximum lifting capacity and radius given in Figure 4-39.

CAUTION

Avoid Damage to Boom Rigging!

Hoisting the block higher than specified can result in damage to the wire rope and sheaves. Do not exceed the minimum block distance given in Figure 4-39.



Item	Configuration	
	Crawler Crane	Truck Crane
A	Gantry Fully Raised	Gantry Fully Raised
B	Counterweight Installed or Removed	Counterweight Removed
C	360° Swing and Travel Permitted	360° Swing and Travel Permitted
D	5,2 m (17 ft) Minimum Block Clearance	5,2 m (17 ft) Minimum Block Clearance
E	27,2 t (30 USt) Rigging Block with 2-Part Hoist Line	27,2 t (30 USt) Rigging Block with 2-Part Hoist Line
F	Capacity Limited to 27 216 kg (60,000 lb) at 6,1 m (20 ft) Radius	Capacity Limited to 22 226 kg (49,000 lb) at 6,7 m (22 ft) Radius
G	Crane Operated on a Firm, Level, Uniformly Supporting Surface	Crane Operated on a Firm, Level, Uniformly Supporting Surface
H	Standard Mode Selected and Confirmed (in crane cab)	Standard Mode Selected and Confirmed (in crane cab)
Not Shown	Not Applicable	Outriggers Installed (retracted) Crane Operated on Rubber

FIGURE 4-39

Blocked Crawler Requirement

To prevent the crawler crane from tipping, some boom and jib lengths must be raised and lowered over the end of the blocked crawlers. See the capacity charts for blocked crawler requirements and see Crawler Blocking Diagram in the Capacity Chart Manual for instructions.

DANGER

Tipping Hazard!

Avoid death, serious injury and tipping the crane. For crawler cranes, do not attempt to raise or lower the boom and jib from the ground or to the ground until the ends of the crawlers are blocked, if required.

Extended Outriggers

To prevent the truck crane from tipping, the outriggers must be fully extended and the carrier leveled to raise and lower all boom and jib combinations from the ground and to the ground—over the rear of the carrier. See Liftcrane Boom and Liftcrane Jib Capacity Charts for the boom and jib raising and lowering limitations.

See Outrigger Operating Controls and Operation in the Carrier Operator Manual for the outrigger instructions.

DANGER

Tipping Hazard!

Avoid death, serious injury, and tipping the crane. For the truck crane, do not attempt to raise or lower the boom and jib from the ground or to the ground over the rear of the carrier until the outriggers are fully extended and the carrier is level.

Handling Components

Handle boom sections with care to avoid damaging the lacings and chords. All boom inserts have lifting lugs (in top chords) designed to provide a balanced load and to prevent damage during lifting.

WARNING

Falling Load Hazard!

Avoid death or serious injury. Do not attempt to lift two or more inserts with the lifting lugs on one insert. Lifting lugs may break, allowing the inserts to fall.

Lifting lugs on each insert are designed only for lifting that insert.

When lifting lugs are not used:

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

Handling Boom

See the table in the Boom Rigging Assembly drawing for boom handling instructions.

Rigging Assembly Drawings

Boom and jib components (top, inserts, straps, pendants) must be assembled in the proper sequence according to Figure 4-47, Figure 4-48, or Figure 4-49 and the Boom and Jib Rigging drawings.

Identifying Boom and Jib Components

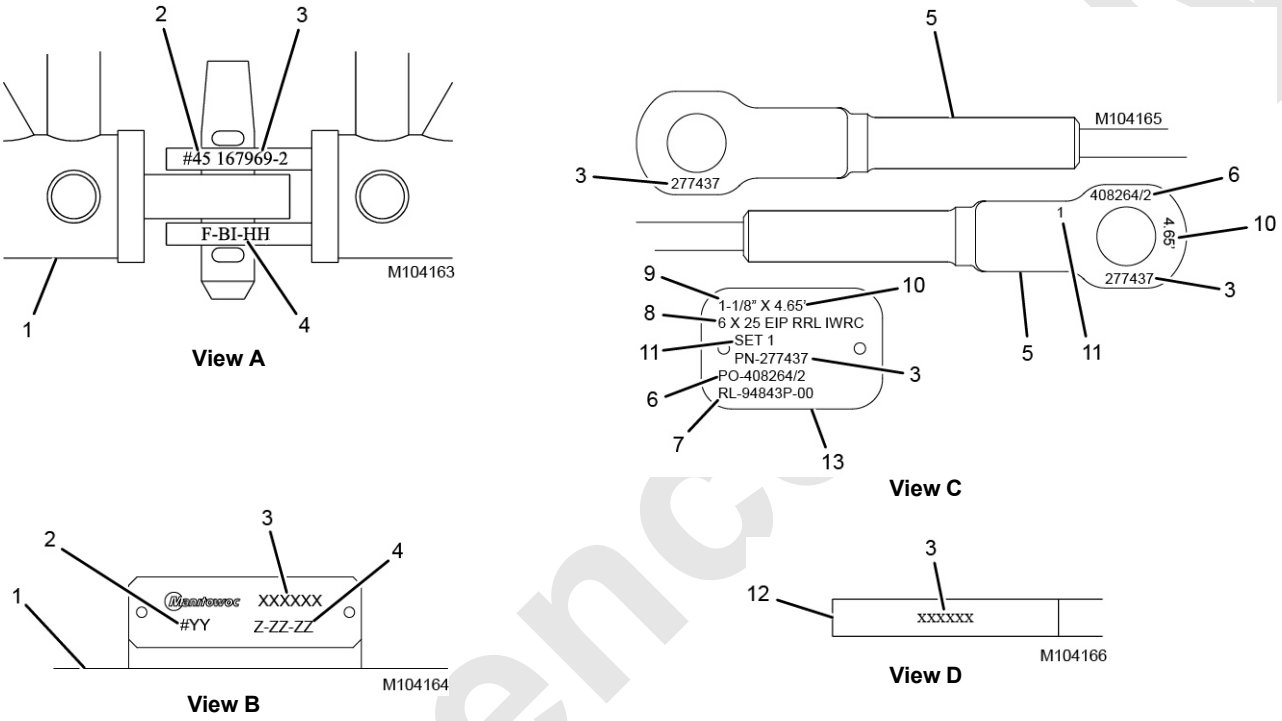
See Figure 4-40 for the following information.

Boom and jib sections are marked for proper identification (see Views A and B).

Boom and jib pendants are marked for proper identification (see View C).

Boom straps and links are marked for proper identification (see View C).

NOTE: The markings can vary depending on when your crane was produced and the original equipment manufacturer.



Item	Description	Item	Description
1	Boom or Jib Chord	8	Wire Rope Type
2	Boom or Jib Number	9	Diameter
3	Manitowoc Cranes Part Number	10	Length
4	Manitowoc Cranes Manufacturing Code	11	Set Number
5	Pendant	12	Strap or Link
6	Manitowoc Cranes Purchase Order Number	13	Aluminum Tag (if equipped)
7	Manufacturer's Number		

FIGURE 4-40

Identifying Inserts

See Figure 4-41 for the identification of the heavy, standard, and light inserts.

Depending on the length and type of boom, boom sections must be installed in the following sequence.

1. Boom butt
2. Any 3,0 m (10 ft) insert
3. Any 6,1 m (20 ft) inserts
4. Any 12,2 m (40 ft) heavy inserts (#44A)
5. Any 12,2 m (40 ft) standard inserts
6. Any 12,2 m (40 ft) light inserts
7. 12,2 m (40 ft) Transition insert (long reach boom only)
8. Boom top

WARNING

Tipping Crane Hazard!

Collapsing Boom Hazard!

The crane can tip or structural failure can occur if the inserts are not installed in the proper sequence.

Boom and jib sections must be assembled in the proper sequence according to Figure 4-47, 4-48, or 4-49 and the Boom and Jib Rigging drawings.

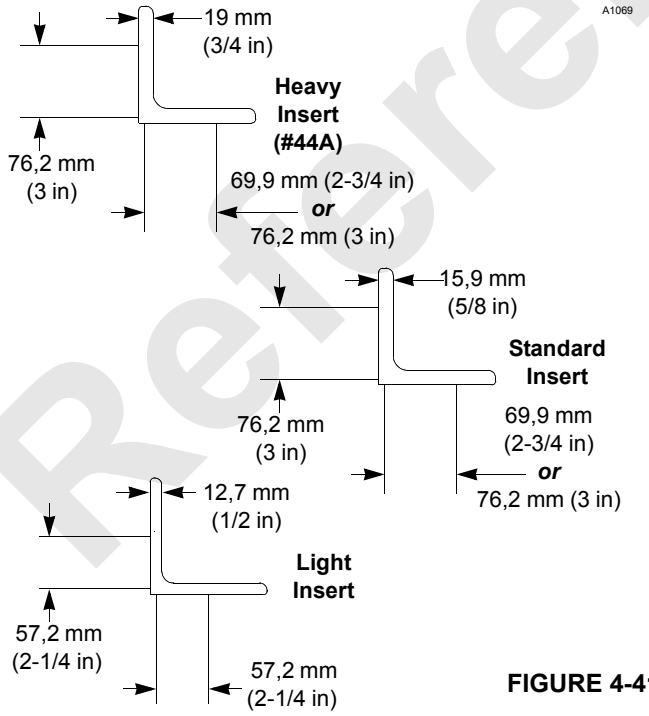


FIGURE 4-41

Removable Lacings

See Figure 4-42 for the following procedure.

The 6,1 m (20 ft) and standard 12,2 m (40 ft) inserts are equipped with removable diagonal lacings. This design feature allows the lacings to be removed so that the jib sections (fixed or luffing) can be stored inside the boom inserts during shipment.

User-supplied blocking can be placed across the bottom chords for supporting the jib sections during shipment.

NOTE: It is the user's responsibility to securely fasten blocking and jib sections so the sections cannot move during shipment.

Prior to operating the crane after removing the jib sections and all the blocking, the removable diagonal lacings must be reinstalled.

1. Thoroughly clean all dirt from the mating surfaces between the lacings and supports on the inserts.
2. Reinstall the proper number of removable lacings in each insert with bolts and stop nuts.
3. Securely tighten the nuts.

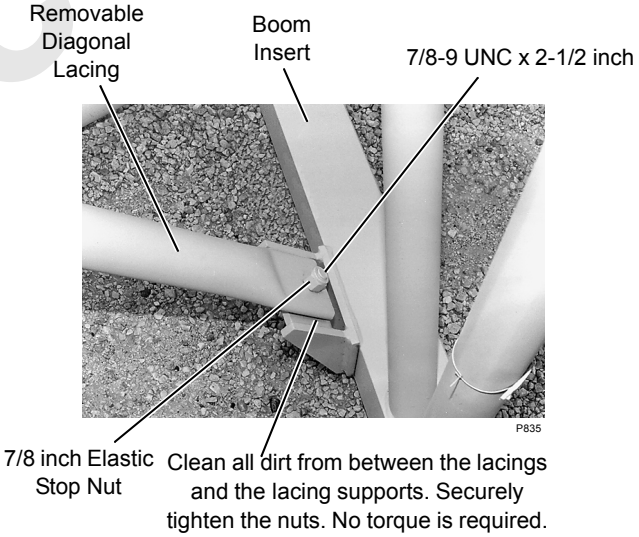


FIGURE 4-42

4

Item	Description
A	Upper Connecting Hole
B	Lower Connecting Hole
1	Fixed Vertical Pin
2	Removable Horizontal Pin with Cotter Pins
3	Washer (fixed vertical pin)
4	Retaining Pin with Cotter Pins
5	Removable Horizontal Pin with Cotter Pins—275 mm (10-27/32 in)
6	Strap Storage Pin
7	Connecting Pin
8	Collar
9	Retaining Pin with Cotter Pins
10	Connecting Pin with Safety Pins

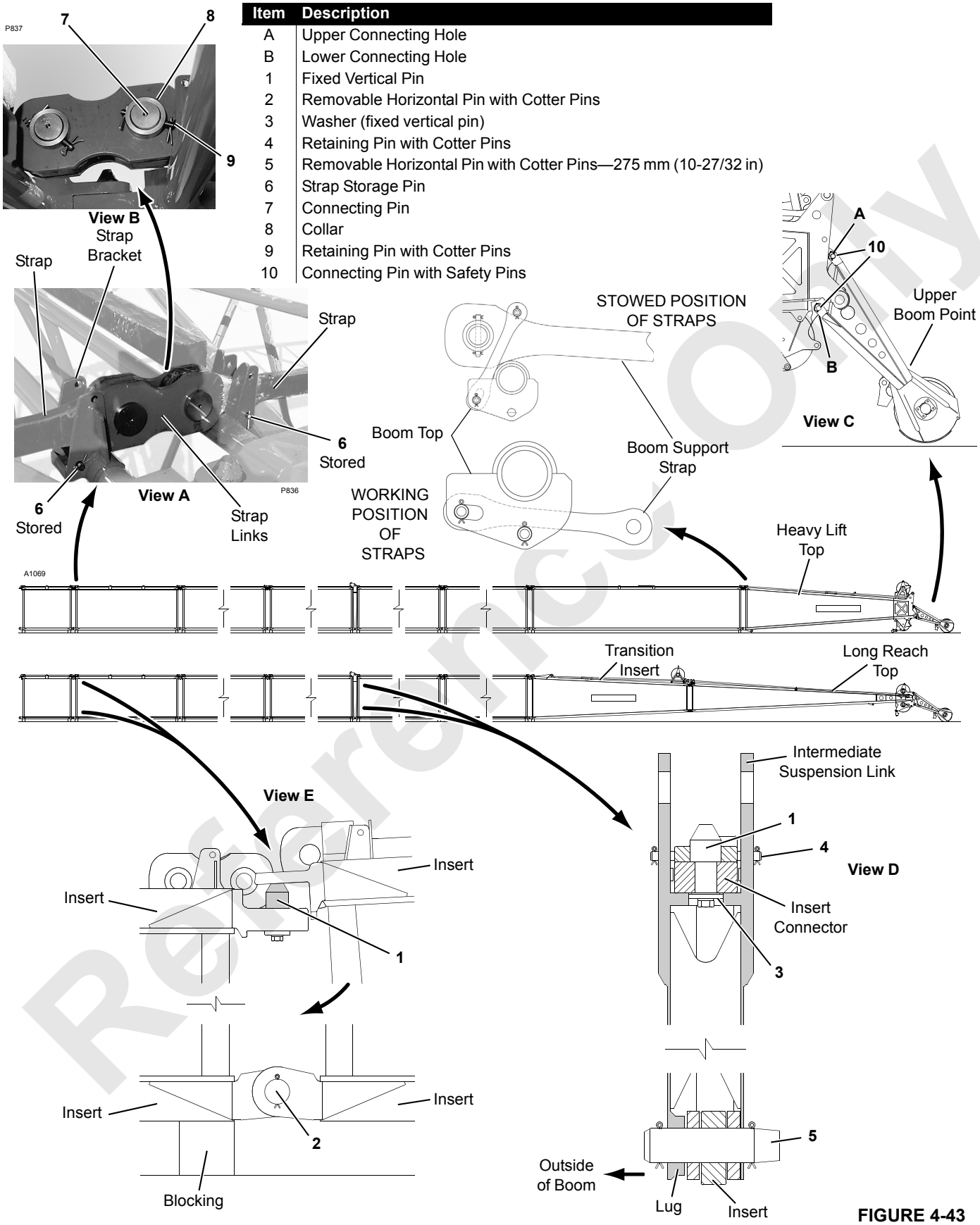


FIGURE 4-43

Boom Installation

General

Before starting to assemble the boom, determine the following:

- Is intermediate suspension required for the selected boom length? If so, the intermediate suspension links must be installed at the proper location between the boom inserts. See Figure 4-47, 4-48, and 4-49 for the installation location.
- Will a fixed jib be installed? If so, the backstay pendant links must be installed at the proper location between inserts (#44 Heavy Lift only). See the Jib Assembly drawing for the installation location.

NOTE: Backstay pendant links are identical to the intermediate suspension links.

The boom inserts are equipped with plastic wire rope guards that are installed at the factory. Do not overtighten the mounting screws. Guards must be free to slide in the mounting slots to allow for thermal expansion and contraction of the plastic.

Read all the notes on the Boom Rigging Assembly drawing.

NOTE: The shortest inserts must be installed next to the boom butt.

WARNING

Collapsing Boom Hazard!

Avoid possible injury. Do not stand on, inside, or under the boom sections during assembly. Always stand outside of boom sections when installing the connecting pins.

Assemble Boom Sections

See Figure 4-43 for the following information and procedure.

The boom sections have FACT™ connectors:

- The top connectors are joined by fixed vertical pins that hook into holes in the adjacent section (see View E).
- The bottom connectors are joined by removable horizontal pins (see View E).

1. Assemble boom inserts in the proper sequence, as follows, starting at the butt end of the boom.
   a. Place the first insert on blocking at least 152 mm (6 in) high.
   b. Lift the next insert into position and engage the top connector holes with the fixed vertical pins (1, View E).
   c. Lower the insert until the bottom connector holes are aligned and install the removable horizontal pins (2, View E).
   d. Block under the bottom chords at the top end of the insert.
2. If your boom length requires intermediate suspension, install the intermediate suspension link on the top end of the required insert as follows. See Figure 4-47 and 4-49 for intermediate suspension requirements.
   a. Lift the intermediate suspension link into position on either side of the insert.

      The lug at the bottom connecting hole in the link must be facing toward the outside of the boom (see View D).
   b. Engage the hole in the link with the washer (3, View D) on the underside of the insert connector.
   c. Install the retaining pin (4, View D) through the holes on the butt side of the link to prevent the link from falling off the insert.
   d. Repeat step 2a through step 2c for the link on the other side of the insert.
   e. Proceed to install the next boom insert (repeat step 1b through step 1d). Replace the standard horizontal connecting pin with the 275 mm (10-27/32 in) long pin (5, View D) supplied with the link.

   NOTE: The above procedure is identical for installing the pendant links required for the fixed jib installation on the #44 heavy lift boom.
3. Repeat step 1b through step 1d until all inserts are installed.
   - Make sure that light insert(s) are installed next to the boom top for a heavy lift boom or next to the tapered insert for the long reach boom.
   - For the long reach boom, the tapered insert must be installed next to the boom top.
4. Install the boom top, heavy lift, or long reach boom, in the same manner that the inserts were installed.

Connect Boom Straps

The boom straps are shipped from the factory in the stored position on the inserts. Connect the straps, as follows.

See Figure 4-43 for the following procedure.

1. Remove the strap storage pin (6, View A) retaining links and strap them to the strap bracket.
2. Store the strap storage pin (6, View A) in the bottom hole in the strap bracket.
3. Rotate the strap links forward and pin them to the adjacent strap (see View B).

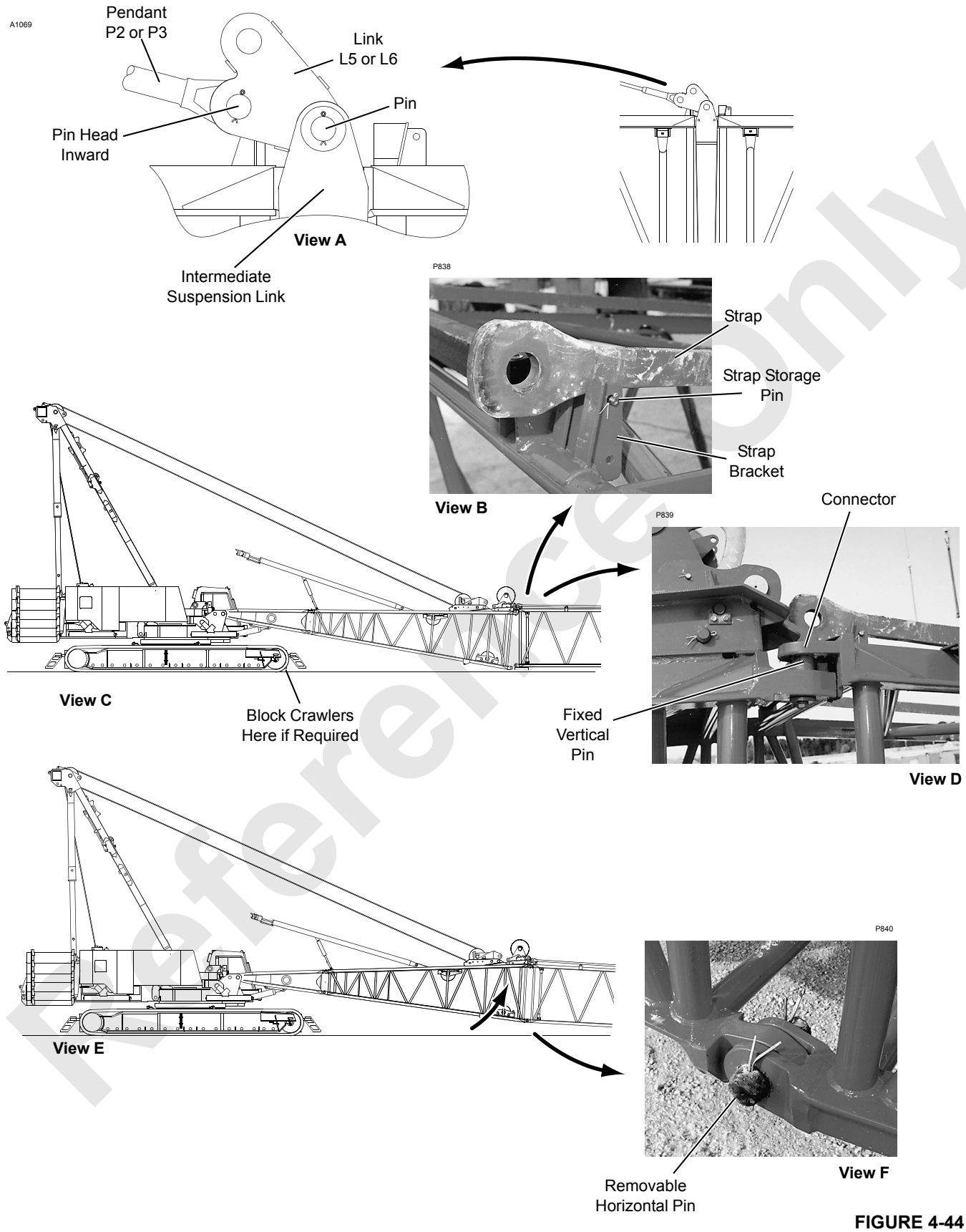


FIGURE 4-44

Install Intermediate Suspension Pendants

If required, install intermediate suspension pendants as follows. See Figure 4-47, 4-48, or 4-49 for the required length and installation sequence of the pendants.

NOTE: The pendants are furnished in matched sets of two and must be installed in matched sets.

See Figure 4-44 for the following procedure.

1. Pin the pendant links (L5 or L6, View A) to the intermediate suspension links. The links must be positioned exactly as shown.
2. Pin the pendants (P2 or P3, View A) to the pendant links (L5 or L6) and lay the pendants along the top of the boom.

NOTE: The head of the pendant pins must face inward.

3. Install the remaining pendants in the proper sequence and lay the pendants along the top of the boom.

Install Upper Boom Point

See Figure 4-43 for the following procedure.

If required, install the upper boom point as follows.

1. Lift the upper boom point into position at the end of the boom top.
2. Align the upper connecting holes (A, View C) and install the connecting pins (10). Rest the boom point on the ground. Install the lower connecting pins in holes (B) when the boom is raised.

Install Jib

If required, install the jib.The upper boom point must be removed prior to jib installation. See Jib Installation (#132 Jib) on page 4-106 for more information.

Connect Boom Butt to Boom

See Figure 4-45, View B for the following procedure.

CAUTION

Wire Rope Guide Damage!

The wire rope guide on the end of the boom butt will hit the straps if step 1 is not performed before attempting to pin the boom butt to the boom.

1. Perform the following steps at the end of both straps on the boom section adjacent to the boom butt.
   a. Unpin the boom strap from the storage position.
   b. Lift the end of the strap clear of the strap bracket.
   c. Install the strap storage pin in the storage hole.
   d. Rest the strap on the storage pin.
2. Remove the assembly block and store the wire rope on the load drum.

See Figure 4-44 for the remaining steps.

3. Position the crane so the boom butt is in line with the boom (see View C).
4. Travel forward slowly, swing, and boom up and down as required to align the fixed vertical pins in the butt with the top connecting holes in the insert (see View D).

DANGER

Tipping Hazard!

Prevent the crane from tipping to avoid death or injury:

- For crawler cranes, do not attempt to raise or lower the boom and jib from the ground or to the ground until the ends of the crawlers are blocked, if required.
- For truck cranes, do not attempt to raise or lower the boom and jib from the ground, to the ground, or over the rear of the carrier until the outriggers are fully extended and the carrier is level.

5. Check the appropriate capacity chart to see if the crawlers must be blocked to raise the boom. If so, proceed as follows.
   a. Mark the ground at the center of the front rollers or the rear tumblers, whichever end is closer to the boom.

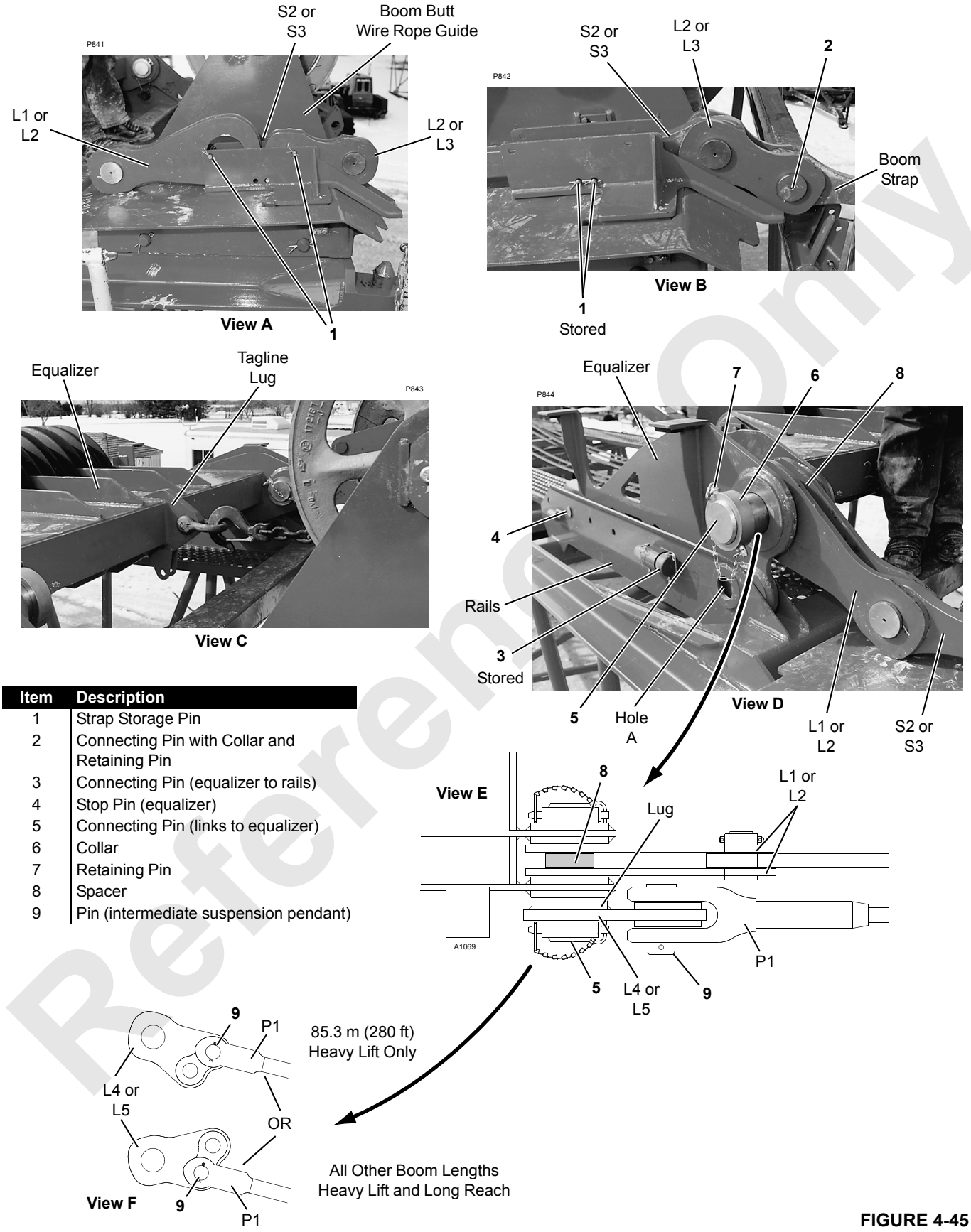
      See the Crawler Blocking Diagram for blocking requirements.
   b. Lower the boom to disengage the top connecting pins, and slowly travel several feet in reverse.
   c. Place the required blocking on the ground at the points marked in step 5a (see View C).
   d. Repeat step 4 while traveling onto the blocking.
6. Slowly boom up only enough to align the bottom connecting holes in the boom butt with the bottom connecting holes in the insert (see View E).

WARNING

Moving Part Hazard!

Prevent serious crushing injury. Do not stand inside the boom while installing the removable horizontal pins. Stand outside of the boom.

7. Install removable horizontal pins (see View F).
8. Boom down enough to slacken the boom hoist wire rope so that the equalizer rests on the rails.



Item	Description
1	Strap Storage Pin
2	Connecting Pin with Collar and Retaining Pin
3	Connecting Pin (equalizer to rails)
4	Stop Pin (equalizer)
5	Connecting Pin (links to equalizer)
6	Collar
7	Retaining Pin
8	Spacer
9	Pin (intermediate suspension pendant)

FIGURE 4-45

Connect Straps and Pendants to Equalizer

See Figure 4-45 for the following procedure.

The straps and links used to connect the boom straps to the equalizer are stored on the boom butt wire rope guide (see View A). To connect the boom straps to the equalizer, proceed as follows.

1. Remove the strap storage pins (1, View A) securing the links and straps to the boom butt wire rope guide.
2. Store the strap storage pins (1, View B).
3. Rotate the links (L2 or L3, View B) forward and pin them to the boom straps on the boom section next to the boom butt.

NOTE: See View B for strap-to-link pinning detail.

4. Attach a tagline to the lug on the front of the equalizer (see View C). The tagline is required to pull the equalizer forward when connecting links to the equalizer. One of three methods can be used:
   - Chain sling from another crane—Route the chain sling around the bottom of the center sheave in the boom butt wire rope guide.
   - Load line from the load drum—Route the load line over the top and around the bottom of the center sheave in the boom butt wire rope guide. Connect to the equalizer lug with a socket and wedge.
   - Lever-operated hoist
5. Pull the equalizer forward with the tagline just enough to loosen the connecting pins (3, View D) in the boom handling holes (A, View D) between the equalizer and rails.
6. Install the stop pins (4, View D) in the equalizer rail holes closest to the end of the equalizer.

NOTE: The stop pins must be installed to prevent the equalizer from accidentally sliding back on the rails during link assembly.

7. Remove the connecting pins (3, View D) from the holes (A, View D) and store them in the holders on the side of the rails.
8. Rotate the links (L1 or L2, View D) to the rear and pin them to the equalizer. Use the tagline to position the equalizer as required.

NOTE: The spacer (8) must be installed between the links (L1 or L2).

9. If equipped with intermediate suspension, proceed as follows.
   a. Pin the links (L4 or L5, View E) to the equalizer. The lug on the links (L4 or L5) must face inward, and the links must be positioned as shown in View F.
   b. Pin the intermediate suspension pendants (P1, View E) to the links (L4 or L5). The head of the pins (9) must face inward, and the pendants must be pinned to the proper holes (see View F).
10. While holding the equalizer with the tagline, remove stop pins (4, View D) from the holes in the rails and store them in the holders on the side of the rails.
11. Slacken the tagline to allow the equalizer to slide back as far as it will go.
12. Disconnect the tagline from the equalizer.

Install Load Line

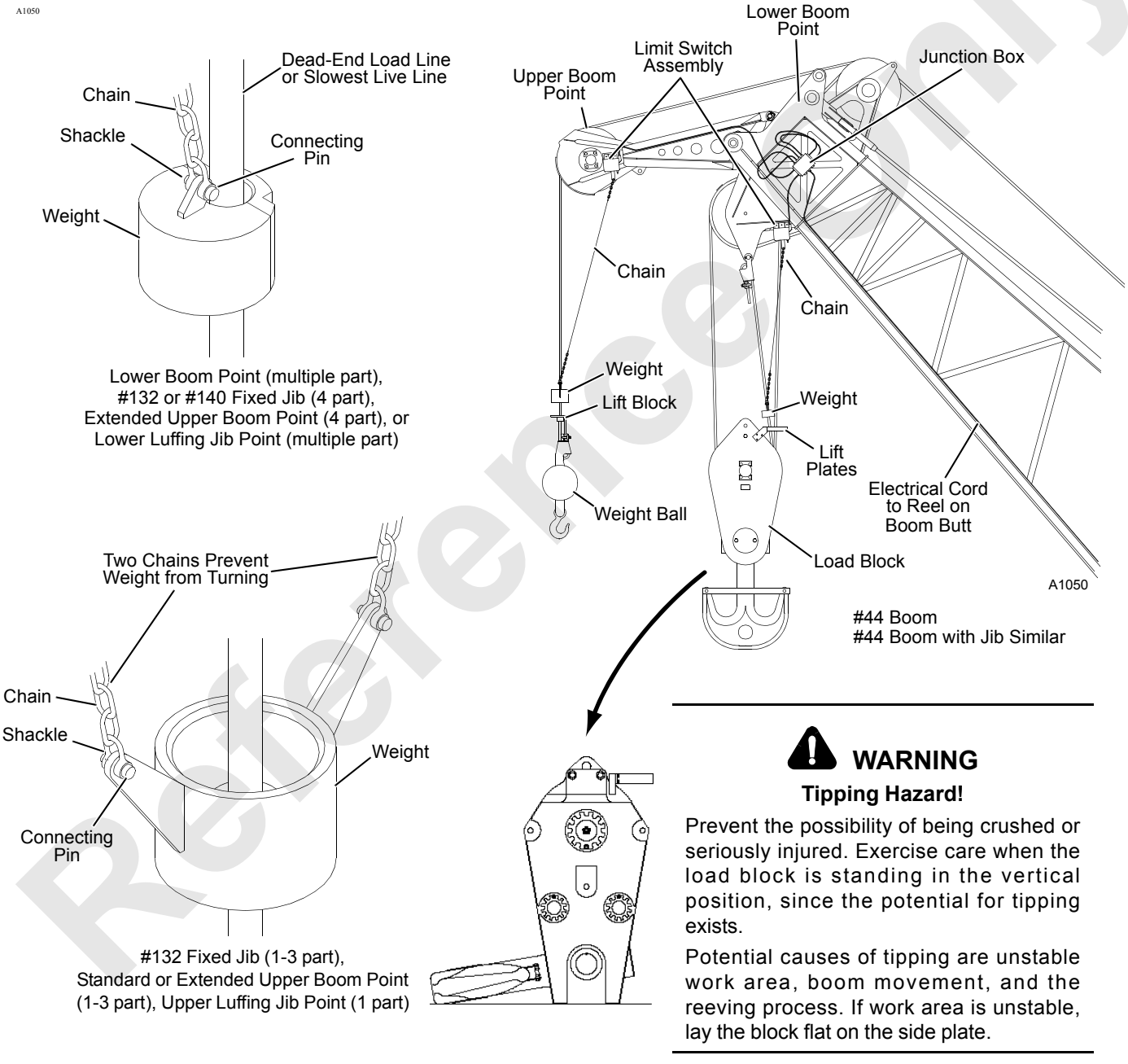
See Figure Figure Figure Load Line Reeving on page 4-122 for proper routing and reeving of the load lines to the upper and lower boom points.

The load lines must be properly routed through the RCL load-sensing sheaves as shown in the reeving diagrams.

Install Block-Up Limit Control and Connect Electric Wiring

Install the block-up limit components (see Figure 4-46 and Block-Up Limit Control Assembly drawing).

1. Connect the electrical cable from the cable reel in the boom butt to the junction box in the boom top.
2. Connect the electrical cable from the front of the crane to the cable reel.
3. Connect the electrical cables from the limit switches to the junction box in the boom top.
4. Adjust the block-up limit switches according to the instruction in Section 5 of the Crane Service Manual.
5. Connect the electrical cables from the rated capacity limiter (RCL) load-sensing sheaves to the junction box in the boom top. See the Indicator Assembly drawing.
6. Check the RCL operation and calibration as instructed in the RCL Operation Guide.



WARNING

Tipping Hazard!

Prevent the possibility of being crushed or seriously injured. Exercise care when the load block is standing in the vertical position, since 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 the block flat on the side plate.

FIGURE 4-46

Boom Removal

Lower Boom

Prepare the crane and the boom as follows.

1. Position the crane in the disassembly area.
2. If required per capacity chart, travel the crawler front rollers or rear tumblers onto blocking or extend the outriggers and level the carrier.

NOTE: See Crawler Blocking Diagram in the Capacity Chart Manual for blocking requirements.

DANGER

Tipping Hazard!

Prevent the crane from tipping to avoid death or injury:

- For crawler cranes, do not attempt to raise or lower the boom and jib from the ground or to the ground until the ends of the crawlers are blocked, if required.
- For truck cranes, do not attempt to raise or lower the boom and jib from the ground, to the ground, or over the rear of the carrier until the outriggers are fully extended and the carrier is level.

3. Lower the boom and jib (if equipped) onto blocking at ground level.
   a. If equipped with a jib, disconnect the jib stop pendants before the jib point contacts the ground, or damage will result.
   b. If equipped with an upper boom point, remove the lower connecting pins (10, Figure 4-43, View C) from the holes (B) before the boom point contacts the ground, or damage will result.
   c. As the boom nears the ground, place blocking at least 152 mm (6 in) high under the bottom chords at the connecting pins between the boom top and first insert or between the transition insert and the adjacent insert.

Remove Block-Up Limit Control

See Figure 4-12 for the following procedure.

1. Disconnect the boom electrical cord from the cable reel on the boom butt and connect the cord to the junction box on the rotating bed (see View C).
2. Remove the block-up limit assembly and spool the electrical cord onto the reel on the boom butt.

Remove Load Block and Weight Ball

Disconnect the load lines from the load block and weight ball and spool the load lines onto the load drums.

Disconnect Straps and Pendants from Equalizer

See Figure 4-45 for the following procedure.

1. Slacken the boom hoist wire rope so the equalizer is resting on the boom butt rails.
2. Attach a tagline to the lug on the front of the equalizer (see View C). The tagline is required to pull the equalizer forward when disconnecting the links from the equalizer. One of three methods can be used:
   - Chain the sling from another crane—Route the chain sling around the bottom of the center sheave in the boom butt wire rope guide.
   - Load line load drum—Route the load line over the top and around the bottom of the center sheave in the boom butt wire rope guide. Connect to the equalizer lug with a socket and wedge.
   - Lever-operated hoist
3. Pull the equalizer forward with the tagline just enough to loosen the connecting pins (5, View D).
4. Install the stop pins (4, View D) in the equalizer rail holes closest to the end of the equalizer.

NOTE: Stop pins must be installed to prevent the equalizer from accidentally sliding back on the rails during link disassembly.

5. Disassemble links (L1 or L2, View D) and, if equipped, links (L4 or L5, View E) from the equalizer.
6. Store pins (5, View D) with spacers (8) in the equalizer holes.
7. Install strap storage pins in the storage holes under the straps next to the boom butt (Figure 4-44, View B). This step is required to support the straps when the boom butt is disconnected from the boom.

See Figure 4-45 for the remaining procedure.

8. Disassemble the links (L2 or L3, View B) from the boom straps. Store connecting pins (2) in the strap holes.
9. Position links (L1 or L2, View A), straps (S2 or S3), and links (L2 or L3) on the boom butt wire rope guide and install the strap storage pins (1) as shown.
10. While holding the equalizer with the tagline, remove the stop pins (4, View D) from the holes in the rails and store them in holders on the side of rails.
11. Slacken the tagline until the boom handling holes in the equalizer are in line with the holes (A, View D) in the equalizer rails.
12. Remove the connecting pins (3, View D) from the storage holders and install the pins in the holes (A) to secure the equalizer to the rails.
13. Slacken the tagline and disconnect it from the equalizer.

Disconnect Boom Butt from Boom

See Figure 4-44 for the following procedure.

1. Slowly boom up until the boom hoist wire rope is taut (see View E).

NOTE: Do not attempt to lift the boom with the equalizer pinned to the rails.

WARNING

Falling Boom Hazard!

Avoid death or serious injury. Do not attempt to remove the horizontal pins in step 2 until the boom hoist wire rope is taut, or the boom butt and inserts will fall violently.

2. Remove the horizontal pins between the boom butt and adjacent insert (see View F).
3. Slowly boom down to lower the boom onto blocking at least 152 mm (6 in) high (see View C).
4. Continue to boom down to disengage the fixed vertical pins (see View D) from the connectors in the adjacent boom section.
5. Travel the crane away from the boom and lower the boom butt to the ground.

Install Assembly Block

If the crane will be used to disassemble its own boom, install the assembly block.

Remove Jib

If equipped, remove the jib. See Jib Removal (#132 Jib) on page 4-113).Figure Figure

Remove Upper Boom Point

See Figure 4-43 for the following procedure.

If equipped, remove the upper boom point as follows.

1. Support the upper boom point with lifting slings from the crane.
2. Remove the upper pins (10, View C) from the holes (A).
3. Remove the upper boom point from the boom top.

Remove Intermediate Suspension Pendants

If equipped, remove and store the intermediate suspension pendants and links (see Figure 4-44, View A, and Figure 4-45, View E).

Store Boom Straps

See Figure 4-43 for the following procedure.

Perform the following steps at each set of strap links between the boom sections (View A and View B).

1. Support the strap links so they cannot fall.
2. Unpin the top end of the strap links from the adjacent strap.

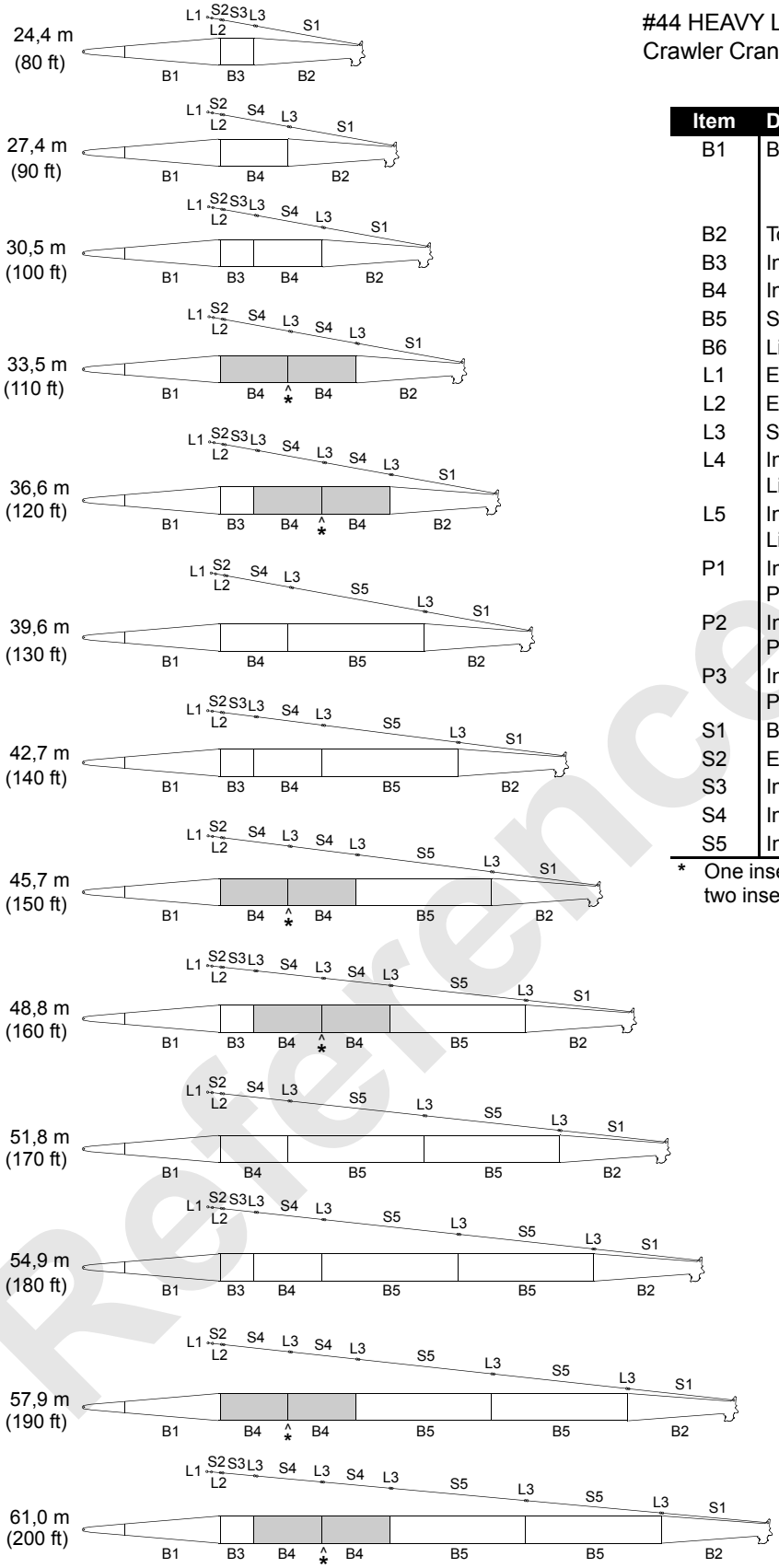
NOTE: Store the connecting pin in the hole in the end of the adjacent strap.

3. Rotate the strap links to the rear onto the strap bracket.
4. Install the strap storage pins in the top hole of all the strap brackets to retain the straps and links for shipping.

Disassemble Boom Sections

Start at the boom top and work toward the boom butt when disassembling inserts.

1. Attach lifting slings from the crane to the boom top.
2. Hoist so that the lifting slings are just taut.
3. Remove the horizontal pins between the boom top and the adjacent insert.
4. Lift the boom top away from the insert.
5. Repeat step 1 through step 4 for each boom section.



#44 HEAVY LIFT BOOM
Crawler Crane Only

Item	Description	Length
B1	Butt	12,2 m (40 ft)
	Lower Section	3,7 m (12 ft)
	Upper Section	8,5 m (28 ft)
B2	Top	9,1 m (30 ft)
B3	Insert	3,0 m (10 ft)
B4	Insert	6,1 m (20 ft)
B5	Standard Insert	12,2 m (40 ft)
B6	Light Insert	12,2 m (40 ft)
L1	Equalizer Links	0,4 m (1 ft 4 in)
L2	Equalizer Links	216 mm (8-1/2 in)
L3	Strap Links	179 mm (7-1/16 in)
L4	Intermediate Suspension Link (Equalizer)	267 mm (10-1/2 in)
L5	Intermediate Suspension Link (Insert)	292 mm (11-1/2 in)
P1	Intermediate Suspension Pendant	3,0 m (9 ft 9 in)
P2	Intermediate Suspension Pendant	9,0 m (29 ft 5 in)
P3	Intermediate Suspension Pendant	14,5 m (47 ft 6 in)
S1	Basic Strap	9,5 m (31 ft 1 in)
S2	Equalizer Strap	0,8 m (2 ft 8 in)
S3	Insert Strap	2,9 m (9 ft 5 in)
S4	Insert Strap	5,9 m (19 ft 5 in)
S5	Insert Strap	12,0 m (39 ft 5 in)

* One insert (B5) and two straps (S5) can be used in place of two inserts (B4) and four straps (S4).

4

FIGURE 4-47

#44 HEAVY LIFT BOOM
Crawler Crane Only

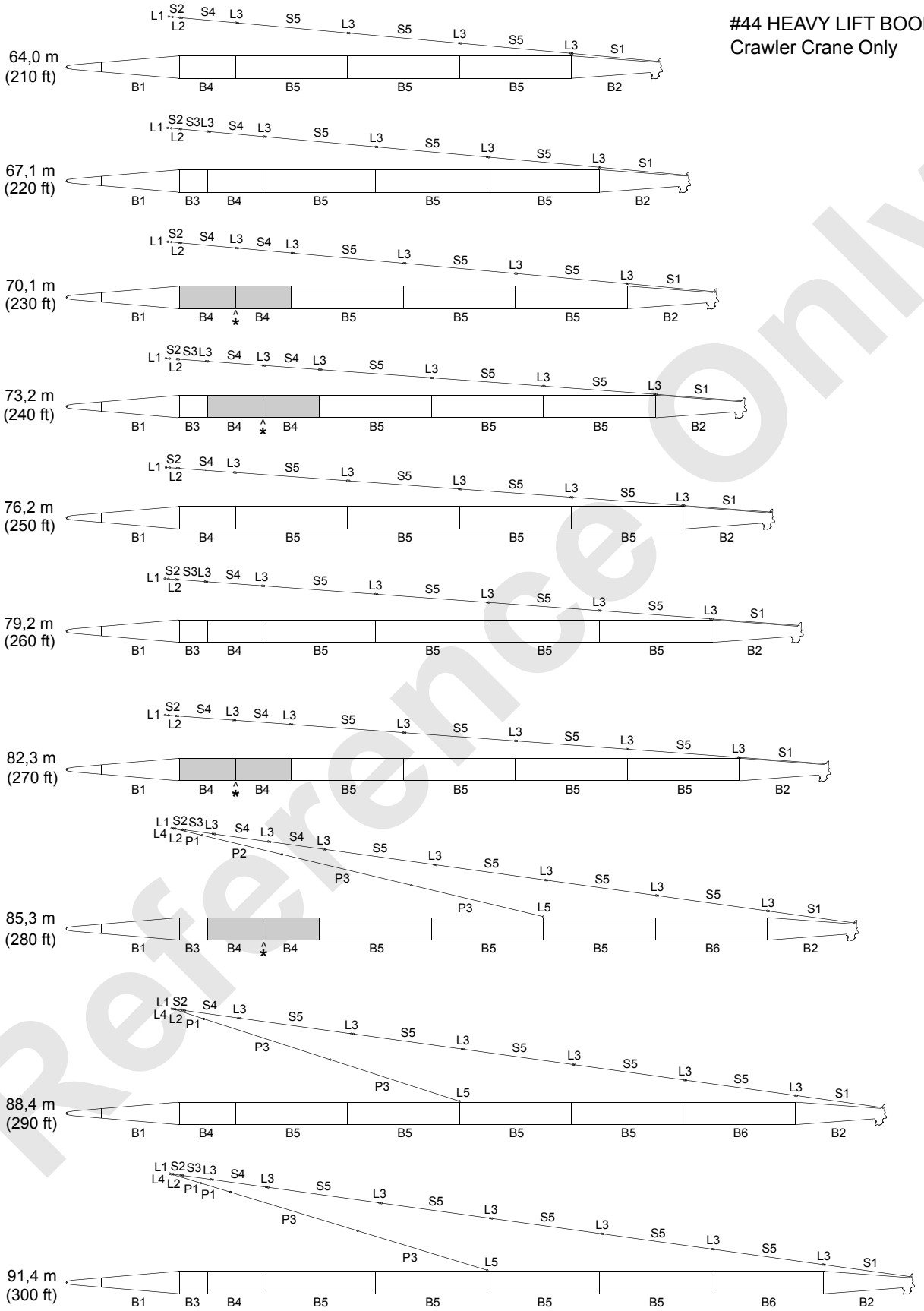
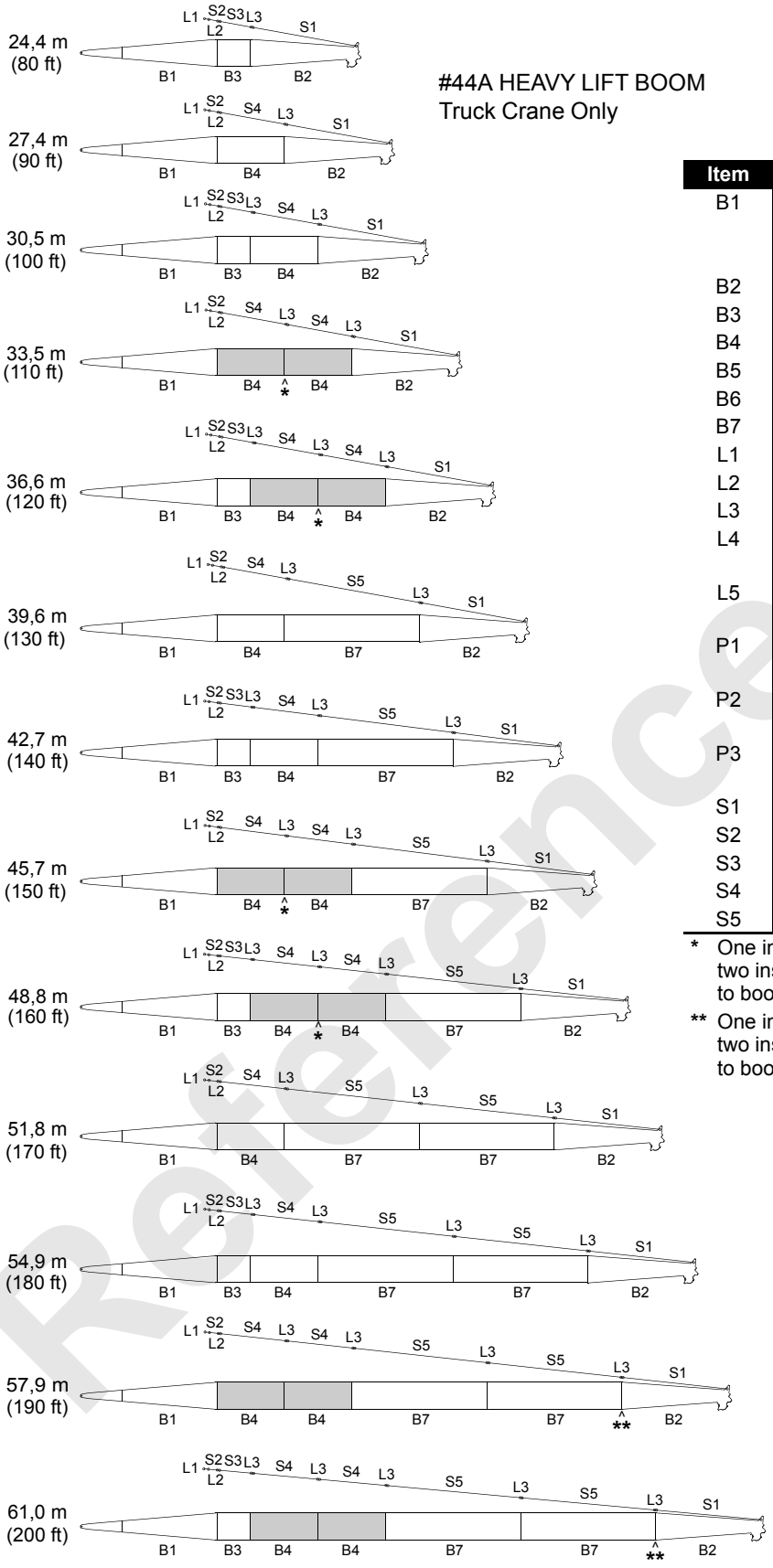


FIGURE 4-47 continued

#44A HEAVY LIFT BOOM
Truck Crane Only



Item	Description	Length
B1	Butt	12,2 m (40 ft)
	Lower Section	3,7 m (12 ft)
	Upper Section	8,5 m (28 ft)
B2	Top	9,1 m (30 ft)
B3	Insert	3,0 m (10 ft)
B4	Insert	6,1 m (20 ft)
B5	Standard Insert	12,2 m (40 ft)
B6	Light Insert	12,2 m (40 ft)
B7	Heavy Insert	12,2 m (40 ft)
L1	Equalizer Links	0,4 m (1 ft 4 in)
L2	Equalizer Links	216 mm (8 ft 1/2 in)
L3	Strap Links	179 mm (7-1/16 in)
L4	Intermediate Suspension Link (Equalizer)	267 mm (10-1/2 in)
L5	Intermediate Suspension Link (Insert)	292 mm (11-1/2 in)
P1	Intermediate Suspension Pendant	3,0 m (9 ft 9 in)
P2	Intermediate Suspension Pendant	9,0 m (29 ft 5 in)
P3	Intermediate Suspension Pendant	14,5 m (47 ft 6 in)
S1	Basic Strap	9,5 m (31 ft 1 in)
S2	Equalizer Strap	0,8 m (2 ft 8 in)
S3	Insert Strap	2,9 m (9 ft 5 in)
S4	Insert Strap	5,9 m (19 ft 5 in)
S5	Insert Strap	12,0 m (39 ft 5 in)

* One insert (B7) and two straps (S5) can be used in place of two inserts (B4) and four straps (S4). Install insert (B7) next to boom butt (B1) or insert (B3).

** One insert (B5) and two straps (S5) can be used in place of two inserts (B4) and four straps (S4). Install insert (B5) next to boom top (B2) or light insert (B6).

FIGURE 4-48

S2

#44A HEAVY LIFT BOOM
Truck Crane Only

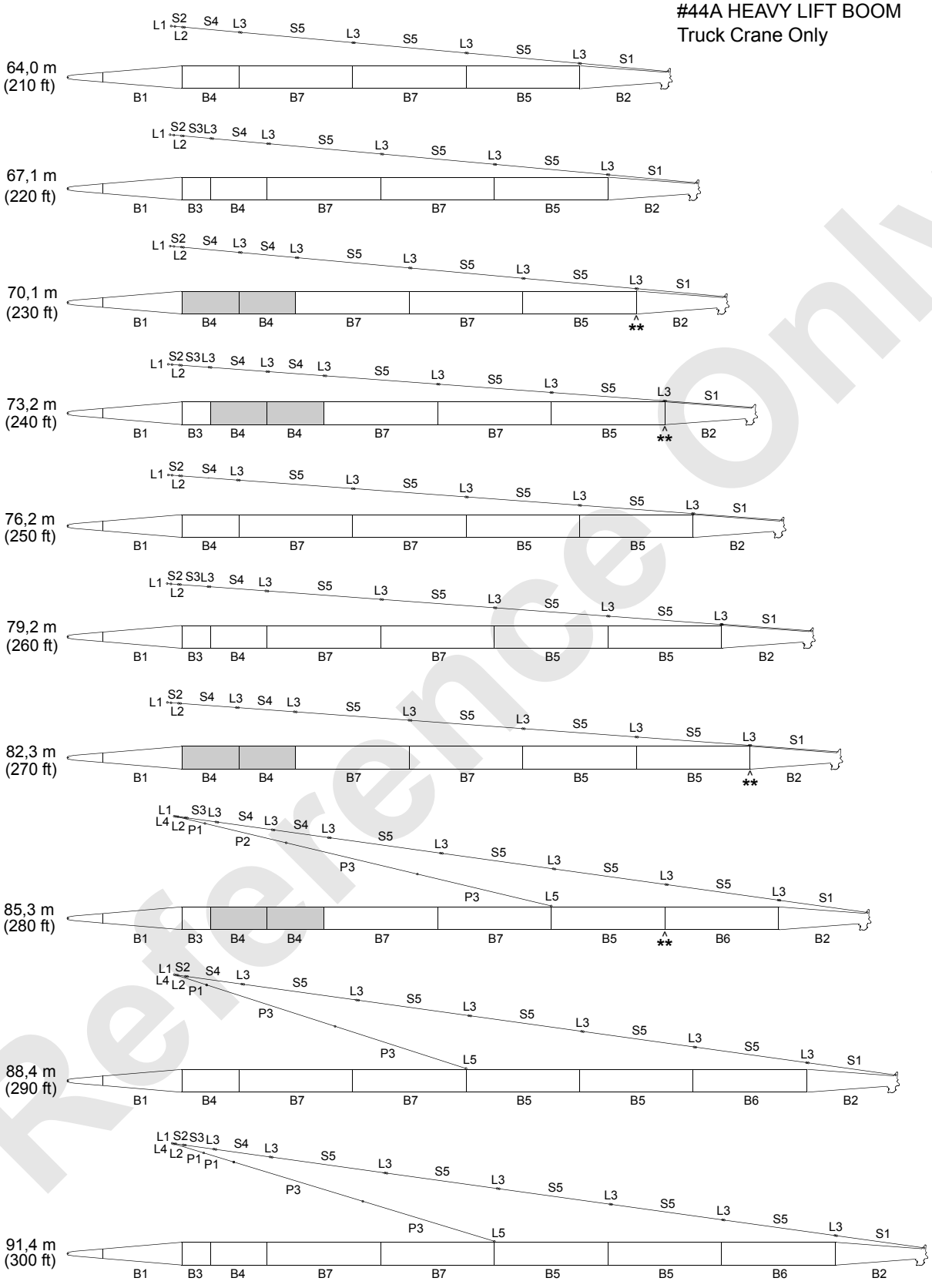
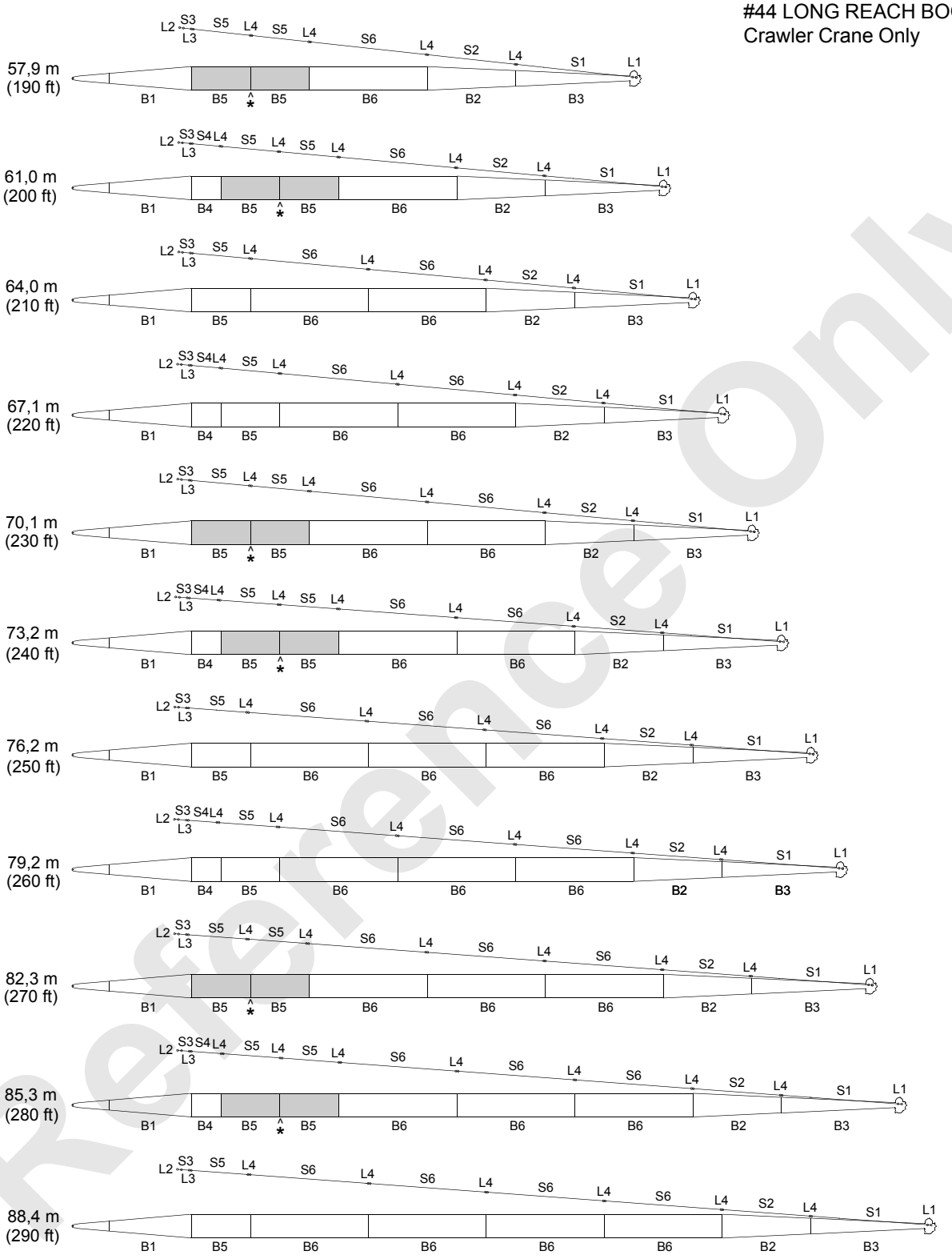


FIGURE 4-48 continued

#44 LONG REACH BOOM
Crawler Crane Only



4

FIGURE 4-49

Item	Description	Size	Item	Description	Size
B1	Butt	12,2 m (40 ft)	L5	Intermediate Suspension Link (Equalizer)	267 mm (10-1/2 in)
	Lower Section	3,7 m (12 ft)	L6	Intermediate Suspension Link (Insert)	292 mm (11-1/2 in)
	Upper Section	8,5 m (28 ft)	P1	Intermediate Suspension Pendant	3,0 m (9 ft 9 in)
B2	Transition Insert	12,2 m (40 ft)	P2	Intermediate Suspension Pendant	14,5 m (47 ft 6 in)
B3	Top	9,1 m (30 ft)	P3	Intermediate Suspension Pendant	9,0 m (29 ft 5 in)
B4	Insert	3,1 m (10 ft)	S1	Basic Strap	12,0 m (3 ft 5 in)
B5	Insert	6,1 m (20 ft)	S2	Transition Strap	9,0 m (29 ft 5 in)
B6	Standard Insert	12,2 m (40 ft)	S3	Equalizer Strap	0,8 m (2 ft 8 in)
B7	Light Insert	12,2 m (40 ft)	S4	Insert Strap	2,9 m (9 ft 5 in)
L1	Basic Links	0,4 m (1 ft 3 in)	S5	Insert Strap	5,9 m (19 ft 5 in)
L2	Equalizer Links	0,4 m (1 ft 4 in)	S6	Insert Strap	12,0 m (39 ft 5 in)
L3	Equalizer Links	216 mm (8-1/2 in)			
L4	Strap Links	179 mm (7-1/16 in)			

* One insert (B6) and two straps (S6) can be used in place of two inserts (B5) and four straps (S5).

** For M-250 and 2250 Series 1, two light inserts (B7) are required. For M-250 Series 2 and 2250 Series 2 and 3, one light insert (B7) is required.

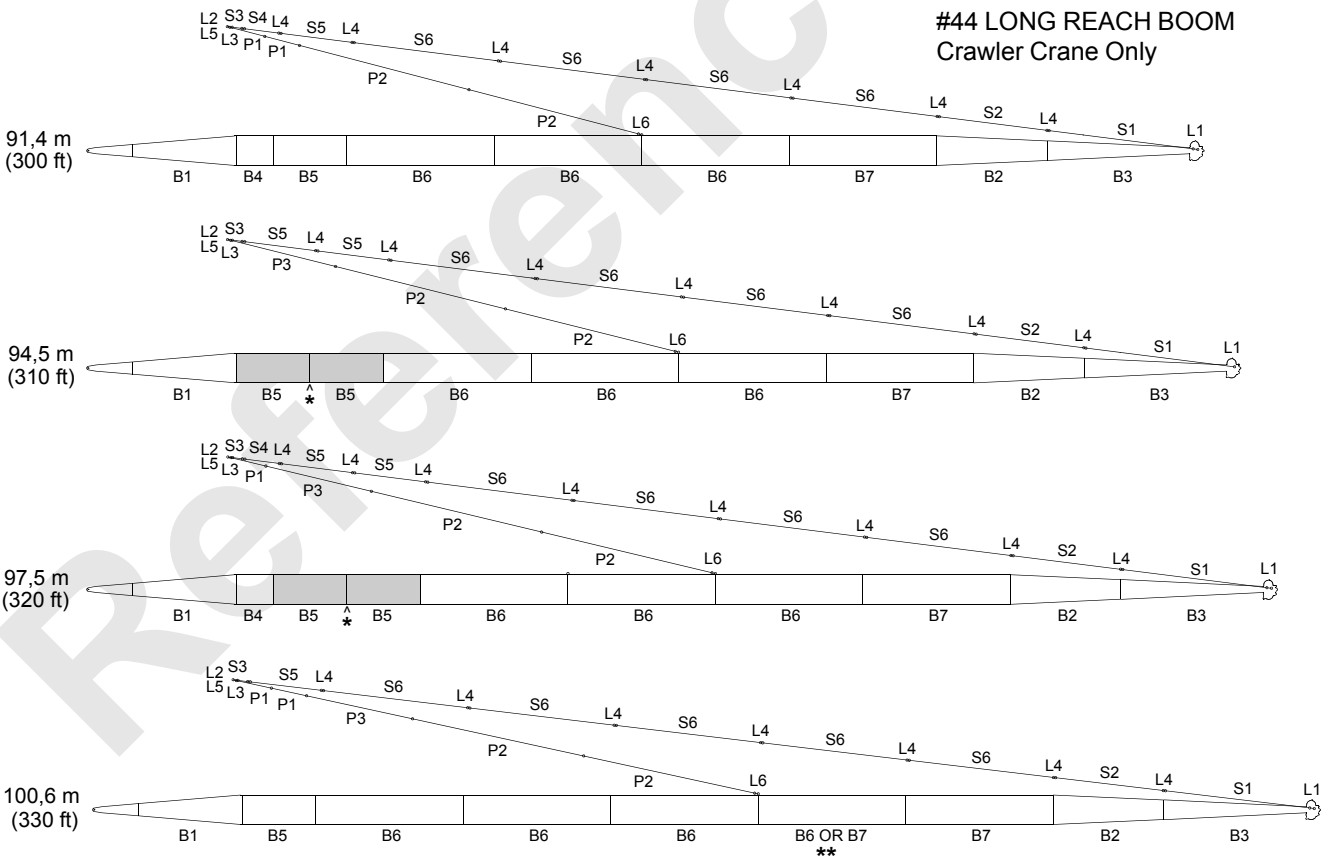
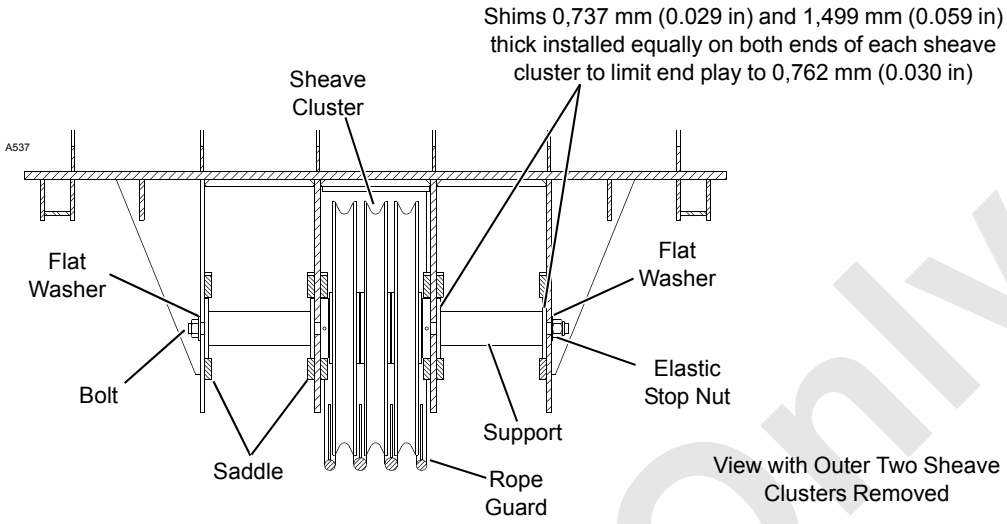


FIGURE 4-49 continued

THIS PAGE INTENTIONALLY LEFT BLANK



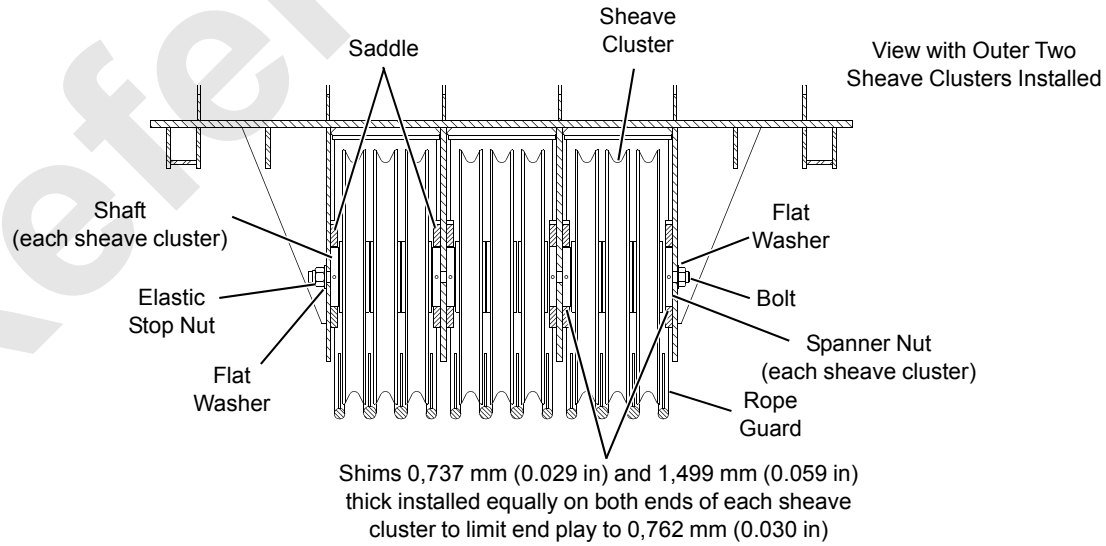


FIGURE 4-50

LOWER BOOM POINT SHEAVES

General

See Figure 4-50 for the following information.

The lower boom point of the #44 or #44A boom with heavy lift top is equipped with nine sheaves (three clusters with three sheaves).

Each sheave cluster is retained on a separate shaft with a spanner nut. The sheave clusters are supported by saddles and retained in the lower boom point with a bolt and elastic stop nut.

The outer two sheave clusters must be removed before the crane can be operated with some boom lengths. See the Capacity Chart to determine which boom lengths require removal of the outer sheave clusters.

WARNING

Tipping Crane Hazard!

Prevent possible injury. The rear of the crane will tip forward when the boom is raised if the following step is not performed.

Do not attempt to raise the boom until the outer two sheave clusters have been removed. Refer to the boom lengths specified on Capacity Chart.

Removing Outer Two Sheave Clusters

See Figure 4-50 for the following procedure.

Perform the following steps prior to installing the boom top when assembling the boom and prior to lengthening the boom to a length that requires the outer two sheave clusters to be removed.

1. Position the boom top or boom so the rope guards are just touching the ground.
2. Remove the screws fastening the outer two rope guards to the boom top.
3. Raise the boom top or boom until the lower boom point is clear of the rope guards.
4. Remove and store the rope guards.
5. Position the boom top or boom so the center rope guard is just touching the ground.
6. Remove the elastic stop nut and bolt.
7. Push or pull both outer sheave clusters from the lower boom point and store them.
8. Install a spacer on both sides of the lower boom point in place of the sheave clusters.
9. Install an equal thickness of shims on both ends of both spacers to limit the side play to 0.762 mm (0.030 in).
10. Install a bolt with flat washers and securely tighten the elastic stop nut.

Installing Outer Two Sheave Clusters

See Figure 4-50 for the following procedure.

Perform the following steps to install the outer two sheave clusters:

- Prior to installing the boom top when assembling the boom
- After shortening the boom to a length that allows use of the outer two sheave clusters

1. Position the boom top or boom so the center rope guard is just touching the ground.
2. Remove the elastic stop nut and bolt.
3. Remove the spacer and shims from both sides of the lower boom point and store the spacer and shims.
4. Install an outer sheave cluster in the saddles on both sides of the lower boom point.
5. Install an equal thickness of shims on both ends of both sheave clusters to limit the side play to 0.762 mm (0.030 in).
6. Install a bolt with flat washers and securely tighten the elastic stop nut.
7. Assemble a rope guard over both sheave clusters.
8. Securely fasten rope guards to the boom top with screws, lockwashers, and nuts provided.

Greasing Sheave Bearings

Carefully hand pack each sheave bearing with N.G.L.I. EP #2 grease at assembly.

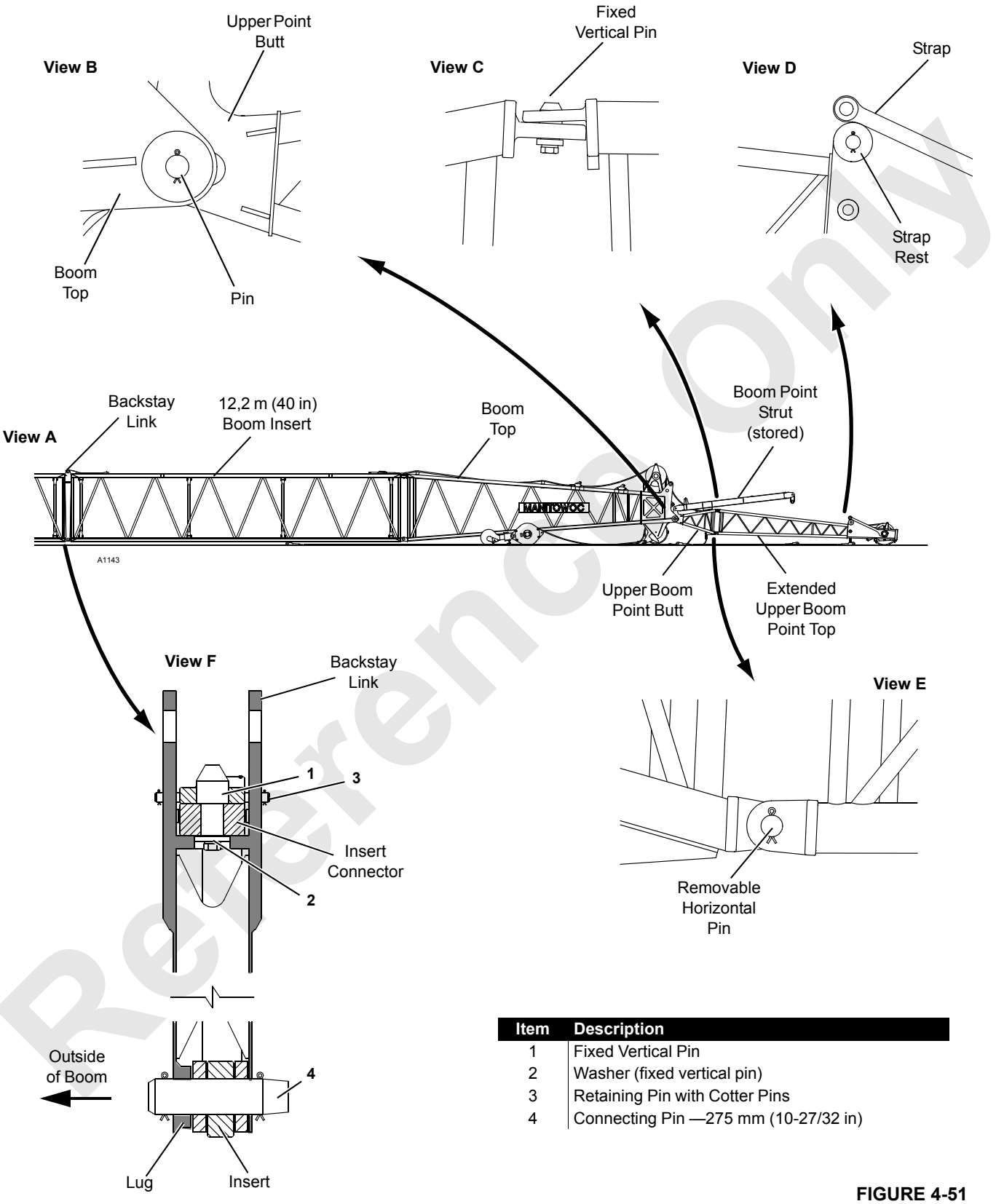
Make sure to also fill cavities between the bearing and seals with grease.

Adjusting Bearing End Play

See Figure 4-50 for the following procedure.

Perform the following steps when assembling a sheave cluster.

1. Assemble three sheave assemblies to the shaft.
2. Clean the threads of the shaft and spanner nut with solvent.
3. Apply Loctite TL277 or equivalent thread-locking adhesive to the threads of the shaft.
4. Install a spanner nut and tighten to 68 to 136 Nm (50 to 100 ft-lb) to remove all bearing end play on the shaft.



Item	Description
1	Fixed Vertical Pin
2	Washer (fixed vertical pin)
3	Retaining Pin with Cotter Pins
4	Connecting Pin —275 mm (10-27/32 in)

FIGURE 4-51

EXTENDED UPPER BOOM POINT RIGGING GUIDE

General

See Figure 4-51 for the following information.

The extended upper boom point rigging guide provides the installation and removal instructions for the #44 boom with heavy lift top.

The extended upper boom point consists of a 1,5 m (5 ft) butt and a 6,1 m (20 ft) top, providing a basic length of 7,6 m (25 ft).

It is assumed for these instructions that the boom is completely installed and ready for operation.

Assist Crane Requirements

An assist crane is not required. See Crane Weights in Section 1 for weights of extended upper boom point components.

Assembly Drawing

Extended upper boom point components (top, butt, pendants) must be assembled in the proper sequence according to the following instructions and the Extended Upper Boom Point Assembly drawing.

- See Figure 4-52 and 4-53 to determine the quantity and length of the pendants required
- See applicable Liftcrane Boom Capacity Chart for the boom length limitations

WARNING

Collapsing Upper Boom Point Hazard!

To prevent death or serious injury, do not stand on, inside, or under the extended upper boom point during assembly or disassembly. Always stand outside of the extended upper boom point when installing or removing the connecting pins.

Installing Extended Upper Boom Point

Prepare Boom

See Figure 4-51 for the following procedure.

1. Lower the boom to the ground. Block if necessary.
2. Remove the load line from the upper boom point, if equipped.
3. Remove and store the upper boom point.
4. Install the upper point backstay links if not already installed. The upper point backstay links must be installed between the boom inserts at the position shown in View A.
5. If necessary, separate the boom inserts to provide space for installing links.
6. Lift the backstay link into position on either side of the insert.

NOTE: The lug at the bottom connecting holes in the link must be facing toward the outside of the boom. (see View F).

7. Lift the backstay link upward and engage the hole in the link with the washer (2, View F) on the underside of the insert connector.
8. Install the retaining pin (3, View F) through the holes on the butt side of the link to prevent the link from falling off the insert.
9. Repeat step 4 through step 8 for the backstay insert on the other side of the boom.
10. Reconnect the boom inserts.
11. Replace the standard horizontal connecting pins with the longer 275 mm (10-27/32 in) connecting pin (4, View F) supplied with the backstay link.

Attach Extended Upper Boom Point

See Figure 4-51 for the following procedures.

NOTE: The extended upper boom point strut is shipped in the stored position on the butt (see View A).

CAUTION

Equipment Damage!

Straps dropping from the strap rests will damage the controls. Handle the upper boom point with care so that the straps remain seated on the rests (see View C).

If the extended upper boom point is shipped assembled, perform the following procedure.

1. Lift the extended upper boom point butt into position at the end of the boom top.
2. Align the holes in the extended upper boom point butt with the holes in the boom top and install the connecting pins (see View B).
3. Make sure that the pin heads on the top are facing toward the outside.

If the extended upper boom point is shipped unassembled, perform the following procedure.

1. Lift the extended upper boom point butt into position at the end of the boom top.

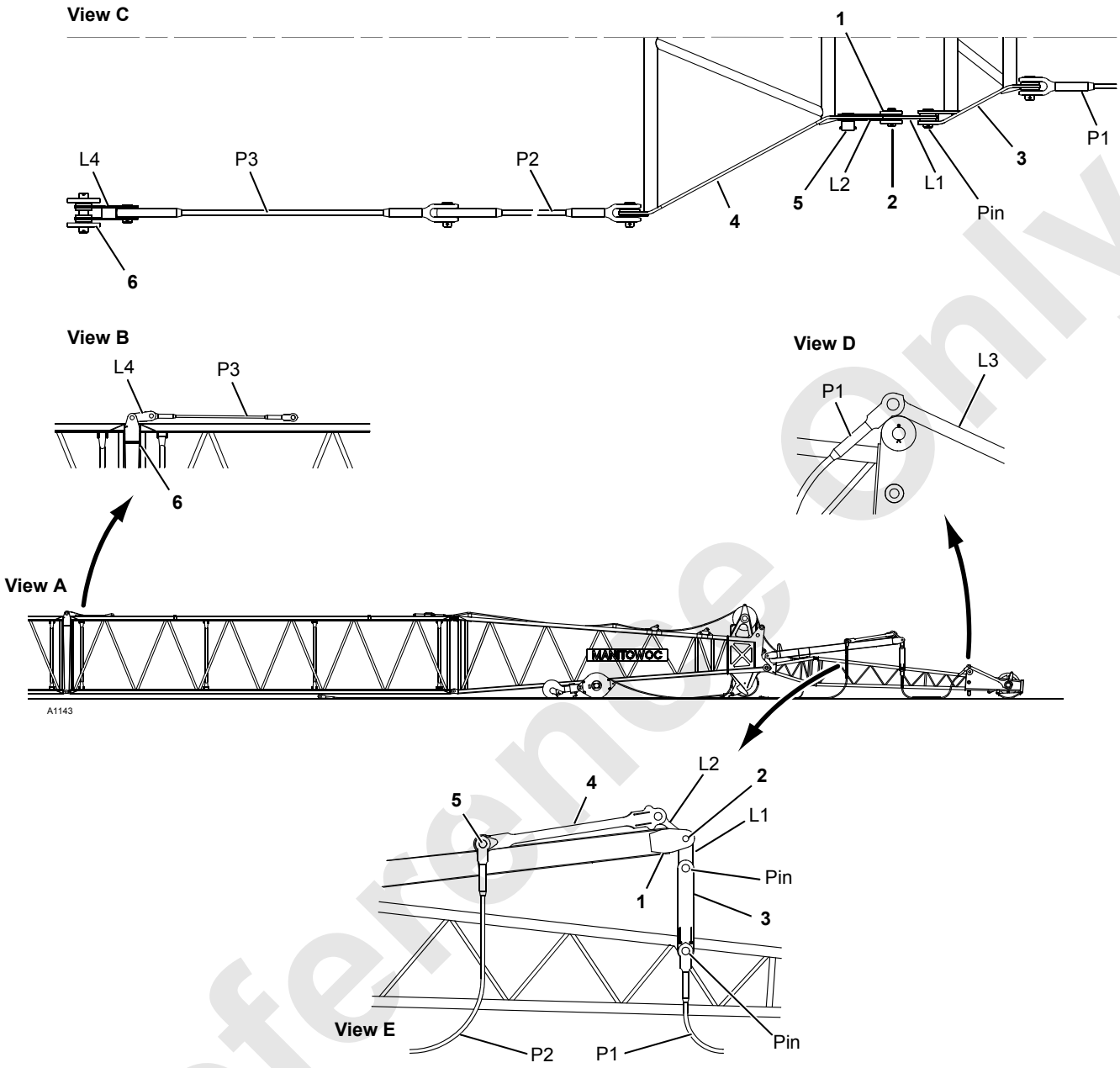
2. Align the holes in the extended upper boom point butt with the holes in the boom top and install the connecting pins (see View B). Install blocking under the top of the upper boom point butt.
3. Lift the top of the extended upper boom point into position at the top of the upper boom point butt.
4. Attach the extended upper boom point to the upper boom point butt.

NOTE: The butt and top sections have FACT™ connectors:

- The top connectors are joined by fixed vertical pins that hook into holes in the adjacent section (see View C).
- The bottom connectors are joined by removable horizontal pins (see View E).

5. Make sure that the pin heads on top are facing toward the outside.

THIS PAGE INTENTIONALLY LEFT BLANK



Item	Description	Item	Description
1	Extended Upper Boom Strut (qty 2)	L2	Link— 305 mm (12 in) (qty 2)
2	Pin (qty 2)	L3	Link—1,4 m (54 in) (qty 2)
3	Spreader (qty 2)	L4	Link—305 mm (12 in) (qty 2)
4	Spreader (qty 2)	P1	Extended Upper Boom Point Pendant—6,4 m (20 ft 10 in) (qty 2)
5	Pin with Collar (qty 2)	P2	Backstay Basic Pendant—20,0 m (65 ft 7 in) (qty 2)
6	Backstay Link (qty 2)	P3	Backstay Pendant—2,2 m (7 ft 4 in) (qty 2)
L1	Link—254 mm (10 in) (qty 2)		

FIGURE 4-52

Install Spreaders

See Figure 4-52, Views C and E for the following procedure.

1. Using the pin (2), pin the links (L1 and L2) to the extended upper boom strut (1).
2. Lift the spreader (3) into position and pin it to the links (L1). Allow the spreader to hang from the strut top.
3. Lift the spreader (4) into position and pin it to the links (L2). Carefully lay the spreader back on the strut.

Install Pendants

See Figure 4-52 for the following procedure.

NOTE: Pendants are furnished in matched sets of two and must be installed as matched sets (pendant on one side must match the pendant on the opposite side).

1. Pin the upper boom point pendants (P1) to the links (L1, View E).

   Pin the other end of the pendants (P1) to the links (L3) on the upper boom top (see View D).
2. Pin the links (L4) to the backstay links (6, View B).
3. Pin the backstay pendants (P3) to the links (L4, View B).
4. Pin the backstay basic pendants (P2) to the lugs on the spreader (4) using the pins (5,View E).

   Lay the pendants (P2) on the ground beside the boom.

Raise Extended Upper Boom Point Strut

See Figure 4-53 for the following procedure.

1. Using appropriate slings, attach the hook from the assist crane to the top of the extended upper boom point strut (see View A).
2. Slowly lift the extended upper boom point strut with assist crane until the backstay basic pendants (P2) have enough slack to be pinned to the backstay pendants (P3).

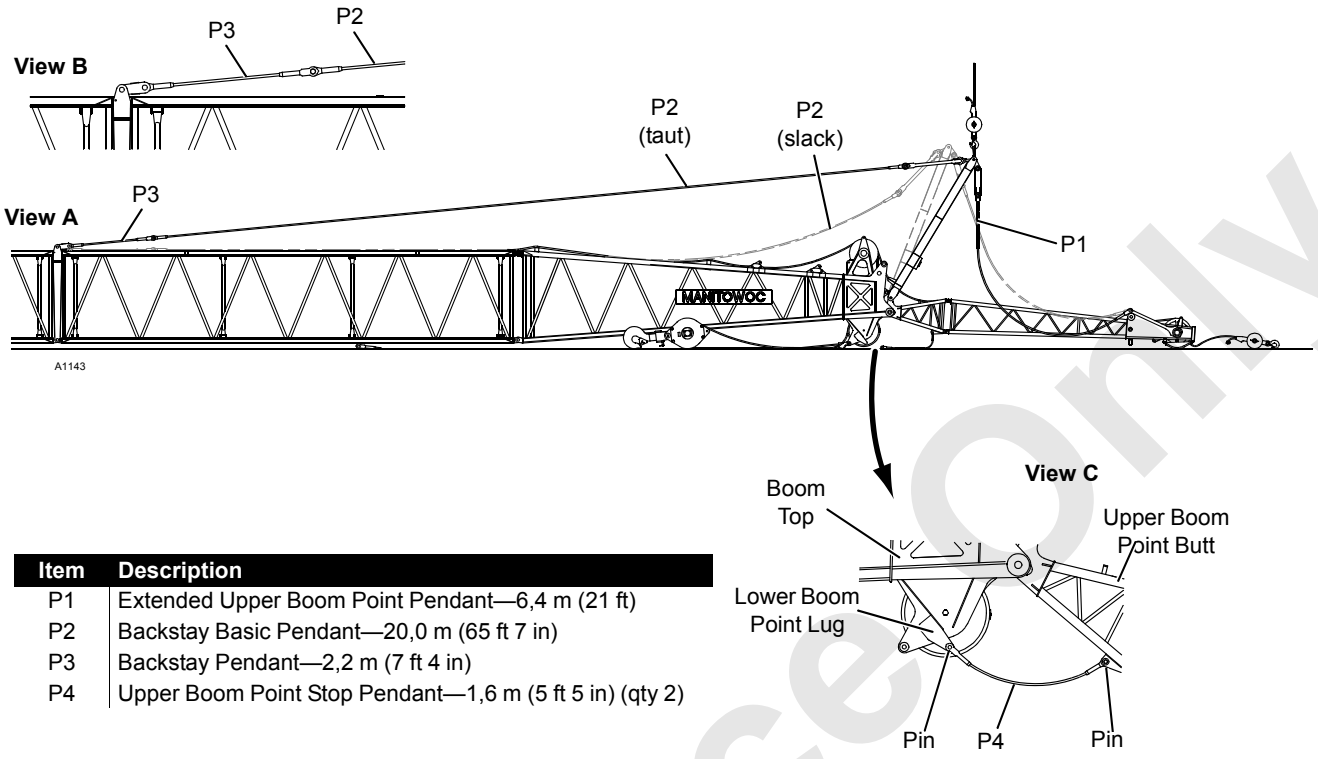
NOTE: Use caution not to side load the strut while lifting.

3. Pin the backstay basic pendants (P2) to the backstay pendants (P3).
4. Using an assist crane, lower the strut forward until the backstay pendants (P3) are taut and supporting the strut.
5. Unhook the assist crane.

Connect Stop Pendant

See Figure 4-53 for the following procedure.

1. Slowly raise the boom until the upper point is supported by the extended upper boom point pendants (P1).
2. Pin the upper boom point stop pendants (P4) to the lugs on the upper boom point butt and lower the lower boom point (see View C).



Item	Description
P1	Extended Upper Boom Point Pendant—6,4 m (21 ft)
P2	Backstay Basic Pendant—20,0 m (65 ft 7 in)
P3	Backstay Pendant—2,2 m (7 ft 4 in)
P4	Upper Boom Point Stop Pendant—1,6 m (5 ft 5 in) (qty 2)

FIGURE 4-53

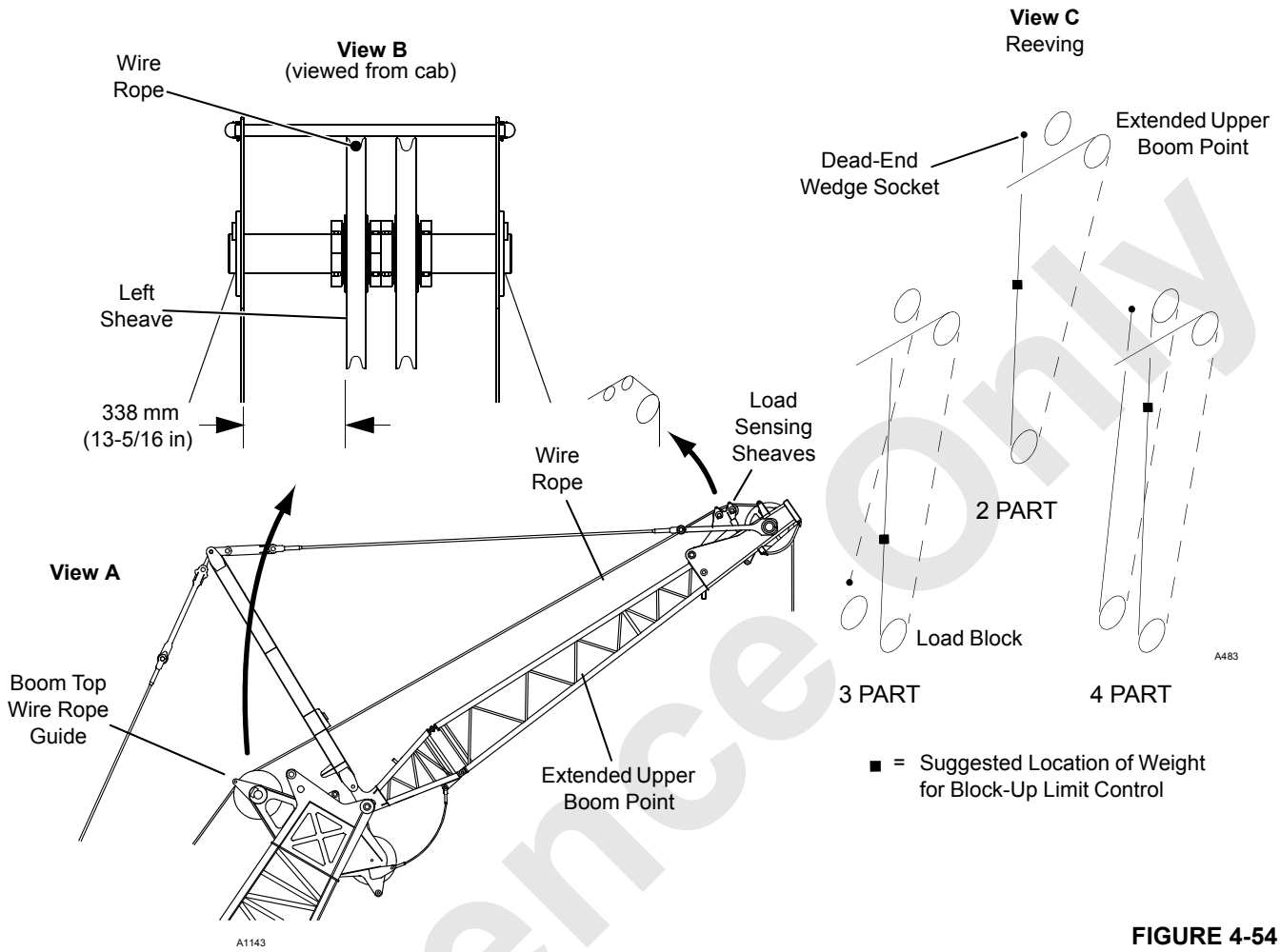


FIGURE 4-54

Install Load Line

See Figure 4-54 for the proper routing and reeving of the load line to the extended upper boom point. The left guide sheave in the boom top is used for routing the load line to the extended upper point.

NOTE: The sheave must be positioned as shown in View B.

Load lines must be properly routed through the RCL load-sensing sheaves as shown in the reeving diagrams.

Install Block-Up Limit Control and Connect Wiring

Install block-up limit components as shown in Figure 4-46 and in Block-up Limit Control Assembly drawing.

1. Connect the electrical cable from the jib to the junction box in the boom top.
2. Connect the electrical cable from the limit switch to the junction box in the upper boom point.
3. Adjust the block-up limit switch according to the instructions in Section 5 of the Crane Service Manual.
4. Connect electrical cables from the rated capacity limiter (RCL) load-sensing sheaves to the junction box in the boom top. See the Indicator Assembly drawing.
5. Check the RCL operation and calibration as instructed in the RCL Operation Guide.

Removing Extended Upper Boom Point

DANGER

Collapsing Upper Boom Point Hazard!

To prevent death or serious injury, do not stand on, inside, or under the extended upper boom during disassembly. Always stand on the outside of the extended upper boom point when removing the connecting pins.

Support the extended upper boom point properly before removing the pins. Block sections at the connection points.

Lower Boom

See Figure 4-53 for the following procedure.

CAUTION

Boom Point Stop Damage!

Do not allow the extended upper boom point to touch the ground until the extended upper boom point stop pendants are disconnected.

1. Lower the boom until the extended upper boom point is approximately 305 mm (1 ft) from contacting the ground.
2. Disconnect the block-up limit electrical cable in the extended upper boom point and at the junction boxes. Store the cable.
3. Remove the load line and the block-up limit chains and weights from the upper boom point.
4. Disconnect the upper boom point stop pendants from the lower boom point lugs (see View C).
5. Lower the boom and the extended upper boom point onto blocking at ground level.

Lower Extended Upper Boom Point Strut

See Figure 4-53 for the following procedure.

WARNING

Falling Strut Hazard!

Prevent possible injury. Do not disconnect the backstay pendants until the strut is supported and the pendants are slack.

1. Using the appropriate slings, attach the hook from the assist crane to the top of the extended boom point strut (see View A).
2. Slowly bring the strut back with the assist crane until the backstay basic pendants (P2) are slack and can be unpinned from the backstay pendants (P3, View A).

   Be careful not to lift the boom top or the extended upper boom point.

NOTE: Use extreme caution not to side load the strut.

3. Disconnect the backstay basic pendants (P2) from the backstay pendants (P3). Lay the backstay pendants on the ground along the boom.
4. Slowly bring the strut forward with the assist crane and lower it onto the upper point butt (Figure 4-52, View E).

IMPORTANT Use extreme caution not to side load the strut while lowering:

5. Disconnect the assist crane from the strut.

Remove Pendants

See Figure 4-52 for the following procedure.

1. Disconnect the backstay pendants (P2) from the spreader (4, View E).
2. Disconnect the pendants (P3) and links (L4, View B).
3. Coil the backstay pendants and store the pendants and links for future use.

Remove Spreaders

See Figure 4-52, Views C and E, for the following procedure.

NOTE: An assist crane will be needed to remove the spreaders.

1. Unpin and remove the spreader (4) from the links (L2).
2. Unpin and remove the spreader (3) from the links (L1).
3. Unpin and remove the links (L1 and L2).

Remove Extended Upper Boom Point

See Figure 4-51 for the following procedure.

1. If desired, unpin and remove the extended upper boom point top from the upper boom point butt (see Views C and E).
2. Unpin and remove the extended upper boom point from the boom top (see View B).

THIS PAGE INTENTIONALLY LEFT BLANK

Table 4-4. Boom Handling Limitations (Travel speed not to exceed 0.8 km/h (1/2 mph)

Maximum Boom Length m (ft)	Boom Makeup (Notes 1, 2)	Maximum Suspended Weight at Boom Point kg (lb)
30,5 (100)	Butt, Inserts, Top, Upper Boom Point	5 670 (12,500)
33,5 (110)	Butt, Inserts, Top, Upper Boom Point	4 082 (9,000)
36,6 (120)	Butt, Inserts, Top, Upper Boom Point	2 495 (5,500)
39,6 (130)	Butt, Inserts, Top, Upper Boom Point	1 361 (3,000)
42,7 (140)	Butt, Inserts, Top with Load Block and Weight Ball Removed	0

Note 1: Gantry in intermediate position for all boom lengths.
Note 2: Boom fully rigged with straps attached between equalizer and boom top for all boom lengths.

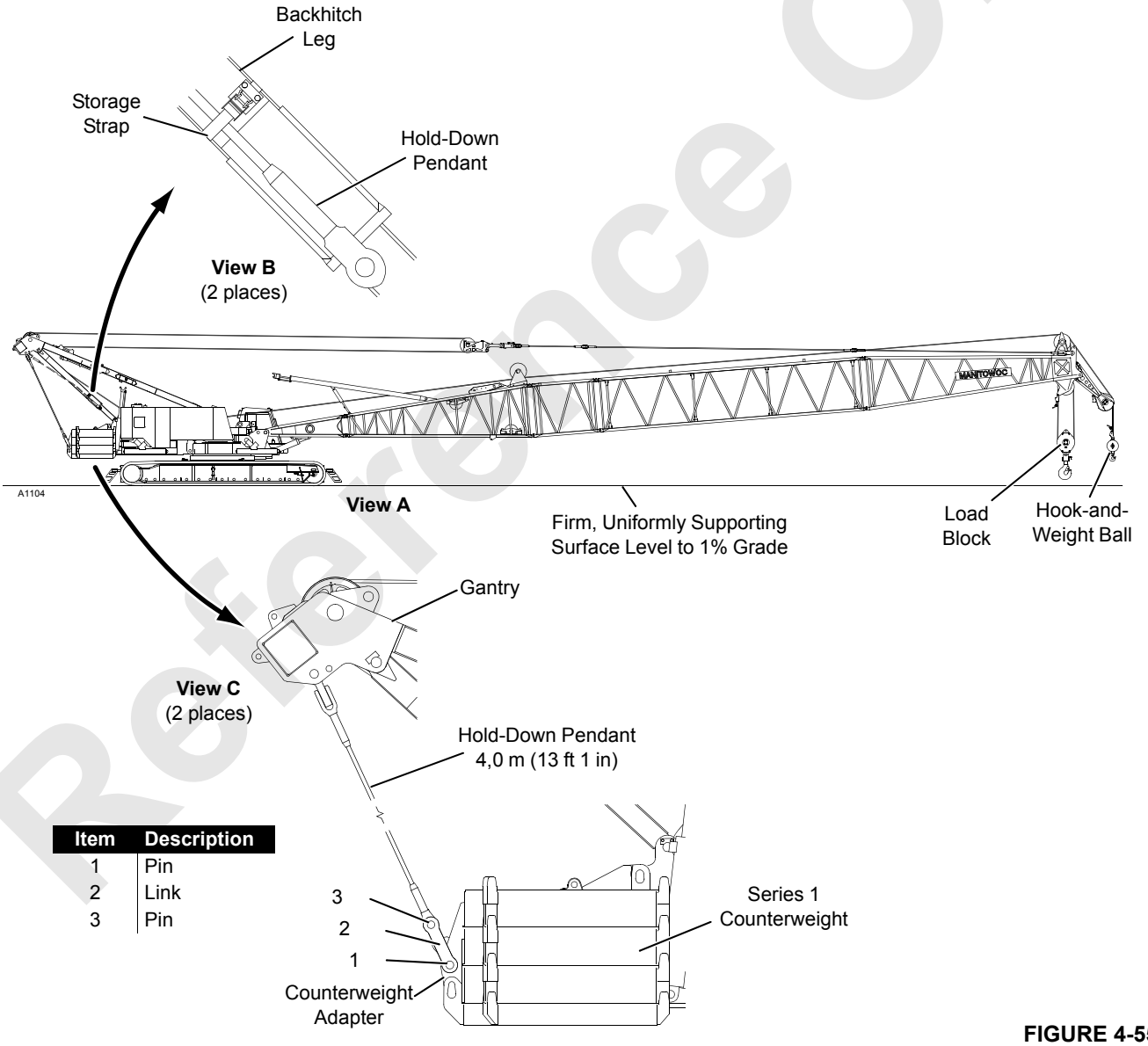


FIGURE 4-55

BOOM HANDLING WITH INTERMEDIATE GANTRY POSITION

General

The intermediate gantry position provides the minimum clearance for traveling with the boom by lowering the crane's overall height to 7 m (23 ft).

- See Figure 4-56 for the boom length and suspended weight limitations.
- See Gantry Raising and Lowering (with Boom Butt Handling Cylinder) on page 4-50 for the raising and lowering instructions.

DANGER

Falling Boom Hazard!

Avoid death or serious injury. Damage to, or structural failure of, the hold-down pendants or gantry may cause the boom to fall when the gantry is in the intermediate position:

- Boom length must not exceed 42,7 m (140 ft)
- Weight of the load must not exceed the maximum allowed for length of the boom
- Hold-down pendants must not be shock loaded

NOTE: For additional boom handling instructions, see the Boom Rigging Assembly drawing.

Machine Equipment

The crane must be equipped as follows to travel with the gantry in the intermediate position:

- 4,0 m (13 ft 1 in) long hold-down pendants and links
- No more than Series 1 counterweight installed

Preparing Crane for Travel

See Figure 4-56 for the following procedure.

1. Position the crane on a firm, level surface.
2. Lower the boom onto blocking at ground level.
3. Reduce the boom to the desired length listed.
4. Fully lower the gantry. See Raising and Lowering Gantry with Fully Rigged Boom on page 4-55.
5. Perform the following steps on both sides of the gantry.
   a. Using the pin (1), pin the links (2) to the counterweight adapter (see View C).
   b. Open the storage strap on the backhitch leg (see View B) and lower the hold-down pendant from the storage position.
   c. Using the pin (3), pin the hold-down pendant to the links.
   d. Make sure to install and open the cotter pins.
6. Fully extend the gantry raising cylinders to raise the gantry. (See Raising and Lowering Gantry with Fully Rigged Boom on page 4-55.
7. Slowly boom up. The gantry will rise until the hold-down pendants are taut, then the boom will rise.

NOTE: Avoid shock loading the hold-down pendants.

8. Raise the suspended load, if any, off the ground.

Traveling

1. Travel only on a firm, uniformly supporting surface that is level to within 1% grade.

NOTE: The boom may be raised higher than the height of the gantry if required for maneuvering (for example, turning a corner).

2. If traveling with a suspended load, keep the load off the ground.

NOTE: Do not drag the load on the ground.

If necessary, carry the load on a transport vehicle with sufficient capacity for the weight of the suspended load.

3. Do not travel faster than 0,8 km/h (1/2 mph).
4. Perform all travel functions—starting, turning, and stopping—slowly and smoothly to avoid shock loading the boom and gantry hold-down pendants.

Returning Crane to Normal Operation

See Figure 4-55 for the following procedure.

1. Position the crane on a firm, level surface.
2. Lower the load to the ground.
3. Lower the boom onto blocking at the ground level.
4. Fully lower the gantry. See Raising and Lowering Gantry with Fully Rigged Boom on page 4-55.
5. Perform the following steps on both sides of the gantry.
   a. Remove the pin (3) to unpin the hold-down pendant from the links (2, View C).
   b. Securely connect the hold-down pendant to the backhitch leg with the storage strap (see View B).
   c. Attach the pin (3) into the links (2).
   d. If desired, leave the links (2) and pins (1 and 3) attached to the counterweight adapter for storage. Otherwise, remove the links and pins and store them in a safe location for future use.
6. Increase the boom to the desired length.
7. Fully raise the gantry. See Raising and Lowering Gantry with Fully Rigged Boom on page 4-55.

JIB INSTALLATION (#132 JIB)

General

This topic contains the installation and removal instructions for the #132 jib on the #44 boom with heavy lift or long reach top.

The jib consists of a 6,1 m (20 ft) butt and a 6,1 m (20 ft) top, providing a basic length of 12,2 m (40 ft). Inserts are available in 6,1 m (20 ft) lengths, allowing the jib to be lengthened to a maximum of 36,6 m (120 ft) (Figure 4-59).

Jib offsets of 5°, 15°, and 30° are obtained by changing the length of the jib backstay straps, links, and pendants (Figure 4-53).

It is assumed for these instructions that the boom is completely installed and ready for operation.

An assist crane with sufficient capacity to lift one half the weight of the jib is required. For weights of the jib components, see Crane Weights on page 1-9.

WARNING

Collapsing Jib Hazard!

To prevent death or serious injury, do not stand on, inside, or under the jib during assembly or disassembly. Always stand outside the jib when installing or removing the connecting pins.

Jib Assembly Drawing

See Figure 4-59 for the following procedure.

Jib components (top, inserts, butt, and pendants) must be assembled in the proper sequence according to this topic and the Jib Rigging drawing.

- Determine the quantity and length of inserts and pendants required for the various jib lengths.
- See the applicable Jib Lifting Capacity Chart for the boom and jib length limitations.

A1069
A1080

Heavy Lift Top Shown, Long Reach Top Similar

Item	Description
1	Fixed Vertical Pin
2	Washer (fixed vertical pin)
3a	Retaining Pin with Cotter Pins
3b	Support Cable Assembly
4	Connecting Pin —275 mm (10-27/32 in)

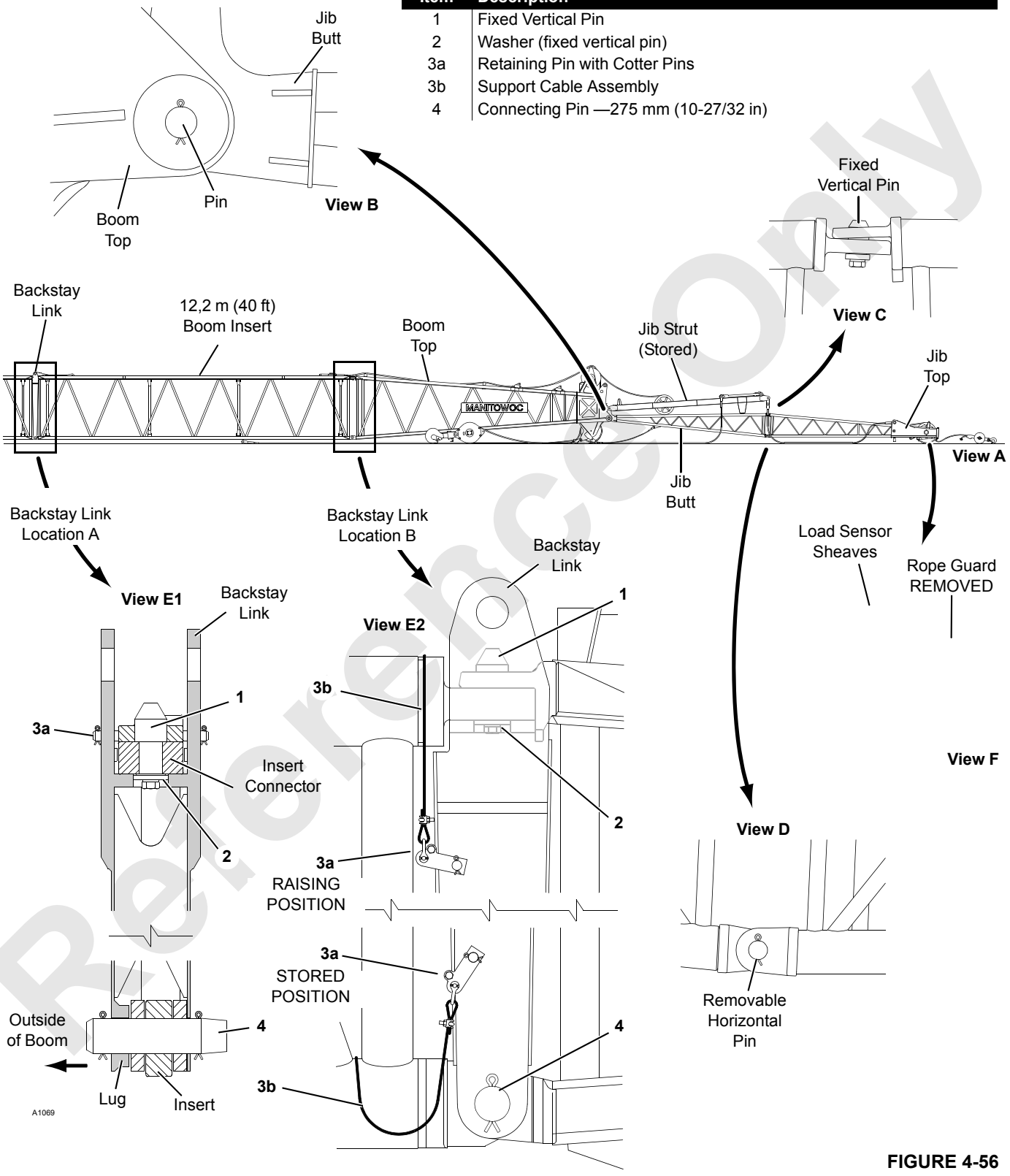


FIGURE 4-56

Prepare Boom

See Figure 4-57 for the following procedure.

1. Lower the boom to the ground. Block if necessary.
2. Remove the load line from the upper boom point, if equipped.
3. Remove and store the upper boom point. See Boom Rigging Guide (#44 HL and LR) on page 4-72.
4. For the long reach top only, install the jib stop strut (8, View D).

NOTE: Gussets on the outside of the strut must be facing toward the ground.

See Figure 4-56 for the remaining procedure.

5. For heavy lift top only, install the jib backstay links between the boom sections (Location A or B). See the Jib Assembly Drawing for the proper mounting location.
   a. If necessary, separate the boom sections to provide space for the links.
   b. Lift a backstay link into position on either side of the required insert. The lug at the bottom of the connecting holes in the link must be facing toward the outside of the boom (see View E1).
   c. Lift the backstay link upward and engage the hole in the link with the washer (2, View E1) on the underside of the insert connector.
   d. For Location A, install the retaining pin (3a, View E1) through the holes on the butt side of the link to prevent the link from falling off the insert.

      For Location B, move the support cable assembly (3b, View E2) from the stored position to the raising position to prevent the link from falling off the insert. If necessary, adjust the cable length so the bottom connecting holes are aligned when the assist crane is disconnected.
   e. Repeat step 5b through step 5d for the backstay link on the other side of the boom.
   f. Reconnect the boom inserts.

      Replace the standard horizontal connecting pins with the longer 275 mm (10-27/32 in) connecting pin (4, View E) supplied with the backstay links.

Install Jib Butt

See Figure 4-56 for the following procedure.

NOTE: The jib strut is shipped in the stored position on the jib butt (see View A).

1. Lift the jib butt into position at the end of the boom top.
2. Align the holes in the jib butt with the holes in the boom top and install the connecting pins (see View B).

Install Jib Inserts

See Figure 4-56 for the following procedure.

NOTE: The jib sections have FACT™ connectors:

- The top connectors are joined by fixed vertical pins that hook into holes in the adjacent section (see View C).
- The bottom connectors are joined by removable horizontal pins (see View D).

1. Pin the desired length of jib inserts to the butt.

NOTE: The tapered end of the pins must point inward.

2. Block the inserts at the ground level as the assembly progresses.

Install Jib Top

Pin the jib top to the last insert or butt, depending on the jib length.

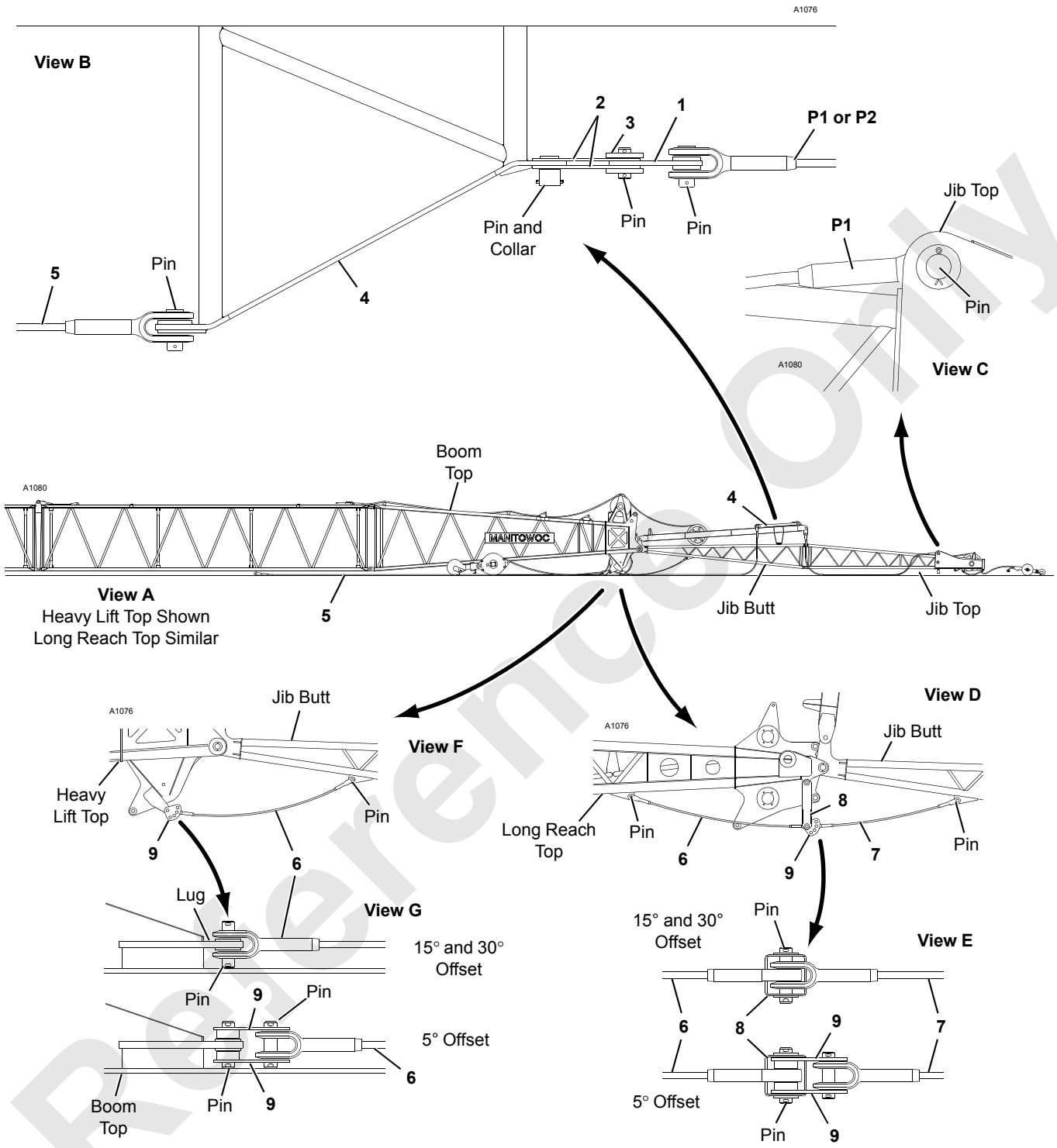
WARNING

Falling Load Hazard!

Prevent possible injury. The load line can be damaged and the load can fall if the following step is not performed.

If the jib top is equipped with load sensor sheaves (see View F), remove and store the rope guard.

THIS PAGE INTENTIONALLY LEFT BLANK



Item	Description	Item	Description
1	Link	7	Jib Stop Pendant—1,8 m (6 ft)
2	Link	8	Jib Stop Strut (long reach top only)
3	Jib Strut	9	Adjusting Link (5° offset only)
4	Spreader	P1	Basic Jib Pendant—12,2 m (40 ft)
5	Basic Backstay Pendant—20 m (65 ft 7 in)	P2	Jib Insert Pendant—5,8 m (19.2 ft)
6	Jib Stop Pendant—2,3 m (7 ft 7 in)		

FIGURE 4-57

Install Jib Pendants

NOTE: With the exception of the basic pendants, the jib pendants must be installed in the same sequence as the inserts (Figure 4-59).

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

1. Pin the basic jib pendants (P1, Figure 4-57, View C) to the lugs on the jib top.
2. If the jib is longer than 12,2 m (40 ft), pin the jib insert pendants (P2, Figure 4-59) to the basic pendants (P1).
3. Pin the links (1 and 2, Figure 4-57, View B) to the jib strut (3).
4. Pin the jib pendants (P1 or P2) to the links (1) on the jib strut (Figure 4-57, View B).

Install Backstay Pendants

See Figure 4-57, View B for the following procedure.

1. Lift the spreader (4) into position and pin it to the links (2) on the jib strut (3).
2. Lay the spreader on the jib strut.
3. Pin the basic backstay pendants (5) to the spreader.
4. Lay the basic backstay pendants on the ground along the boom top.

Install Jib Stop Pendants and Links

Choose the correct jib stop pendants and links for the jib offset and the boom top being used.

For the long reach boom top, see Figure 4-57, Views D and E.

1. Pin the jib stop pendants (6) to the lugs on the boom top.
2. Pin the jib stop pendants (7) to the lugs on the jib butt.
3. Depending on the jib offset, proceed as follows.
   a. 5°— Pin the pendants (6) and adjusting links (9) to the strut (8). Do not pin the pendants (7) to the adjusting links until after the jib point is raised clear of the ground. See Connect Jib Stop on page 4-113.
   b. 15° and 30°—Do not pin the pendants (6 and 7) to the strut until after the jib point is raised clear of the ground. See Connect Jib Stop on page 4-113.

For the heavy lift boom top, see Figure 4-57, Views F and G.

1. Pin the jib stop pendants (6) to the lugs on the boom top.
2. Depending on the jib offset, proceed as follows.
   a. 5°—Pin the adjusting links (9) to the strut (8). Do not pin the pendants (6) to the adjusting links (9) until after the jib point is raised clear of the ground. See Connect Jib Stop on page 4-113.
   b. 15° and 30°—Do not pin the pendants (6) to the strut (8) until after the jib point is raised clear of the ground. See Connect Jib Stop on page 4-113.

Item	Description
1	Basic Backstay Pendant—20 m (65 ft 7 in)
2	Backstay Pendant—2,2 m (7 ft 4 in)
3	Backstay Link—1,1 m (3 ft 8 in)
4	Connecting Link—0,3 m (12 in)

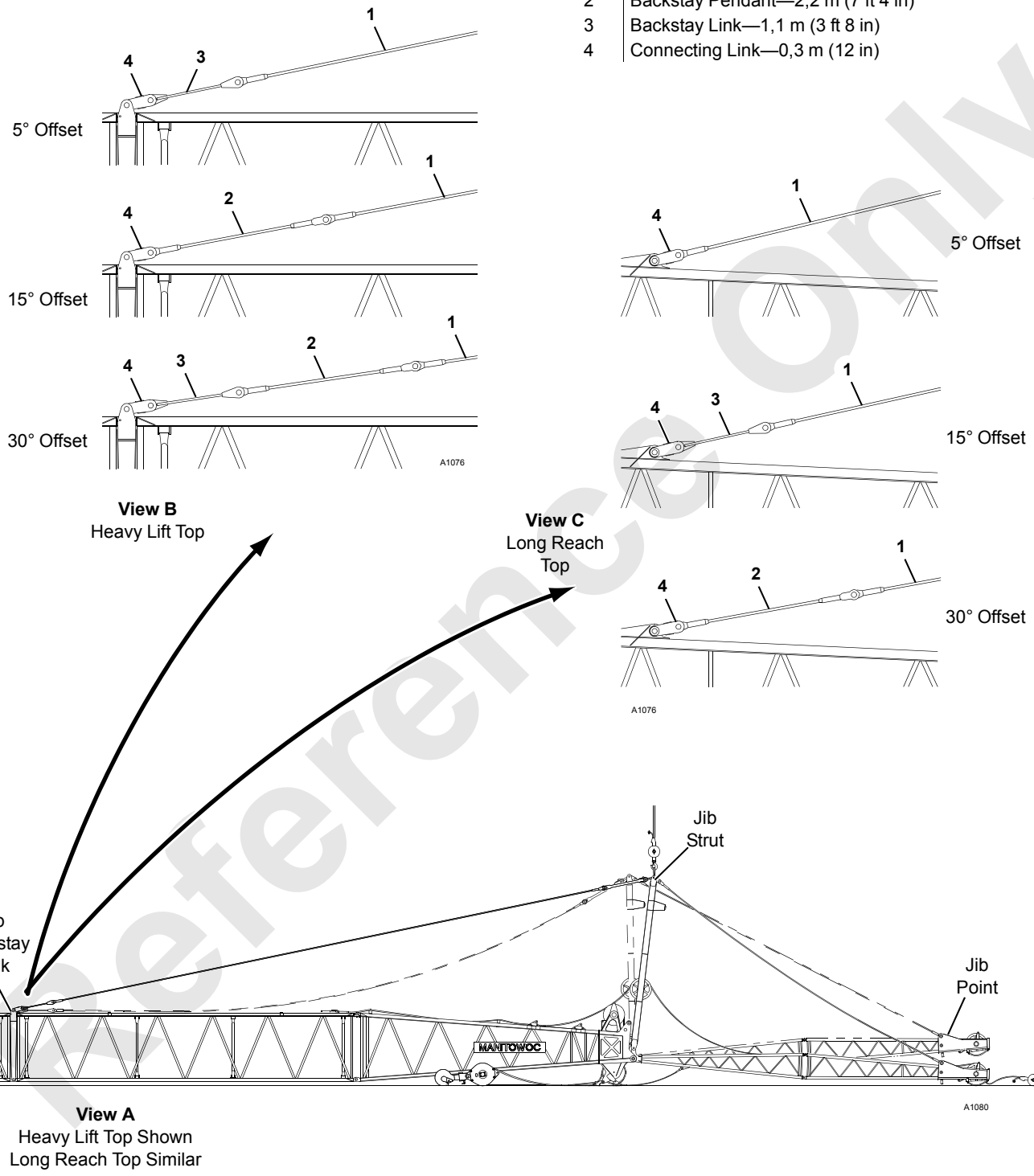


FIGURE 4-58

Raise Jib Strut

See Figure 4-58 for the following procedure.

1. Determine the pendants and links (2—4, View B or View C) required for the jib offset.
2. Pin the pendants and links to the backstay links (heavy lift top) or the lugs on the transition insert (long reach top).

NOTE: Backstay links (3, View B or View C), if used, must be adjacent to the connecting links (4).

3. Using an assist crane or forklift truck, lift the jib point approximately 0,9 m (3 ft) off the ground and block it (see View A).

   Raising the jib point provides enough slack to allow pinning the backstay pendants.

4. Using the appropriate slings, attach the hook from an assist crane to the top of the jib strut (see View A).
5. Slowly lift the jib strut over the center with the assist crane.

NOTE: Use extreme caution not to side load the strut while lifting.

6. Pin the basic backstay pendants (1) to the links or pendants (2—4) previously pinned to the lugs on the transition insert (long reach top) or the boom backstay links (heavy lift top) (see View B or C).
7. Remove the blocking from the jib point and lower the jib point to the ground.

Connect Jib Stop

See Figure 4-57 for the following procedure.

1. Slowly raise the boom until the jib is supported by the backstay and jib pendants.
2. For the long reach boom top (see Views D and E), proceed as follows depending on the jib offset.
   a. 5°—Pin the pendants (7) to the holes in the adjusting links (9) that give the least pendant slack or some preload.
   b. 15° and 30°—Pin the pendants (6 and 7) directly to the strut (8).
3. For the heavy lift boom top (see Views F and G), proceed as follows depending on the jib offset.
   a. 5°—Pin the pendants (6) to the holes in the adjusting links (9) that give the least pendant slack or some preload.
   b. 15° and 30°—Pin the pendants (6) directly to the strut (8).

Install Load Line

See Load Line Reeving on page 4-122 for the proper routing and reeving of the load lines to the jib point.

NOTE: Load lines must be properly routed through the RCL load-sensing sheaves as shown in the reeving diagrams.

Install Block-Up Limit Control and Connect Wiring

See Figure 4-46 for the following procedure.

Install the block-up limit components. (See Figure 4-46 and the Block-up Limit Control Assembly drawing).

1. Connect the electrical cable from the jib to the junction box in the boom top.
2. Connect the electrical cable from the limit switch to the junction box in the boom top.
3. Adjust the block-up limit switch according to Section 5 of the Crane Service Manual.
4. Connect the electrical cables from the rated capacity limiter RCL load-sensing sheaves to the junction box in the boom top. See the Indicator Assembly drawing.
5. Check the RCL operation and calibrate as instructed in the RCL Operation Guide.

JIB REMOVAL (#132 JIB)

DANGER

Collapsing Jib Hazard!

To prevent death or serious injury, do not stand on, inside, or under the jib during disassembly. Always stand on the outside of the jib when removing the connecting pins.

Support the jib properly before removing the pins. Block sections at the connection points.

Lower Boom and Jib

See Figure 4-57 for the following procedure.

CAUTION

Jib Stop Damage!

Do not allow the jib point to touch the ground until the jib stop pendants are disconnected.

1. Lower the boom until the jib point is approximately 0,3 m (1 ft) from contacting the ground.
2. Disconnect the jib stop pendants (6 or 7, View D or F) from the lugs on the jib butt.
3. Lower the boom and the jib onto blocking at the ground level.
4. Disconnect the block-up limit electrical cable at the chord in the boom point and at the junction box in the jib point. Store the cable on the jib butt.

   Connect the block-up limit electrical cable to the terminator plug on the junction box in the boom points (see Block-Up Limit Adjustment in Section 5 of the Service Manual).
5. Remove the load line, block-up limit chains, and weights from the jib.

Lower Jib Strut

See Figure 4-57 for the following procedure.

WARNING

Falling Strut Hazard!

Avoid death or serious injury. Do not disconnect the backstay pendants until the strut is supported and the pendants are slack.

1. Using an assist crane or a forklift truck, lift the jib point approximately 0,9 m (3 ft) off the ground and block it (see View A).

   Raising the jib point provides enough slack to allow removing the backstay pendant pins.
2. Using the appropriate slings, attach a hook from an assist crane to the top of the jib strut (see View A).
3. Disconnect the backstay pendants and links (see View B or C) from the backstay links (heavy lift boom top) or the lugs on the transition insert (long reach boom top). Lay the pendants on the ground along the boom top.
4. Slowly rotate the jib strut forward over the center with the assist crane and lower the strut onto the jib butt.

NOTE: Avoid lifting the jib butt/boom top in the process.

Use extreme caution not to side load the strut while lowering.

5. Disconnect the assist crane from the jib strut.
6. Remove the blocking from the jib point and lower the jib point to the ground.

Remove Backstay Pendants

See Figure 4-57 for the following procedure.

1. Disconnect the basic backstay pendants (5) from the spreader (4, View B).
2. Coil the backstay pendants and store the pendants and links for future use.

NOTE: The spreader can be stored on the jib strut for shipping.

Remove Jib Pendants

See Figure 4-57 for the following procedure.

1. Disconnect the jib pendants (P1 or P2) from the links (1) on the jib strut (3) and lugs on the jib top.
2. Coil the jib pendants and store them for future use.

Remove Jib Top and Inserts

See Figure 4-56 for the following procedure.

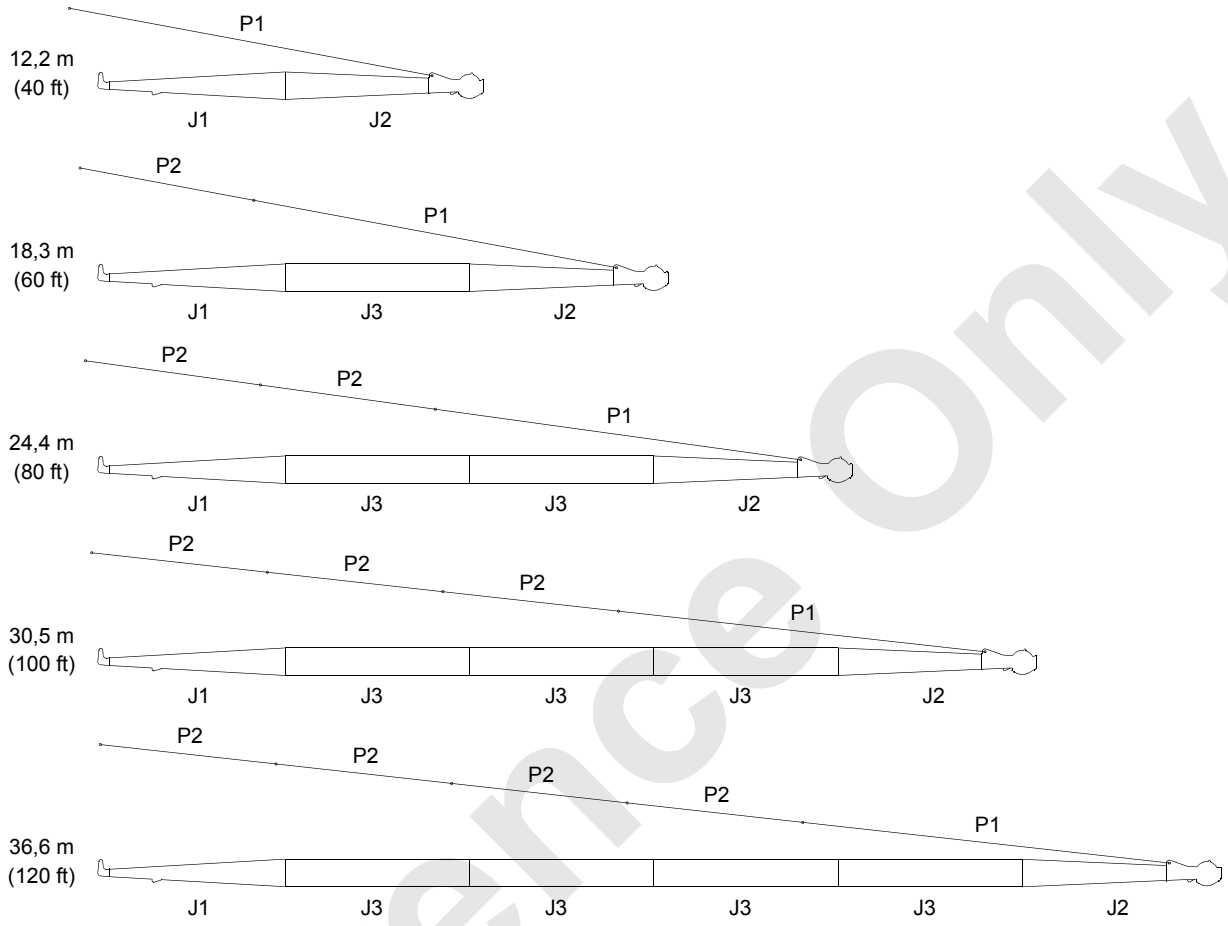
1. Unpin and remove the jib top from the jib butt or the jib insert (see Views C and D).
2. Unpin and remove the jib inserts from the jib butt, as required (see Views C and D).

Remove Jib Butt

See Figure 4-57 for the following procedure.

1. Remove the jib stop pendants, links, and struts from between the boom top and the jib butt (see View D or F).
2. Support the jib butt with the assist crane.
3. Unpin and remove the jib butt from the boom top (Figure 4-56, View B).

A1076



Section	Type	Length	Pendant	Type	Length
J1	Jib Butt	6,1 m (20 ft)	P1	Basic Jib	12,2 m (40 ft)
J2	Jib Top	6,1 m (20 ft)	P2	Jib Insert	5,8 m (19.2 ft)
J3	Jib Insert	6,1 m (20 ft)			

FIGURE 4-59

WIRE ROPE INSTALLATION

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

Wire Rope Storage

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

Removing Wire Rope from Shipping Reel

CAUTION

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. Mount the wire rope shipping reel on a shaft supported at both ends by jacks or blocks (Figure 4-60).

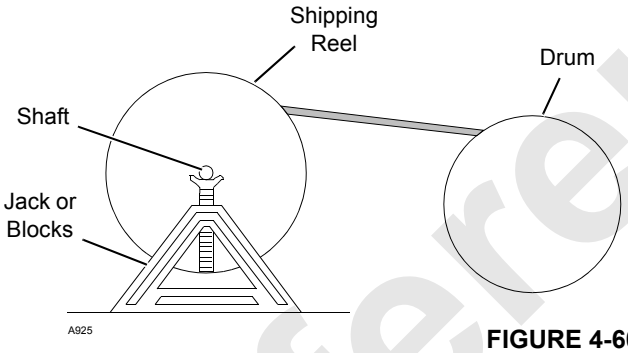


FIGURE 4-60

2. Provide a brake at the shipping reel so the wire rope can be wound tightly onto the drum (Figure 4-61).

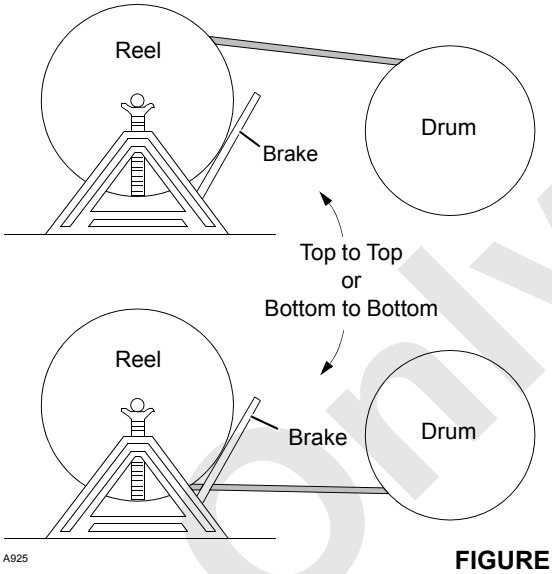


FIGURE 4-61

3. Wind from the top of the reel to the top of the drum or from the bottom of the reel to the bottom of the drum (Figure 4-61).

NOTE: Avoid a reverse bend when winding the wire rope onto the drum.

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

Seizing and Cutting Wire Rope

See Figure 4-62 for the following information.

Apply tight seizings of annealed wire to the ends of all wire rope, otherwise the rope wires and strands may slacken. This action will result in overloading of some strands and underloading of others. Bird-caging and breakage of the wire rope can occur.

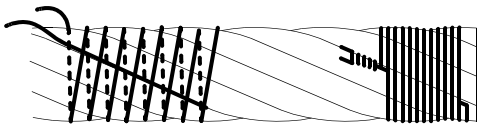
Before cutting the wire rope, apply seizings on both sides of the point where the cut will be made. Then cut the wire rope with a torch, rope cutter, or abrasive cut-off wheel.

See Figure 4-62 for the following information.

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

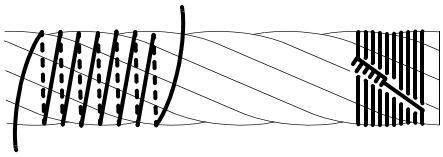
Wire Rope Type	Seizings Required
Preformed	1
Non-preformed	3

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



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

FIGURE 4-62

A925

Anchoring Wire Rope to Drum

See Figure 4-63 for the following procedure.

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

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

WARNING

Falling Load Hazard!

Prevent possible injury. Wire rope can be pulled out of the drum if the following steps are not taken:

- Install a 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 the wedge, but not out of the drum socket.
- Make sure seizing is not under the wedge. Remove the seizing if it interferes with the assembly.

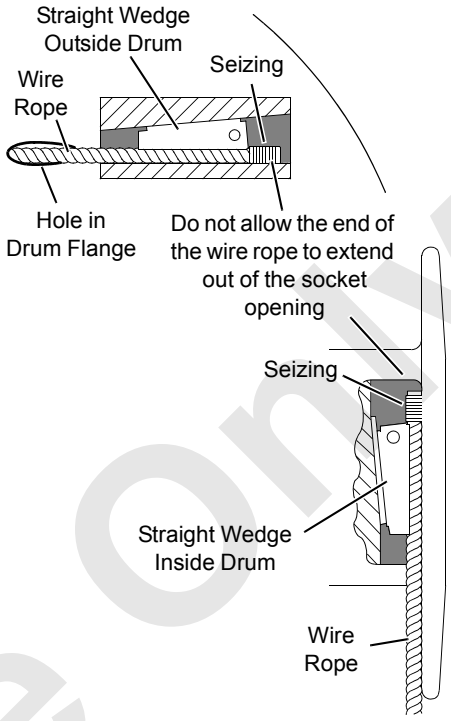


FIGURE 4-63

Winding Wire Rope onto Drum

See the Drum and Lagging Chart in the Capacity Chart Manual for the correct size of drum laggings, if used.

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 load drums.

See the Boom Rigging drawing for the correct type, size, and amount of wire rope to be installed on the boom hoist drums.

1. Carefully inspect the drums and all the rope guides, rollers, and sheaves for defects that can cause the wire rope to wear or be cut. If the defects cannot be fixed, replace the faulty parts.
2. Apply tension to the wire rope as it is being wound slowly onto the drum.

   The first wrap must be tight against the drum flange for approximately three-fourths of the drum diameter (Figure 4-64).
3. Tap the adjacent wraps against each other with a soft metal or wooden mallet.

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

4

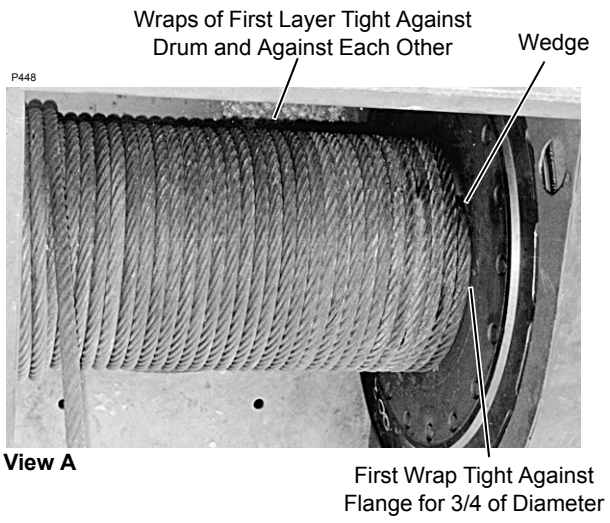


FIGURE 4-64

CAUTION!

Wire Rope Damage!

Wedging action will cause crushing and abrasion of the wire rope. Voids or spaced wraps in the first layer (Figure 4-64, View B) will permit movement and a wedging action with subsequent layers.

Never allow the wire rope to cross wind on the drums.

Anchoring Wire Rope to Socket and Wedge

WARNING

Falling Load Hazard!

- Avoid death or serious injury. Inspect all the parts prior to use. Do not use parts that are cracked or otherwise damaged.
- Remove minor nicks, burrs, or rough edges from the socket, wedge, or pin by lightly grinding. Do not reduce the original dimensions by more than 10%.
- Do not reinstall shipping material (bolt, plastic strap, or wire) in the hole of the wedge or socket after assembling. Discard these materials because they can prevent the wedge from tightening in the socket.
- Only use a wedge and socket that are the correct size for the wire rope being used. Do not mix and match parts from one assembly with parts from another assembly.

  Terminator socket and wedge has “go” and “no-go” holes to check for proper rope size.
- Attach the wire rope clip to the dead end of the wire rope after assembling the wire rope to the wedge and socket.
- If the dead end of the wire rope is welded, seize the end of the wire rope and cut off the weld before assembling to the wedge and socket. The weld will not allow strands of wire rope to adjust around the bend of the wedge, resulting in high strands and wavy rope. This condition can seriously weaken the attachment.

See Figure 4-65 for the following procedure.

1. Assemble the wire rope and wedge to the socket so that the live end of the wire rope is in a straight line with the socket pin hole. Do not assemble the wrong ways shown in Figure 4-65.
2. Allow the dead end of the wire rope to extend past the end of the socket.
3. Allow the wire rope to assume its natural lay.
4. Pull against the wedge and the live end of the wire rope enough to tighten the wedge in the socket.

   Use a brass hammer to seat the wedge and wire rope as deep into the socket as possible.
5. Attach a wire rope clip to the dead end of the wire rope using one of the right methods shown in Figure 4-65. The rope clip will aid in preventing the wire rope from being pulled out of the socket.

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

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

⚠ WARNING

Falling Load Hazard!

Avoid death or serious injury. Wire rope can break if the following precaution is not observed.

Do not attach the dead end of the wire rope to the live end 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.

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)

T (**Rope Clip Nut Torque**)

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

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

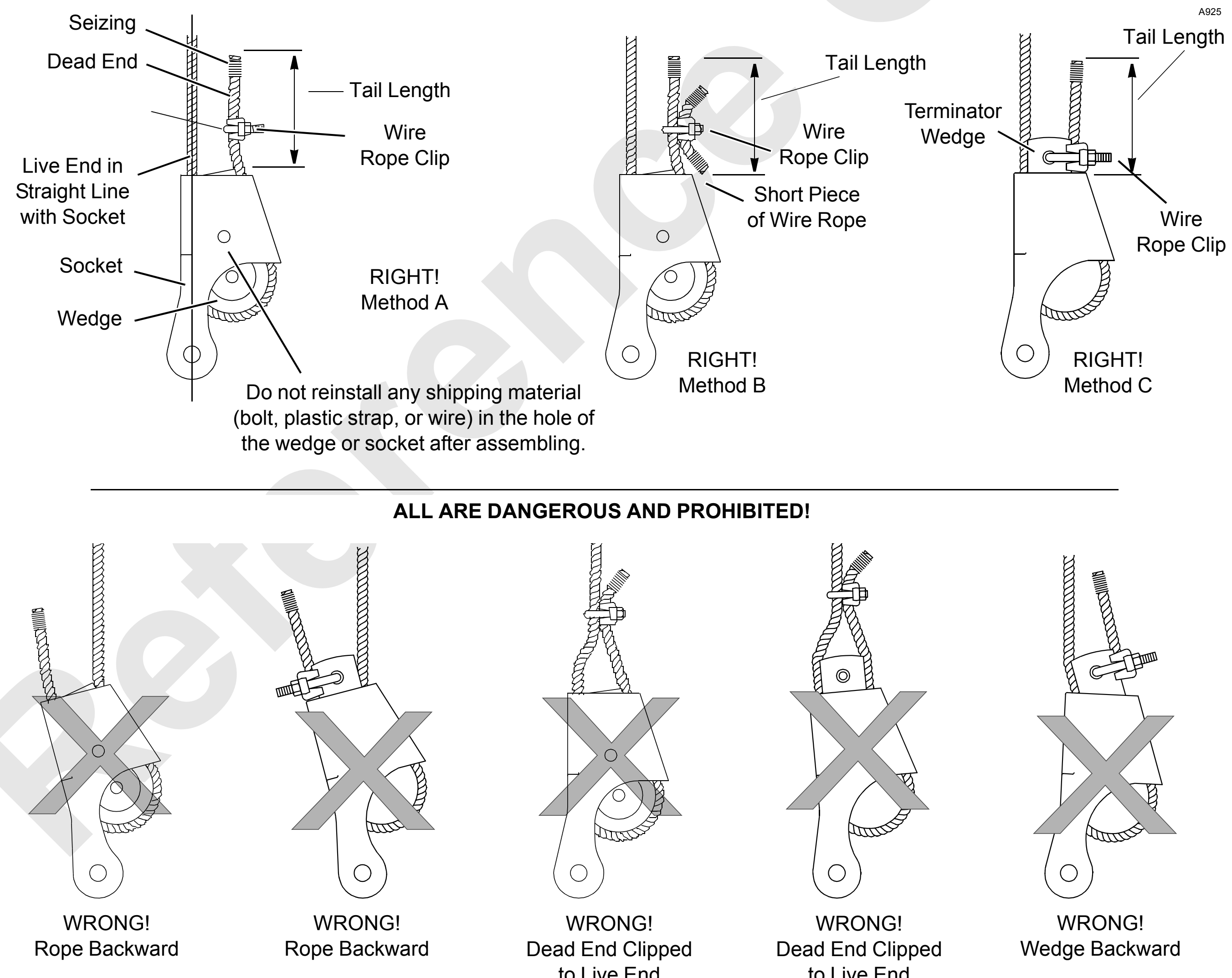


FIGURE 4-65

Breaking in Wire Rope

After installing a new wire rope, break it in by operating it several times under a light load and at a reduced speed. This practice allows the wire rope to form its natural lay and the strands to seat properly.

NOTE: Wire rope will stretch during the break-in period, reducing the wire rope's diameter as the strands compact around the core.

The dead wraps of the 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.

Anchoring Wire Rope to Button Socket

See Figure 4-66 for the following procedure.

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

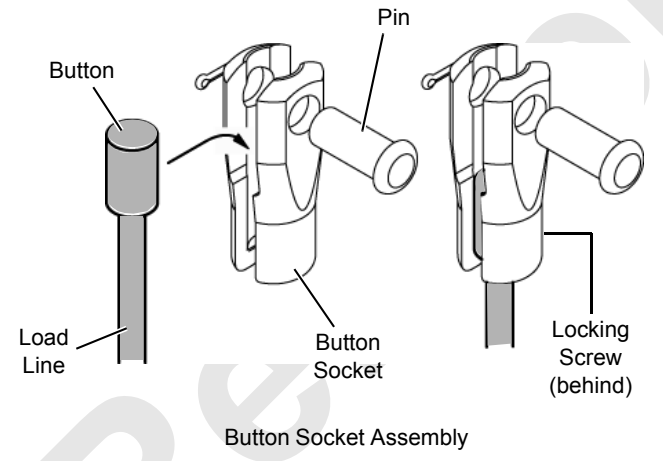


FIGURE 4-66

PAD EYE USAGE FOR WIRE ROPE REEVING

See Figure 4-67 for the following procedure.

General

Some rotation-resistant wire rope supplied by Manitowoc Cranes is equipped with a No. 1.5 pad eye welded to the leading end of the wire rope.

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

Safety

1. For the No. 1.5 pad eye, do not exceed 4,45 kN (1,000 lb) single line pull.
2. Make sure the sucker line and the rope clips are rated for at least 4,45 kN (1,000 lb) line pull.
3. Inspect the pad eye prior to each use. Replace it if the following occur:
   - Any original dimensions have changed
   - Cracks or breaks exist in the metal or weld

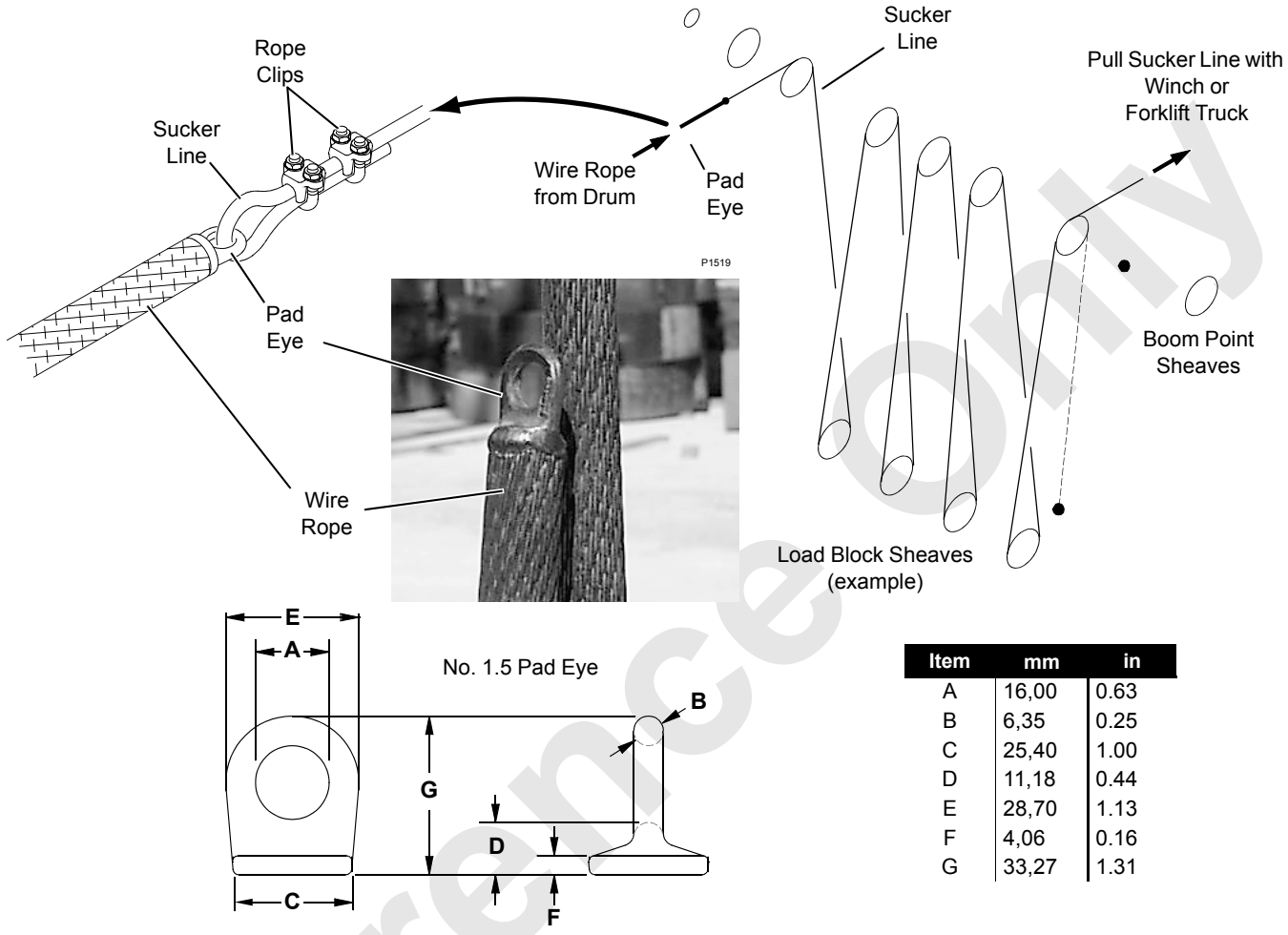
WARNING

Flying Part Hazard!

Prevent possible injury. The pad eye on the end of wire rope has been provided for reeving purposes only. Any other use is neither intended nor approved.

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

A1189



Item	mm	in
A	16,00	0.63
B	6,35	0.25
C	25,40	1.00
D	11,18	0.44
E	28,70	1.13
F	4,06	0.16
G	33,27	1.31

FIGURE 4-67

4

LOAD LINE REEVING

Wire Rope Specifications

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

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

CAUTION

Wire Rope Damage!

Avoid wire rope damage from an improper fleet angle or contact with adjacent parts. Do not hoist the load block or hook-and-weight ball any closer to the boom or jib points than specified on the Range Diagram in the Capacity Chart Manual.

Wire Rope Installation

See Wire Rope Installation on page 4-116 for the following instructions:

- Anchoring wire rope to the drums
- Installing wire rope on the drums
- Anchoring wire rope to the wedge sockets

Load Block

The following load blocks are available from Manitowoc Cranes:

- 454 t (500 USt)—7 484 kg (16,500 lb)
- 272 t (300 USt) with weight plates—7 484 kg (15,400 lb)
- 91 t (100 USt) with weight plates—6 985kg (9,800 lb)
- 55 t (60 USt) with weight plates—2 007kg (4,425 lb)
- 27 t (30 USt) with weight plates—1 587 kg (3,500 lb)
- 14 t (15 USt) swivel hook with weight plates—861 kg (1,900 lb)

NOTE: Manitowoc Cranes recommends laced reeving. Using this type of reeving will result in the least amount of block spin and load rotation. It is normal with this type of reeving for the block to tip slightly when it is raised and lowered empty.

When reeving rotation-resistant wire rope with odd parts of line, dead end the wire rope as close to the center of the block as possible to avoid rope damage.

WARNING

Falling Load Hazard!

Avoid death or serious injury. The load block can fail if overloaded, allowing the load to fall. Use only a load block with a capacity equal to or greater than the load to be handled.

Avoid overloading the bearings of the load block sheaves. Attach the load to a duplex hook so the load hangs straight.

Universal Anchor Joint

See Figure 4-72 for the following procedure.

The universal anchor joint on the #132 jib point provides an alternate dead-end location for 2-part reeving. The anchor joint swivels in both directions to prevent bending loads. Its location in the jib point minimizes twisting of the load line.

The universal anchor joint must be removed from the jib point when a 2- or 4-part line is dead ended at the upper dead-end lug and when a 3-part line is used. If the universal anchor joint is not removed, the load line will rub against the anchor joint support when operating at high boom angles.

Duplex Hook

See Figure 4-68 for the following procedure.

The duplex hook capacities are based on the lifting sling angles. Attach the load so it is balanced equally on each ear of the hook. The duplex hook has a hole to which a shackle can be attached.

WARNING

Falling Load Hazard!

Avoid death or serious injury. The load block or shackle can fail if overloaded, allowing the load to fall. Limit the load to be handled with the shackle to the capacity of the load block or shackle, whichever is less.

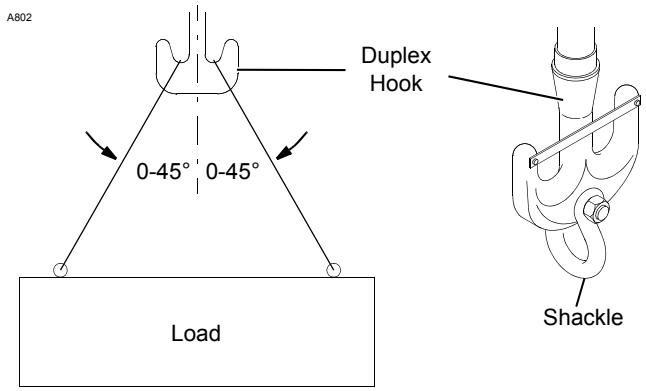


FIGURE 4-68

Guide Sheaves

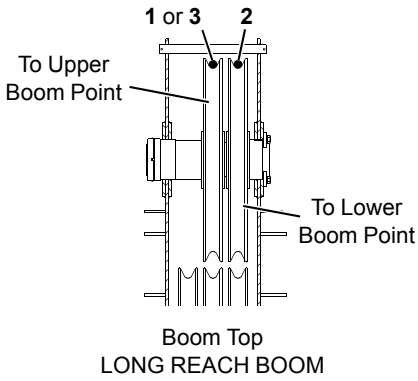
See Figures 4-69 and 4-70 for guide sheave identification.

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

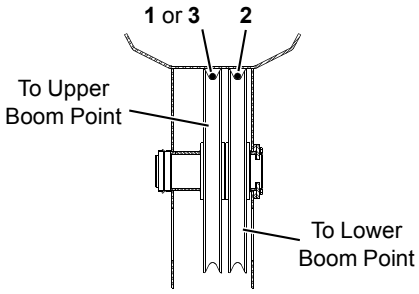
Drum Spacers

See Drum Spacer/Lagging Installation on page 4-48 for installation of the spacers on the load drums.

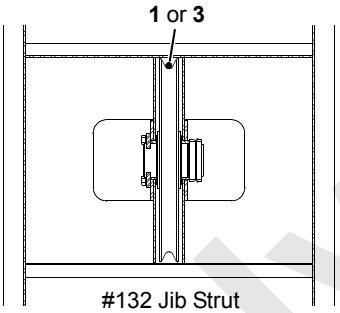
Spacers are required on the ringer-prepared cranes with 1,9 m (73 in) wide load drums. Failing to install spacers can result in wire rope damage due to improper fleet angles.



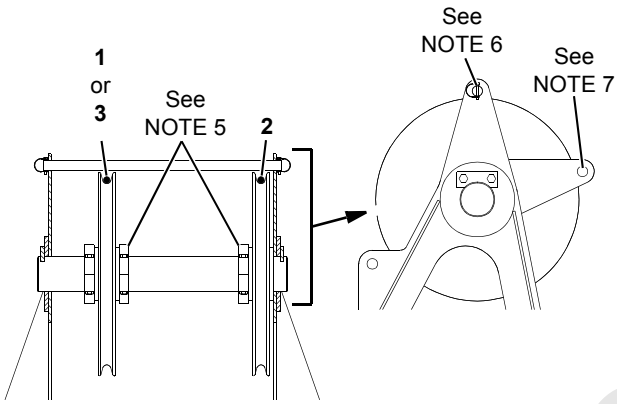
Boom Top
LONG REACH BOOM



Transition Insert
LONG REACH BOOM

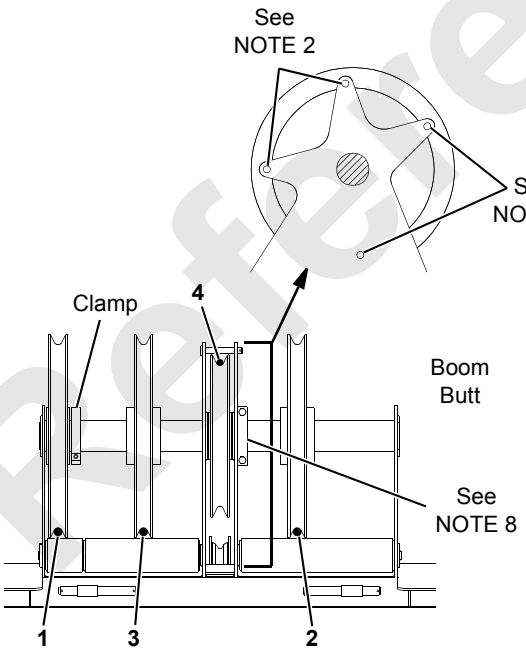


#132 Jib Strut
See NOTE 4



Boom Top
HEAVY LIFT BOOM

STANDARD LIFTCRANE
#44 or #44A Boom



Sheave	Load Line
1	Left Rear Drum
2	Right Rear or Rear Drum
3	Front Drum
4	Luffing Hoist

NOTE 1: See Guide Sheaves on page 4-123 for the identification of the 2250 with #44 or #44A Heavy Lift or the Long Reach Boom.

Guide sheave identification for other attachments is located in Operator Manual for the specific attachment.

Bold dots (•) indicate load line engagement with sheaves when viewed from boom butt.

NOTE 2: Install the rope retaining pins in these holes for the luffing hoist operation.

NOTE 3: Install the rope retaining pins in these holes for the equalizer handling.

NOTE 4: For #132 jib operation, do not route the load line through the guide sheave on the transition insert or on the boom top. Route the desired load line through the proper guide sheave on the boom butt and then directly to the guide sheave on the jib strut.

NOTE 5: See Figure 4-70 for guide sheave positioning.

NOTE 6: Install the rope retaining pin in this hole for #44, #44A, or #49A-#44 boom.

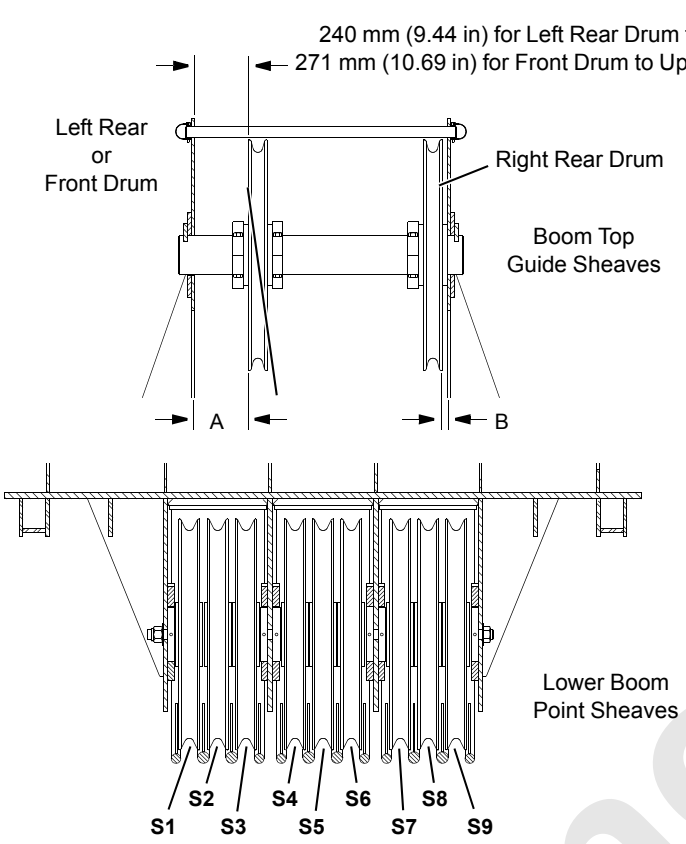
NOTE 7: Install the rope retaining pin in this hole for #49A-#44 boom with 133A luffing jib.

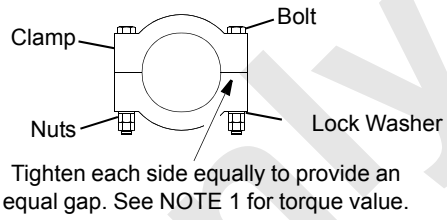
NOTE 8: Clamp must be installed when equipped with the equal width split rear drums.

A791

FIGURE 4-69

Standard Liftcrane — Heavy Lift Boom





NOTE 1: Hand position the clamps tight against the bearing. Before tightening the bolts, make sure that the sheave turns freely. Tighten the bolts lubricated with SAE 20 oil to 163 Nm (120 ft-lb).

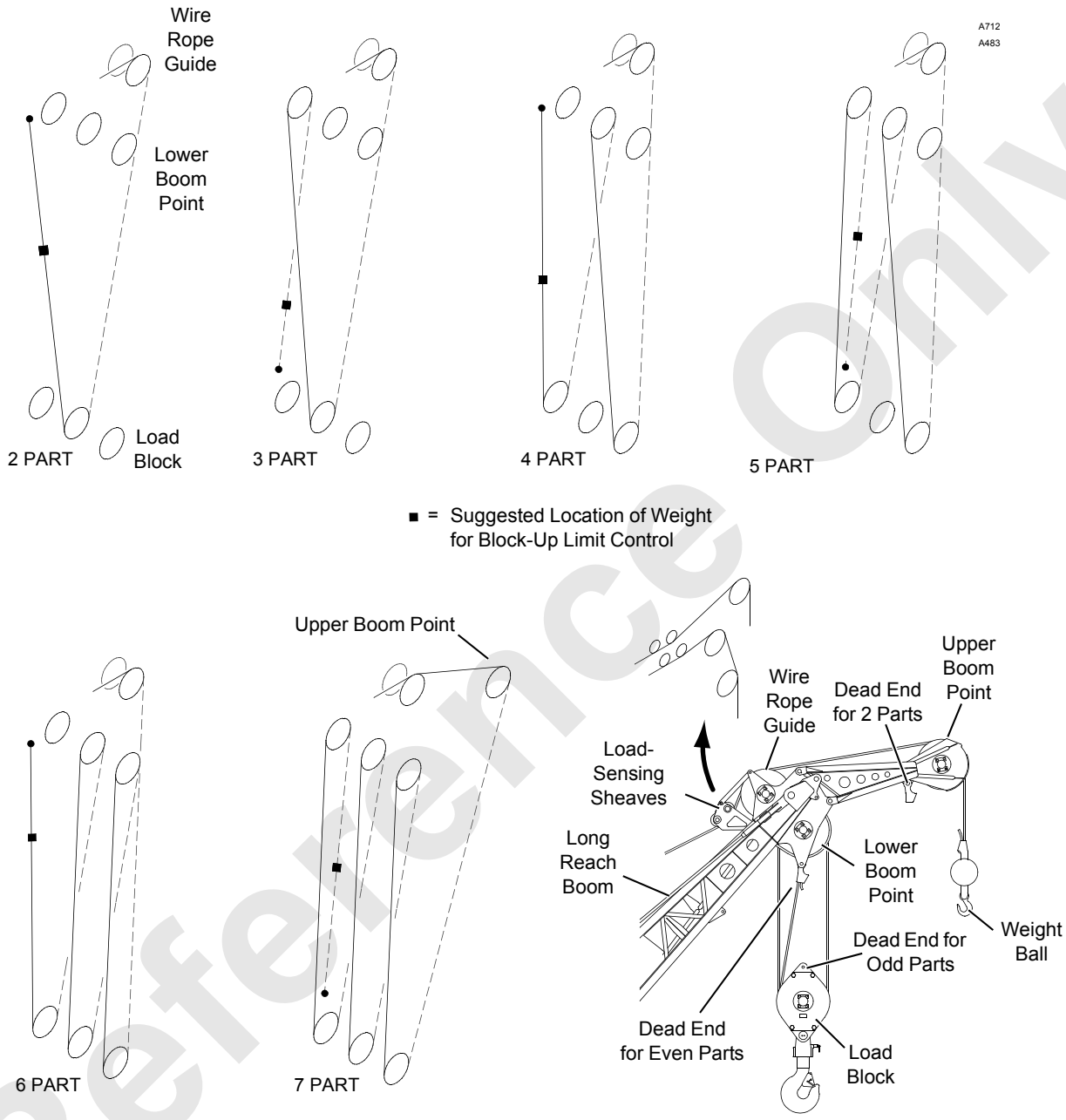
NOTE 2: This location requires the sheave bearing to bear up against the boom top plate as shown at Dimension B.

NOTE 3: This location requires four clamps as shown at Dimension A.

Location of Guide Sheaves with Load Line Going to Lower Boom Point Sheave Indicated

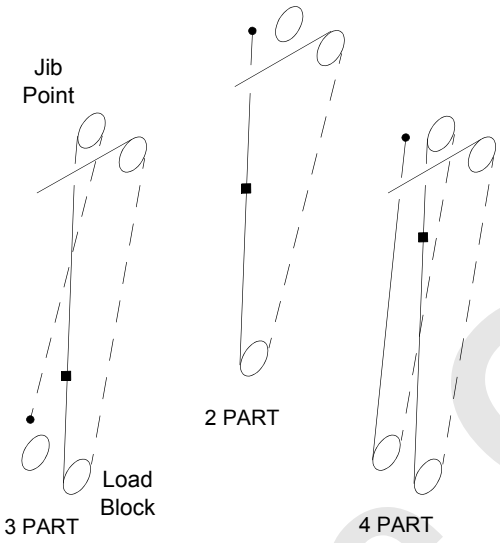
Right Rear Drum Sheave	
Load Line Reeving to Sheave	**Dimension B**
S9	16 mm (0.62 in) NOTE 2
S8	52 mm (2.06 in) NOTE 3
S7	121 mm (4.75 in) NOTE 3
S6	265 mm (10.44 in) NOTE 3
Left Rear Drum Sheave	
Load Line Reeving to Sheave	**Dimension A**
S4	240 mm (9.44 in) NOTE 3
S3	95 mm (3.75 in) NOTE 3
S2	16 mm (0.62 in) NOTE 2
S1	16 mm (0.62 in) NOTE 2
Front Drum Sheave	
Load Line Reeving to Sheave	**Dimension A**
S4	271 mm (10.69 in) NOTE 3
S3	125 mm (4.92 in) NOTE 3
S2	52 mm (2.06 in) NOTE 3
S1	16 mm (0.62 in) NOTE 2

FIGURE 4-70



STANDARD LIFTCRANE
#44 Long Reach Boom

FIGURE 4-71

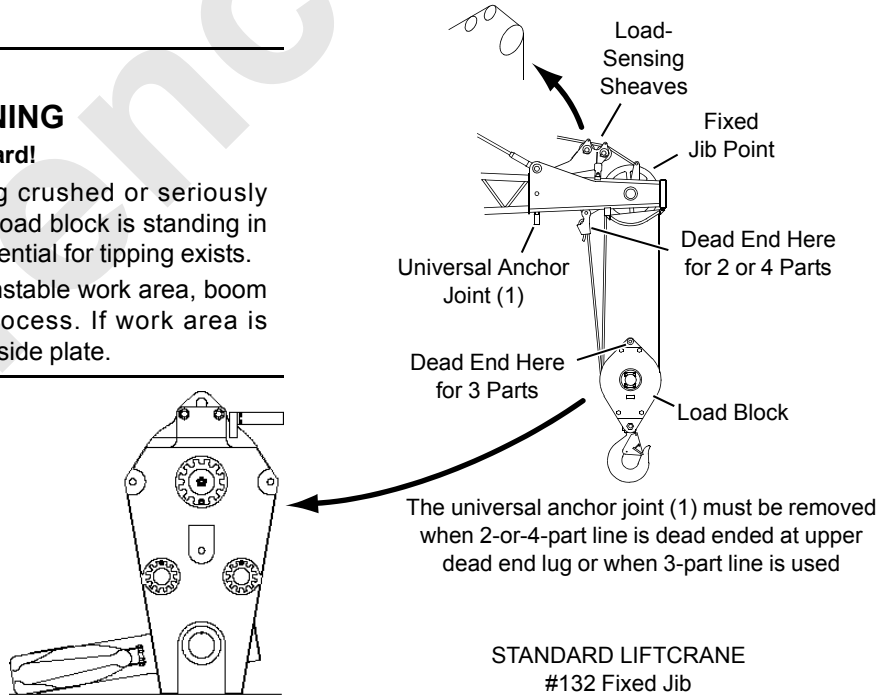


WARNING

Tipping Hazard!

Prevent the possibility of being crushed or seriously injured. Exercise care when the load block is standing in the vertical position, since 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 the block flat on the side plate.



STANDARD LIFTCRANE
#132 Fixed Jib

FIGURE 4-72

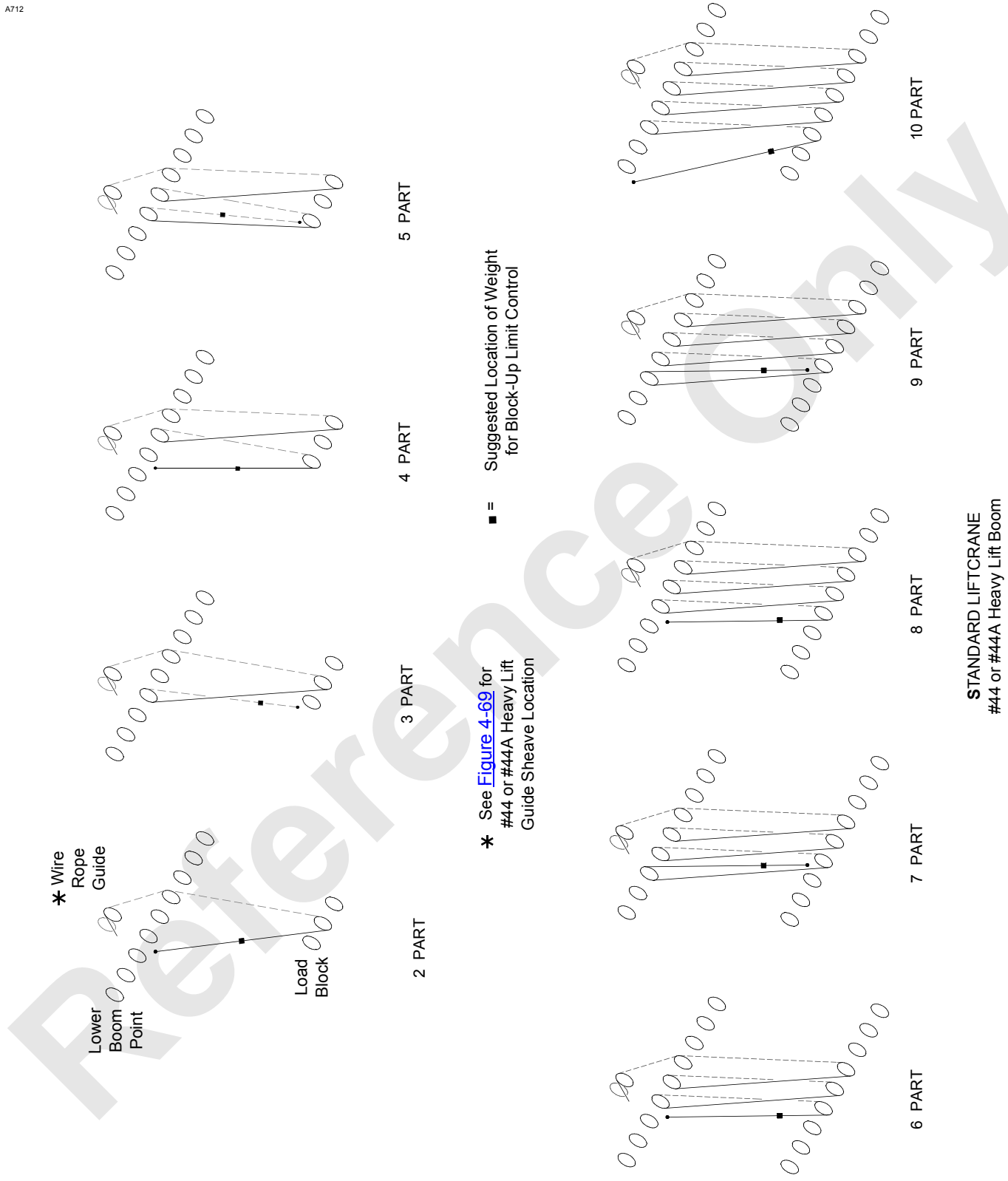


FIGURE 4-73

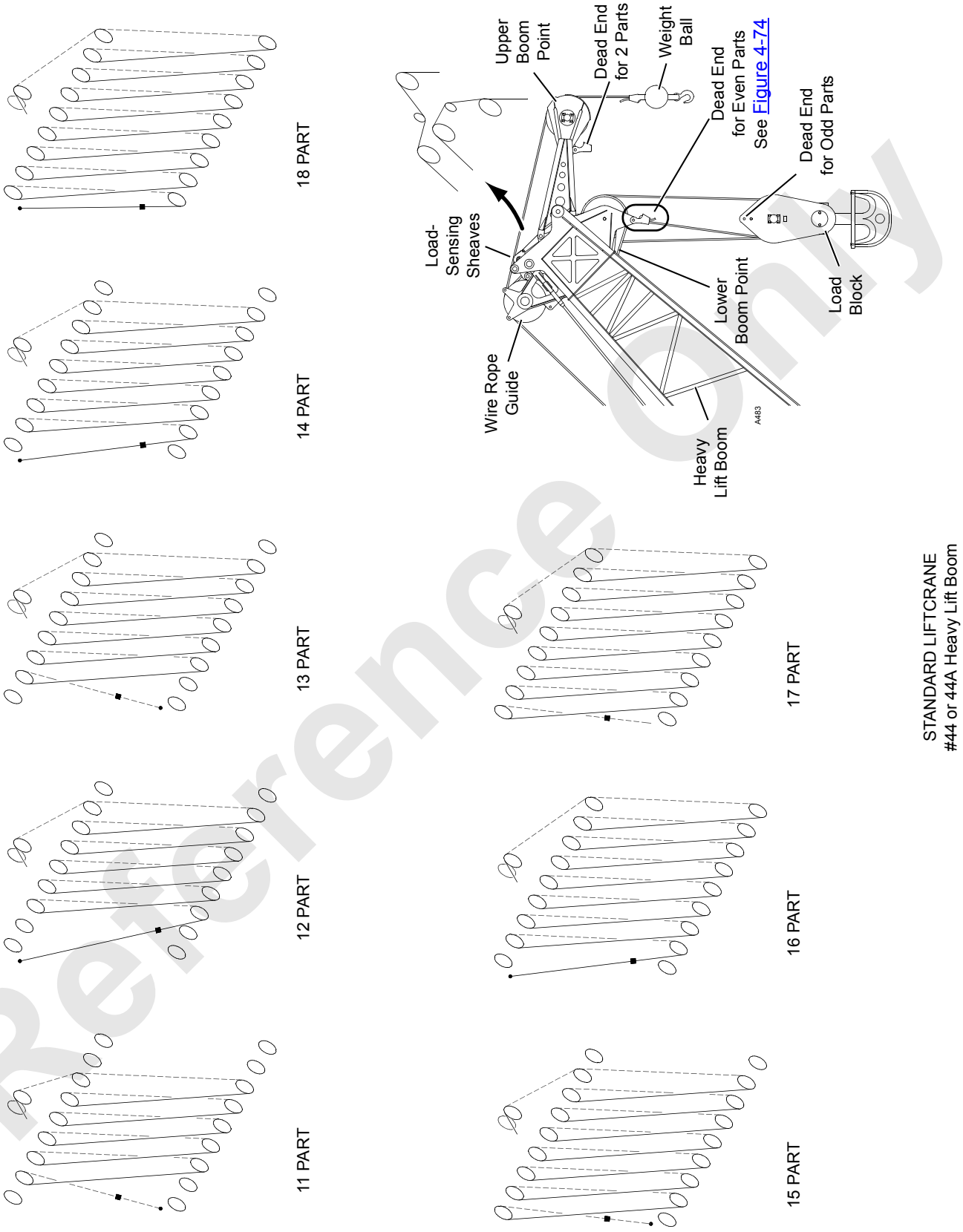
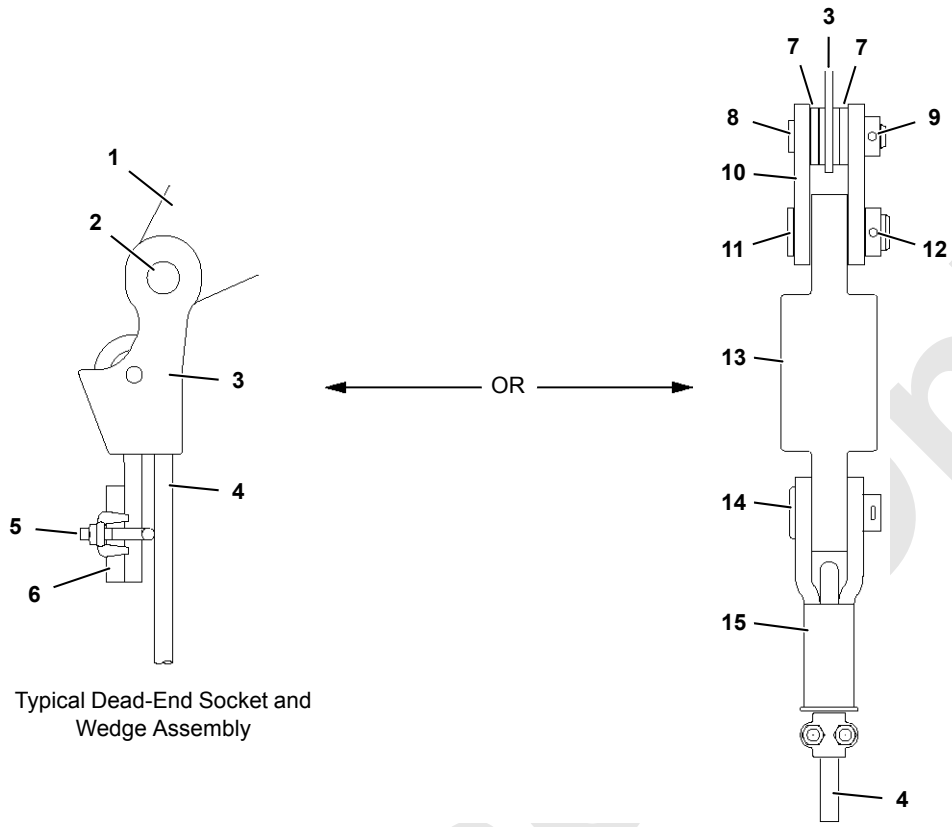


FIGURE 4-73 continued

172960



Typical Dead-End Socket and Wedge Assembly

Item	Description
1	#44 Boom Top
2	Pin with Cotter Pin
3	Socket and Wedge (size to match wire rope)
4	Wire Rope
5	Rope Clip (size to match wire rope)
6	Length of Wire Rope—152 mm (6 in)
7	Spacer (2 each)—Must Be Installed to Prevent Overloading Pin (8)
8	Pin
9	Collar with Retaining Pin and Cotter Pins
10	Link (2 each)
11	Pin
12	Collar with Retaining Pin and Cotter Pins
13	Swivel
14	Pin with Cotter Pin
15	Terminator Socket and Wedge

FIGURE 4-74

10-Part Continuous Reeving

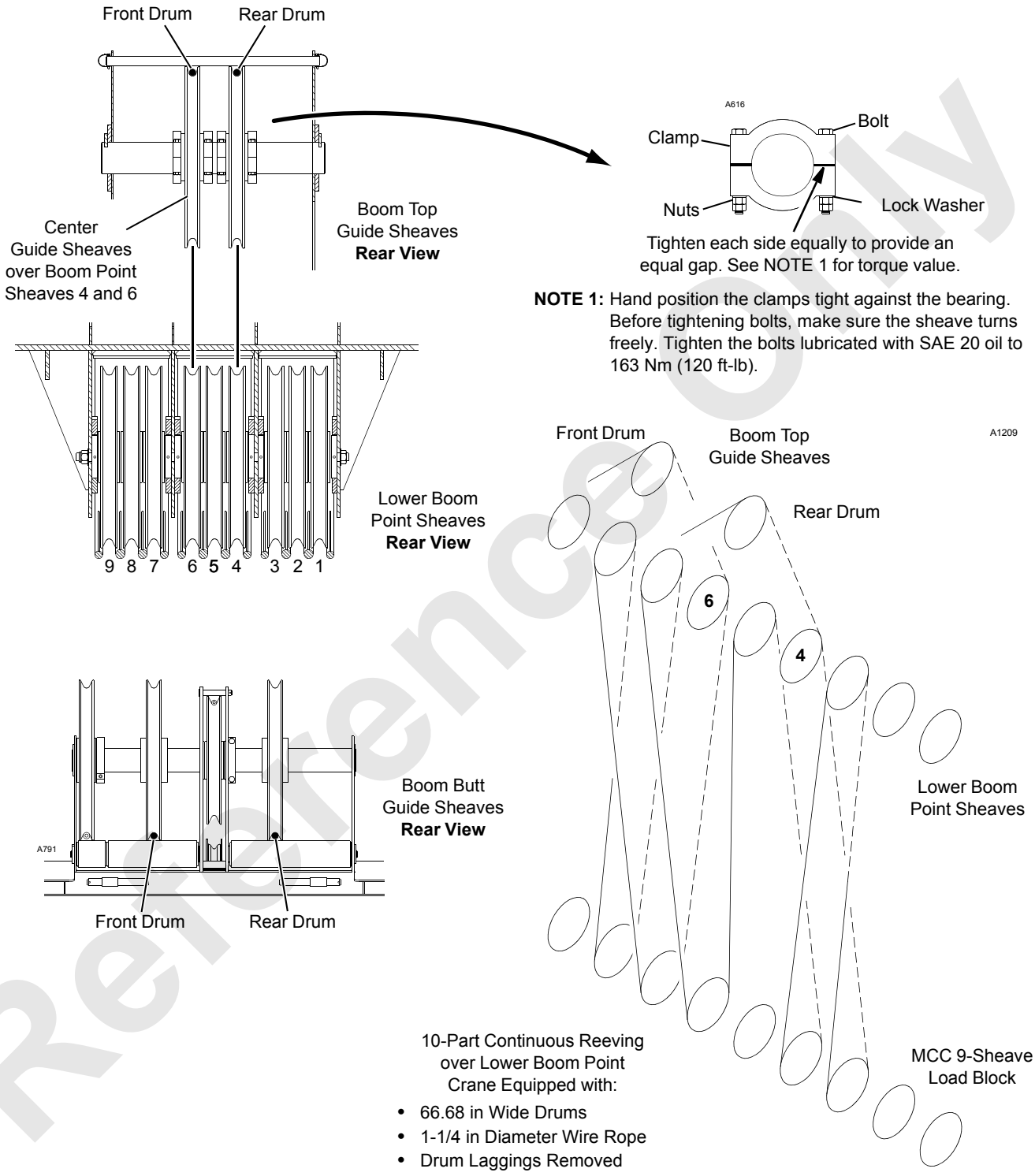


FIGURE 4-75

3 Lines Up Top of Boom

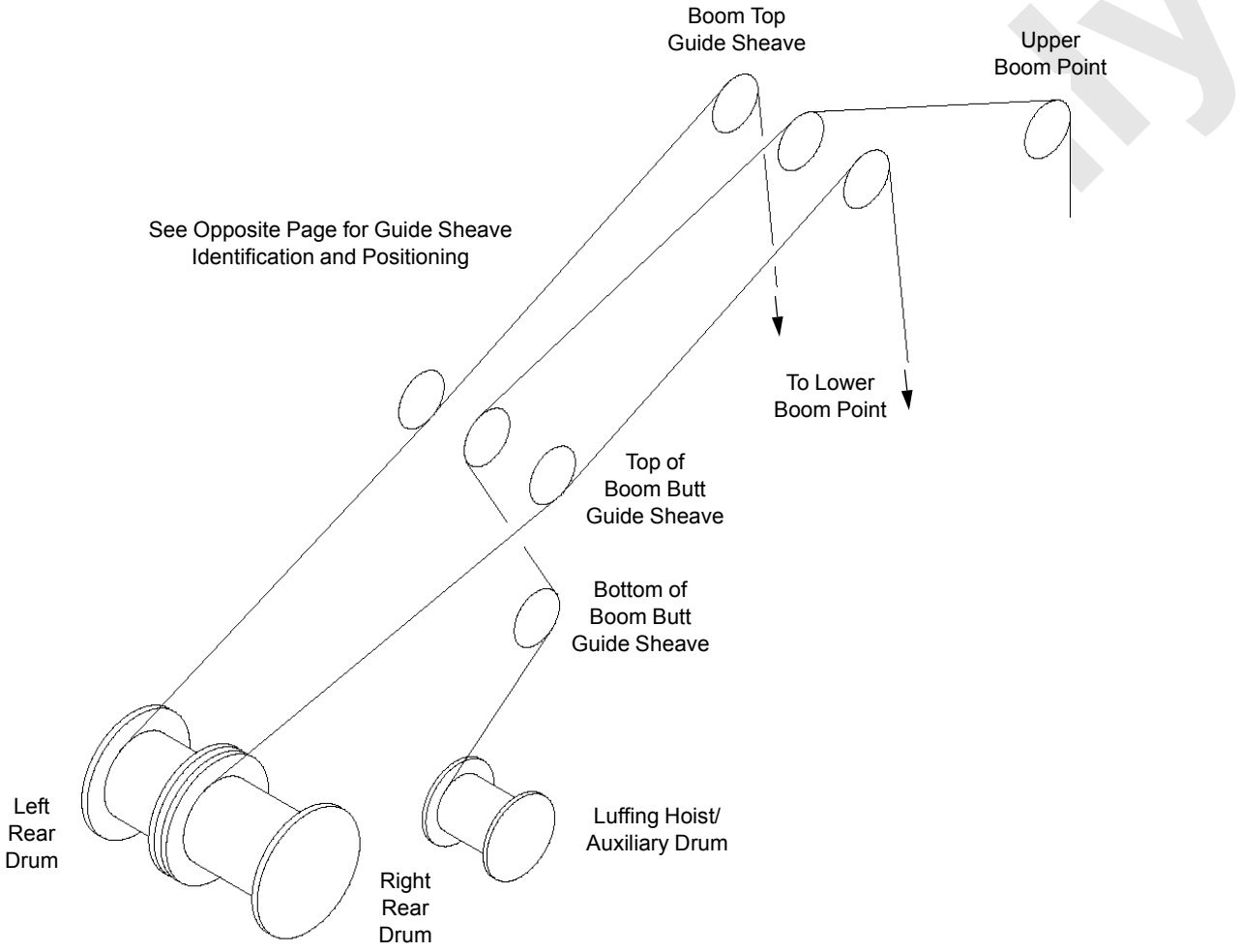
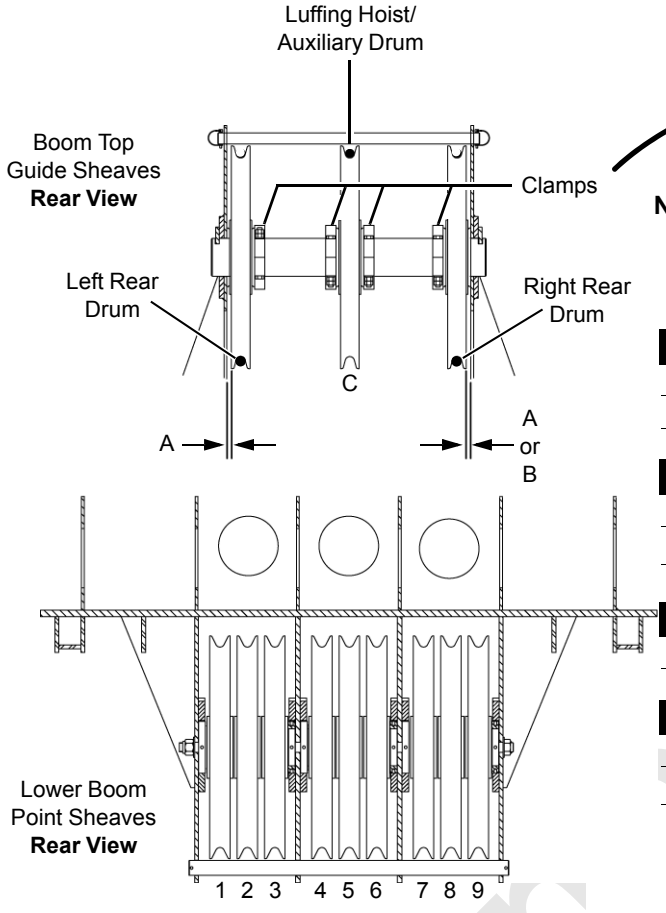
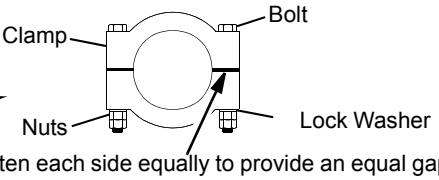


FIGURE 4-75 continued

A1276
A616





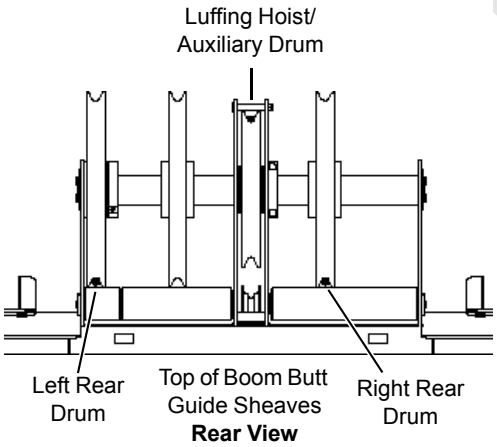
NOTE: Hand position the clamps tight against the bearing. Before tightening the bolts, make sure the sheave turns freely. Tighten the bolts lubricated with SAE 20 oil to 163 Nm (120 ft-lb).

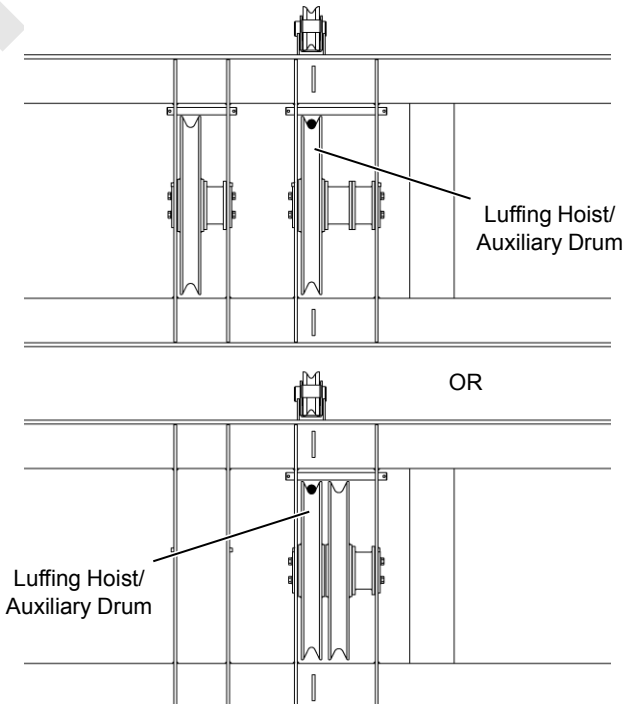
LEFT REAR DRUM GUIDE SHEAVE	
Rope routed to sheave	Dimension A
1	Sheave tight against side frame
2	
RIGHT REAR DRUM GUIDE SHEAVE	
Rope routed to sheave	Dimension A
8	52 mm (2-1/16 in) [1]

[1] This position requires two sets of clamps.

RIGHT REAR DRUM GUIDE SHEAVE	
Rope routed to sheave	Dimension B
9	Sheave tight against side frame
LUFFING HOIST DRUM GUIDE SHEAVE	
Rope routed to sheave	Dimension C
Upper boom point	Sheave centered [1]

[1] This position requires two sets of clamps.





• = Wire Rope

Avoid Damage to the Wire Rope:

- Route the rope as shown
- Position the boom top guide sheaves as shown

FIGURE 4-75 continued

Container Handling Reeving—Heavy Lift Boom

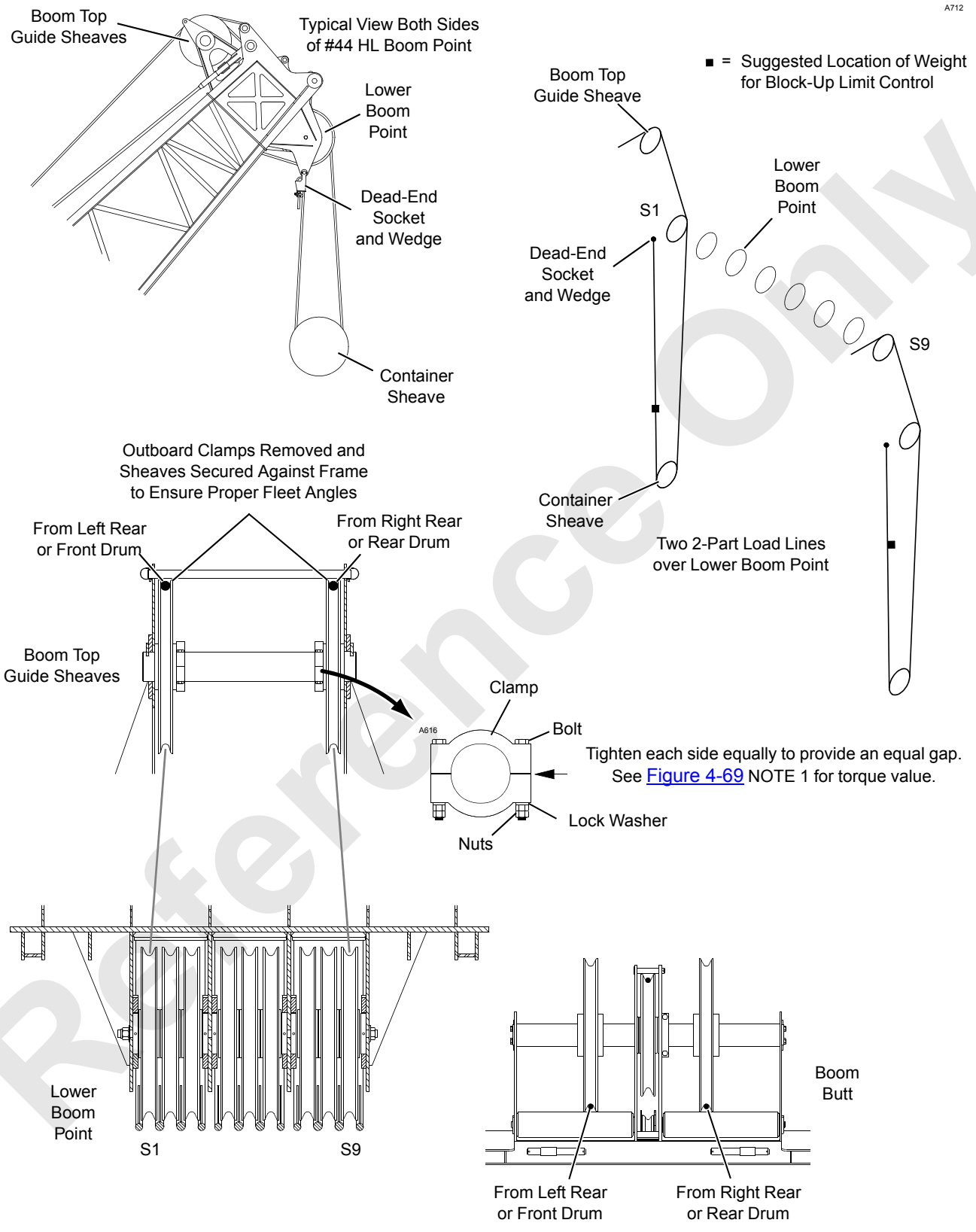
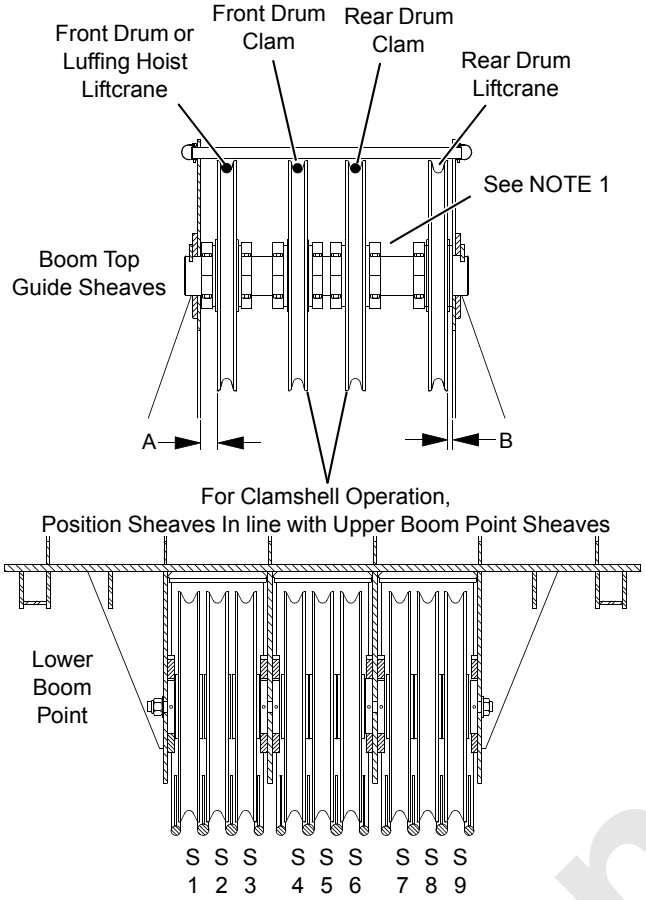


FIGURE 4-76

Clamshell Reeving—Heavy Lift Boom with Clamshell Upper Boom Point



Location of Guide Sheaves with Load Line Going to Lower Boom Point Sheave Indicated

Front Drum Sheave		Rear Drum Sheave	
Load Line to Sheave	Liftcrane (NOTE 2) Dimension A	Load Line to Sheave	Liftcrane (NOTE 2) Dimension B
S4	271 mm (10.69 in) NOTE 4 & NOTE 5	S9	16 mm (0.62 in) NOTE 3
S3	125 mm (4.92 in) NOTE 4	S8	52 mm (2.06 in) NOTE 2
S2	52 mm (2.06 in) NOTE 4	S7	121 mm (4.75 in) NOTE 4
S1	16 mm (0.62 in) NOTE 2	S6	265 mm (10.44 in) NOTE 4

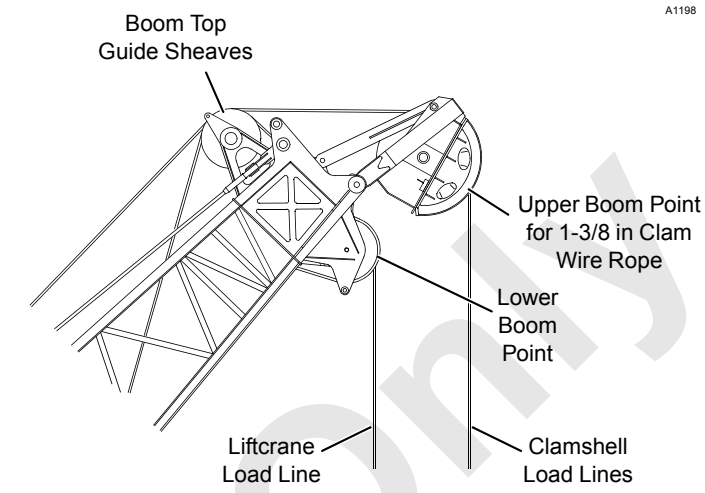
NOTE 1: Position the clamps tight against the bearing. Before tightening the bolts, make sure the sheave turns freely. Tighten the bolts, lubricated with SAE 20 oil to 163 Nm (120 ft-lb).

NOTE 2: When using the liftcrane sheaves, it may be necessary to move or remove the clamshell sheaves to properly position the liftcrane sheaves.

NOTE 3: Remove the outboard clamp and position the sheave against the boom point plate.

NOTE 4: This location requires two clamps.

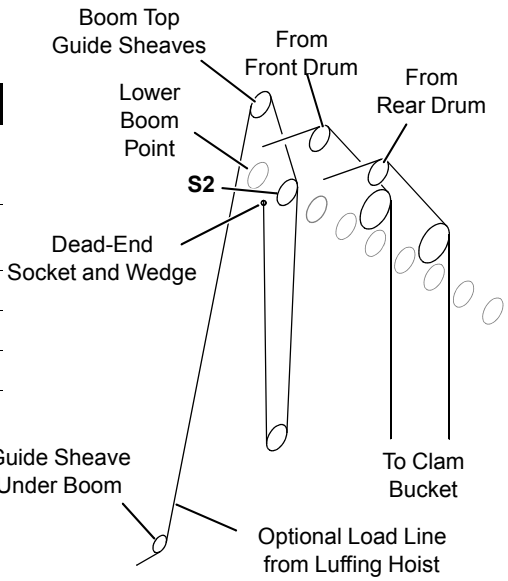
NOTE 5: Position the guide sheave here for liftcrane operation with single-part line over the upper point. Use two clamps.



WARNING

Falling Load Hazard!

Prevent possible injury. When using the luffing hoist wire rope as a load line (routed under boom), do not operate with the boom higher than 75°. Wire rope will rub against the wire rope guide frame under the boom top. The wire rope could break, allowing the load to fall.



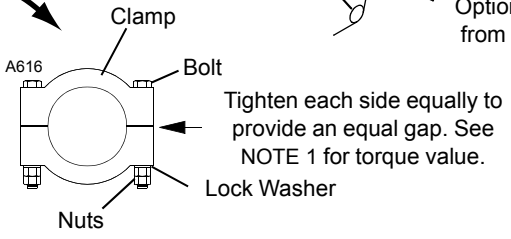


FIGURE 4-77

UNIVERSAL ANCHOR JOINT

See Figure 4-76 for the following procedure.

The dead-end socket and wedge can be anchored to any of the following locations in the boom and jib point, depending on the type of operation.

- Link in the boom or the jib point for the liftcrane operation
- Lug (if equipped) welded inside the boom or jib point directly behind the boom or jib point shaft for liftcrane operation
- Universal anchor joint located behind the boom or jib point—This location provides greater separation between the load lines, which reduces twisting of the load. The universal anchor joint is used for the magnet, clamshell, grapple, and liftcrane operation requiring a 2-part load line.

NOTE: Movement of the dead-end socket on the link or lug operation is in two directions only—forward and back. Movement of the dead-end socket on the universal anchor joint operation is in four directions—forward, back, and sideways.

WARNING

Falling Load Hazard!

Prevent possible injury. Sideways motion of the load line may break the link or lug, causing the load to fall.

Do not dead end a 2-part load line to the anchor link or lug in the boom or jib point for a magnet, clamshell, grapple, or other operation requiring rapid swing cycles.

If the link or lug in the boom or jib point has been used for any duty-cycle work with a 2-part load line, check for cracks due to side-bending loads. Consult with the Manitowoc Crane Care Lattice Team for the repair procedure.

If the boom or jib point is not prepared for the universal anchor joint, the boom or jib top is neither designed nor intended for duty-cycle work.

For the liftcrane operation requiring 3-part load line or greater, it is necessary to remove the universal anchor joint. This step will prevent interference of the universal anchor joint with the wire rope at high boom angles.

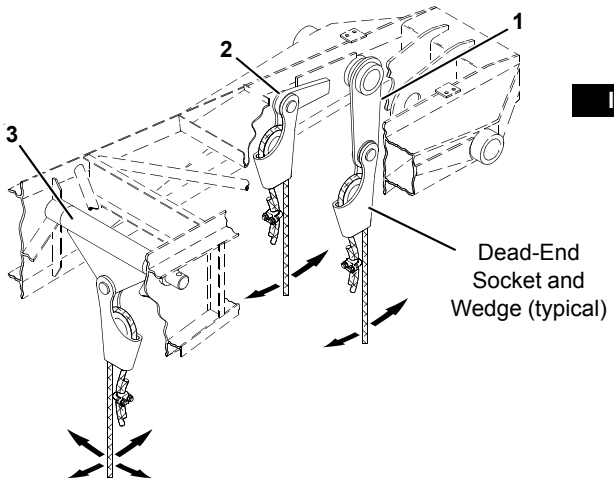
WARNING

Falling Load Hazard!

Prevent possible injury. Interference of the wire rope with the universal anchor joint can damage the wire rope, causing the wire rope to break and the load to fall.

Do not operate the liftcrane at a high boom angle with the universal anchor joint in place.

For the wire rope size and the maximum load of the universal anchor joint, see the appropriate wire rope chart, capacity chart, or rigging drawing.



Item	Description
1	Dead-End Link
2	Lug
3	Universal Anchor Joint

FIGURE 4-78

LOAD BLOCK TIE-BACK

General

See Figure 4-79 for the following information.

A lug is provided on the front of the rotating bed (see View A) and on the luffing hoist frame (see View B) for tying back the load block when not in use.

Specifications

Sling Length

The sling should be long enough to connect it to a shackle in the tie-back hole and to the hook of the freely suspended load block. This will prevent personnel from having to swing the block in, toward the crane, to make the connection.

Sling Capacity

The sling must be capable of supporting the weight of the load block and half the weight of the wire rope suspended from the boom point. When sizing the sling, take into account the dynamic effects of traveling and swinging the crane. It is the crane user's responsibility to calculate this load.

Shackle

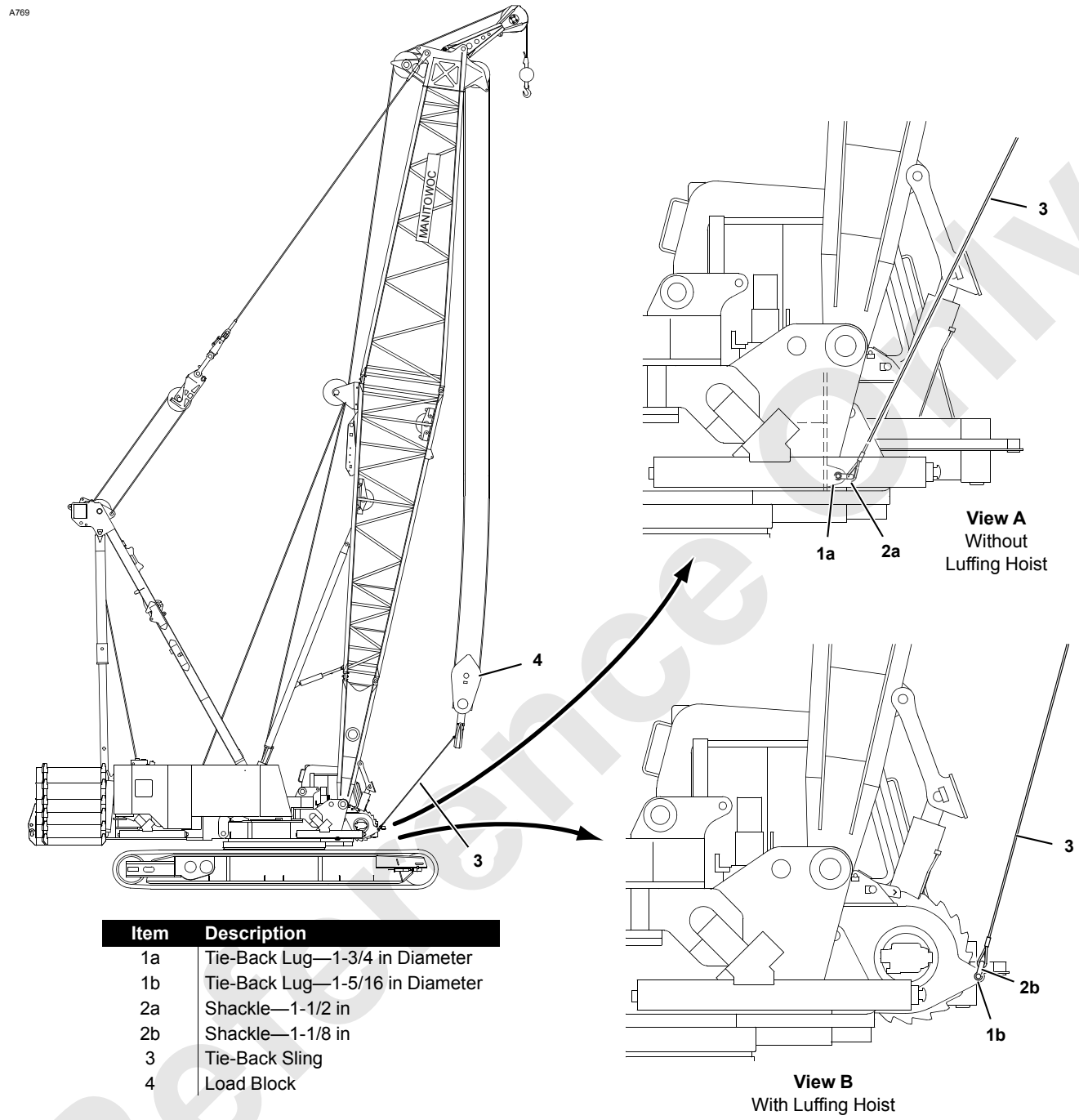
See Figure 4-79 for identification of the tie-back hole diameter and the shackle size.

CAUTION

Avoid Boom Damage!

- Haul in the load line just until the tie-back sling is taut. The only purpose of the tie-back is to prevent the load block from swinging when not in use.
- Do not tighten the load line to a point that the load line can rub against the lacings in the boom section or the load block can bounce into the lacings.

  The operator shall be aware that when booming down, the load lines and tie-back sling will tighten even more. Pay out the load line while booming down to prevent the load block from being pulled into the boom. Damage to the lacings or chords could result.
- Make sure that the tie-back sling, load block, and load lines do not interfere with the operation of the luffing hoist wire rope.



Item	Description
1a	Tie-Back Lug—1-3/4 in Diameter
1b	Tie-Back Lug—1-5/16 in Diameter
2a	Shackle—1-1/2 in
2b	Shackle—1-1/8 in
3	Tie-Back Sling
4	Load Block

FIGURE 4-79

SECTION 5
LUBRICATION

TABLE OF CONTENTS

5

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 5
LUBRICATION

LUBRICATION GUIDE

See F2298 at the end of this section.

LUBE AND COOLANT PRODUCT GUIDE

See the publication at the end of this section.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 6
MAINTENANCE CHECKLIST

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 6
MAINTENANCE CHECKLIST

INSPECTION AND MAINTENANCE CHECKLIST

See F2097 at the end of this section.

FIBERGLASS MAINTENANCE

See Bulletin W04-009 at the end of this section.

THIS PAGE INTENTIONALLY LEFT BLANK

ALPHABETICAL INDEX

Published 06-24-16, Control # 241-01