

Manitowoc 2250

Operator Manual



Grove

Manitowoc

National Crane

Potain





OPERATOR MANUAL

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

2250

Crane Model Number

2251000

Crane Serial Number

This Manual is divided into the following sections:


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

NOTICE

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

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

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

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

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Reference Only

SECTION 1 INTRODUCTION

CRANE DATA

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

- Basic Specifications.
- EC Declaration (if applicable).

CRANE/ATTACHMENT IDENTIFICATION

An identification plate is attached to the outside of the operator's cab (see Figure 1-1) and to the attachments (i.e. luffing jibs, MAX-ER's, and Ringers) available for this crane.

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

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

CHANGE OF OWNERSHIP REGISTRATION

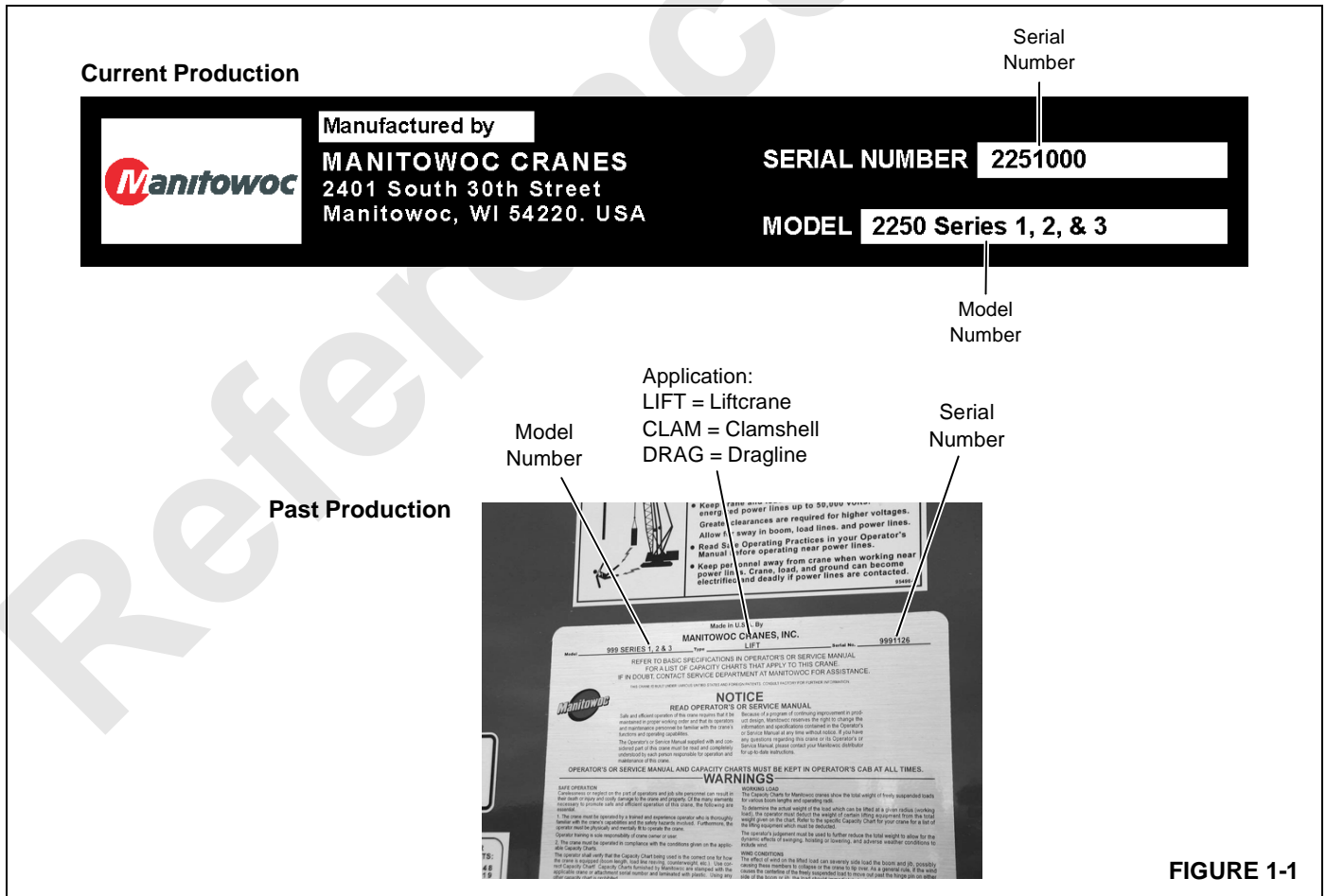
A new owner of a Manitowoc crane should register the crane with Manitowoc Crane Care so we can contact you if the need arises. To register your crane:

1. Go to www.manitowoccranes.com/en/services/crane-care/service-and-tech-support/Change-of-Ownership-Form
2. Complete the form.

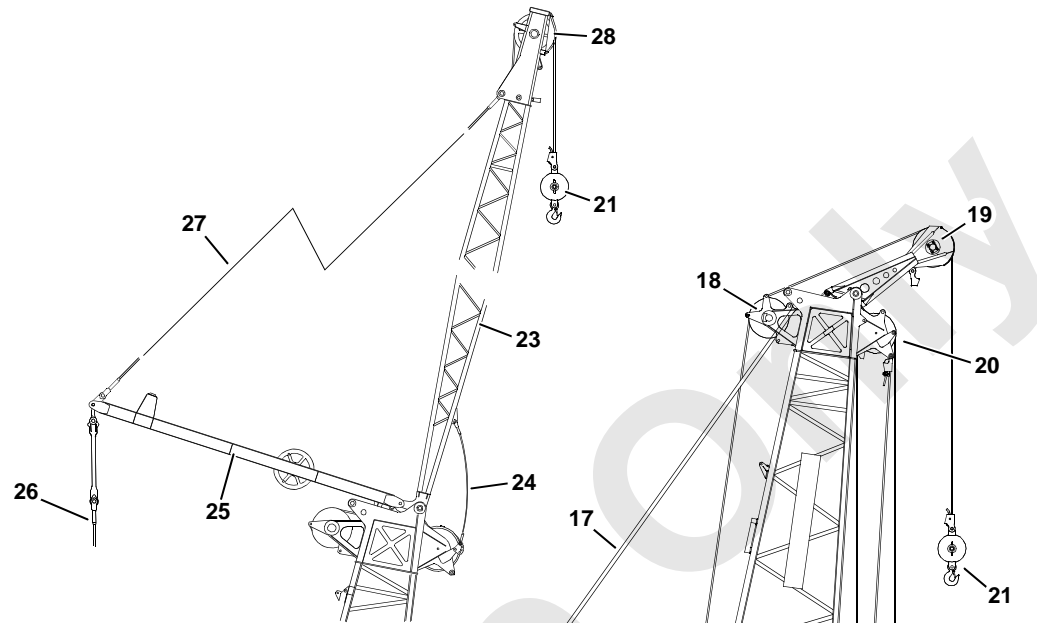
CRANE ORIENTATION

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

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

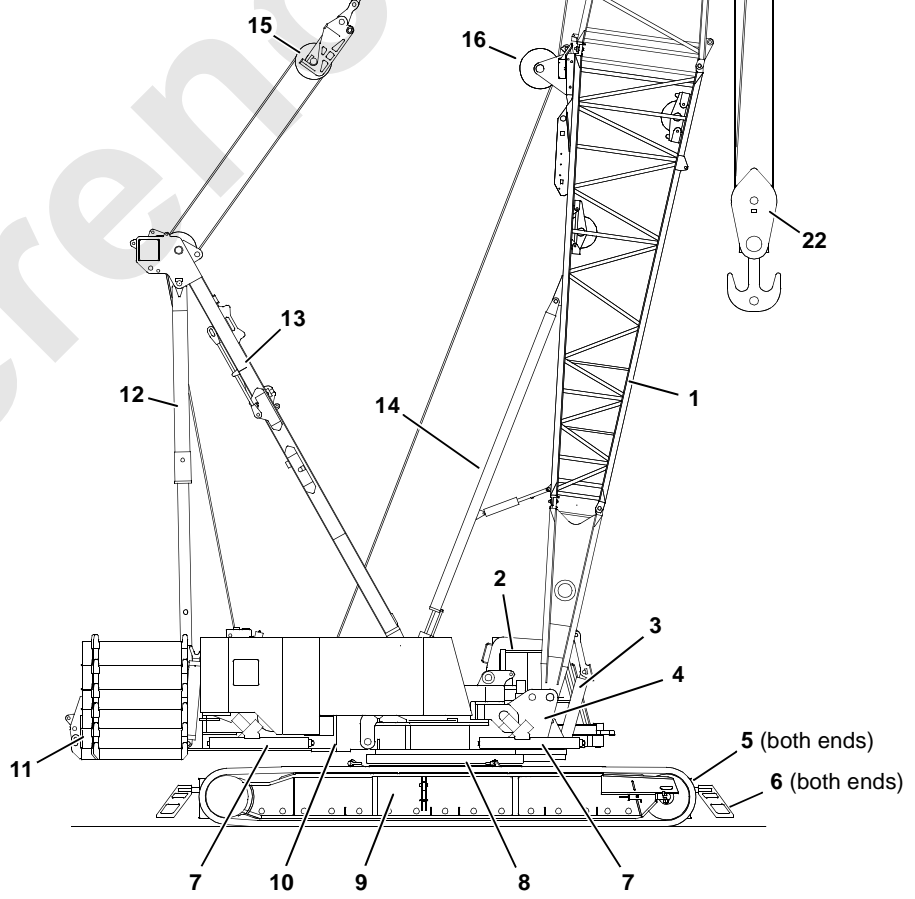


IDENTIFICATION AND LOCATION OF COMPONENTS



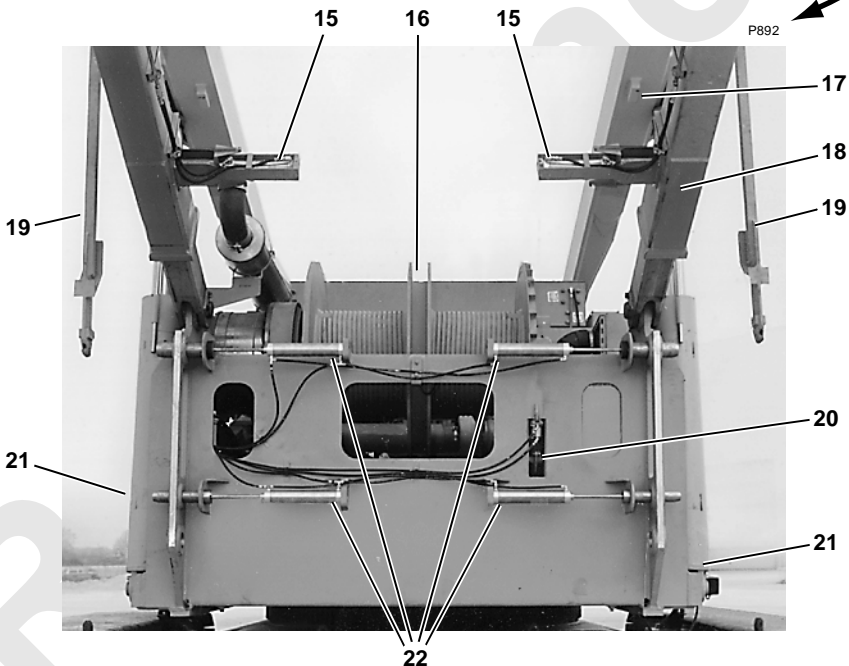
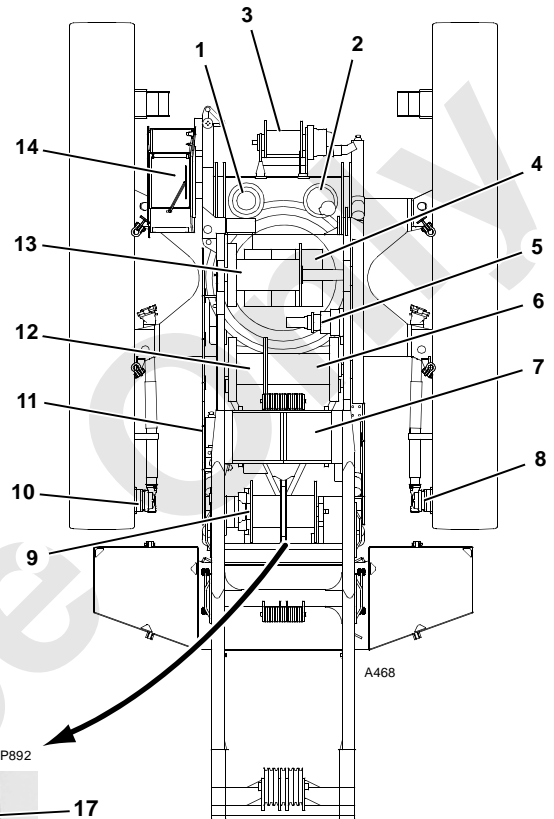
Item Description

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



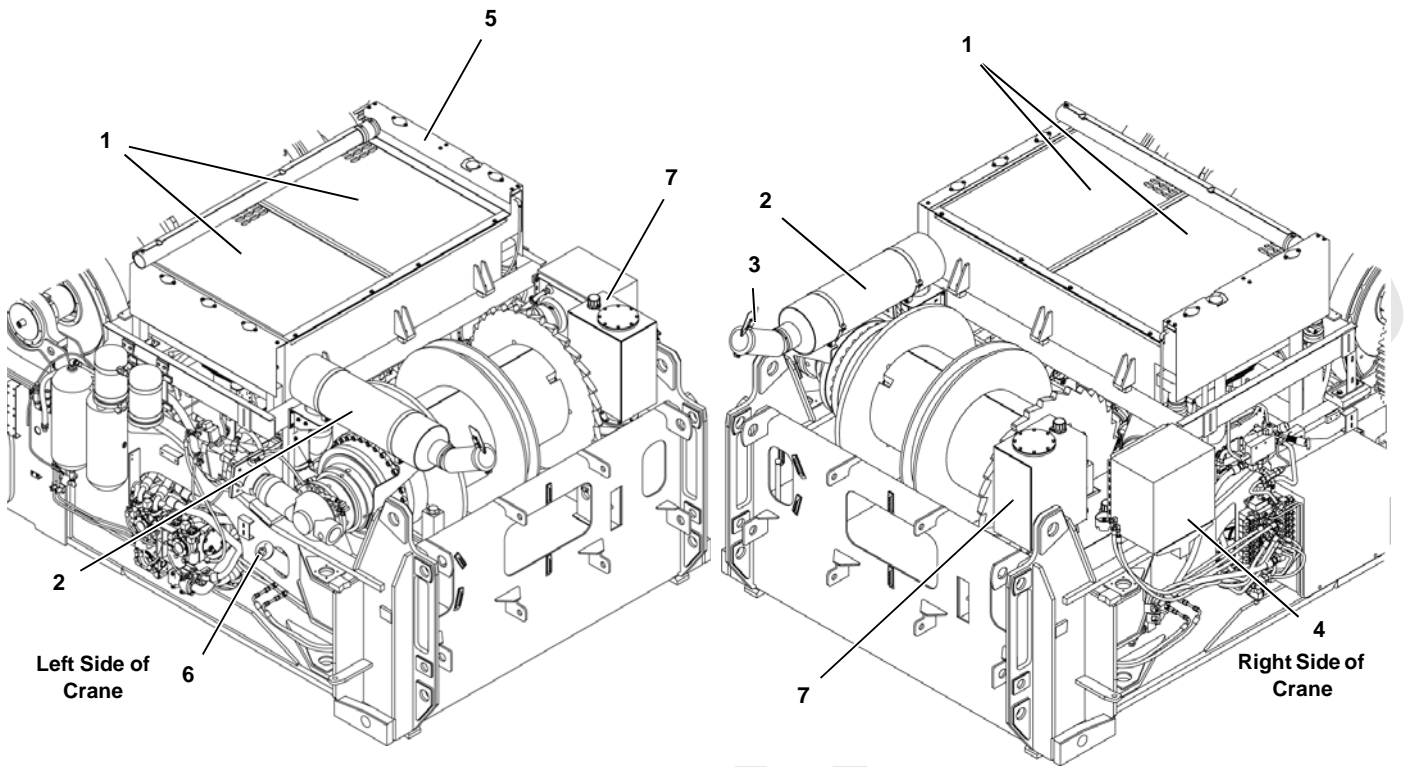
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Item	Description
1	Motor, Left Swing (optional)
2	Motor, Right Swing
3	Drum, Luffing Hoist
4	Swivel
5	Motor, Load Drum(s)
6	Drum, Right Rear Load
7	Engine
8	Drive, Right Crawler
9	Drum, Boom Hoist
10	Drive, Right Crawler
11	Pumps, Pump Drive and System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



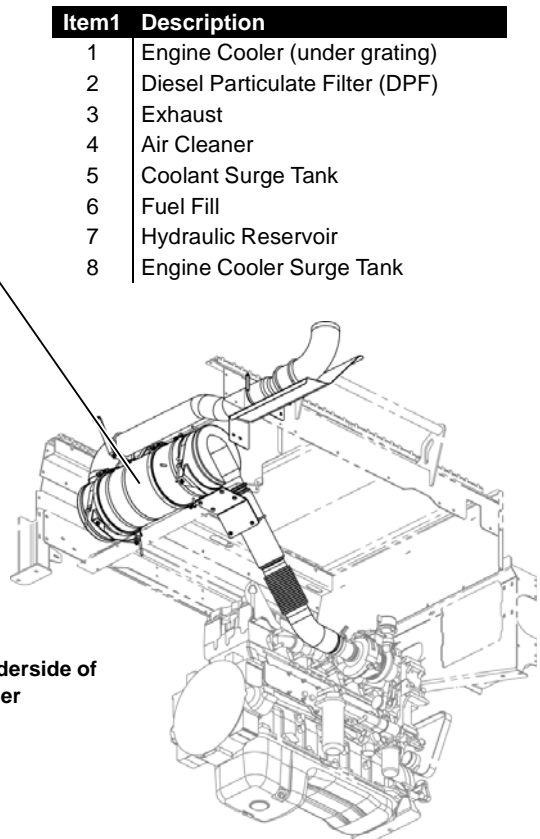
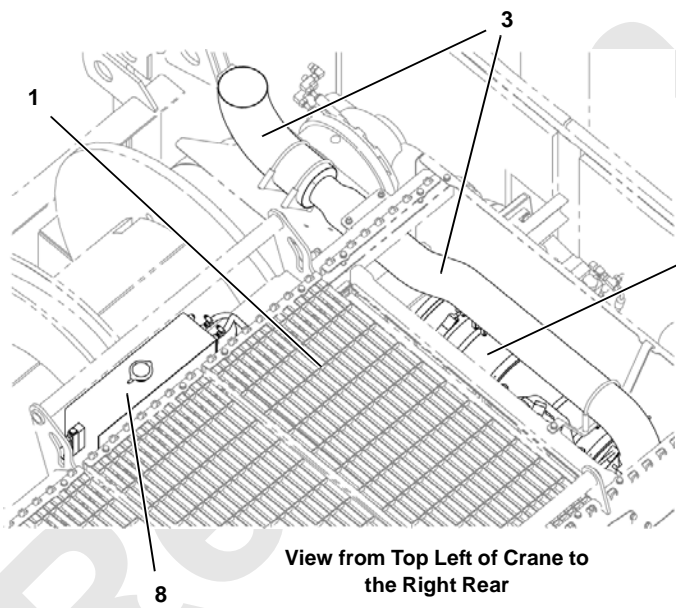
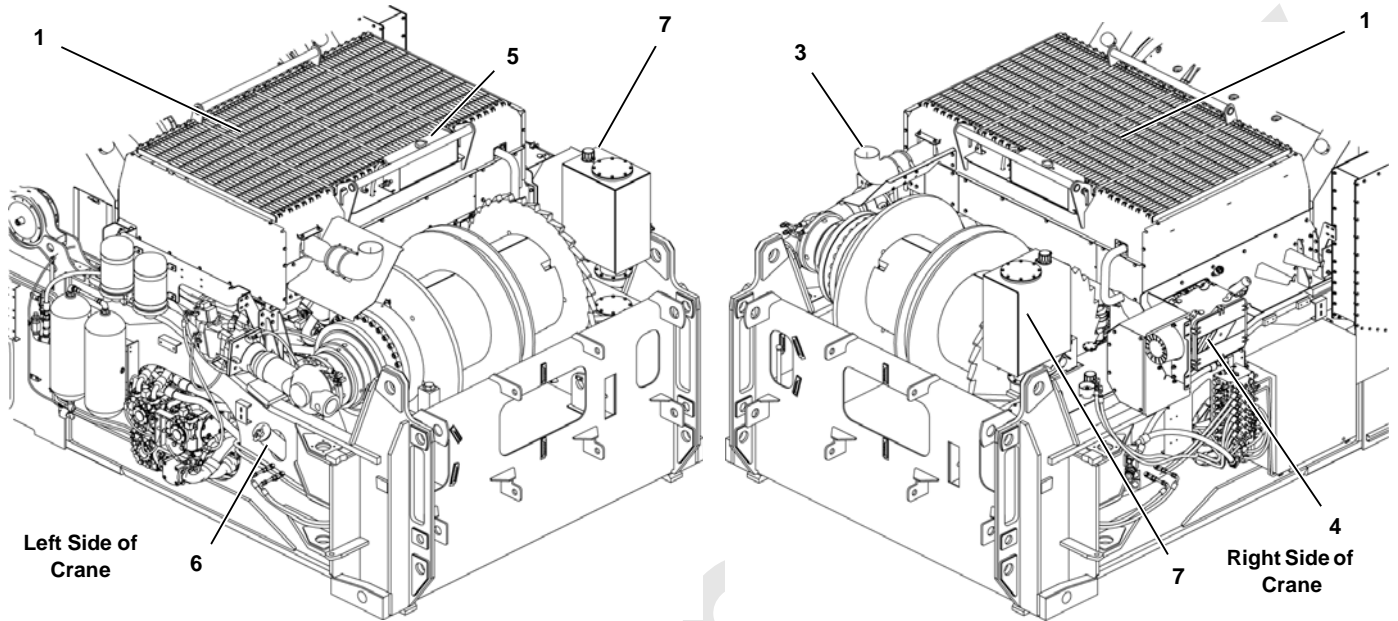
Rear View with Upper Counterweight Removed
Upper Counterweight Attached to Crane with Items 22

Current Tier 3 Production



Item1	Description
1	Engine Cooler (under covers)
2	Muffler
3	Exhaust
4	Air Cleaner
5	Coolant Reservoir
6	Fuel Fill
7	Hydraulic Reservoir

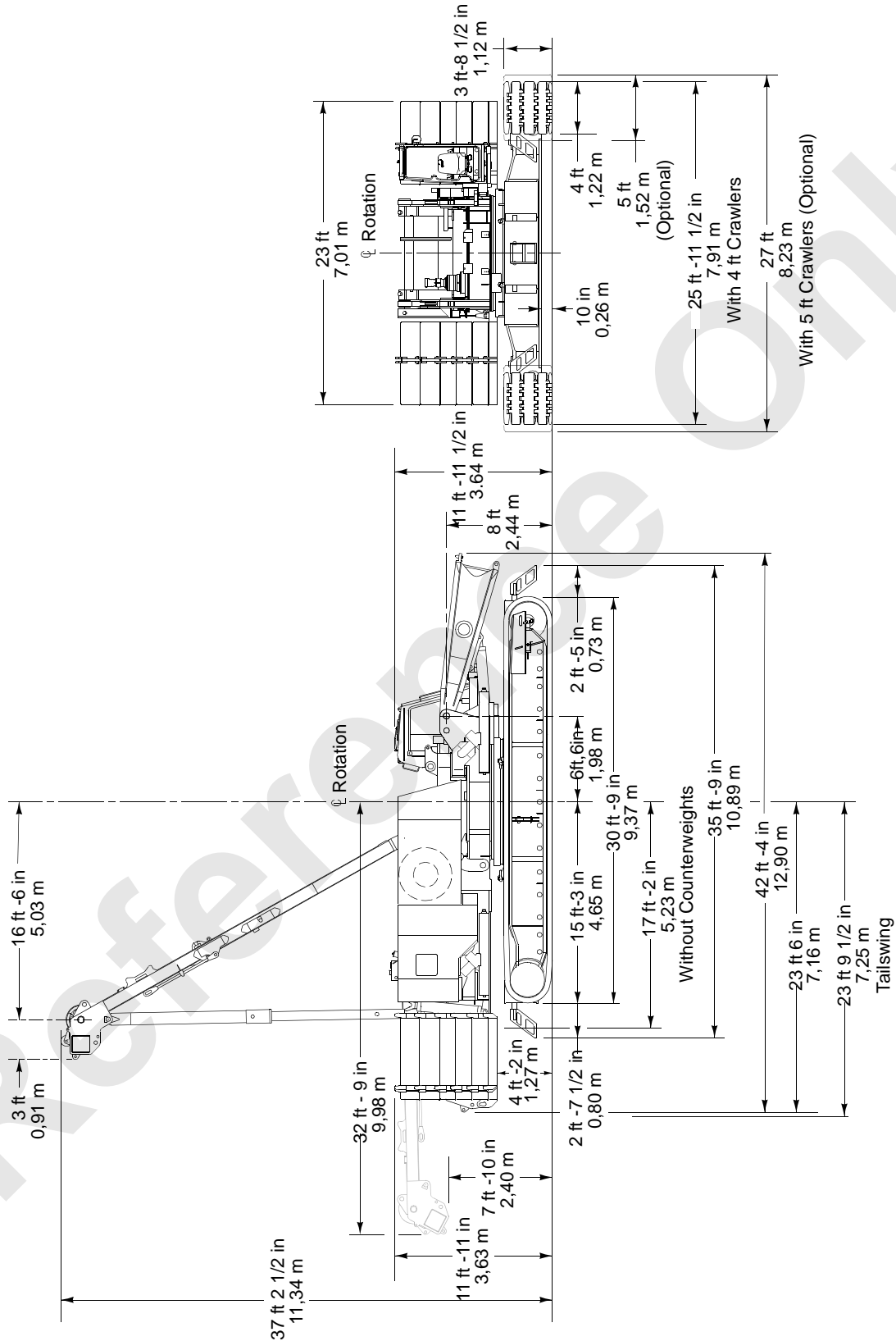
Current Tier 4 Production



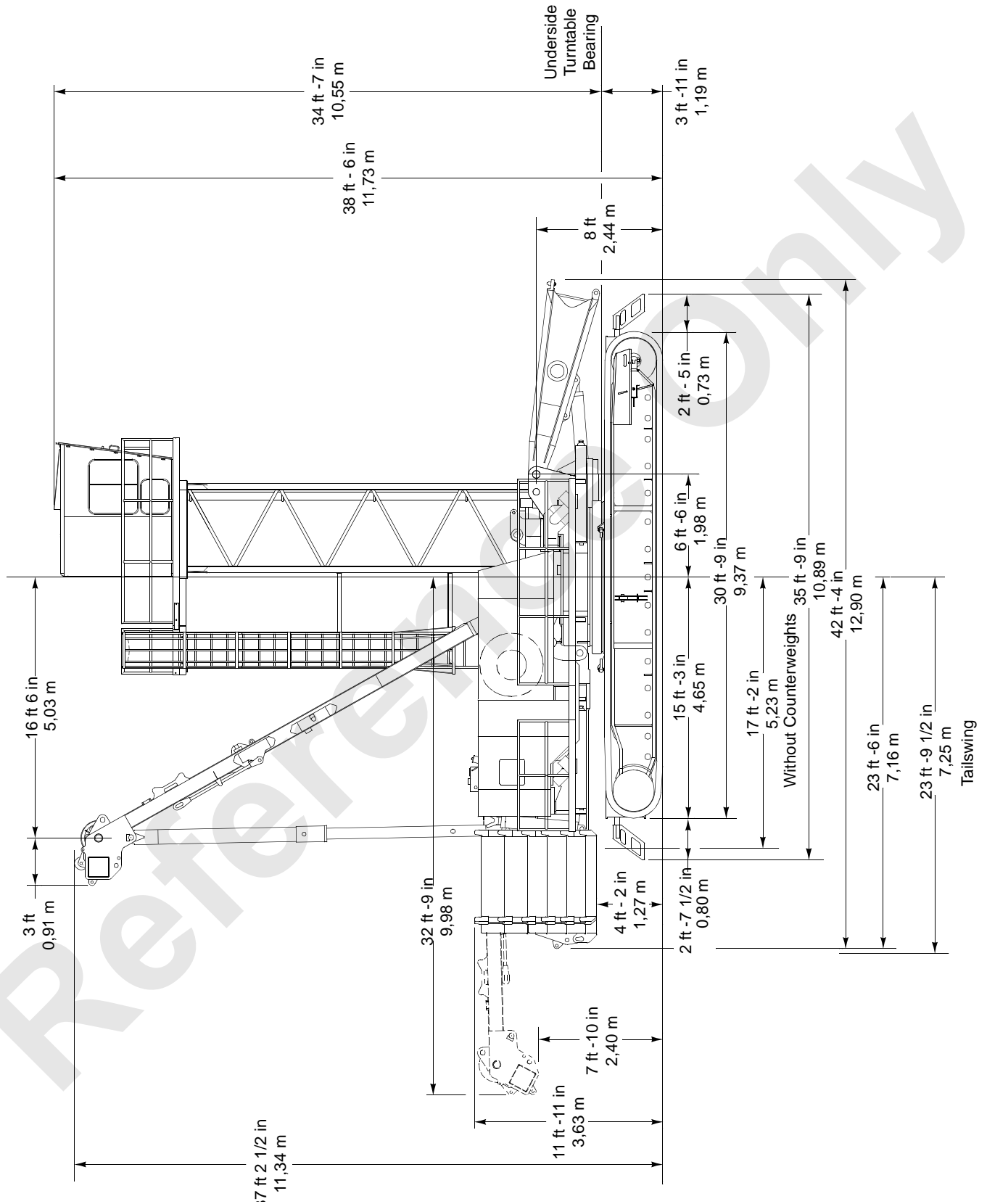
Item1	Description
1	Engine Cooler (under grating)
2	Diesel Particulate Filter (DPF)
3	Exhaust
4	Air Cleaner
5	Coolant Surge Tank
6	Fuel Fill
7	Hydraulic Reservoir
8	Engine Cooler Surge Tank

OUTLINE DIMENSIONS

Standard Crane (Series 3 Counterweight Arrangement Shown)



35 Foot Elevated Cab



CRANE WEIGHTS

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

Description	Weight	
	Pounds	Kilograms
LIFTCRANE:		
Rotating bed and under carriage complete, counterweight, gantry, backhitch, fully rigged 70 ft (21,3 m) boom No. 44 with one piece butt and heavy lift top (including upper boom point, 300 USt (272 t) block, and 15 USt (14 t) hook and weight ball), boom stops and load lines		
2250 SERIES 1 - - - - -	449,615	203 941
2250 SERIES 2 - - - - -	549,740	249 357
2250 SERIES 3 - - - - -	649,740	294 717
2250 SERIES 1 with RINGER prep - - - - -	461,340	209 260
2250 SERIES 2 with RINGER prep - - - - -	561,465	254 676
2250 SERIES 3 with RINGER prep - - - - -	661,465	300 035
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) - - - - -	77,695	35 241
With RINGER prep - - - - -	83,930	38 070
ROTATING MODULE WITH CARBODY:		
Rotating bed front section with bearing turntable, swing drive, carbody with pin pullers, rotating union, piping and installation, 40 ft (12,2 m) boom butt and boom stops - - - - -	69,465	31 508
With RINGER prep - - - - -	74,955	33 999
Replace 40 ft (12,2 m) butt and boom stops with 12 ft 3,7 m) lower 2 piece butt - - - - -	63,475	28 791
CRAWLERS:		
30 ft 9 in (9 373 mm) crawler assembly with 48 in (1 219 mm) treads (each) - - - - -	53,820	24 412
COUNTERWEIGHT - UPPER:		
Tray - - - - -	38,775	17 588
Lifting frame (each) 2 required - - - - -	170	77
Center counterweight - - - - -	37,000	16 782
Lower side counterweight (6 on all SERIES) (each) - - - - -	15,500	7 030
Upper side counterweight (2 on SERIES 2; 4 on SERIES 3) (each) - - - - -	20,000	9 071
Upper power pin with cylinder (each) - - - - -	30	13
Lower power pin with cylinder (each) - - - - -	20	9
Center counterweight lifting pendant (each) - - - - -	20	9
Total rotating bed counterweight - - - - - 2250 SERIES 1 - - - - -	169,200	76 747
2250 SERIES 2 - - - - -	209,200	94 891
2250 SERIES 3 - - - - -	249,200	113 035
COUNTERWEIGHT - LOWER:		
Carbody center counterweight (2 on SERIES 2 and SERIES 3) (each) - - - - -	30,000	13 607
Carbody side counterweight (4 only on SERIES 3) (each)- - - - -	15,000	6 803
GANTRY:		
28 ft 0 in (8 534 mm) gantry with polyamide sheaves - - - - -	11,330	5 139
Backhitch (each leg) - - - - -	1,585	718
Counterweight handling link (each) - - - - -	90	40

Description	Weight	
	Pounds	Kilograms
BOOM NO. 44:		
40 ft 0 in (12,2 m) butt	8,605	3 903
30 ft 0 in (9,1 m) top (with lower point, wire rope guide)	11,625	5 273
10 ft 0 in (3,0 m) insert	1,890	857
20 ft 0 in (6,1 m) insert	3,215	1 458
40 ft 0 in (12,2 m) light insert	4,250	1 927
40 ft 0 in (12,2 m) insert	5,420	2 458
31 ft 1-3/16 in (9,5 m) basic strap (each)	425	192
10 ft 0 in (3,0 m) strap (with connector links) (each)	175	79
20 ft 0 in (6,1 m) strap (with connector links) (each)	295	133
40 ft 0 in (12,2 m) strap (with connector links) (each)	540	244
3 ft 4-3/8 in (1,0 m) strap (with connector links) (each)	80	36
Intermediate suspension link (each)	65	29
47 ft 6 in (14,5 m) intermediate suspension pendant (each)	240	108
29 ft 5 in (9,0 m) intermediate suspension pendant (each)	175	79
9 ft 9 in (3,0 m) intermediate suspension pendant (each)	105	47
Lower intermediate suspension link with pin (each)	60	27
Upper boom point (single sheave)	930	421
Wire rope guide (on butt)	2,090	948
Equalizer	1,810	821
Strap link (attached to equalizer) (each) 4 required	25	11
Boom stop (each tube)	825	374
NO. 132 JIB:		
20 ft 0 in (6,1 m) butt	1,020	462
20 ft 0 in (6,1 m) top (with jib point sheaves)	1,885	855
20 ft 0 in (6,1 m) insert	800	362
40 ft 0 in (12,2 m) basic pendant (each)	175	79
19 ft 2 in (5,8 m) pendant (each)	115	52
Jib stop pendant and link (each)	35	15
Jib stop strut and additional pendants (used with long reach boom top)	85	38
20 ft 0 in (6,1 m) strut with sheave and links	1,360	616
65 ft 7 in (20,0 m) backstay pendant (each)	240	108
7 ft 4 in (2,2 m) backstay pendant (each)	80	36
Backstay link (each)	65	29
Backstay spreader	285	129
MACHINE OPTIONS:		
35 ft (10,7 m) elevated operator's cab (increase over standard operator's cab)	4,370	1 982
35 ft (10,7 m) elevated operator's cab with 52 in (1 321 mm) wide cab (increase over standard operator's cab)	7,390	3 352
45 in (1 143 mm) wide front drum assembly	6,190	2 807
73 in (1 854 mm) wider RINGER drum assembly (each)	7,310	3 315
Gear case assembly for tandem drums (increase over standard)	275	124
Luffing jib hoist assembly	3,065	1 390
2nd swing drive assembly	1,790	811
Supplemental hydraulic reservoir for RINGER	300	136
Boom hinge pin pullers	395	179
RINGER attachment lugs on carbody	3,700	1 678
24-1/2 in (622 mm) Diameter lagging for 45 in (1 143 mm) wide front or right rear drum	1,020	462
24-1/2 in (622 mm) Diameter lagging for narrow left rear drum	425	192
24-1/2 in (622 mm) Diameter lagging for 73 in (1 854 mm) wide RINGER drum (each)	1,800	816

Description	Weight	
	Pounds	Kilograms
BOOM NO. 44 OPTIONS:		
30 ft (9,1 m) tapered insert (with wire rope guide) - - - - -	4,065	1 843
40 ft (12,2 m) long reach top (with lower point) - - - - -	6,705	3 041
Rigging winch in butt - - - - -	820	371
300 USt (272 t) load block with swivel hook - - - - -	8,000	3 628
100 USt (91 t) load block with weight plates - - - - -	4,800	2 177
60 USt (55 t) load block with weight plates - - - - -	2,825	1 281
60 USt (55 t) load block with weight plates - - - - -	4,425	2 007
15 USt (14 t) hook and weight ball (swivel) - - - - -	1,250	566
SELF-ERECT OPTIONS:		
Rotating bed jacking system with pads - - - - -	7,325	3 322
Carbody support pedestals - - - - -	400	181
Crawler handling arrangement - - - - -	430	195
12 ft (3,7 m) lower 2 piece butt - - - - -	4,265	1 934
28 ft (8,5 m) upper 2 piece butt with wire rope guide - - - - -	7,395	3 354
Butt raising cylinder and installation - - - - -	875	396
Assemble and rigging rope guides in butt - - - - -	2,095	950
30 USt (27 t) load block with weight plates - - - - -	2,000	907
Rigging line - 160 ft (49 m) of 1-1/8 in (28,6 mm) wire rope 2.34 lb per ft (3,48 kg/m) - - - - -	375	170
Rigging winch line - 800 ft (244 m) of 3/8 in (9,5 mm) wire rope 0.26 lb per ft (0,39 kg/m) - - - - -	210	95
WIRE ROPE:		
Boom hoist - 975 ft (297 m) of 1 in (26 mm) wire rope - 1.85 lb per ft (2.75 kg/m) - - - - -	1,805	818
Load lines		
1-1/8 in (28,6 mm) wire rope - 2.70 lb per ft - - - - -	5,535	2 510
Whip line - 1,270 ft (387 m) with heavy lift top - - - - -	3,430	1 555
Whip line - 1,325 ft (404 m) with long reach top - - - - -	3,580	1 623
29 mm wire rope - 2.85 lb per ft (4.25 kg/m)		
Hoist line - 2,050 ft (625 m) - - - - -	5,845	2 651
Whip line - 1,270 ft (387 m) with heavy lift top - - - - -	3,620	1 642
Whip line - 1,325 ft (404 m) with long reach top - - - - -	3,775	1 712

ENGLISH AND METRIC CONVERSIONS

Direct Conversion

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

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

Inverse Conversion

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

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

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

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

MANITOWOC DEALER

For questions about this manual or your 2250 crane and attachments, contact a Manitowoc dealer. Before calling, find the model and serial number of the crane or attachment. This information is located on the identification plate on the crane cab or attachment.

To locate the Manitowoc dealer nearest to you:

1. Go to www.manitowoccranes.com/en/our-company/dealers
2. Follow the on-screen prompts to locate your Manitowoc dealer.

SECTION 2

SAFETY INFORMATION

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

CONTINUOUS INNOVATION

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

NAMEPLATES AND DECALS

See drawing at the end of this section.

SAFETY MESSAGES

General

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

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

Safety Alert Symbol



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

Signal Words



DANGER

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



WARNING

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



CAUTION

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

CAUTION

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

NOTE: Highlights operation or maintenance procedures.

Symbol Identification

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

Table 2-1 Common Safety Symbols





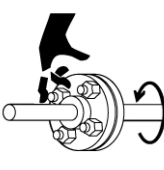















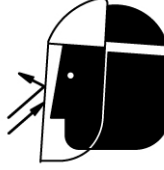




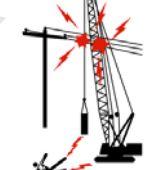


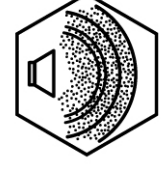









Cut or Crush Hazards					Cut Hazard
 M100090	 M100091	 M100066	 M100065	 M100069	 M100067
Crush Hazards					Fire Extinguisher
 M100070	 M100071	 M100072	 M100073	 M100074	 M100082
Fall Hazards			Falling Boom (Crush) Hazards		Explosion Hazard
 M100083	 M100084	 M100085	 M100068	 M100075	 M100080
Falling 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)				
 M100270	 M100266				

2

SAFETY AND INFORMATION SIGNS

Maintaining Signs

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

Ordering Signs

Order replacement safety and information signs from your Manitowoc dealer.

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

CRANE ACCESS POINTS



WARNING

Crush Hazard!

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

Moving crawlers can crush personnel climbing on or off crane.

To prevent death or serious injury:

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

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

General

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

Manitowoc has provided stairways, ladders, and platforms at the locations shown in Figure 2-1.

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

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

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

This practice will prevent ground personnel from being crushed or electrocuted when they attempt to access personal belongings stored on the crane.

- Tools, oil cans, spare parts, and other necessary equipment must be stored in tool boxes or other appropriate locations. Do not allow these items to lie around loose in operators cab or on steps, ladders, catwalks, and platforms.
- To reduce risk of slipping, non-skid material (sand in paint) has been applied to painted walkways and platforms.
Walkways and platforms can be slippery when wet and when oil or is grease is spilled on them. **Keep walkways and platforms clean and dry to prevent slipping on them.** When non-skid material wears out, reapply it.
- Wear shoes with a highly slip-resistant sole material. Clean any mud or debris from shoes before entering the crane cab or climbing onto the cab. A shoe that is not clean might slip off a control pedal during operation.
- Do not make modifications or additions to the crane's access system that have not been evaluated and approved by Manitowoc.
- Do not use top of mast, boom, or jib as walkways unless they have catwalks.

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

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

GETTING ON OR OFF CRANE

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

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

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

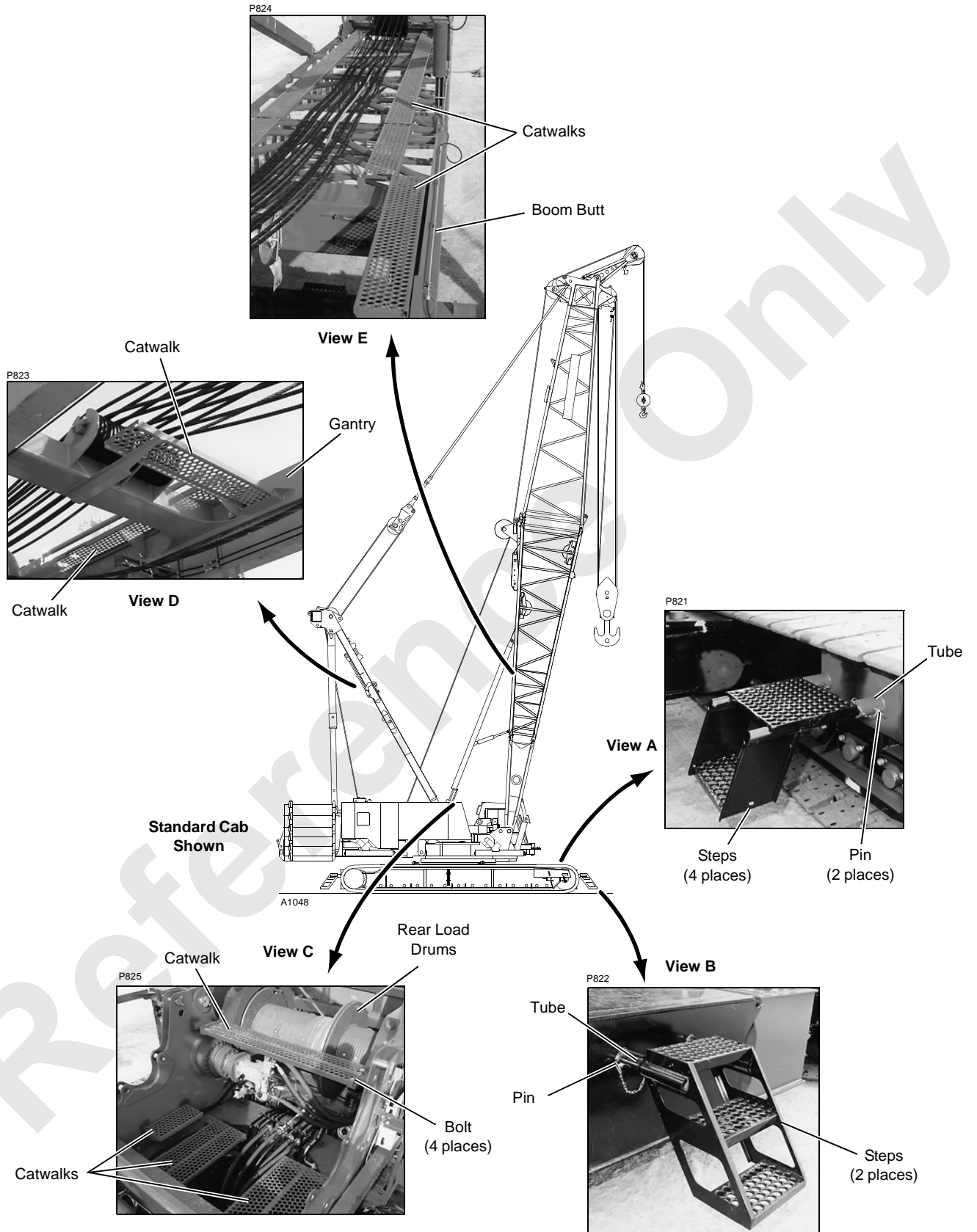
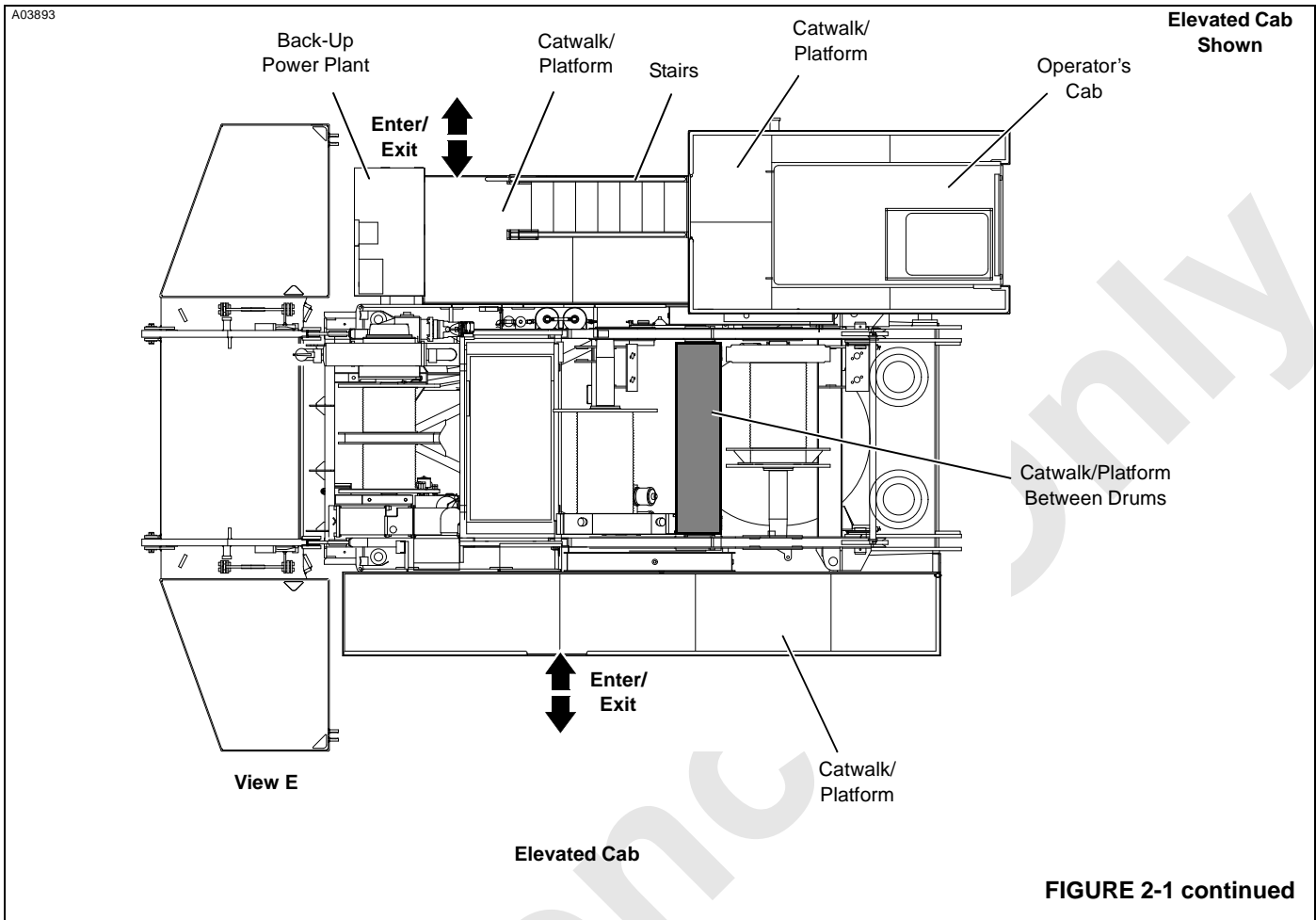


FIGURE 2-1



OPERATOR'S MANUAL/CAPACITY CHART STORAGE

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

- Operator's Manual (Serial Numbered)
Contains safety information, crane specifications, assembly/erection procedures, operating instructions, lubrication and maintenance checks.
- Parts Manual (Serial Numbered)
Contains illustrations and part numbers of replaceable parts.
- Capacity Chart Manual (Serial Numbered)
Contains lifting capacities and related information (wire rope specifications, drum and lagging information, etc.)
- Maintenance Checks and Lube Guide
Contains lists of maintenance checks and lube services and their prescribed intervals.
- 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 which must be retained in the operator's cab (Operator's Manual, Capacity Charts, Maintenance Checks and Lube Guide, and RCL Operation) are supplied in an OPERATOR INFORMATION binder. A separate binder is provided for the crane and each applicable attachment.

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

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

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

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

Storing Manuals

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

Chain the manual to the link provided.

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

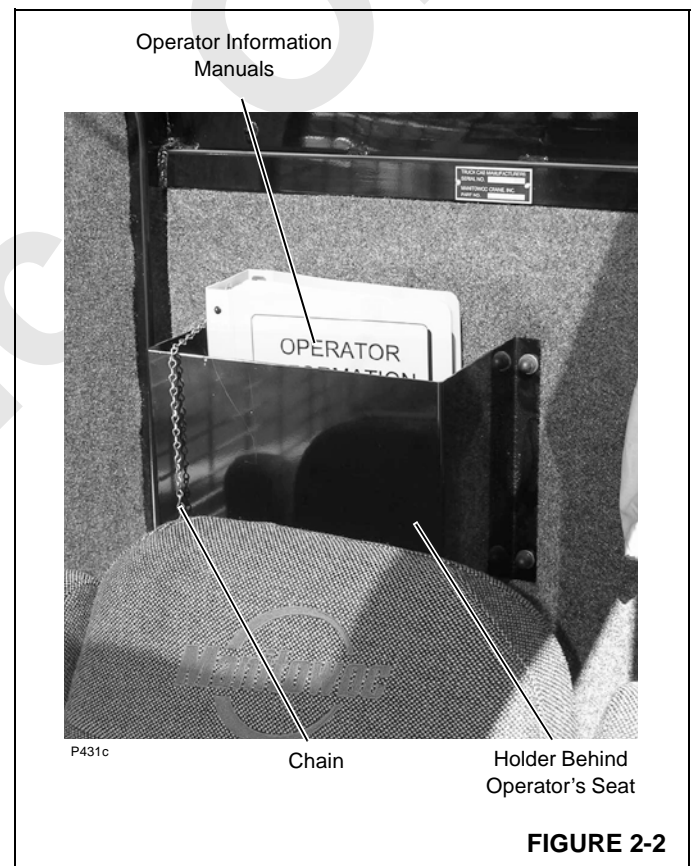


FIGURE 2-2

SAFE OPERATING PRACTICES

General

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

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

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

Read Operator's 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's 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's 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 reserves the right to change the information and specifications contained in the Operator's Manual at any time without notice. If you have any questions regarding the crane or its Operator's Manual, please contact your Manitowoc dealer.

Operator Qualifications

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

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

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

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

Operator training and qualification is crane owner's responsibility.

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

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

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

ASME (formerly ANSI) B30 Series American National Standards are available by mail from the ASME, 22 Law Drive, Fairfield, New Jersey, 0700-2900 or by:

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

Operator Conduct

1. The operator shall not engage in any practice which diverts his/her attention while operating the crane.
2. The operator shall not operate the crane when he/she is physically or mentally unfit.
3. The operator shall be responsible for all operations under his/her direct control. When safety of an operation is in doubt, the operator shall stop the crane's functions in a controlled manner. Lift operations shall resume only after safety concerns have been addressed or the continuation of crane operations is directed by the lift supervisor.
4. The operator shall be thoroughly familiar with operation of crane and its proper care. If adjustments or repairs are necessary or if there are known defects that impair safe

operation, the crane shall not be operated until unsafe conditions have been corrected.

5. If there is a warning sign at the start controls, the operator shall not start the engine until the warning sign has been removed by the person who installed it.
6. Before starting the engine, the operator shall make sure that:
 - a. All daily inspection and maintenance services have been performed.
 - b. All controls are in off the position and all brakes and locking devices are applied or engaged.
 - c. All personnel are clear of the crane. Deploy a swing radius barrier.



WARNING

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

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

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

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

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



WARNING

Moving Load/Tipping Crane Hazard!

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

- c. The operator shall perform the following operations before leaving the operator's cab for any reason:
 - a. Park crane and position upperworks so crane does not interfere with operation of other equipment.
 - b. Apply travel and swing brakes or locking devices.
 - c. Land any attached load.
 - d. Lower the boom onto blocking at ground level or onto a boom rest if possible.

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

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

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

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

12. The operator shall perform the following operations if power or a control function fails during operation:
 - a. Land all suspended loads, if possible, under brake or power control.
 - b. Apply all brakes and locking devices.
 - c. Move all controls to off.

13. 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 shall be illuminated.

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

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

Never operate the crane during an electrical thunderstorm.

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

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

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

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

- a. If the wind causes the load to swing forward past the allowable operating radius or sideways past either boom hinge pin, land the load and apply the drum brakes.
- b. If the wind exceeds 35 mph, land all loads and apply the drum brakes, lower the boom onto blocking at ground level or otherwise restrain it, and apply the swing and travel brakes and/or locks.

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

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

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

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

Handling Load

Size of Load

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

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

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

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

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

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

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

Attaching Load

1. Attach the hook to the load with slings, or other suitable rigging. Each hook shall have a latch that is in proper working order. **Hook latches shall not be wired open.**
 - a. Inspect each hook and latch before using.
 - b. Never use a hook or latch that is distorted or bent.
 - c. Make sure spring will force the latch against the tip of the hook.
 - d. Make sure the hook supports the load. The latch must never support the load. Latches are only intended to retain loose slings under slack conditions.
2. Only use slings and other rigging that are in safe operating condition and have a rating equal to or greater than the load to be lifted.
3. Do not wrap the load line around the load.
4. Use suitable protection between slings and any sharp edges on the load. When synthetic slings are used, the synthetic sling manufacturer's instructions, limitations, specifications, and recommendations must be followed.

5. Secure unused legs of a multi-leg sling before handling a load with one leg of sling.

Lifting/Moving Load

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

- a. Crane has a firm, uniformly supporting foundation under all crawlers. Unless otherwise specified in the Capacity Chart, the foundation shall be *level to within 1% — 1ft (0,3 m) rise or fall in 100 ft (30,5 m) distance.*

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

*For ground bearing data go to:
www.manitowoccranes.com/site/EN/
groundbearingpressure.aspx.*

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

The operator shall test the load drum brakes each time a load approaching the rated load is handled. Lift the load 3 to 6 in (76 to 152 mm) and fully apply the brakes — *load must not lower through applied brakes.*

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

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

- a. Accelerate and decelerate the load smoothly to avoid excessive stress on the crane boom and machinery.

- b. Avoid sudden starts and stops while swinging. Keep the swing speed under control to prevent the load from swinging out beyond the radius at which the load can be handled and to minimize the pendulum action of the load.

- c. Sound the signal horn before swinging and intermittently while swinging, especially when approaching personnel.

If equipped, the automatic swing alarm will sound when the crane is swung.

- d. Use taglines or other restraints to control the load when necessary.

- e. Do not exceed any swing limitations (areas of operation) given in the Capacity Chart.

- f. Do not allow the load, the boom, or any other part of the crane to contact obstructions.

- g. Do not use the crane to drag a load.

- h. Do not hoist, lower, or swing the load while personnel are on the load or the hook. See Personnel Handling in this section.

- i. Avoid carrying the load over personnel. Loads which are suspended shall be blocked or cribbed before personnel are allowed to work under or between them.

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

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

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

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

- Free of defects.
- Strong enough to prevent crushing, bending, or shear failure.
- Of sufficient thickness, width, and length to completely support the jack pad or float, transmit the load to the supporting surface, and

prevent shifting, toppling, or excessive settlement under load.

- k. Fully retract and lock the jacks and the outrigger beams so they cannot extend when not in use.
- l. Operate with extreme caution when using two or more cranes to lift the same load.

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

- m. Do not lower the load or the boom to a point where less than three full wraps of wire rope are remaining on the respective drum (or as otherwise indicated in local, state, or federal regulations).
 - n. Engage the boom hoist pawl when operating with the boom at a fixed radius.
 - o. Engage the luffing hoist pawl when operating with the luffing jib at a fixed radius.
3. While traveling, the operator shall take the following precautions:
- a. Sound the signal horn before traveling and intermittently while traveling, especially when approaching personnel.
If equipped, the automatic travel alarm will sound when the crane is traveled.
 - b. Carry the boom in-line with the lowerworks and facing the direction of travel.
 - c. Do not position the boom so high that it could bounce over backwards whether traveling with or without load.
 - d. Secure the rotating bed against rotation except:
 - When operating with a MAX-ER[®] attachment.
 - When it is necessary to negotiate a turn, and then only when the operator is seated at controls or the boom is supported on a dolly.
 - e. Lash or otherwise restrain unused hooks so they cannot swing freely.
4. Before traveling with a load, the operator shall take the following additional precautions:
- a. A designated person shall be responsible for operation. Decisions such as the necessity to

reduce crane ratings, load position, boom position, ground support, and speed of movements shall be in accordance with the designated person's decision.

- b. Maintain specified tire pressures (truck cranes).
- c. Avoid sudden starts and stops. Use taglines or other restraints to control the position of the load.

Multiple Load Line Operation



WARNING

Avoid Over Load and Side Load Damage to Crane

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

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

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

1. The qualified lift planner and the crane operator shall read and become thoroughly familiar with the appropriate Capacity Charts and Wire Rope Specification Charts.
2. The lift planner and the crane operator shall make sure the total load does not exceed the rated capacity given in the Capacity Chart and Wire Rope Specification Chart for given boom point or jib point, whichever is less.

EXAMPLE: If one load line is lifting from the jib point, the proper jib chart applies.
3. The crane shall be thoroughly inspected by a qualified person prior to setup.
4. The crane shall be thoroughly inspected for load line interference caused by routing and reeving of multiple load lines. If interference is found, it shall be eliminated.
5. For cranes produced before 2003, Rated Capacity Indicators/Limiters were not required by ASME B30.5 for non-personnel lifting.

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

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

6. Manitowoc recommends that each load line be equipped with an anti two-block device.
7. Manitowoc's Capacity Charts are based on freely suspended loads. To prevent side load damage to the boom, the jib, and the sheaves:
 - The load lines must hang as close to vertical as possible to minimize side and forward loads.
The distance between the load points and the hook points must be a minimum of three times the horizontal distance between the hook point on the load being lifted.
 - The load must remain centered on the boom and jib point shafts unless special lift approval is granted by Manitowoc.
 - The load lines should be located over the load's center of gravity as it is supported on a trailer, a barge, or the ground.
8. The crane operator must be familiar with the operational characteristic of the crane as it relates to multiple drum operation (simultaneous operation, same or opposite direction, or individual operation).
9. When using tandem drums, the maximum operating layers may be limited depending on whether the crane was initially designed for tandem drum operation or not.
10. Load shift when lifting with two hooks may be more unpredictable than typical one hook lifting.

Holding Load

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

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

SIGNALS

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

SAFETY DEVICES



WARNING

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

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

Manitowoc provides the following safety devices on its cranes.

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

OPERATIONAL AIDS



WARNING

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

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

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

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

Category 1 Operational Aids

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

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

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

Temporary alternative measures if inoperative or malfunctioning:

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

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

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

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

2. Anti-Two-Block Device

Temporary alternative measures if inoperative or malfunctioning:

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

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

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

Category 2 Operational Aids

If a Category 2 operational aid is not working properly, it must be repaired no later than 30 calendar days after the deficiency occurs. Exception: If the employer documents that it has ordered the necessary parts within 7 calendar days of the occurrence of the deficiency, and the part is not received in time to complete the repair in 30 calendar days, the repair must be completed within 7 calendar days of receiving the parts.

1. Rated Capacity Indicator/Limiter

Temporary alternative measures if inoperative or malfunctioning:

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

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

2. Boom Angle or Radius Indicator

Temporary alternative measures if inoperative or malfunctioning:

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

3. Jib Angle or Radius Indicator

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

- a. First, make sure you know the boom angle (see item 2 above).
- b. Then, measure radius using a tape measure.

4. Drum Rotation Indicator

Temporary alternative measures if inoperative or malfunctioning:

Mark the drum to indicate its rotation.

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

5. OPTIONAL Swing Limiter or Proximity Device

Temporary alternative measures if inoperative or malfunctioning:

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

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

Temporary alternative measures if inoperative or malfunctioning:

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

7. OPTIONAL Closed-Circuit Television (CCTV)

Temporary alternative measures if inoperative or malfunctioning:

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

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

Electrocution Hazard

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

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

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

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



WARNING

Electrocution Hazard!

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

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

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

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

The rules in this section must be followed at all times, even if the electrical power lines or equipment have been de-energized.

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

The safest way to avoid electrocution is to stay away from electrical power lines and electrical power sources.

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

Set-Up and Operation

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

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

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

Electrocution Hazard Devices

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

Electrical Contact

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

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

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

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

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

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

REFUELING

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

FIRE EXTINGUISHERS

- A portable fire extinguisher with a minimum rating of 10 BC shall be installed in operator's 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 dealer or the Product Safety and Reliability Department at the following address:

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

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

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

SAFE MAINTENANCE



WARNING

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

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

Maintenance Instructions

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

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

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

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

Safe Maintenance Practices

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

- f. Place a warning sign at the start controls alerting other personnel that crane is being serviced and the engine must not be started. **Do not remove sign until it is safe to return crane to service.**
2. Do not attempt to maintain or repair any part of the crane while the engine is running, unless absolutely necessary.
If the engine must be run, keep your clothing and all parts of your body away from moving parts. **Maintain constant verbal communication between person at controls and person performing maintenance or repair procedure.**
 3. Wear clothing that is relatively tight and belted.
 4. Wear appropriate eye protection and approved hard hat.
 5. Never climb onto or off a moving crane. **Climb onto and off crane only when it is parked and only with operator's permission.**
Use *both hands* and handrails, steps and ladders provided to climb onto and off the crane.
Lift tools and other equipment which cannot be carried in pockets or tool belts onto and off the crane with hand lines or hoists.
 6. The boom and gantry are not intended as ladders. Do not attempt to climb lattice work of the boom or gantry to get to maintenance points. If the boom or gantry is not equipped with an approved ladder, lower them before performing maintenance or repair procedures.
 7. Do not remove cylinders until the working unit has been securely restrained against movement.
 8. Pinch points are impossible to eliminate; watch for them closely.
 9. Pressurized air, coolant, and hydraulic oil can cause serious injury. Make sure all air, coolant, and hydraulic lines, fittings, and components are tight and serviceable.
Do not use your hands to check for air, coolant or hydraulic oil leaks:
 - Use a soap and water solution to check for air leaks (apply to fittings and lines and watch for bubbles).
 - Use a piece of cardboard or wood to check for coolant and hydraulic oil leaks.
 10. Relieve pressure before disconnecting air, coolant, and hydraulic lines and fittings.
 11. Do not remove the radiator cap while the coolant is hot or under pressure. Stop the engine, wait until the pressure drops and the coolant cools, then slowly remove the cap.
 12. Avoid battery explosion: do not smoke while performing battery maintenance or short across battery terminals to check its charge.
 13. Read the safety information in the battery manufacturer's instructions before attempting to charge a battery.
 14. Avoid battery acid contact with skin and eyes. If contact occurs, flush the area with water and immediately consult a doctor.
 15. Stop the engine before refueling crane.
 16. Do not smoke or allow open flames in refueling area.
 17. Use a safety-type can with an automatic closing cap and flame arrestor for refueling.
 18. Hydraulic oil can also be flammable. Do not smoke or allow open flames in the area when filling hydraulic tanks.
 19. Never handle wire rope with bare hands. Always wear heavy-duty gloves to prevent being cut by broken wires.
 20. Use extreme care when handling coiled pendants. Stored energy can cause the coiled pendants to uncoil quickly with considerable force.
 21. When inflating tires, use a tire cage, a clip-on inflator, and an extension hose which permits standing well away from the tire.
 22. Only use cleaning solvents which are non-volatile and non-flammable.
 23. Do not attempt to lift heavy components by hand. Use a hoist, jacks, or blocking to lift components.
 24. Use care while welding or burning on the crane. Cover all hoses and components with non-flammable shields or blankets to prevent a fire or other damage.
 25. To prevent damage to crane parts (bearings, cylinders, swivels, slewing ring, computers, etc.), perform the following steps **before welding on crane:**
 - Disconnect all cables from batteries.
 - Disconnect output cables at engine junction box.
 - Attach the ground cable from the welder directly to the part being welded and as close to the weld as possible.

Do not weld on the engine or engine mounted parts (per engine manufacturer).
 26. Disconnect and lock the power supply switch before attempting to service high voltage electrical components and before entering tight areas (such as carbody openings) containing high voltage components.
 27. When assembling and disassembling booms, jibs, or masts on the ground (with or without support of boom

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

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

28. Unless authorized in writing by Manitowoc, do not alter the crane in any way that affects the crane's performance (to include welding, cutting, or burning of structural members or changing pressures and flows of air/hydraulic components). Doing so will invalidate all warranties and Capacity Charts and make the crane owner/user liable for any resultant accidents.
29. **Keep crane clean.** Accumulations of dirt, grease, oil, rags, paper, and other waste will not only interfere with safe operation and maintenance but also create a fire hazard.
30. Store tools, oil cans, spare parts, and other necessary equipment in tool boxes. Do not allow these items to lie around loose in the operator's cab or on walkways and stairs.
31. Do not store flammable materials on the crane.
32. Do not return the crane to service at completion of maintenance or repair procedures until all guards and covers have been reinstalled, trapped air has been bled from hydraulic systems, safety devices have been

reactivated, and all maintenance equipment has been removed.

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

ENVIRONMENTAL PROTECTION

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

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

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

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

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



FIGURE 2-3

BOOM DISASSEMBLY SAFETY



DANGER!

Collapsing Boom Hazard!

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

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

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

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

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

General

Safety decals (Figure 2-3) are placed near the connectors on the boom sections as shown on the Boom Disassembly Decal Drawing at the end of this section.

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



WARNING

Falling Boom Hazard!

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

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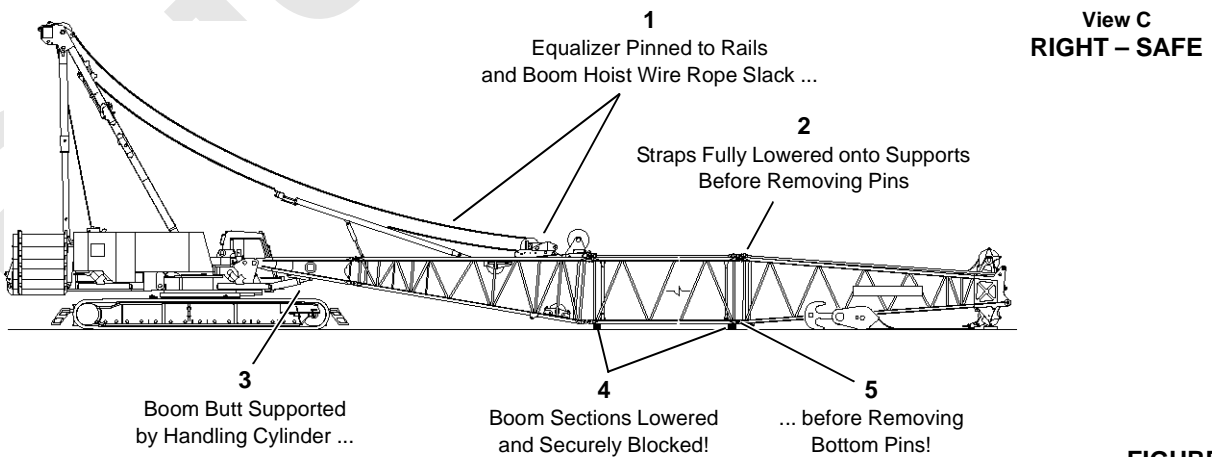
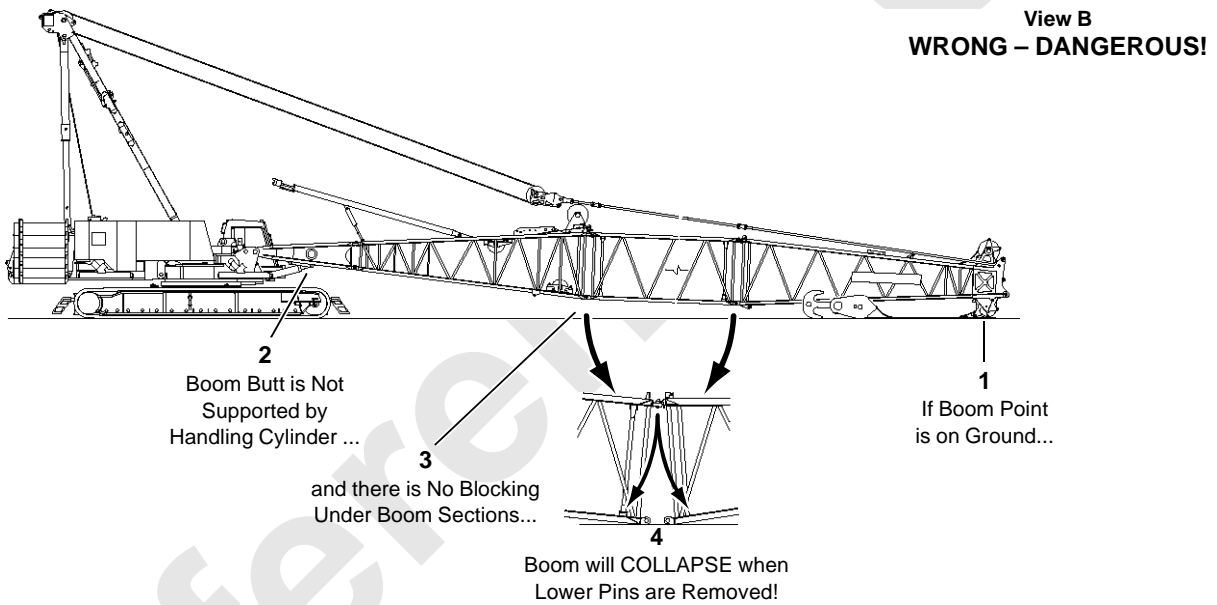
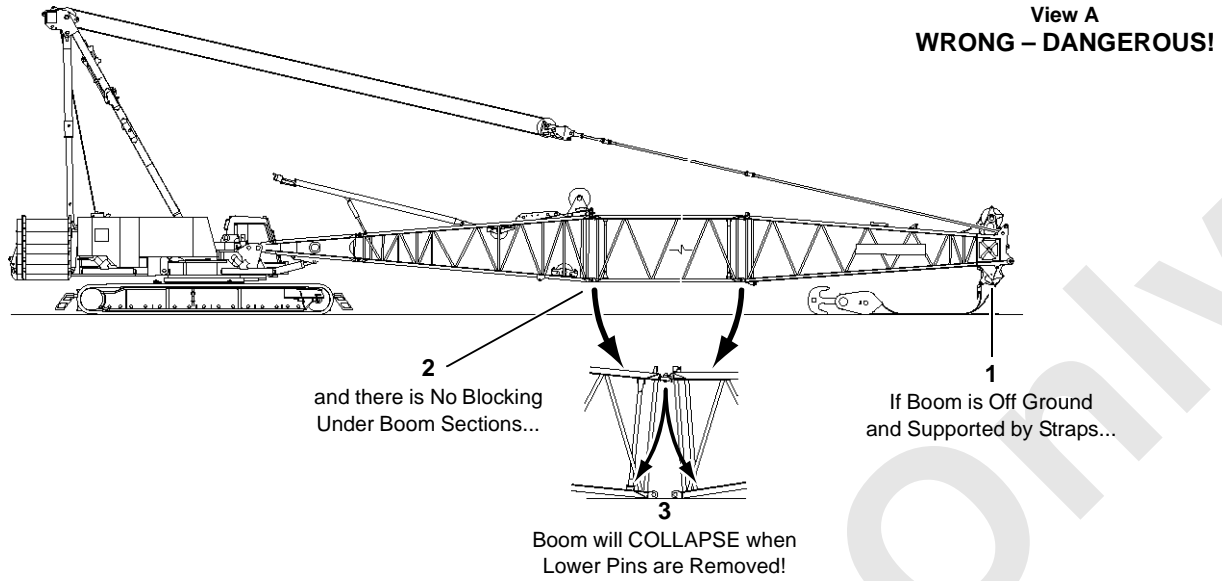


FIGURE 2-4

Pin Removal



DANGER

Collapsing Boom Hazard!

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

- Do not remove bottom connecting pins from any boom section when boom is supported by straps as shown in Figure 2-4, View A.
 - Do not remove strap connecting pins until straps are fully lowered into supports as shown in Figure 2-4, View C.
 - Do not remove bottom connecting pins from any boom section when boom point is resting on ground and boom butt is not supported by handling cylinder as shown in Figure 2-4, View B.
 - Never work or stand inside boom unless it is lowered and securely blocked as shown in Figure 2-4, View C.
 - Do not stand or walk on top of 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 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 provides, ***“lifting and lowering of personnel using ASME B30 Standard hoisting equipment shall be undertaken only in circumstances when it is not possible to accomplish the task by less hazardous means. Unless all of the applicable requirements of this volume are met, the lifting or lowering of personnel using ASME B30 Standard equipment is prohibited.”***

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

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

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

- The crane user shall comply with the manufacturer's specifications and limitations for lifting accessories (hooks, slings, personnel platforms, etc.).
- The requirements of the applicable national, state and local regulations and safety codes are met.
- A determination has been made that use of a crane to handle personnel is the least hazardous means to perform the work.
- The crane operator shall be qualified to operate the specific type of hoisting equipment used in the personnel lift.
- The crane operator must remain in the crane cab at all times when personnel are off the ground.
- The crane operator and occupants have been instructed in the recognized hazards of personnel platform lifts.
- The crane is in proper working order.
- Load and boom hoist drum brakes, swing brakes, and locking devices such as pawls and dogs shall be

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

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

For friction cranes, this implies the addition of spring applied brakes activated by the anti-two block device. The load line hoist drum shall 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's 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 shall 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 shall 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 (i.e., personal fall-protection system, etc.)

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

For operation outside the United States, the requirements of the applicable national, state and local regulations and safety codes 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) shall be provided in the hydraulic or pneumatic systems to prevent uncontrolled movement of the hoisting equipment in the case of a system failure.

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

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

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

Manitowoc Cranes

2401 So. 30th St.
Manitowoc, WI 54220

Phone: 920-684-6621

PEDESTAL/BARGE MOUNTED CRANES

WARNING Overload Hazard!

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

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

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

WARNING

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

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

Pedestal Mounted Crane

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

Definition

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

Examples

1. Crane rotating bed mounted on a turret (pedestal) which is securely fastened to the foundation (Figure 2-5).

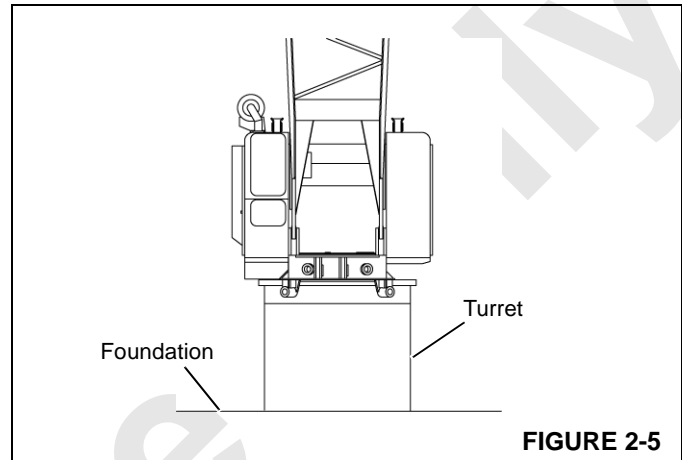


FIGURE 2-5

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

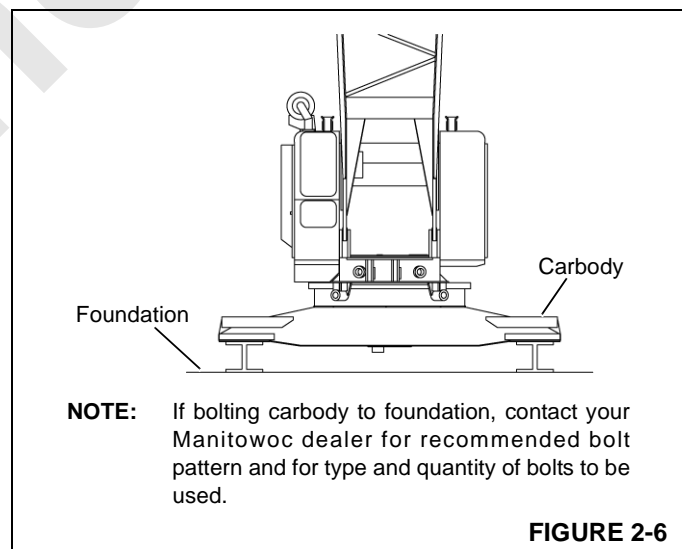


FIGURE 2-6

Barge Mounted Crane

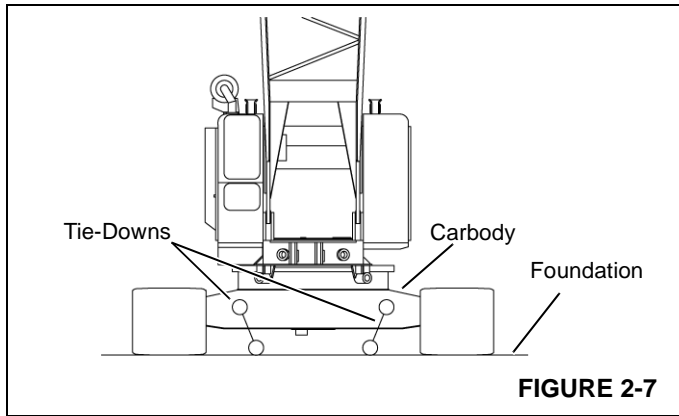
Definition

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.

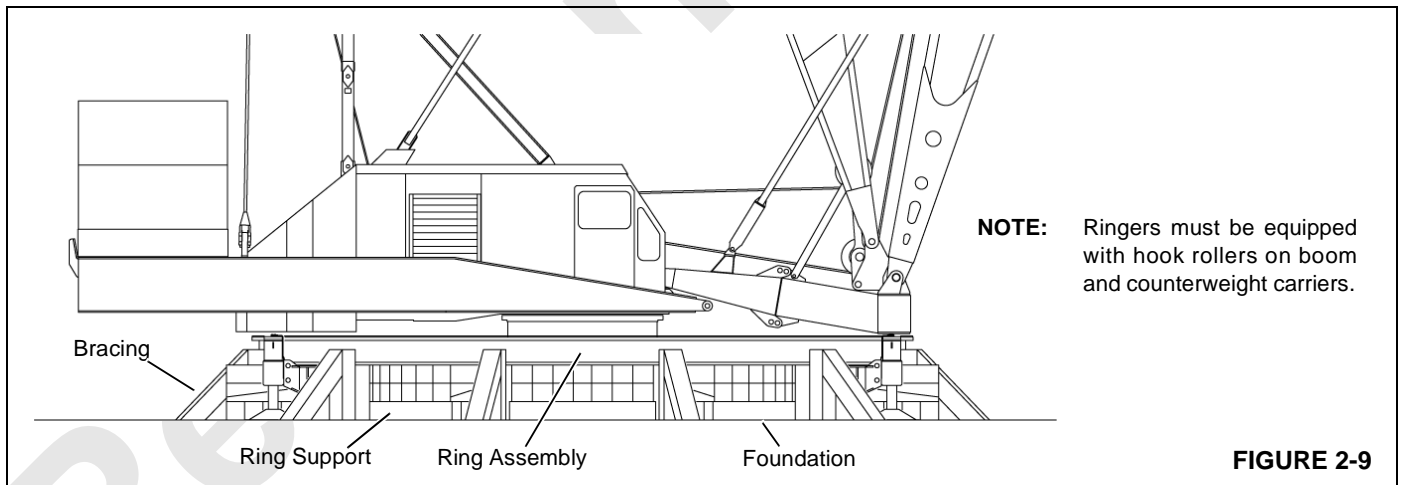
Examples

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

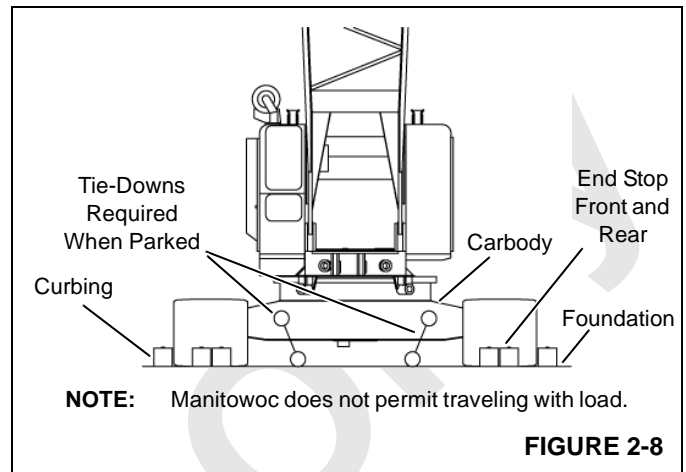
1. Crawler-mounted crane with carbody anchored with tie-downs to the foundation (Figure 2-7).



2. Crawler-mounted crane working on a timbered area of the barge, ship, or floating platform with the crawlers



restrained by curbing and end stops (Figure 2-8). When not working, the crane carbody is anchored with tie-downs to the foundation. **Traveling with load is not permitted.**



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

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

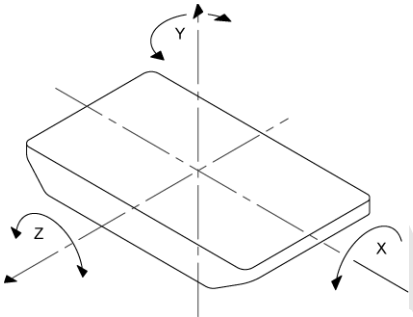


FIGURE 2-10

Capacity Charts

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

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

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

Shock Loading

Definition

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

CAUTION

Structural Damage Hazard!

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

NOTE: Manitowoc does not recommend crane operation under dynamic conditions.

Operation On Barge

General

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



WARNING

Tipping Crane Hazard!

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

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

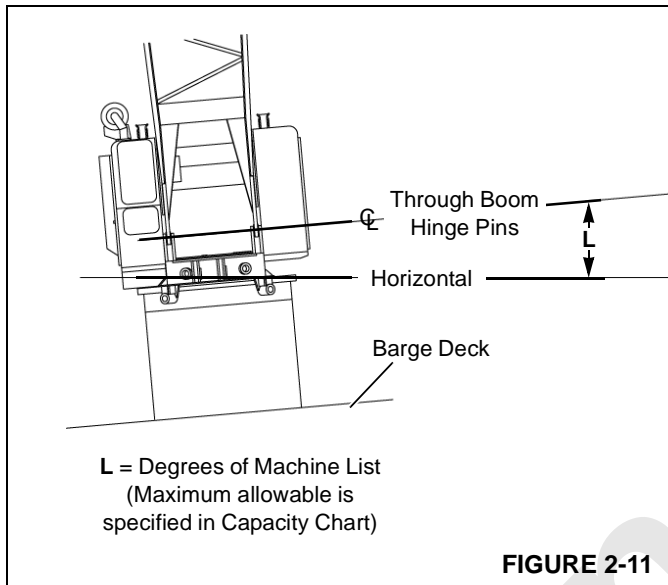
Definitions

1. *Machine List*, as defined by Manitowoc, is the crane's out-of-level condition — from side-to-side — as measured by the angle between horizontal and a line drawn through the centerline of the crane's boom hinge pins (Figure 2-11). This out-of-level condition creates side load and affects the crane's lifting capacity.
2. *Barge List* (also referred to as heel or trim) causes swing out of the load and may produce side load. When Manitowoc provides a Capacity Chart showing capacities for a 2 degree machine list for example, we are referring to the maximum allowable lifting capacity for the crane when experiencing an out-of-level condition (side-to-side) of 2 degrees as measured by

angle between horizontal and a line drawn through centerline of the crane's boom hinge pins.

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

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



Crane Inspection

To aid in preventing harmful and damaging failure as previously indicated, regular inspection for signs of

overloading in the following load bearing components is required. Correct each defect found before placing the crane into service.

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

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

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

Transporting Crane on Barge

If it is necessary to transport the crane on a barge, ship, or floating platform when dynamic conditions will be experienced, the boom shall be lowered onto a cradle (or other support) and the crane's boom, rotating bed, and lowerworks shall be secured against movement. If the crane is equipped with a mast, the mast shall 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

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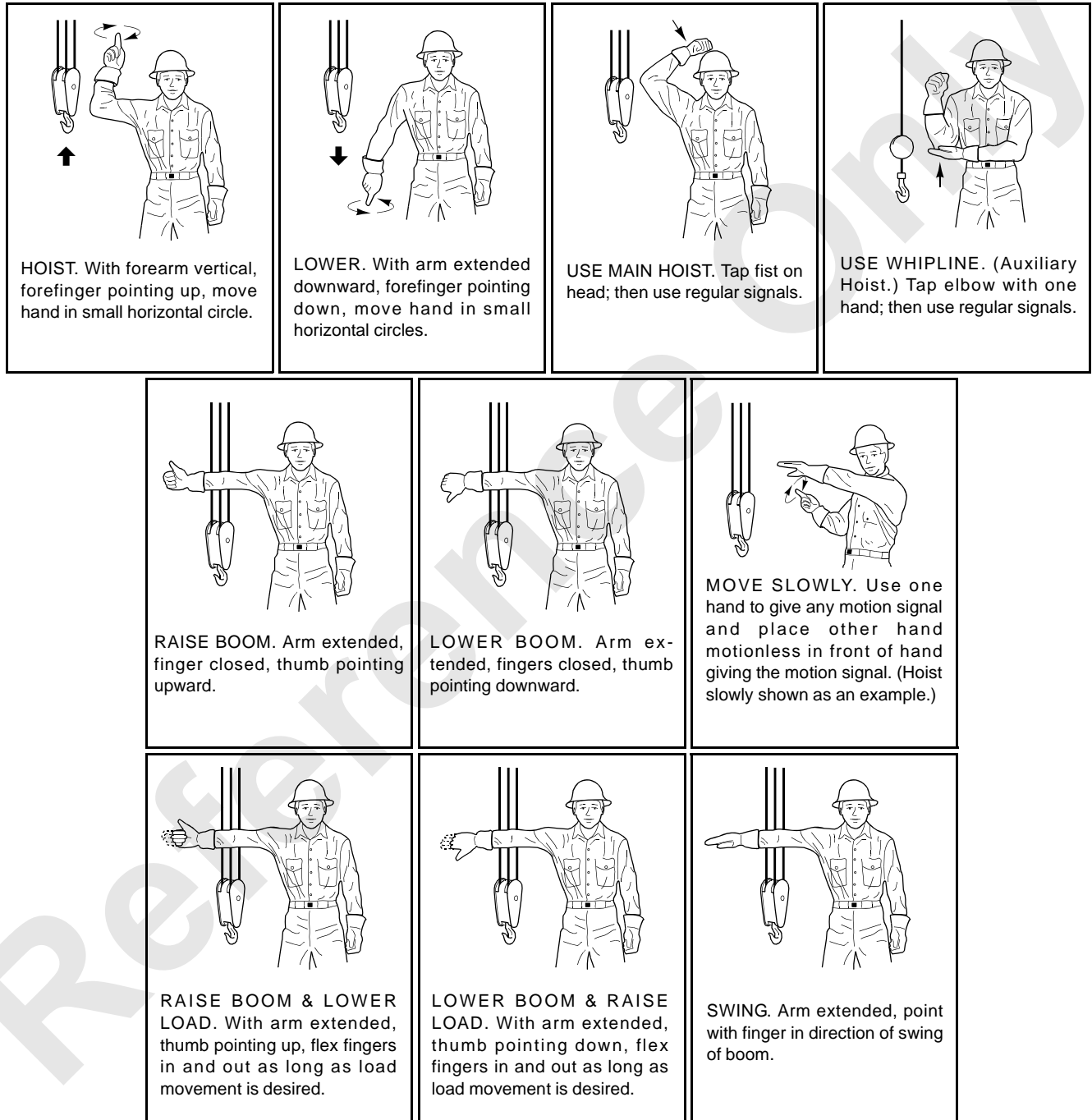
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SECTION 3 OPERATING CONTROLS AND PROCEDURES

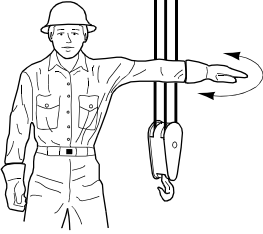
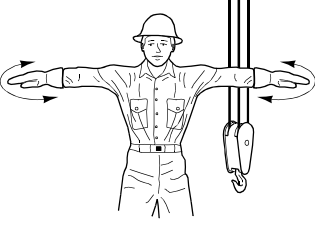
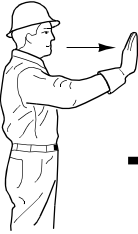

STANDARD HAND SIGNALS FOR CONTROLLING CRANE OPERATIONS

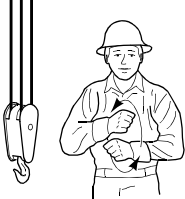
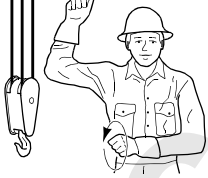
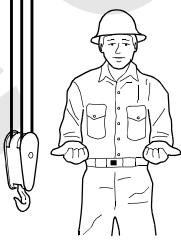

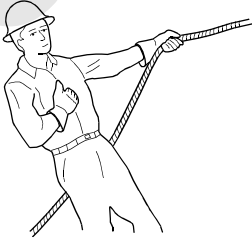
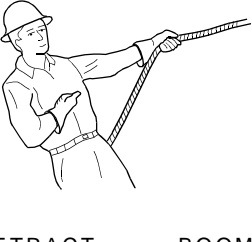
The following standard hand signals comply with ASME B30.5-2007



da0108

FIGURE 3-1

 <p>STOP. Arm extended, palm down, move arm back and forth horizontally.</p>	 <p>EMERGENCY STOP. Both arms extended, palms down, move arms back and forth horizontally.</p>	 <p>TRAVEL. Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.</p>	 <p>DOG EVERYTHING. Clasp hand in front of body.</p>
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 <p>TRAVEL. (Both Tracks.) Use both fists in front of body, making a circular motion about each other, indicating direction of travel; forward or backward.</p>	 <p>TRAVEL. (One Track.) Lock the track on side indicated by raised fist. Travel opposite track in direction indicated by circular motion of other fist, rotated vertically in front of body.</p>	 <p>EXTEND BOOM. (Telescoping Booms.) Both fists in front of body with thumbs pointing outward.</p>
 <p>RETRACT BOOM. (Telescoping Boom.) Both fists in front of body with thumbs pointing toward each other.</p>	 <p>EXTEND BOOM. (Telescoping Boom.) One Hand Signal. One fist in front of chest with thumb tapping chest.</p>	 <p>RETRACT BOOM. (Telescoping Boom.) One hand signal. One fist in front of chest, thumb pointing outward and heel of fist tapping chest.</p>

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FIGURE 3-1 continued

SYMBOL IDENTIFICATION

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

















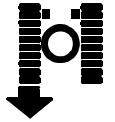
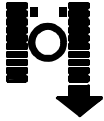





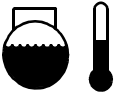
Safety Alert: Warning/Caution Operating Limit System Fault Engine Diagnostics		Data, Enter	
Hazard Warning		Data, Save Entered	
Stop (emergency)		Monitor/Display	
Off/Stop		Park On	
On/Start		Park Off	
Up (Scroll)		Limit Bypass	
Down (Scroll)		Limit Bypass, Luffing Jib	
Horn		Locked/Unlocked	

FIGURE 3-2

Swing Lock		Drum Pawl	
Swing		Split Drums	
Swing Right (Current and Past Production)		Lower Load	
Swing Left (Current and Past Production)		Raise Load	
Lower - Load, Boom, Luffing Jib, or Mast (Depends on drum use.)		Raise Boom	
Raise - Load, Boom, Luffing Jib, or Mast (Depends on drum use.)		Lower Boom	
Drum Number (Identifies which drum is in use.)		Left Crawler Travel Forward <i>Arrow indicates which crawler is operating and direction of travel with drive motors to the rear.</i>	
Drum Free Fall (with drum number)		Right Crawler Travel Forward <i>Arrow indicates which crawler is operating and direction of travel with drive motors to the rear.</i>	

FIGURE 3-2 continued

Left Crawler Travel Reverse <i>Arrow indicates which crawler is operating and direction of travel with drive motors to the rear.</i>	
Right Crawler Travel Reverse <i>Arrow indicates which crawler is operating and direction of travel with drive motors to the rear.</i>	
Travel Parked	
Travel	
Low Travel Speed	
Engine	
Engine Start (Current and Past Production)	
Engine Temperature	









Engine Run	
Engine Warning	
Engine Stop	
Engine Pressure	
Ether Starting Aid	
Slow	
Fast	
Battery Voltage	

FIGURE 3-2 continued












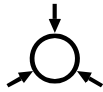




Fuel		Air Conditioning	
Contrast		Air Conditioning Temperature	
Decrease/Increase		Level Warning	
Dome Light		Windshield Wiper – Overhead with Washer	
Panel Lights (Current and Past Production)		Windshield Wiper – Front with Washer	
Blower (Fan)		Air Pressure Gauge	
Heater		Clam Closing Pressure	
Rotating Beacon Light		Energize (turn on)	

FIGURE 3-2 continued


















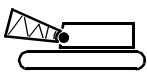
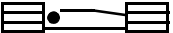
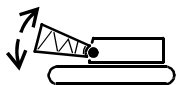
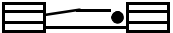

Remote Control		<p>Cylinders, Jacking – Location</p> <p>Left Front </p> <p>Right Front </p> <p>Left Rear </p> <p>Right Rear </p> <p>All </p>	
Setup Mode			
Pins – Disengage			
Pins – Engage			
Cylinders, Jacking – Extend or Retract			
Winch, Rigging– Haul In Rope		Pins – Rotating Bed Front	
Winch, Rigging – Pay Out Rope		Pins – Rotating Bed Rear	
Upper Counterweight Switch		Pins – Back Hitch	
Lower Counterweight Switch		Pins – Boom Hinge	
Left Crawler Pin		Cylinder – Boom	
Right Crawler Pin		Cylinders – Gantry	

FIGURE 3-2 continued

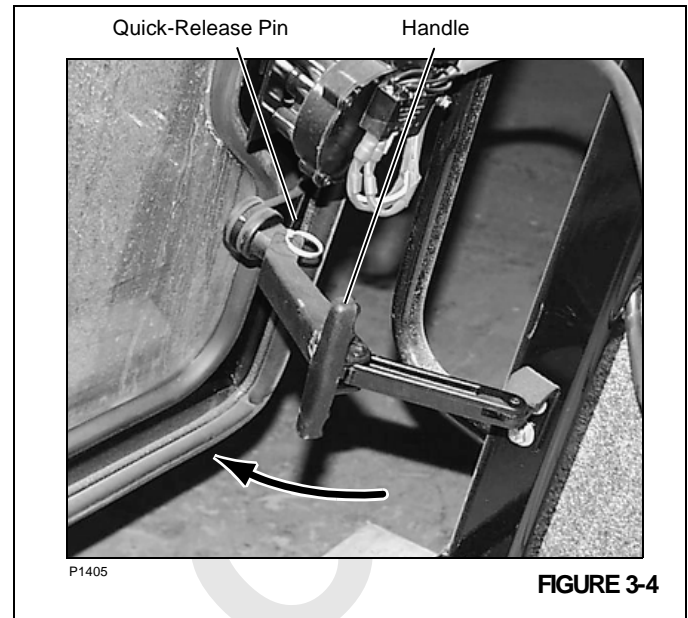
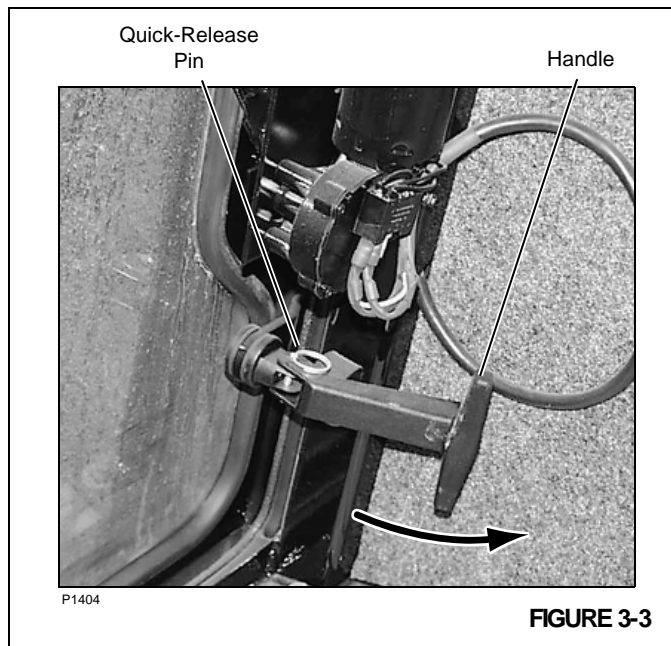
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Reference Only

FRONT WINDOW OPERATION

Closing Window

Rotate window latch handles to position shown in View A.



3

Opening Window for Ventilation

Rotate window latch handles to position shown in Figure 3-4. Window can be swung open 8 in (203 mm) for ventilation.

Opening Window for Emergency Exit

Pull out both quick-release pins. Window can be swung open fully to allow emergency exit from cab.

CONTROLS IDENTIFICATION AND FUNCTION

Refer to Figure 3-5 for the following paragraphs identifying controls and their function.

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 in this topic will not apply.

WARNING

Prevent death or serious injury to personnel!

Read and thoroughly understand instructions in this section, in Section 2, and in Capacity Chart Manual.

Contact Crane Care Customer Service at the factory for assistance if any operating procedure is not clearly understood.

Unauthorized Start-Up!

Always turn off cab power and remove key before leaving crane unattended. This practice will prevent unauthorized personnel from starting engine.

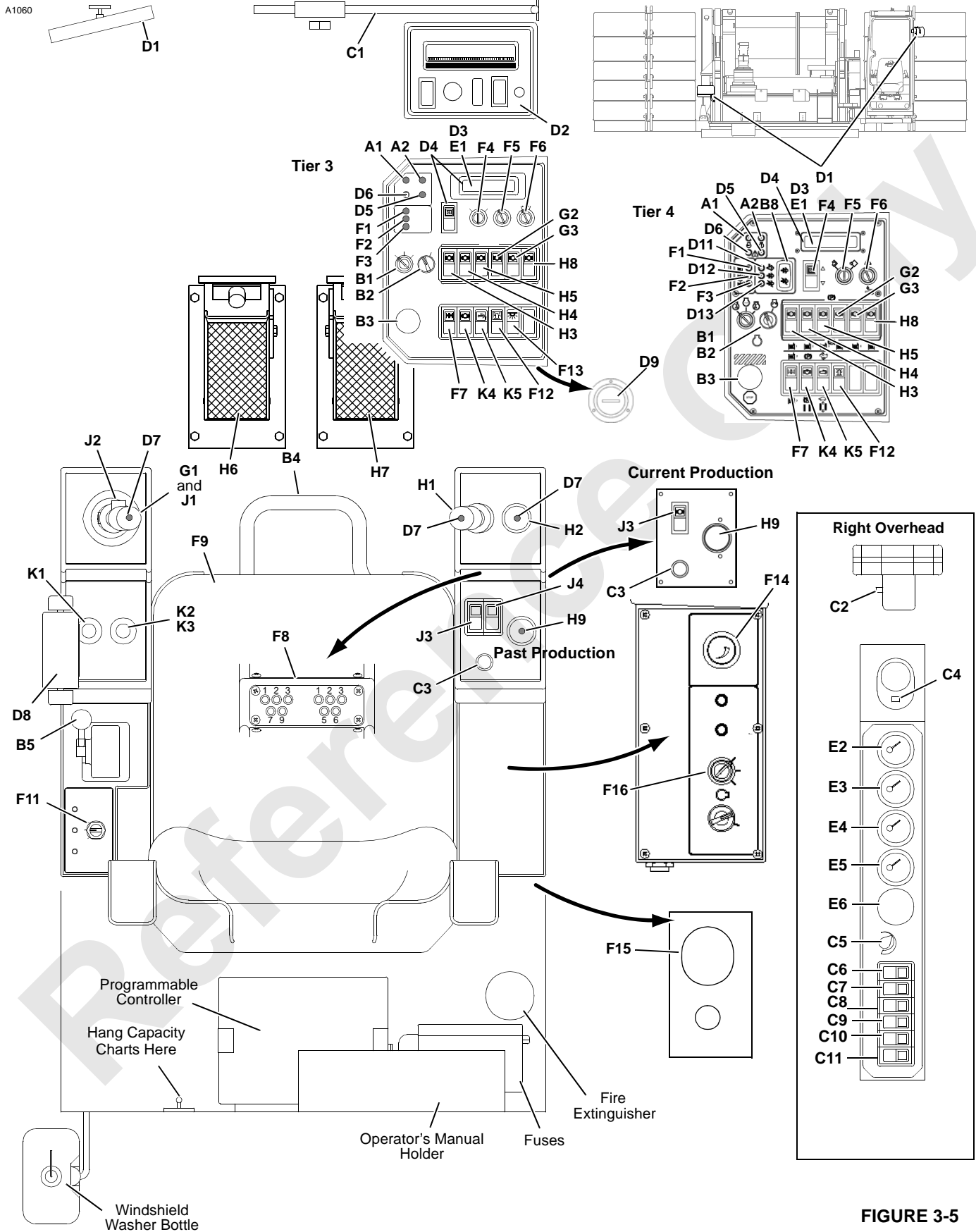


FIGURE 3-5

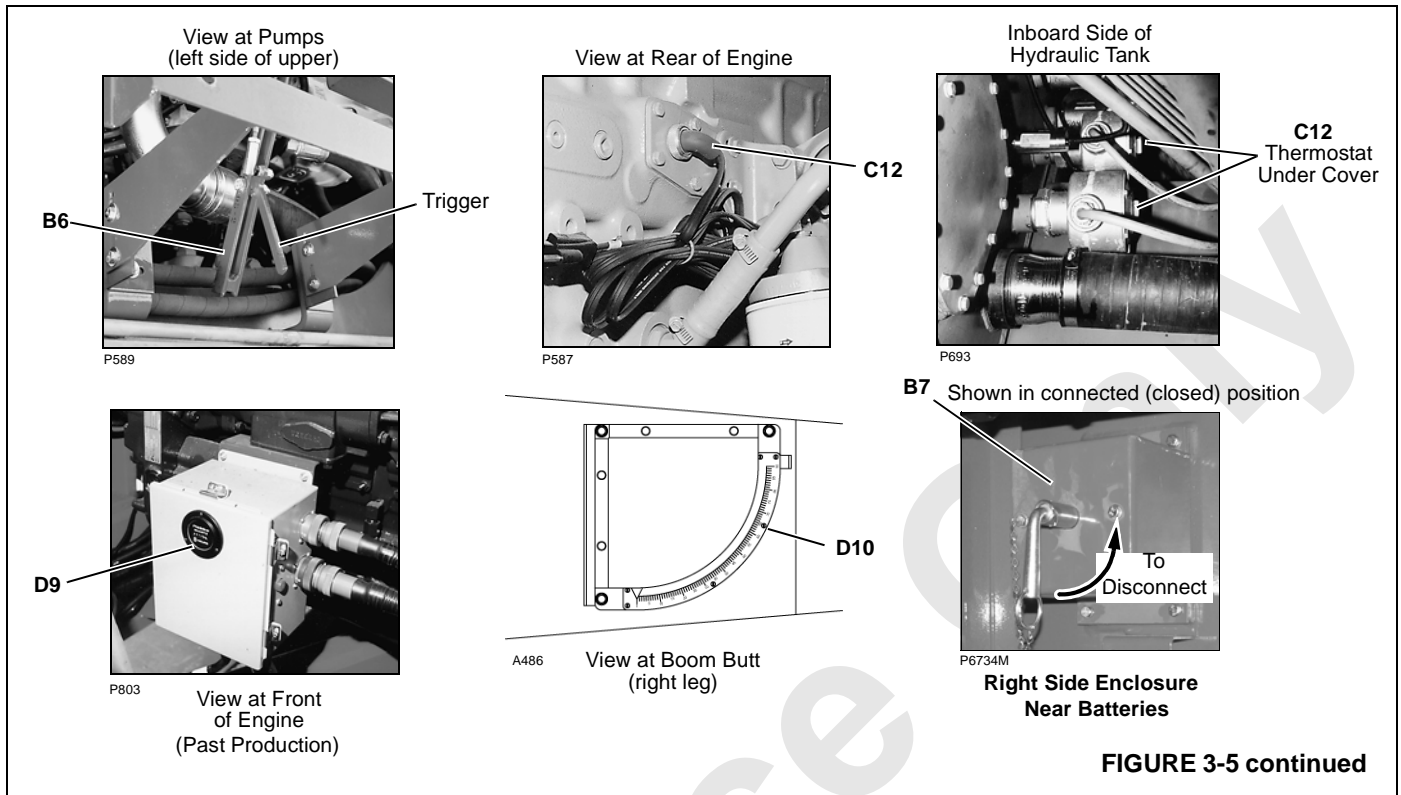


FIGURE 3-5 continued

A – Engine Diagnostics

See Figure 3-5 for the following procedure.

A1. Engine Stop Light

A2. Engine Warning Light

See Engine Diagnostics in Section 10 of the Crane Service Manual for a complete description of the engine diagnostic lights and fault codes.

B1. Engine Run/Stop/Run Key Switch

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

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

NOTE: Stopping engine in an emergency will cause all brakes to apply and any functions being operated to stop. Beware, that **functions will stop abruptly.**

B2. Engine Start Switch

Turn knob CLOCKWISE and hold to START engine. **RELEASE knob as soon as engine starts.**

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

The digital display will come on when the run/stop/run switch is in the proper position. The digital display will go off while the engine is being started.



WARNING

Avoid Unauthorized Start-Up!

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

B – Engine Controls

See Figure 3-5 for the following procedure.

NOTE: Engine start and speed controls are also mounted remotely on a junction box on the right side of the rotating bed. See Remote Controls in this section for operation of the remote controls.

CAUTION

Avoid Engine Damage!

Using too much ether starting fluid can damage engine. See engine manual for cold weather starting instructions and precautions.

B3. Emergency Engine Stop Switch

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

Beware — when knob is pushed down, engine stops, brakes apply, and any **functions being operated 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 disk brakes for proper operation before putting the crane back in service. See Section 2 of Service Manual for procedure.

NOTE: Use engine ignition switch (A1) to stop engine for normal operating conditions.

B4. Engine Foot Throttle

PRESS pedal to INCREASE engine speed above the hand throttle setting.

RELEASE pedal to DECREASE engine speed to idle or to the hand throttle setting.

B5. Engine Hand Throttle

Pull handle BACK to INCREASE engine speed.

Push 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.

Engine speed must be fast enough to provide sufficient power for the work being done. **Engine can stall under load if engine speed is too slow.**

B6. Pump Drive Disconnect Handle

SQUEEZE and hold trigger against handle.

PUSH handle toward engine to ENGAGE gears or PULL handle away from engine to DISENGAGE gears.

RELEASE trigger to LOCK handle in desired position.

CAUTION**Avoid Pump Drive Damage!**

Pump drive gears will be damaged if disconnect is not operated properly. See Engine Start-Up for instructions and precautions.

B7. Battery Disconnect Switch

Turn handle CLOCKWISE to CONNECT the battery circuit.

Turn handle COUNTERCLOCKWISE to DISCONNECT the battery circuit for the following reasons:

- When servicing the crane's electrical control system.
- If desired, to prevent batteries from discharging when the crane is stored for extended periods of time.
- If desired, to prevent crane from being started by unauthorized personnel.

CAUTION**Engine Damage!**

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

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

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

B8. DPF Switch (Tier 4 only)

NOTE: DPF = Diesel particulate filter (only on cranes with Tier 4 engine).

Press TOP of rocker to START stationary regeneration. The amber LED in the rocker will glow.

Perform a stationary regeneration only if indicated by the DPF diagnostic in the Tier 4 Engine Diagnostics — Cummins QSX-15 Tier 4, (see page 3-15 in this manual for details).

NOTE: A guard over the top of the rocker prevents unintended regeneration.

Press rocker to CENTER for NORMAL engine operation. Regeneration of the DPF will occur automatically.

Press BOTTOM of rocker to INHIBIT active regeneration. The amber LED in the rocker will glow. The switch will stay in this position until it is moved out of the position.

Use INHIBIT only for special circumstances where it is desirable to disable active regeneration. Prolonged engine operation with INHIBIT on will cause the DPF to fill with soot. Too much soot could cause the engine to stop. If that occurs it will be necessary to clean the DPF before the engine can be restarted.

See Engine Manufacturer's Manual for additional information.

C – Accessory Controls

See Figure 3-5 for the following procedure.

C1. Tinted Visor

Move to desired position to shade sun light.

C2. Defroster Fan

The defroster fan has a three-position switch with off, low, and high settings.

C3. Horn Switch

PRESS and hold button to TURN ON the horn. **Sound horn when necessary to warn or signal personnel while crane is being operated or serviced.**

RELEASE button to TURN OFF the horn.

C4. 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.

C5. Air Conditioner Temperature Selector

Rotate knob CLOCKWISE for COOLER temperatures and COUNTERCLOCKWISE for WARMER temperatures.

C6. Air Conditioner/Heater Switch

Press TOP of rocker to TURN ON the cab heater.

CENTER rocker to TURN OFF the cab air conditioner or heater.

Press BOTTOM of rocker to TURN ON the cab air conditioner.

NOTE: The shut-off valves in the heater hoses (Figure 3-6) at the engine must be open for heater operating.

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

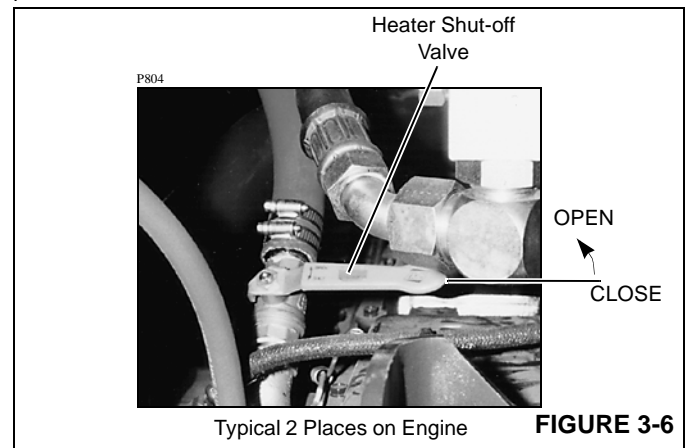
The shut-off valve in the supply line can be partially opened and closed to regulate heat.

C7. Heater/Air Conditioner Fan Switch

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

Press TOP of rocker to TURN ON the fan at high speed.

Press BOTTOM of rocker to TURN ON the fan at low speed.



Typical 2 Places on Engine

FIGURE 3-6

C8. Panel Lights Switch

Press TOP of rocker to TURN ON the panel lights.

Press BOTTOM of rocker to TURN OFF the panel lights.

C9. Windshield Washer Switch

Press and hold TOP end of rocker to SPRAY washing solution onto the upper front window.

RELEASE rocker to STOP spraying washing solution onto the upper front window.

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

C10. Front Windshield Wiper Switch

C11. Overhead Windshield Wiper Switch

Press TOP of rocker to TURN ON the wiper and operate it in HIGH SPEED.

CENTER rocker to TURN ON the wiper and operate it in LOW SPEED.

Press BOTTOM of rocker to TURN OFF the wiper.

C12. Machinery Heaters

To aid starting in cold weather, plug in the heaters at shut-down; unplug the heaters at start-up.

The hydraulic tank can be equipped with thermostatically controlled heaters (120 V or 240 V), designed to keep the oil temperature 30°F (17°C) warmer than ambient temperature. To set each thermostat, remove cover and turn knob fully clockwise to 100°F (38°C).

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

D – Indicators

See Figure 3-5 for the following procedure.

D1. 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.

D2. Load Indicator Console

See the RCL Manual for operation.

D3. Crane Level Display

Crane levelness is shown on the OPERATING CONDITIONS screen of the digital display (see Digital Display Readings in this section).

! WARNING

Tipping Hazard!

Unless otherwise specified on capacity chart, all crane operations must be performed with crane *level* to within one percent of grade – 1 ft (0,3 m) in 100 ft (30 m). Operating crane at a greater angle can cause crane to tip.

D4. Digital Display and Selector Switch

Allows the operator to monitor three groups of crane information: operating conditions, operating limits, and system faults. See Digital Display Readings in this section for tables identifying the information which can be displayed.

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

D5. Operating Limit Alert

GLOWS YELLOW and a BUZZER comes ON to alert the operator that an operating limit has been reached (limit automatically appears on digital display). See Digital Display Readings in this section for a list of operating limits, function responses, and corrective actions.

D6. System Fault Alert

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 in this section for a list of system faults, causes, function responses, and corrective actions.

D7. Rotation Indicators

Move UP and DOWN to signal operator by feel, that 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.

D8. 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).

D9. Engine Hourmeter

Shows the total number of hours the engine has been run. Mounted on engine junction box (past production) or on front console (current production).

D10. Boom Angle Indicator

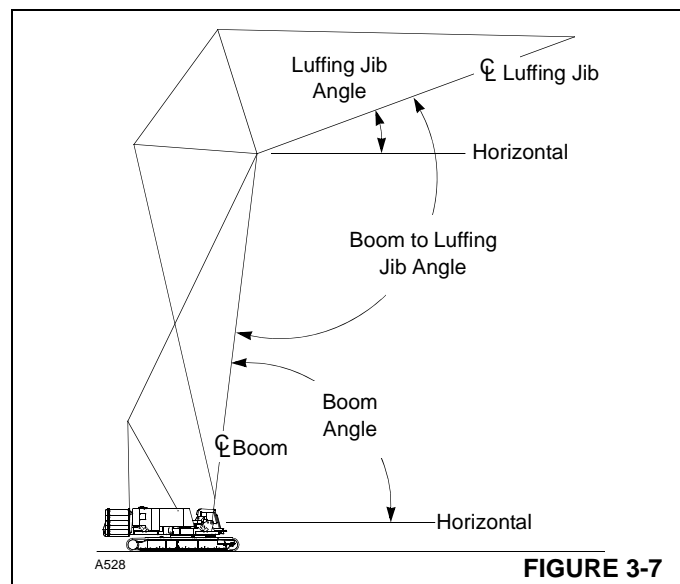
Shows the angle of the boom in degrees above horizontal. The boom and luffing jib angles can also be viewed on the OPERATING CONDITIONS screen of the digital display. See Figure 3-7 for identification of the various boom and luffing jib angles.

! WARNING

Overload Hazard!

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

IN ALL CASES, radius shall govern capacity. Exceeding radius given in capacity chart can result in tipping or structural damage.



D11 – High Exhaust System Temperature (Tier 4)

GLOWS YELLOW to alert that operator that the exhaust system temperature is higher than normal due to DPF regeneration.

WARNING**High Exhaust Temperatures!**

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 and possible death.

D12 – DPF ON (Tier 4)

Displays one of three conditions if the Regeneration Inhibit switch is on (see Figure page 3-12 and the Engine Manufacturer's Manual for additional information):

- GLOWS YELLOW when DPF is active and starting to fill. **Turn off regeneration inhibit switch.** No immediate action is required.
- FLASHING when DPF is nearly full. The operator may sense a reduction in power. **Turn off regeneration inhibit switch.** Perform a manual stationary regeneration of the DPF at earliest convenience.
- OFF when DPF is full and Red Engine Warning Light is ON. The soot level is critically high and past the point of a manual stationary regeneration. The operator will notice a significant reduction in engine power. **Turn off regeneration inhibit switch and shut down crane.** Do **NOT** perform a manual stationary regeneration. The DPF must be removed from the crane and physically cleaned and the Red Engine Warning Light can only be cleared by a Cummins Service Technician. (see Engine Manufacturer's Manual for details).

D13 – DPF Regeneration Inhibit (Tier 4)

GLOWS YELLOW when active regeneration has been stopped by pressing the Inhibit function (bottom) of the regeneration switch (B8). Excessive use of regeneration inhibit will result in the need to service or replace the DPF.

E – Gauges

See Figure 3-5 for the following procedure.

E1. Hydraulic Tank Temperature Display

Hydraulic tank temperature is shown on the OPERATING CONDITIONS screen of the digital display (see Digital Display Readings in this section).

CAUTION**Avoid Pump Damage!**

Do not operate crane functions until temperature of hydraulic oil is at least 60°F (16°C). Damage to pumps and related hydraulic parts can result if this precaution is not followed.

E2. Fuel Level Gauge

Shows how much fuel is left in the fuel tank.

E3. Engine Water Temperature Gauge

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

E4. Engine Oil Pressure Gauge

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

E5. Battery Voltage Gauge

Shows the condition of the battery charging system. For a complete description of meter readings, see Figure 3-8.

E6. Air Pressure Gauge

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

F – Special Controls/Indicators

See Figure 3-5 for the following procedure.

NOTE: See Figure 3-9 for drum identification.

F1. Drum 1 Free-Fall Light**F2. Drum 2 Free-Fall Light****F3. Drum 3 Free-Fall Light**

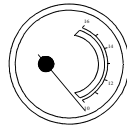
GloWS YELLOW when free-fall is on for the corresponding load drum.

Engine not running or running at idle.

Engine running fast enough to make alternator produce.

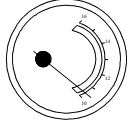
1 - Dead or disconnected battery. Disconnected or badly connected meter.

A915



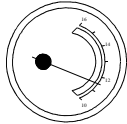
1 - Disconnected meter. Engine could not run with dead or disconnected battery unless circuit was completed around battery.

2 - Very low battery charge. Engine might not start.



2 & 3 - When pointer stays below 13.3V 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 & 5 - When engine is started, pointer might stay in this area temporarily, but it should gradually rise above 13.3V 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 & 7 - Under normal conditions, a 12V battery is fully charged at 12.8V. A slightly higher reading might occur under conditions outlined in No. 5; generally speaking, however, any reading above 12.8V when engine is stopped is not a true reading.



6 - This is area where pointer should be when alternator, voltage regulator, and battery are all in good condition and working properly.



7 - When pointer goes above 15.2V, voltage regulator is set too high or jammed; continued operation of engine will burn out battery.

FIGURE 3-8

F4. Crane Mode Selector



WARNING Moving Load Hazard!

Operator must select proper operating mode prior to operating.

Unexpected drum motion or improper limit responses can result if wrong mode is selected.

Insert and turn key CLOCKWISE and hold to SELECT the desired crane mode. CRANE MODE appears on 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 key COUNTERCLOCKWISE to CONFIRM the desired crane mode when it appears on the digital display.

Release key to CENTER. **Remove key to prevent unauthorized operation.**

NOTE: To check the crane mode in effect at anytime, 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 start-up, 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.

The following crane modes are available:

Main 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

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)

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 Luffing Jib Attachment 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)

Same as standard mode, except Drum 5 is also operable (see Figure 3-9).

TANDEM DRUM

Same as standard mode, except that two load drums operate at the same time with the left handle (see Figure 3-9).

CRANE SET-UP

Same as standard mode except:

- Operating limit fault is turned on.
- Boom hoist handle controls Drum 4 regardless of auxiliary mode.
- Drum 1 and 2 control handles control 2250's main and auxiliary drums regardless of auxiliary mode.
- Boom Max UP and Mast 80° Degree operating limit faults are disabled.
- Luffing jib angle sender fault is disabled.
- Boom to high and jib too low portions of 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).



WARNING Falling Boom Hazard!

Crane setup mode is provided for crane assembly and disassembly purposes only.

Do not use this mode for normal load handling operations. Boom up limit is inoperable which could allow boom to be pulled over backwards.

LUFFING JIB SET-UP

On Crane Serial Number 2251337 and newer — cranes without Luffing Jib Limit Bypass Switch (F6) — this mode allows the limits listed in Table 3-2 to be bypassed with Limit Bypass Switch (F5).

Auxiliary Modes

FFALL

Allows the desired load drum (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!

For MAX-ER 2000, do not switch Drum 2 (boom hoist) to free-fall. Boom will fall uncontrolled.

To **TURN ON FREE-FALL** for the desired load drum, proceed as follows. The following example is for Drum 1. The process is the same for the other drums.

1. Bring Drum 1 to complete stop.
2. Press down drum working brake pedal fully. **Free-fall cannot be turned on until this step is performed.**

3. Turn mode selector key **CLOCKWISE** and hold until DRUM 1 FFALL OFF appears on digital display.
4. Turn mode selector key **COUNTERCLOCKWISE** to CONFIRM free-fall.
5. DRUM 1 FFALL ON will appear on digital display and Drum 1 free-fall light will glow yellow.

To **TURN OFF FREE-FALL** for the desired load drum, proceed as follows. The following example is for Drum 1. The process is the same for the other drums.

1. Press down drum working brake pedal fully to bring Drum 1 to complete stop.
2. Turn mode selector key **CLOCKWISE** and hold until DRUM 1 FFALL ON appears on digital display.
3. Turn mode selector key **COUNTERCLOCKWISE** to CONFIRM free-fall.
4. DRUM 1 FFALL will appear on digital display (word ON will disappear) and Drum 1 free-fall light will turn off.

NOTE: When free-fall is off, the corresponding load drum operates in full-power. See Load Hoist Controls in this section for a description of full-power operation.

MAXER

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

Reference Only

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Table 3-1 Bypassable Limit Identification — Prior to Crane Serial Number 2251337

Limit	Limit Bypass Switch (F5) (momentary key switch)	Limit Bypass Switch (F5) (momentary key switch)	Luffing Jib Limit Bypass (F6) ^{1,2} (maintained key switch)
	Non-CE ¹	CE	
Boom Up Limit	Yes or No ⁴	No	Yes or No ⁴
Boom Down Limit	Yes	Yes	No
Block-Up Limit (each drum)	Yes	Yes	No
Bail Limits - Max & Min (each drum)	Yes	Yes	No
Rated Capacity Indicator/Limiter	Yes	Yes	No
Luffing Jib Maximum UP 1	Yes	No	Yes
Luffing Jib Maximum UP 2	Yes ⁵	Yes	No ⁵
Luffing Jib Maximum Down	Yes	Yes	No

¹ This switch is not provided on current production cranes.

² Use only for rigging.

³ CE = Cranes that comply with European Requirements.

⁴ The boom up limit cannot be bypassed on current production cranes. To determine if the boom up limit can be bypassed on your crane, perform the test given on page 3-28 in this section.

⁵ Only when boom is below 50°.

Table 3-2 Bypassable Limit Identification — Crane Serial Number 2251337 and Newer

Limit	Limit Bypass Switch (F5) (momentary key switch)		Limit Bypass Switch (F5) (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 & 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 UP 1	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 Limit Bypass Switch (F5) for instructions.

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 boom is below 50°.

F5. Limit Bypass Switch



WARNING

Falling Boom or Load Hazard!

When bypassing a limit, follow instructions under Limit Devices topic in this section carefully.

This switch bypasses the limits identified in Table 3-1 and Table 3-2.

Insert key. Turn CLOCKWISE to BYPASS the reached operating limits. This position allows the functions to be operated beyond the limits.

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

Remove key to prevent unauthorized operation.

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 limit bypass switch (F5) 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.

F6. Luffing Jib Limit Bypass Switch

This switch is not provided on current production cranes.

This switch bypasses the limits identified in Table 3-1.

This switch is provided to allow the jib up limit (maximum boom to luffing jib angle) to be bypassed when the boom and luffing jib are lowered to the ground.

Insert key. Turn CLOCKWISE to BYPASS the jib up limit. All other limits will be operational.

Turn key COUNTERCLOCKWISE to ACTIVATE the jib up limit and allow it to operate in the normal manner. **Key must be in this position for all normal operation. Otherwise, structural damage can occur.**

Remove key to prevent unauthorized operation.

F7. Drum Selector

Press FRONT end of rocker to operate DRUM 2 load drum.

Press REAR end of rocker to operate DRUM 3 load drum.

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

Drum clutch releases and the drum parking brake will apply to prevent the unused drum from turning.

F8. 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 3-9 for drum and handle identification.

F9. Seat Switch

Prevents the crane from being operated until the operator is seated. When the operator is not seated, all control handles are inoperable, all parking brakes are applied, free-fall is turned off, and the travel detent is turned off.

F10. Not Used

F11. MAX-ER Controls

MAX-ER 400 controls shown. Controls vary by model; see the MAX-ER Operator's Guide for identification and operation of the MAX-ER controls.

F12. Aircraft Beacon Warning Light - (Optional)

Press TOP of the rocker to TURN ON red aircraft warning beacon light on boom or jib top.

Press BOTTOM of rocker to TURN OFF beacon light.

F13. Dome Light - (Optional)

Press TOP of the rocker to TURN ON dome light.

Press BOTTOM of rocker to TURN OFF dome light.

F14. Dome Light Dimmer Control - (Optional)

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

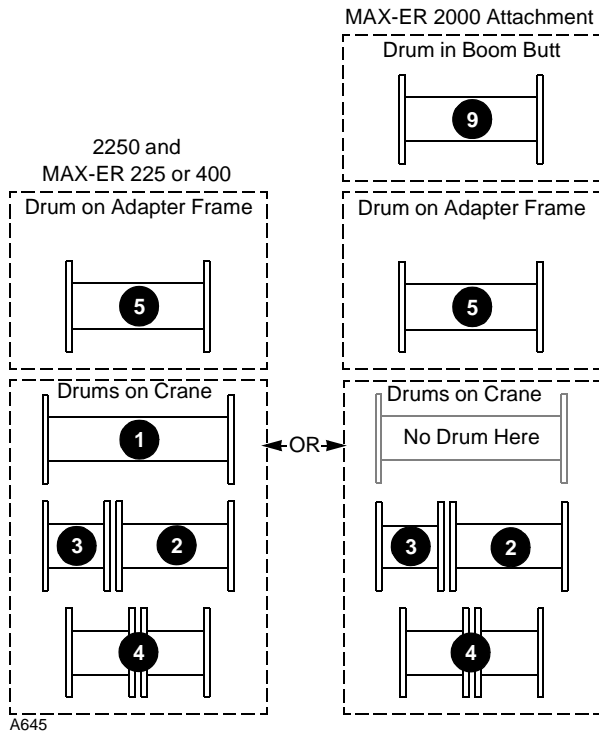
F15. Clam Closing Control and Air Pressure Gauge

See page 3-52 for detailed operating instructions.

F16. Auxiliary Engine Controls

See page 3-50 for detailed operating instructions.

Drum Identification



Drum Number	2250 and MAX-ER 225 or 400	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 (MAX-ER)	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. Desired drum must be selected with drum selector.
- NOTE 2:** Only one drum (boom or luffing) can be operated at a time. To operate boom hoist, select standard mode. To operate luffing hoist select Drum 5 (Luff Hoist). Drum not in use must be parked before other drum can be used.
- NOTE 3:** If auxiliary hoist is powered by boom hoist circuit, only one drum (boom or auxiliary) can be operated at a time. Drum not in use must be parked before other drum can be used.
- If auxiliary hoist is powered by travel circuit, auxiliary drum and travel cannot be operated at same time. Function not in use must be parked before other function can be used.
- Auxiliary drum is always controlled by Handle C. All other drums that could be controlled by Handle C are parked and inoperable.
- Drum 5 (Aux Hst) mode is not available for Clamshell Attachment.



WARNING

Falling Boom and Jib Hazard!

Do not use Drum 5 (Aux Hoist) to operate luffing hoist when equipped with MAX-ER 2000 Attachment. Luffing jib limits are turned off in this mode. Boom and luffing jib could be pulled over backwards.

To operate luffing jib on a MAX-ER 2000, always select Drum 5 (Luff 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 MAX-ER 2000 mast with Drum 4. See MAX-ER Assembly and Disassembly Guide.

FIGURE 3-9

Handle-to-Drum Identification

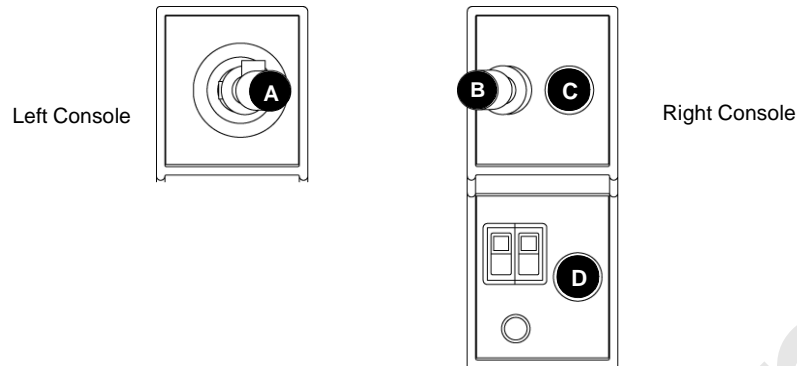


FIGURE 3-9 continued

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*) (225 or 400)				
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)	
MAX-ER Mode (M*) (2000) (NOTE 5)				
	2 - Boom Hoist	9 - Boom Butt	3 - Left Rear	

G – Boom/Luffing Hoist Controls

See Figure 3-5 for the following procedure.

NOTE: Drum 5 can also be used as an auxiliary hoist (load drum). See Drum 5 Operation on page 3-56.

G1. Boom/Luffing Hoist Handle

Both hoists — boom (Drum 4) and luffing (Drum 5) — have a spring-applied, hydraulically-released disc brake. The brake will spring apply 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 handle to REAR to RAISE the boom or luffing jib. The brake releases and speed increases in relation to handle movement.

Release handle to CENTER to STOP the boom or luffing jib. Speed decreases to off and the brake applies to stop the boom or luffing jib and hold it in position.

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

G2. Drum 4 Park Switch

The Drum 4 park switch enables and disables boom hoist operation. With 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 TOP of rocker to TURN ON boom hoist park and engage drum pawl.

Press BOTTOM of rocker to TURN OFF boom hoist park (allow boom hoist to be operated) and disengage drum pawl.

G3. Drum 5 Park Switch

The Drum 5 park switch enables and disables luffing hoist operation. With 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 TOP of rocker to TURN ON luffing hoist park and engage drum pawl.

Press BOTTOM of rocker to TURN OFF luffing hoist park (allow luffing hoist to be operated) and disengage drum pawl.

H – Load Drum Controls

See Figure 3-5 for the following procedure.

Each load drum has a spring-applied, air-released, band-type parking brake. The brake will spring apply 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 anytime to stop the load drum.

Full-Power Mode (either load drum)

- The drum parking brake applies when the drum handle is released to off.
- The drum parking 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 parking brake remains released at all times.
- The drum clutch releases when the drum handle is moved to off. **Use drum working brake to control 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, load will lower uncontrolled if drum brake is not applied with brake pedal when load drum handle is moved to off.

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

CAUTION

Avoid Clutch/Motor Damage!

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

For same reason, do not turn off free-fall or turn on drum park while free-falling a load. Stop load with brake pedal; then turn off free-fall or turn on drum park.

H1. Left Handle

H2. 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 3-9 for drum and handle identification.

For the following procedure, see Figure 3-10.

Move handle to FRONT to LOWER the load.

Release handle to CENTER to STOP the load and hold it in position.

In free-fall mode, drum brake must be applied with brake pedal to stop and hold load (see Figure 3-11).

Move handle to REAR to RAISE the load.

H3. Drum 1 Park Switch

H4. Drum 2 Park Switch

H5. Drum 3 Park Switch

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

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

Press TOP of rocker to TURN ON corresponding drum park.

Press BOTTOM of rocker to TURN OFF corresponding drum park (allow drum to be operated).

H6. Left Working Brake Pedal

H7. Right Working Brake Pedal

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

For the following procedure, see Figure 3-11.

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

PRESS pedal to APPLY working brake in relation to pedal movement. Fully press and latch pedal to fully apply brake.

RELEASE pedal to RELEASE working brake gradually as pedal is eased up (press heel of latch to unlatch pedal).

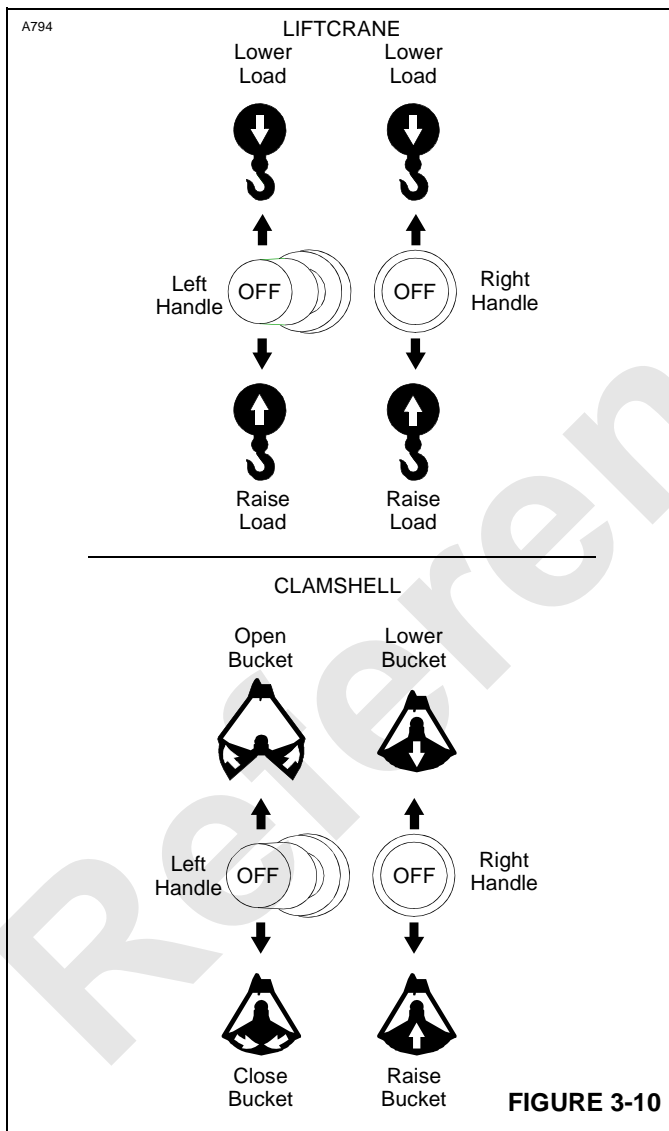


FIGURE 3-10

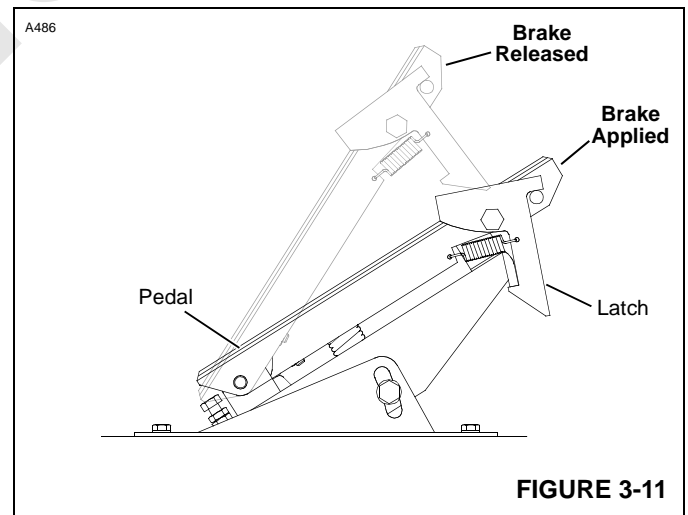


FIGURE 3-11

H8. Drum 9 Park Switch

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

Press the TOP of rocker to TURN ON the corresponding drum park and engage the drum pawl.

Press the BOTTOM of rocker to TURN OFF corresponding drum park and disengage the drum pawl to allow drum operation.

H9. Auxiliary Drum 5 Handle (Optional)

See Figure 3-9 and page 3-56 for identification and operation of the Drum 5 auxiliary hoist controls.

J – Swing Controls

See Figure 3-5 for the following procedure.

J1. Swing Handle

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

Move handle to LEFT to SWING LEFT. Swing speed increases in relation to handle movement.

Release handle to 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 handle to 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.

J2. Swing Holding Brake Switch

Use the swing holding brake switch (on side of 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 button to APPLY the swing holding brake.

RELEASE button to RELEASE the swing holding brake.

CAUTION**Avoid Swing Drive or Boom Damage!**

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

J3. Swing Brake Switch

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

Press FRONT of rocker to TURN ON the swing brake.

Press REAR of rocker to TURN OFF the swing brake.

J4. Swing Lock Switch

NOTE: On current production cranes, the swing lock has been disabled and the rocker switch has been removed from the console.

The swing lock provides a positive means of locking the rotating bed in position when swinging is not required.

Press FRONT of rocker to ENGAGE the swing lock with the ring gear.

Press REAR of rocker to DISENGAGE the swing lock from the ring gear.

CAUTION**Avoid Swing Lock Damage!**

Do not engage swing lock while swinging; structural damage to swing lock and ring gear will result. Do not swing until swing lock is disengaged.

K – Travel Controls

See Figure 3-5 for the following procedure.

The crawlers are equipped with spring-applied, hydraulically-released disc brakes.

- 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.

K1. Left Crawler Handle**K2. Right Crawler Handle**

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

Move handle to FRONT to travel FORWARD. Speed increases in relation to handle movement.

Release handle to CENTER to STOP traveling.

Move handle to 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.

K3. 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 desired speed and direction of travel. PULL UP and release KNOB on right crawler handle to TURN ON the travel detent. Release 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.

K4. 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 TOP of rocker to TURN ON travel park.

Press BOTTOM of rocker to TURN OFF travel park (allow travel to be operated).

K5. Travel Speed Selector

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

Press BOTTOM end of rocker 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:

- 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 Crane Assembly and Disassembly before selecting setup mode or using setup controls.

LIMIT DEVICES

See Table 3-1 to determine which limit bypass switch bypasses a given limit.

1. Boom Up Limit

Automatically stops the boom when it is raised to a preset maximum angle:

- 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's Manual supplied with the MAX-ER.



WARNING Falling Boom/Jib Hazard!

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

Crush Hazard!

Maintain constant communication between operator and assistant during the following steps.

Stay clear of moving parts.

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 boom up limit switch plunger in to trip limit switch open.
3. Rotate limit bypass key (F5) to the bypass position and hold.
4. Try to boom up **SLOWLY** — do not raise the boom any higher than necessary to perform the test:
 - a. If the boom rises, your boom up limit can be bypassed.
 - b. If the boom does not rise, your boom up limit cannot be bypassed.

The test is complete: release the limit bypass key and the boom stop rod to the normal operating positions.

2. Boom Down Limit (if equipped)

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



WARNING Falling Boom Hazard!

When lowering boom below down limit, do so slowly with extreme caution. Do not lower boom to point where less than three full wraps of wire rope are on boom hoist drums; wire rope could be pulled out of drums allowing boom to fall.

3. Block-Up 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 appropriate limit bypass switch must be turned to the bypass position before the load can be hoisted above the limit.



WARNING Two-Blocking Hazard!

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

Do not hoist load above minimum block clearance given on Range Diagram in Capacities Section of your Operator's Manual.

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

4. Luffing Jib Up Limit

Two luffing jib up limits are provided:

- **LUFFING JIB MAX UP 1** limit which automatically stops the luffing hoist when the boom to luffing jib angle is 168°.

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

- **LUFFING JIB MAX UP 2** limit which 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°). Rotate corresponding limit bypass switch to bypass position to bypass limit.

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

NOTE: For Crane Serial Number 2251337 and newer meeting 2010 European Requirements, the luffing jib cannot be lowered after the jib maximum up 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 lowered.

LUFFING JIB MAX UP 2
CONFIRM TO RESET

FIGURE 3-12

**WARNING****Falling Boom/Jib Hazard!**

Proceed slowly when operating the luffing jib above the Max Up 1 limit.

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

5. Luffing Jib Max Down Limit

On past production cranes, this limit automatically stops the luffing jib when the boom to luffing jib angle is 60°.

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

6. Luffing Jib Down Limits

On Crane Serial Number 2251337 and newer, two luffing jib down limits are provided. Both limits can be bypassed as indicated in Table 3-2.

- **LUFFING JIB MAX DOWN 1** limit which automatically stops the luffing hoist when the boom to luffing jib angle is:
 - 73° if equipped with a MAX-ER 2000 attachment.
 - 63° for all other attachments.

- **LUFFING JIB MAX DOWN 2** limit which automatically stops the luffing hoist when the boom to luffing jib angle is:
 - 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.

NOTE: For Crane Serial Number 2251337 and newer meeting 2010 European Requirements, the luffing jib cannot be raised after jib maximum down 2 limit is contacted until the limit switch is reset. When the limit is contacted, the screen shown in Figure 3-13 will appear on the digital display.

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

LUFFING JIB MAX DN 2
CONFIRM TO RESET

FIGURE 3-13

**WARNING****Falling Boom/Jib Hazard!**

Do not lower luffing jib below minimum angle given in Luffing Jib Raising Procedure in Capacity Chart Manual. Structural damage can result, possibly causing boom and luffing jib to collapse.

7. Maximum Bail 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 appropriate limit bypass switch must be turned to the bypass position before the boom can be hoisted above the limit.

**WARNING****Falling Load Hazard!**

Do not exceed maximum allowable spooling capacity given on Wire Rope Specifications Chart in Capacities Section of your Operator's Manual. Wire rope could jump off drum allowing load to fall.

7. Minimum Bail 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 appropriate limit bypass switch must be turned to the bypass position before the load can be lowered below the limit.

**WARNING****Falling Load Hazard!**

When lowering load below minimum bail limit, do so slowly with extreme caution. Do not lower load to point where less than three full wraps of wire rope are on drum. Wire rope could be pulled out of drum allowing load to fall.

8. Load Indicator

See RCL Manual for operating instructions.

**WARNING****Overload Hazard!**

Crane load indicator has been installed on crane to aid operator.

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

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

9. Mast Up Limit

For MAX-ER 2000, this limit automatically stops the mast when it is raised to 80° in the 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 limit when raising mast to operating position, switch to standard setup mode (MAX-ER mode off).

**WARNING****Falling Mast Hazard!**

Do not raise mast above 80° except when raising mast to operating position. When raising mast to operating position, make sure proper size hold-back is used to prevent mast from falling over backwards.

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

SEAT CONTROLS

A794

CAUTION

Avoid Damage!

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

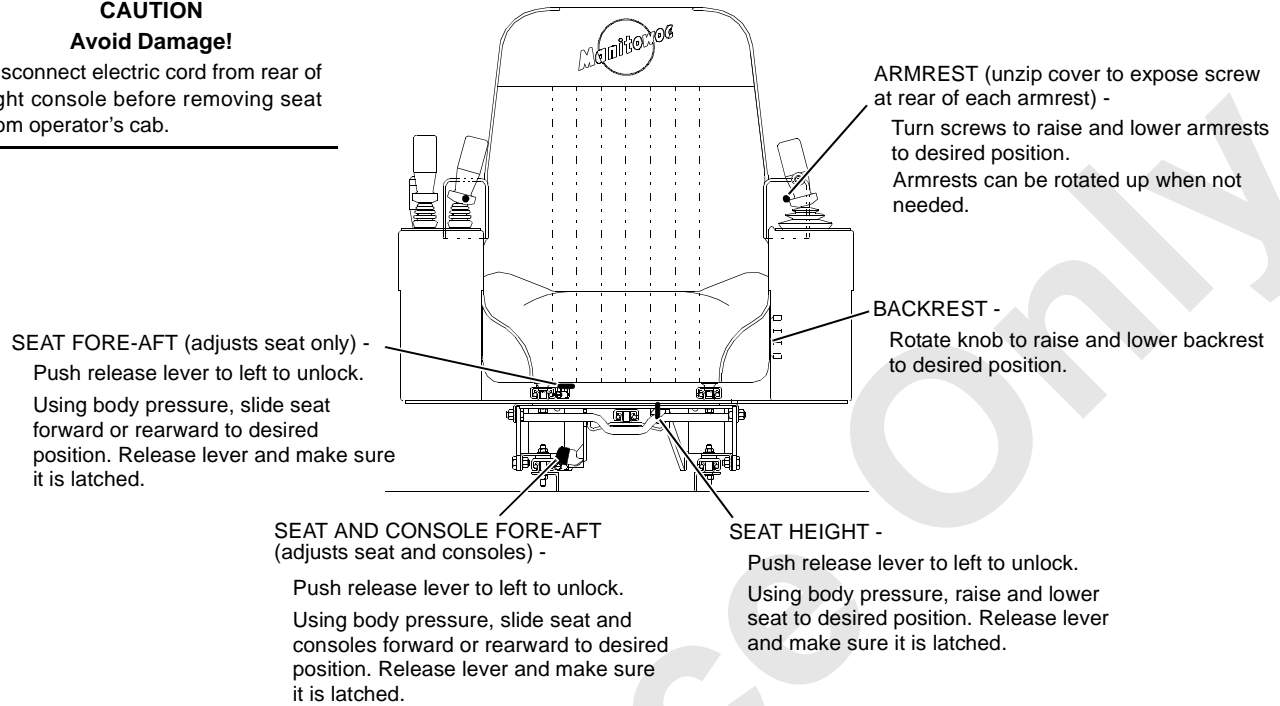


FIGURE 3-14

PREPARING CRANE FOR OPERATION



WARNING

Read Capacity Charts!

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

Crane must be rigged and operated according to instructions given in capacity charts and rigging guides.

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

Observe minimum block weight requirement given on capacity charts.

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

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

Do not operate crane, to include raising boom from ground level, if wind exceeds limits given in Capacity Charts. Contact your local weather station for wind velocity.

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



WARNING

Moving Load Hazard!

Operator must select proper operating mode prior to operation.

Unexpected drum motion or improper limit responses can result if wrong mode is selected.

Limit bypass switches must be in activate position and all limits with which crane is equipped must be operational before operating crane. See Service Manual for adjustment procedures.

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

CAUTION

Avoid Machinery Damage!

Before operating crane at start of each shift, perform preventive maintenance checks and lubrication services listed in your Operator's Manual. Adjust operator's seat as shown in Figure 3-14.

OPERATION

Engine Start-up



WARNING

Avoid injuring personnel or damaging crane and property:

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

See engine manual for additional start-up instructions and precautions.

1. Unplug or turn off engine block heater and any other tank heaters crane is equipped with.
2. Open hydraulic shut-off valve (Figure 3-15).

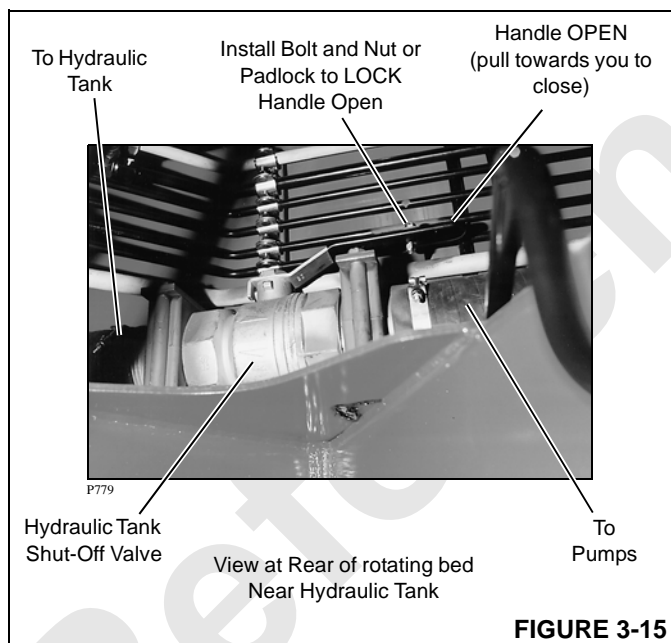


FIGURE 3-15

CAUTION

Avoid Pump Damage!

Do not start engine until hydraulic shut-off valves are open; otherwise, pumps could cavitate and be damaged.

3. Turn engine run/stop/run key switch to RUN position.

NOTE: The operating limit alert and the system fault alert (lights, buzzer, beeper) should come on for three

seconds when the run/stop/run switch is moved to proper run position; if not, replace worn parts.

4. If required, disengage pump drive, as shown in Figure 3-16. This step will disconnect the pumps from the engine and aid in cold weather start-up.

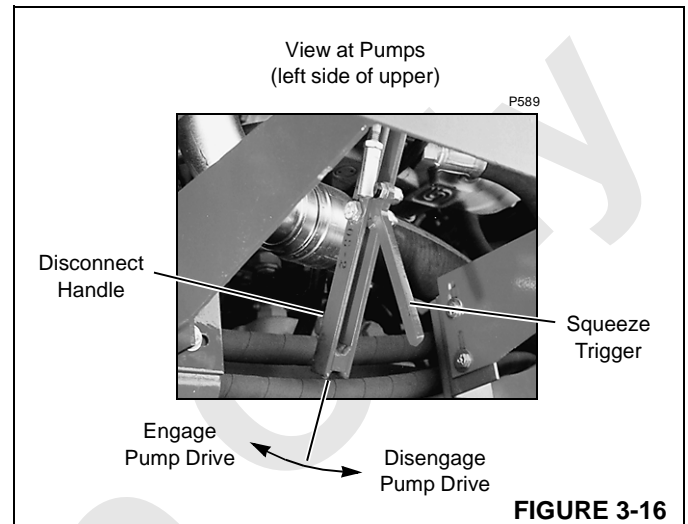


FIGURE 3-16

CAUTION

Avoid Pump Drive Damage!

Observe following precautions when equipped with a pump drive disconnect:

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

5. Turn engine start switch to START engine.

CAUTION

Avoid Starter Motor Damage!

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

NOTE: The engine has a ether starting aid which is activated automatically when needed by the engines computer. There is not need to manually spray ether into the engine during cold weather starts.

6. Increase engine speed as necessary to keep engine running after it starts.
7. If disengaged, engage pump drive within 2 minutes after starting engine.

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

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 crane when system fault alert is on. If alert does not go off soon after engine is started or comes on during operation, immediately proceed as follows:

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

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

CAUTION

Avoid Machinery Damage!

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

Boom/Luffing Hoist Operation

! WARNING

Falling Boom/Jib Hazard!

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

CAUTION

Avoid Rigging Damage!

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

See Boom or Luffing Jib Rigging Drawings for wire rope and reeving specifications. See Wire Rope Installation for instructions on attaching wire rope to drums.

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

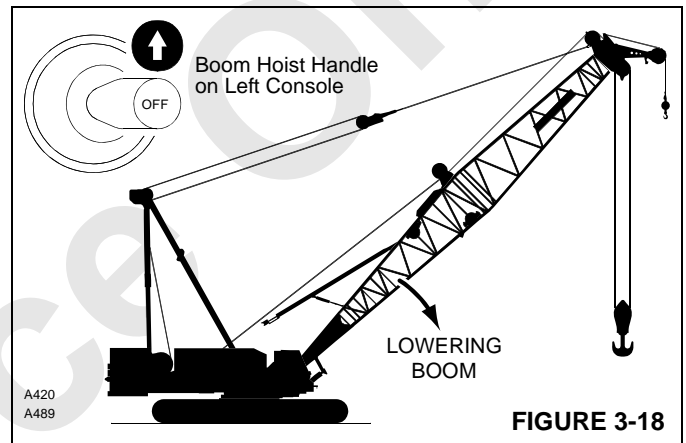
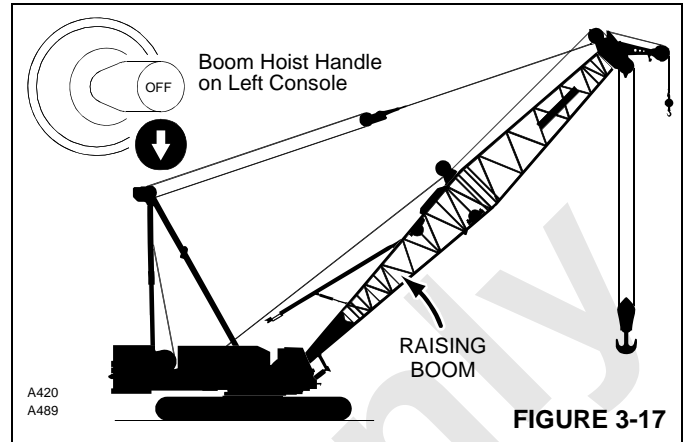
For MAX-ER 2000, Drum 2 (boom hoist) cannot be operated until Drum 3 (load hoist) is parked, and vice versa.

4. Increase engine speed to desired rpm with hand throttle. Press foot throttle to momentarily increase engine speed when power is required.
5. Move handle to REAR from off to RAISE boom or luffing jib (Figure 3-17); move handle to FRONT from off to LOWER boom or luffing jib (Figure 3-18).

! WARNING

Two-blocking Hazard!

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



6. As boom or luffing jib nears desired angle, slowly move control handle toward off to decrease speed. Then move handle to off to stop 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 up limit. The boom stop also provides a physical stop at 90°.

! WARNING

Falling Boom/Jib Hazard!

Operation with boom or luffing jib above up limit is neither intended nor approved. Boom or luffing jib could be pulled over backwards.

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

Swing Operation

WARNING Tipping Hazard!

Prevent crane from tipping; adhere to swing limitations given in capacity charts.

DANGER Moving Crane Hazard!

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

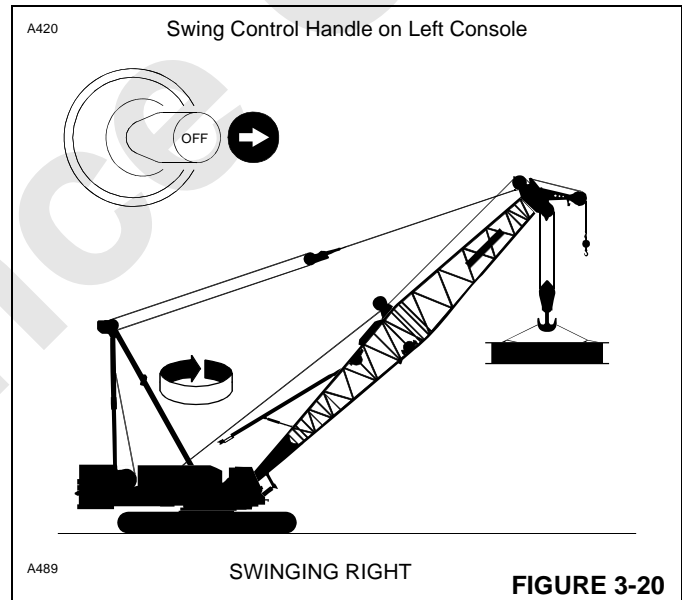
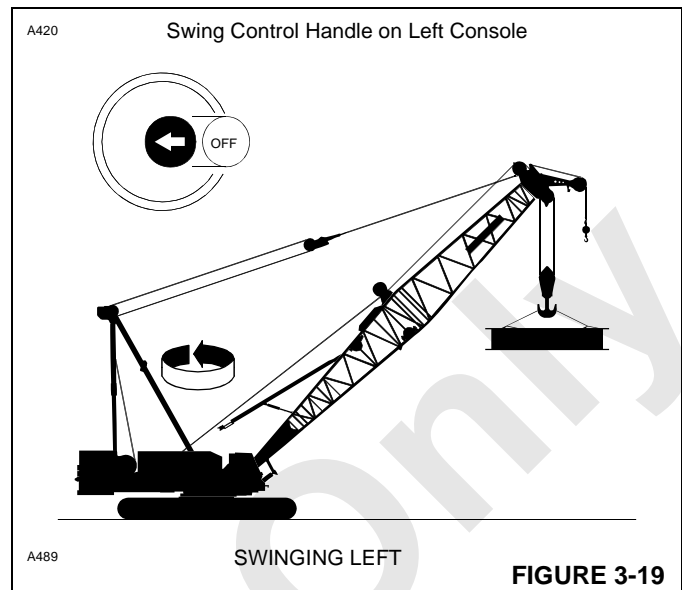
1. Turn off swing brake.
2. Disengage swing lock.

CAUTION Avoid Swing Lock Damage!

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

Do not engage swing lock while swinging; bring rotating bed to complete stop first.

3. Increase engine speed to desired rpm with hand throttle. Press foot throttle to momentarily increase engine speed when more power is required.
4. Move swing handle to LEFT from off to SWING LEFT (Figure 3-19) or to RIGHT from off to SWING RIGHT (Figure 3-20).
5. Start swing motion with a smooth acceleration. Continue handle motion to swing at desired speed.
6. Stop swinging by releasing swing handle to off. Swing speed will decrease to off and rotating bed will coast to a stop. If a faster stop is desired, move swing handle slightly past off to opposite swing direction.



CAUTION

Avoid Boom and Swing Drive Damage!

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

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

Load Drum Operation

NOTE: See Drum and Lagging Charts in Capacity Chart Manual for drum identification.

The corresponding indicator lights glow GREEN to indicate which handles and drums are active (operable) for the selected operating mode. See Figure 3-9 for drum and handle identification.

For 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!

Prevent load on unused drum from falling. Apply drum brake with brake pedal, and turn on 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 can be powered at a time. While one drum is being powered, however, the load can be lowered in free fall on another drum (use drum working brake to control lowering speed).

If TANDEM DRUM mode is selected two load drums are operated at the same time with the left handle (see Figure 3-9). The programmable controller automatically parks any unused drums.

If equipped with the DRUM INTERLOCK option, see Drum Interlock in this section for installation and operation instructions.

1. Turn off free-fall for drum to be operated.
2. Select and confirm desired crane mode.
3. If equipped with a split drum, switch drum selector to desired position. Drum parking brake will apply and clutch will release for drum not in use (both drums cannot be operated at same time).
4. Turn off drum park to release drum brake and disengage 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 park brake while lowering a load. Damage to pawl or drum may result.

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

5. Release drum working brake with brake pedal for 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 desired rpm with hand throttle. Press foot throttle to momentarily increase engine speed when more power is required.
7. Move drum handle to REAR from off to RAISE load (Figure 3-21) or to FRONT from off to LOWER load (Figure 3-22).
8. As load nears desired position, slowly move drum handle toward off to slow down load. Then release handle to off to stop load and hold it in position (drum brake will apply).

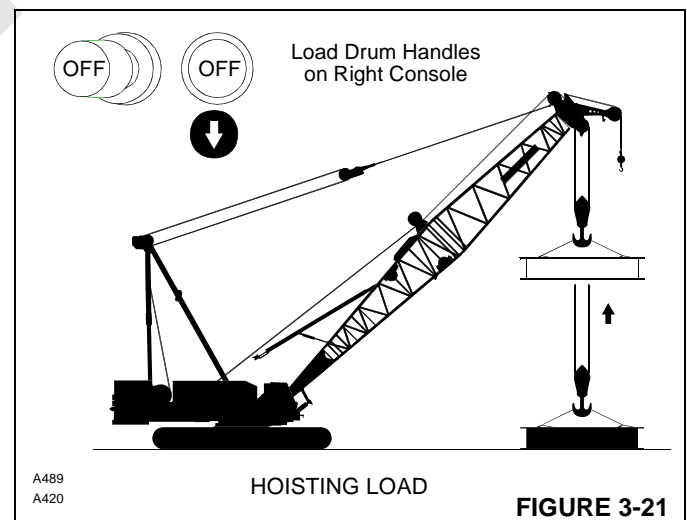
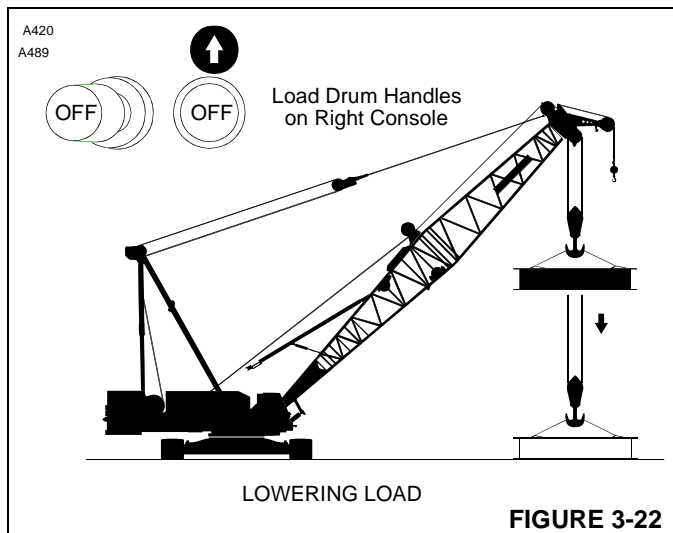


FIGURE 3-21



For MAX-ER 2000, Drum 2 (boom hoist) cannot be operated in free-fall.



DANGER

Falling Boom Hazard!

For MAX-ER 2000, do not switch Drum 2 (boom hoist) to free-fall. Boom will fall uncontrolled.

Liftcrane Operation — Free-fall

1. Fully apply drum working brake for drum to be operated in free-fall.
2. Turn off drum park to release drum brake and disengage drum pawl (if equipped) for each load drum.
3. Select and confirm FFALL ON mode for drum to be operated.

NOTE: The load drum will not switch to free-fall until drum park is off and the selection and confirmation steps have been performed (see Crane Mode Selector for procedure).

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 park brake while lowering a load. Damage to pawl or drum may result.

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

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

5. Move drum handle to REAR from off and release drum brake with brake pedal to RAISE load (Figure 3-21).
6. As load nears desired position, slowly move drum handle toward off to slow down load. Then fully apply drum brake with brake pedal to stop load and release drum handle to off.



WARNING

Falling Load Hazard!

When operating in free-fall, load will lower uncontrolled if drum working brake is not applied with brake pedal when drum handle is released to off.

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

7. Load can be lowered in one of two ways — with drum working brake or with hydraulic power:

- a. To lower load with DRUM BRAKE, leave drum handle in off and release drum brake with pedal to lower load at desired speed.

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

- b. To lower load with HYDRAULIC POWER, move drum handle to front from off and release drum brake with pedal. Lowering speed is controlled by handle movement.

As load nears desired position, slowly move drum handle toward off to slow down load. Then fully apply drum working brake with pedal to stop load and to hold it in position.

CAUTION

Avoid Clutch or Motor Damage!

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

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

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

Clamshell Operation — Standard

See Figure 3-10 for identification of handle motions in the clamshell mode. See F4 for clam closing control operation.

Selecting Clamshell Mode

1. If equipped with three drums, switch drum selector to 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 clam closing control at rear of right side console in operator's cab.

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

5. Turn off drum park to release drum brake and disengage 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 desired rpm.

Closing Bucket (Digging)

1. Lower open bucket into digging area.
2. Fully release closing and holding line brakes and pull back closing line handle to close bucket.
3. Use holding line brake to control digging depth: more brake to dig shallower; less brake to dig deeper.
4. Fully apply closing and holding line brakes and release closing line handle to off when 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 holding line handle back and fully release holding and closing line brakes to hoist bucket.
2. Swing to dumping area as bucket is hoisted.

3. Fully apply closing and holding line brakes and release holding line handle to off when bucket is hoisted to desired height.
4. Stop swinging when bucket is over 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 closing line brake to dump bucket (keep holding line brake applied).
2. Use care not to slacken closing line while dumping. Any slack in closing line will have to be taken out while digging. This action will slow down clam cycle.
3. Fully apply closing line brake once bucket is empty.

Lowering Bucket

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

NOTE: 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.

CAUTION

Drum Clutch Damage!

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

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

Travel Operation



WARNING

Tipping Hazard!

Travel surface must be firm and uniformly supporting.

For **traveling with load**, grade must not exceed 1% in any direction.

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

Failing to comply with above specifications can result in tipping.

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

1. Before traveling:
 - a. Plan travel route. It must be free of ground and overhead constructions.
 - b. Check crawlers for proper adjustment.
 - c. Warn personnel to stand clear of travel area. **Do not travel without a signal person.**
2. Position boom at or above boom angle given on capacity chart when **traveling with load**.
3. Travel with boom in-line with crawlers except when swinging is necessary while traveling. Travel with boom facing direction of travel.
4. For **traveling with load**, carry load as close to ground as possible; stabilize load with taglines.
For **traveling without load**, carry load block and weight ball low enough that they cannot swing into boom or jib. If desired, tie off load block at front of rotating bed.
5. Increase engine speed to desired rpm with hand throttle. Press foot throttle to momentarily increase engine speed when more power is required.

6. Select desired travel speed, low or high.



WARNING

Moving Crane Hazard!

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

Flying Object Hazard!

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

CAUTION

Avoid Shock Load Damage to Boom and Rigging!

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

Avoid Crawler Damage!

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

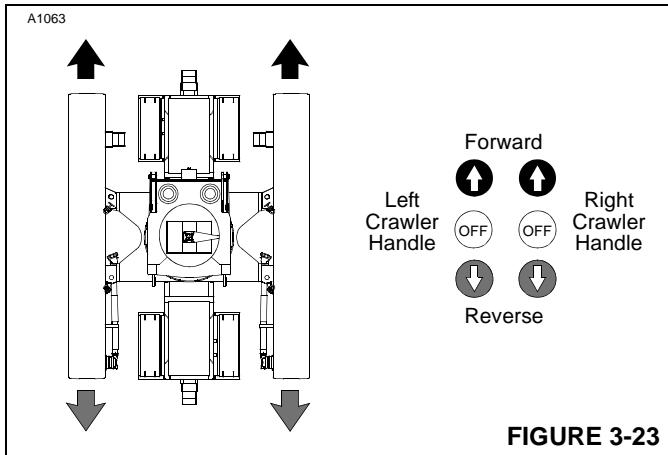
Use care to prevent dirt from piling up at tumbler and front roller ends of crawlers when turning on soft surfaces:

- Bring crawlers to a complete stop before changing travel direction.
- Turn a few degrees. Then slowly travel forward or reverse so dirt falls away from crawlers. Continue this procedure until desired turn has been made.
- Avoid sharp turns (Figure 3-24) if possible.
- Make gradual turns (Figure 3-25) or counter-rotate (Figure 3-26) whenever possible so both crawlers are always powered.
- Clean crawlers often.

Keep crawler treads properly adjusted.

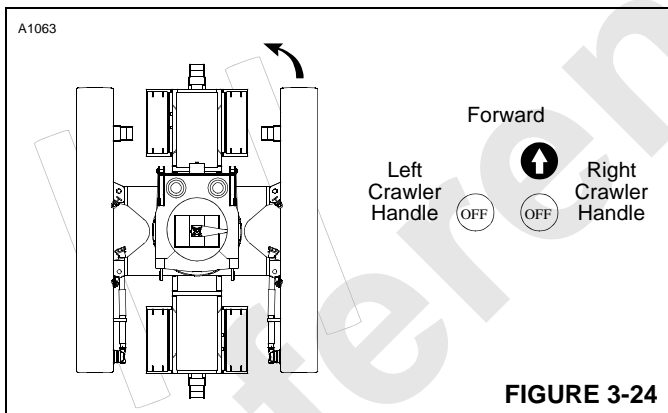
NOTE: The following directions of travel are with *crawler drive shafts to rear of operator*. If the motors are to the front, the crane will travel in the direction opposite of handle movement.

7. To TRAVEL STRAIGHT (Figure 3-23), move both crawler handles same amount in desired direction from off.



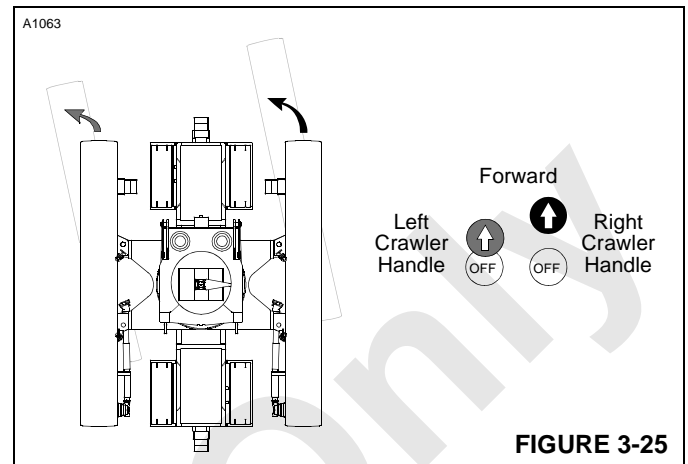
8. To make a SHARP LEFT TURN (Figure 3-24), move right crawler handle to front from off and leave left crawler handle in off; crane will pivot about left crawler.

9. To make a SHARP RIGHT TURN, reverse step 8.



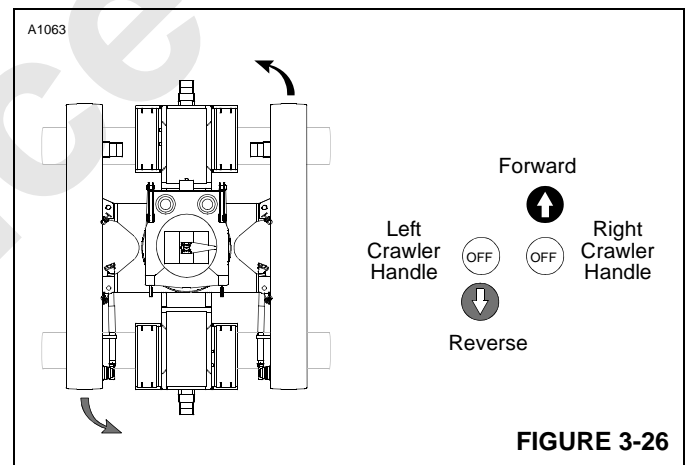
10. To make a GRADUAL LEFT TURN (Figure 3-25), move both crawler handles to front from off, but move right

crawler handle farther to front than left crawler handle; right crawler will turn faster than left crawler.



11. To make a GRADUAL RIGHT TURN, reverse step 10.

12. To COUNTER-ROTATE LEFT (Figure 3-26), move right crawler handle to front from off and move left crawler handle to rear from off.



13. To COUNTER-ROTATE RIGHT, reverse step 12.

14. Slowly move both crawler handles to off to stop traveling and to hold crane in position.

15. Turn on travel park.

STOPPING ENGINE / LEAVING CRANE UNATTENDED



WARNING

Moving Load/Tipping Crane Hazard!

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

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

1. Travel crane onto a level surface; **do not leave crane unattended on a grade.**
2. Turn on travel park.
3. Swing rotating bed to desired position. Then engage swing lock and turn on swing brake.
4. Lower all loads to ground and fully apply drum working brakes with brake pedals and latch pedals down.
5. Turn on drum park to apply drum brake and engage drum pawl (if equipped) for each load drum.

6. If possible, lower 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 Capacity Chart Manual).

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

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

Reference Only

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SPECIAL CONTROLS

Electric Drive

General

This section identifies and describes operation of the instruments and controls provided for the electric power plant on this crane.



WARNING

Electrocution Hazard!

This crane is powered by high voltage electricity. Disconnect power supply before servicing electric components.

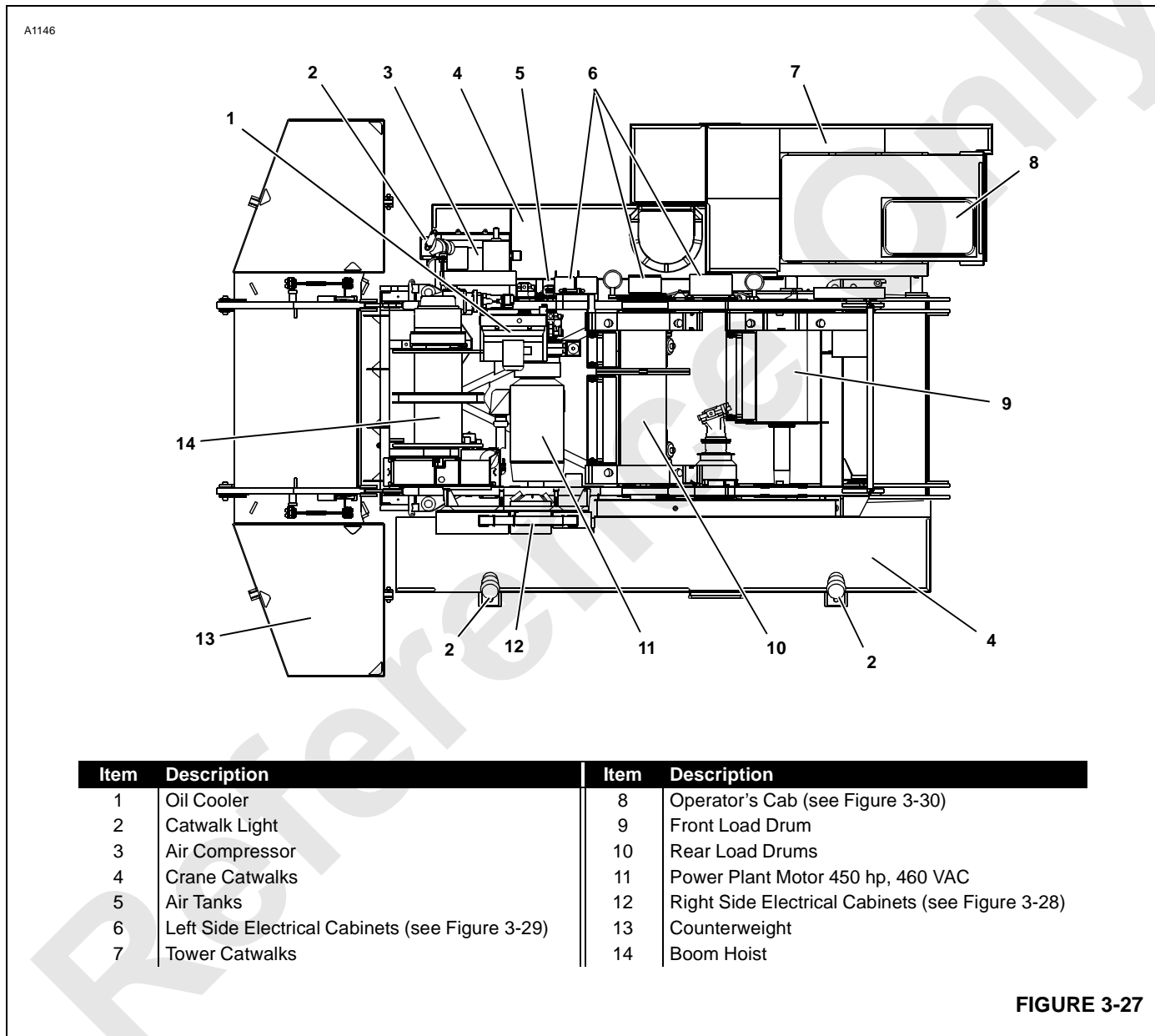
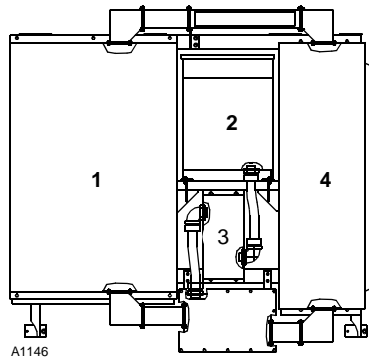


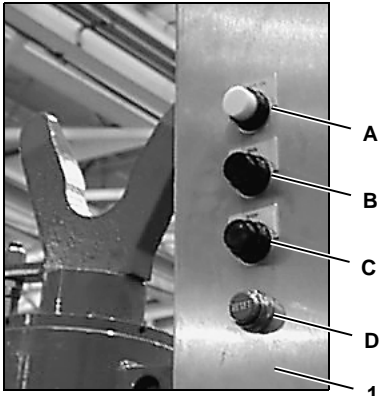
FIGURE 3-27



Right Side Panels

Item	Description
1	Power Plant Motor Starter
2	30 KVA Transformer
3	Transformer Circuit Breaker Disconnect
4	Main Circuit Breaker Disconnect

P1250

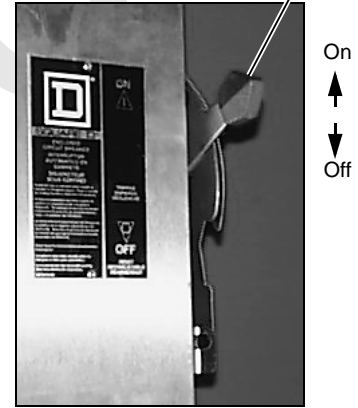


Upper Left Corner

P1251



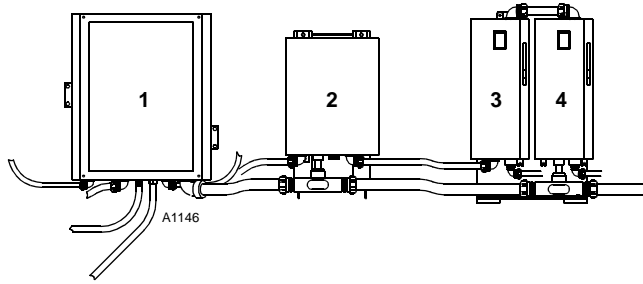
P1252



Motor Starter Panel

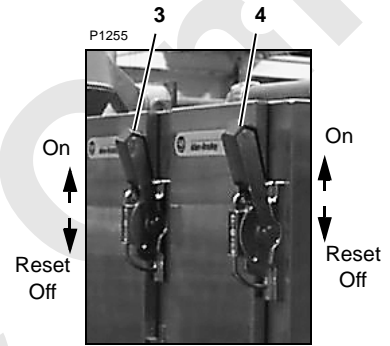
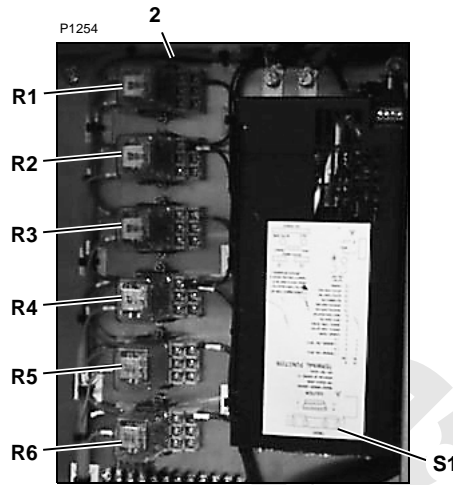
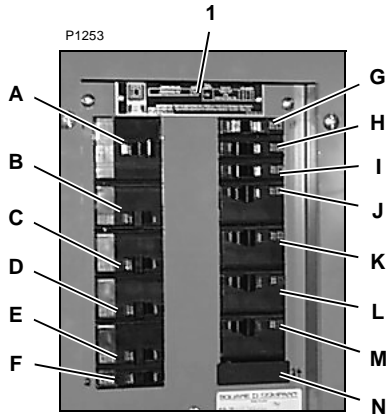
Item	Description	Function
A	Light (White)	Indicates Power On When Illuminated
B	Light (Red)	Indicates Power Plant Motor Stopped When Illuminated
C	Light (Green)	Indicates Power Plant Motor Running When Illuminated
D	RESET Pushbutton	Press To Reset Power Plant Motor After Shutdown Due To Overload

FIGURE 3-28



Left Side Panels

Item	Description
1	Load Center Panel
2	Power Supply/Relay Box
3	Air Compressor Motor Starter Disconnect
4	Oil Cooler Motor Starter Disconnect



Lighting Panel (Item 1)
(120/208 VAC, 3 Phase)

Breaker ID	Amps	Components Powered	Breaker ID	Amps	Components Powered
A		Main Circuit Breaker 120 VAC	H	15	Spare
B	15	Right Side Boom Floodlights (Inner)	I	15	Power Plant Motor Heater (see NOTE 1)
C	15	Right Side Boom Floodlights (Outer)	J	15	Left Side Catwalk Lights; Operator Cab Walkway Light
D	15	Left Side Boom Floodlights (Inner)	K	15	Right Side Catwalk Lights Air Compressor Light
E	15	Left Side Boom Floodlights (Outer)	L	20	Cab Air Conditioner
F	15	Gantry Floodlight	M	20	Cab Heater
G	15	Power Supply Enclosure	N		Blank

Power Supply/Relay Box (Item 2)
(120 VAC & 12 VDC)

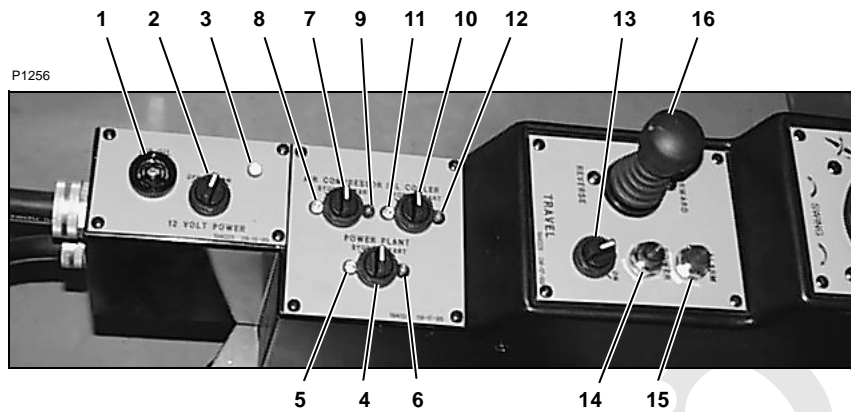
Relay No.	Components Powered
R1	Air Compressor Motor Start
R2	Air Compressor Motor Stop
R3	Oil Cooler Motor Start (see NOTE 1)
R4	Oil Cooler Motor Stop (see NOTE 2)
R5	Power Plant Start
R6	Power Plant Stop
S1	12 VDC Power Supply

NOTE 1: Energizing R3 turns off power plant motor heater.

NOTE 2: Energizing R4 turns on power plant motor heater.

NOTE 1: Under normal conditions, this breaker is left on. Power plant motor heater protects motor by preventing moisture accumulation in motor windings.

FIGURE 3-29



Left Console
Controls and Indicators

Item	Description	Function
1	AIR/OIL Alarm	Indicates oil cooler or air compressor motor is off while power plant motor is running. Stop power plant motor as soon as practical.
2	OFF/ON Switch (2-position)	Controls 12 VDC power to crane Controls; switch maintains selected position.
3	Light (Green)	Indicates 12 VDC power ON.
4	STOP/START Switch (3-position)	Controls operation of power plant motor; switch returns to center and maintains selected operation.
5	Light (Red)	Indicates power plant motor off.
6	Light (Green)	Indicates power plant motor on.
7	STOP/START Switch (3-position)	Controls operation of air compressor motor; switch returns to center and maintains selected operation.
8	Light (Red)	Indicates air compressor motor off.
9	Light (Green)	Indicates air compressor motor on.
10	STOP/START Switch (3-position)	Controls operation of oil cooler motor; switch returns to center and maintains selected operation.
11	Light (Red)	Indicates oil cooler motor off.
12	Light (Green)	Indicates oil cooler motor on.
13	OFF/ON Switch (2-position)	Controls DC power to gantry travel Controls; switch maintains selected position.
14	Light (Green)	Indicates power on to gantry travel controls
15	Alarm Light (Red)	Indicates drive system alarm.
16	Handle	Controls gantry travel.

FIGURE 3-30

Electric Drive Start-Up

1. Make the following checks before attempting to start the power plant motor:
 - a. Power on to crane collector ring.
 - b. Main circuit breaker on (Figure 3-28, item 4).
 - c. Power on to power plant (white light on motor starter panel illuminated) (Figure 3-28, item 1).
 - d. Transformer circuit breaker on (Figure 3-28, item 3).
 - e. Circuit breakers on for desired auxiliary equipment (Figure 3-29, item 1).

**WARNING****Moving Machinery Hazard!**

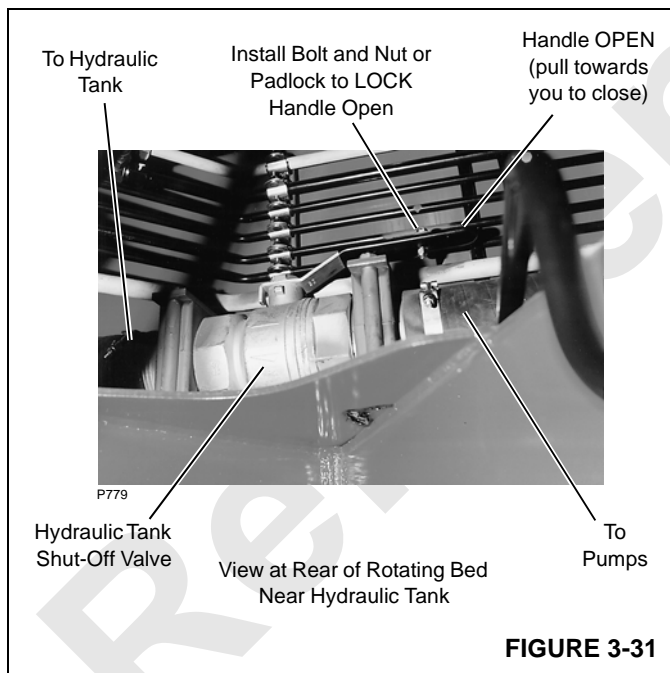
Avoid injury or electric shock to personnel working on machinery:

- Do not start power plant motor if caution or out-of-order sign is displayed in operator's cab or at motor starter.
- Check that all personnel are clear of machinery before starting power plant motor.
- Check that all controls are off and that all brakes are applied before starting power plant motor.

CAUTION**Pump Damage!**

Do not start power plant motor until hydraulic tank shut-off valves are open. Pumps could cavitate and be damaged.

2. Unplug or turn off any heaters crane is equipped with. Power plant motor heater shuts off automatically when oil cooler motor is started.
3. Open hydraulic shut-off valve (Figure 3-31).

**FIGURE 3-31**

4. Turn 12 V POWER switch to ON (left console). Green ON indicating light comes on.
5. Turn CAB POWER switch to ON (right console).

NOTE: The operating limit alert and system fault alert (lights, buzzer, beeper) should come on for three seconds when switch is moved to on; if not, replace bad parts.

6. Turn AIR COMPRESSOR switch to START and release (left console). When air compressor starts, red OFF indicating light goes off; green ON indicating light comes on.

**WARNING****Loss of Control!**

Operation of safety features such as drum brakes will be disabled if air compressor fails. If AIR/OIL alarm sounds. Land load immediately and stop power plant motor immediately.

7. Turn OIL COOLER switch to START and release (left console). When oil cooler starts, red OFF indicating light goes off; green ON indicating light comes on. Motor heater turns off.

CAUTION**Hydraulic System Damage!**

Hydraulic oil will overheat if oil cooler is not running. If AIR/OIL alarm sounds, land load and stop power plant motor as soon as possible.

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

8. Turn POWER PLANT switch to START and release. After five seconds, red OFF indicating lights at console and motor starter panel go off; green ON indicating lights comes on.

NOTE: Power plant motor cannot be started before air compressor and oil cooler are started.

9. Run power plant motor without load until hydraulic oil is at least 60°F (16°C).
10. See Operating Controls in this section for information about system fault alert and confirming crane mode.

Shut Down / Unattended Crane with Electric Drive**WARNING****To prevent death or serious injury!**

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

1. Park gantry and turn off travel.
2. Swing rotating bed to desired position and engage swing lock and turn on swing brake.
3. Lower all loads to ground and fully apply drum working brakes with brake pedals and latch pedals down.
4. Turn on drum park for each drum.
5. Engage drum pawls (if equipped).
6. If possible, lower boom onto blocking at ground level.
If this cannot be done, engage hoist pawl and secure boom so it cannot be moved by wind or other outside forces.
7. Check that all handles are off.
8. Turn POWER PLANT switch to STOP (left console). Red OFF indicator lights at console and motor starter panel come on, and green ON indicator lights go out.
9. Turn AIR COMPRESSOR switch to STOP and release (left console). Green ON indicating light goes off. Red OFF indicating light comes on.
10. Turn OIL COOLER switch to STOP and release (left console). Green ON indicating light goes off. Red OFF indicating light comes on.
11. Turn CAB POWER switch to OFF (right console).
12. Turn 12 V POWER switch to OFF (left console). Green ON indicating light goes off. Red OFF indicating light at motor starter panel comes on.
13. At lighting panel, turn off desired circuit breakers.

Auxiliary Engine — Cummins QSX15 Engine

General Engine Information

The **Main** engine powers the normal crane functions - swing, travel, boom, and the rear drum (DRUM 2).

The **Auxiliary** engine powers half the front drum (DRUM 1). The auxiliary engine and main engine are the same.

This section identifies and describes the controls provided for the auxiliary engine. The auxiliary engine is self-contained with closed-loop hydraulic system, air system, provisions for cold weather starting, and auxiliary computer linked to the crane's main computer.

Auxiliary Engine Controls

See Figure 3-32 for the following procedure.

The auxiliary engine diagnostics and start/stop controls are mounted on the operator's cab right console behind the load drum handles.



WARNING

Prevent death or serious injury to personnel!

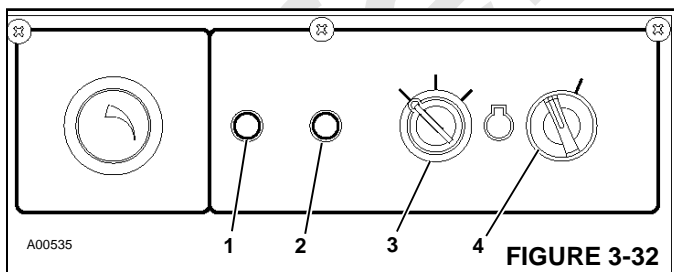
Read and thoroughly understand instructions in this section and in Section 2 of this manual.

Contact Crane Care Customer Service at the factory for assistance if any operating procedure is not clearly understood.

1. Engine Stop Light

2. Engine Warning Light

See Engine Manufacturer's Manual or Engine Diagnostics in Section 7 of the Crane Service Manual for a complete description of the engine diagnostic lights and fault codes.



3. Engine Run/Stop/Run Key Switch

Insert key and turn to either RUN position to turn on crane's electrical system and before starting engine.

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

4. Auxiliary Engine Start Switch

Turn knob **CLOCKWISE** and hold to **START** engine. **RELEASE knob as soon as engine starts.**

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

Auxiliary Engine Start-Up

Make the following checks before attempting to start the auxiliary Engine.



WARNING

Prevent death or serious injury to personnel!

- Do not start engine if warning or out-of-order sign is present at start controls.
 - Check that drum controls are off so load does not move when engine is started.
 - Check that all personnel are clear of crane before starting engine. **Sound horn to alert personnel.**
 - When auxiliary engine is not in use, remove key to prevent unauthorized personnel from starting engine.
1. If crane engine is running, place the crane engine throttle in low idle position. The main computer synchronizes the auxiliary engine speed with the crane engine speed.
 2. Insert key and turn to either RUN position to turn on crane's electrical system (on right console).
 3. Turn auxiliary engine start knob **CLOCKWISE** and hold to **START** engine (on right console). **RELEASE knob as soon as engine starts.**
 4. If engine does not start after 30 seconds, wait a few minutes so starter motor cools before trying again.
 5. The crane engine throttle controls the auxiliary engine speed.

Auxiliary Engine Shut Down



WARNING

To prevent death or serious injury!

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

1. Lower all loads to ground and fully apply drum working brakes.
2. Move crane engine throttle to low idle.

- Turn engine run/stop switch to STOP position (on right console).

Auxiliary Engine Junction Box

See Figure 3-33 for the following procedure.

The auxiliary engine electrical controls and fuses are located in the auxiliary engine junction box.

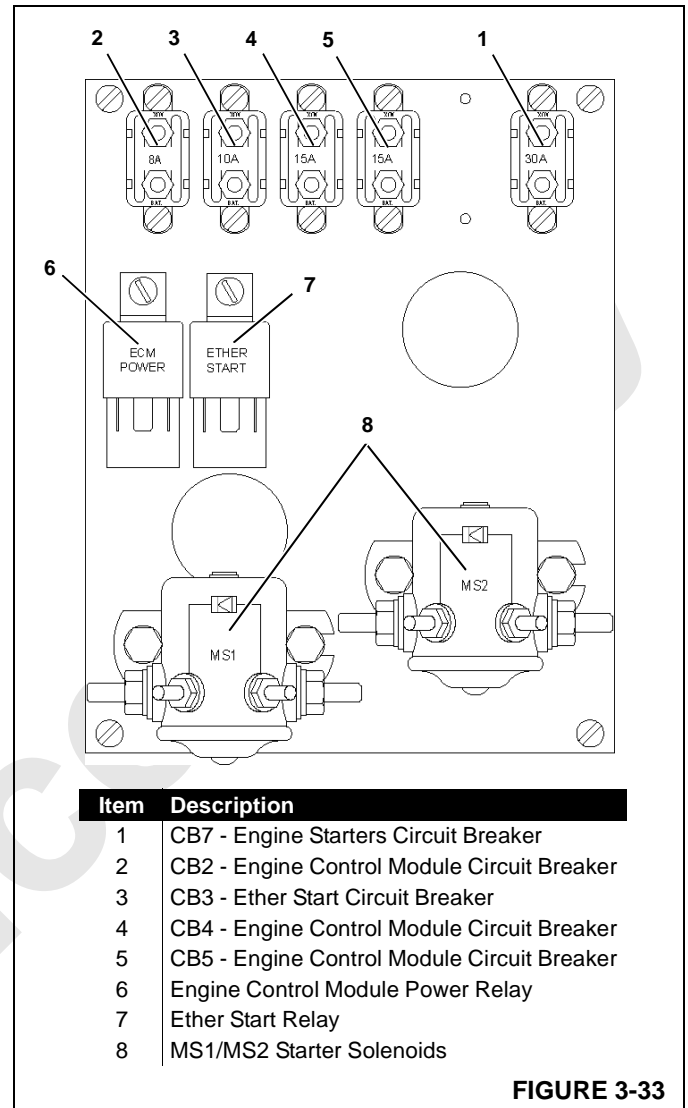


FIGURE 3-33

Reference

Clamshell Operation — Manually Operated Clutch

General

This topic describes clamshell operation for cranes where right rear air applied drum clutch is manually controlled with clutch button on left control handle and 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 3-34 for identification of the clam controls and drums.

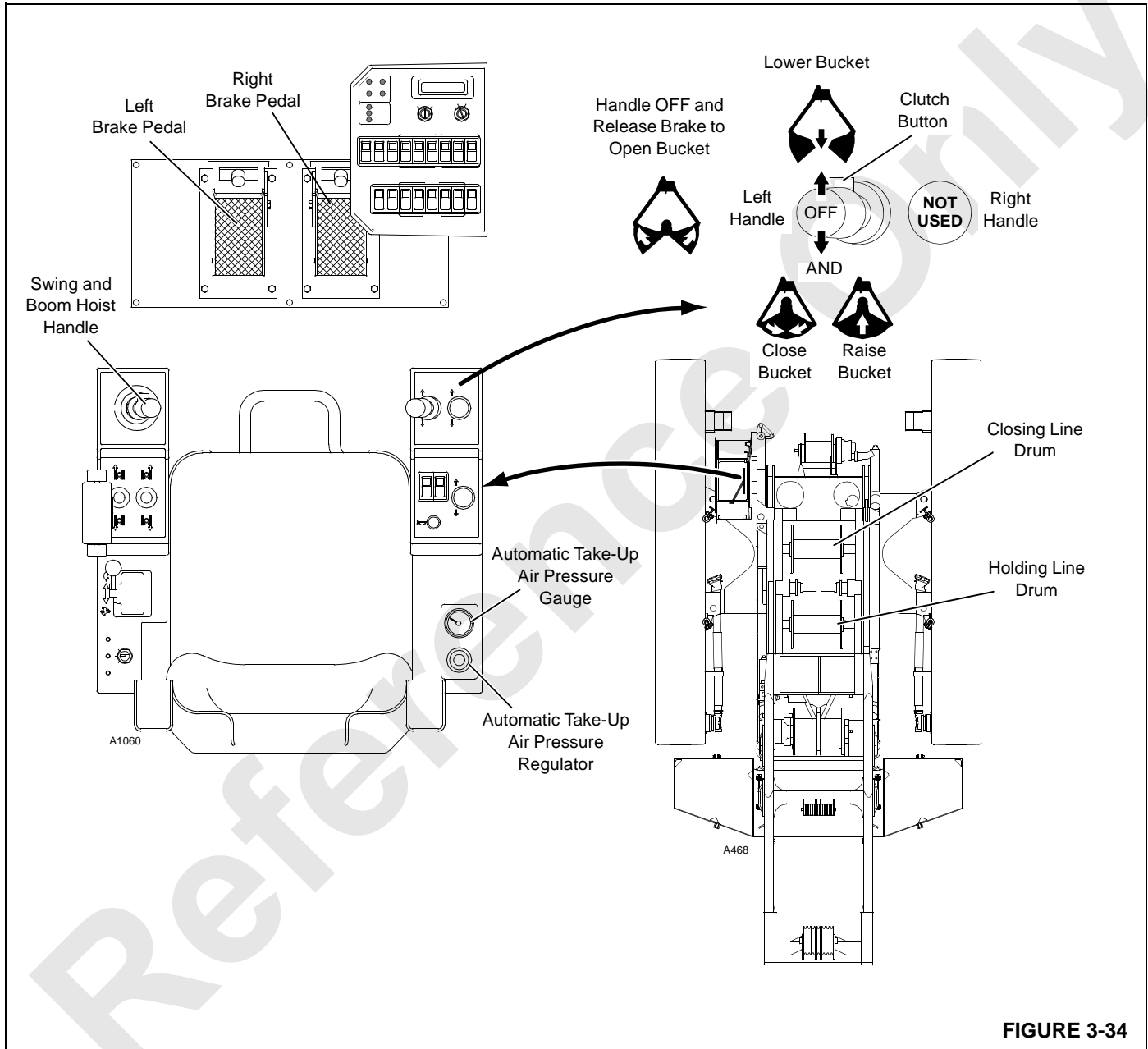


FIGURE 3-34

Manual Clutch Control



WARNING

Turning Drum Hazard!

In standard mode, right rear drum may turn when another drum is operated if automatic take-up air pressure is on.

Falling Load Hazard!

Be aware that right rear drum clutch on this crane is air released with air clutch button on left handle and spring applied when clutch button is released.

Be ready at all times to apply drum working brake so 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 drum selector to right rear position.

1. Select and confirm FREE-FALL mode for both drums.
2. Select and confirm CLAMSHELL mode.
3. At the automatic take-up pressure level, the right rear drum clutch is air applied with air clutch button on left handle and is air applied at full pressure when clutch button is released.



WARNING

Bucket Falling Hazard!

Do not engage air clutch button on left handle when bucket is in the air. The clutch will slip and bucket will drop suddenly.

4. Adjust automatic take-up pressure, as follows:
 - a. Push regulator knob DOWN to UNLOCK
 - b. Turn knob CLOCKWISE to INCREASE pressure or COUNTERCLOCKWISE to DECREASE pressure.
Adjust pressure so holding line clutch slips while closing bucket on closing line. If setting is too high, holding line will hoist bucket. If setting is too low, holding line will have excessive slack while hoisting.
 - c. Pull regulator knob UP to LOCK.
5. Disengage drum pawls (if equipped).
6. Set engine speed to desired rpm.

Closing Bucket (Digging)

1. Lower open bucket into digging area (see Lowering Bucket). Press and hold clutch button on left handle to take out any slack in holding line when using handle.
2. Fully release both brake pedals and pull left drum handle back to close bucket.
3. Use right brake pedal to control digging depth, if required.
4. Except for closing a suspended open bucket, this is the only time right brake pedal needs to be used.

CAUTION

Avoid Drum Clutch Damage!

Holding line clutch is always fully engaged until drum clutch is air released with air clutch button on left handle.

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

Automatic Clutch Control



WARNING

Falling Load Hazard!

Be aware that right rear drum clutch on this crane is air applied and spring released. Clutch will release allowing drum to turn (load will lower) if air pressure to clutch is lost for any reason.

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

Selecting Clamshell Mode

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

This setting controls holding line pressure when the programmable controller automatically removes holding line slack (see Hoisting Bucket procedure). The pressure selected will remain in computer memory even after the engine is stopped.

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

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

5. Adjust automatic take-up pressure, as follows:
 - a. Push regulator knob DOWN to UNLOCK
 - b. Turn knob CLOCKWISE to INCREASE pressure or COUNTERCLOCKWISE to DECREASE pressure.
Adjust pressure so holding line clutch slips while closing bucket on closing line. **If setting is too high, holding line will hoist bucket. If setting is too low, holding line will get excessively slack while hoisting.**
 - c. Pull regulator knob UP to LOCK.
6. Disengage drum pawls (if equipped).
7. Set engine speed to desired rpm.

Closing Bucket (Digging)

1. Lower open bucket into digging area (see Lowering Bucket).
2. Fully release both brake pedals and pull left drum handle back to close bucket.
3. Use right brake pedal to control digging depth, if required.

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

Manual and Automatic Clutch Control

Hoisting Bucket

1. Continue to pull left drum handle back to hoist bucket.
2. When bucket has been hoisted to desired height, release drum handle to off and fully apply left brake pedal.

3. Swing to dumping area.
4. When air clutch button on left handle is pressed and held, the programmable controller will automatically take out any slack in holding line while you swing.
5. Stop swinging when bucket is over dumping area.

Dumping Bucket

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

Lowering Bucket

1. Push left drum handle forward and fully release both brake pedals to lower bucket.
2. Control lowering speed by slowly moving left drum handle toward off.

CAUTION

Avoid Drum Clutch Damage!

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

3. Swing back to digging area as bucket lowers.
4. Stop swinging when bucket lands in digging area.
5. Repeat clam cycle.

Liftcrane Operation

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

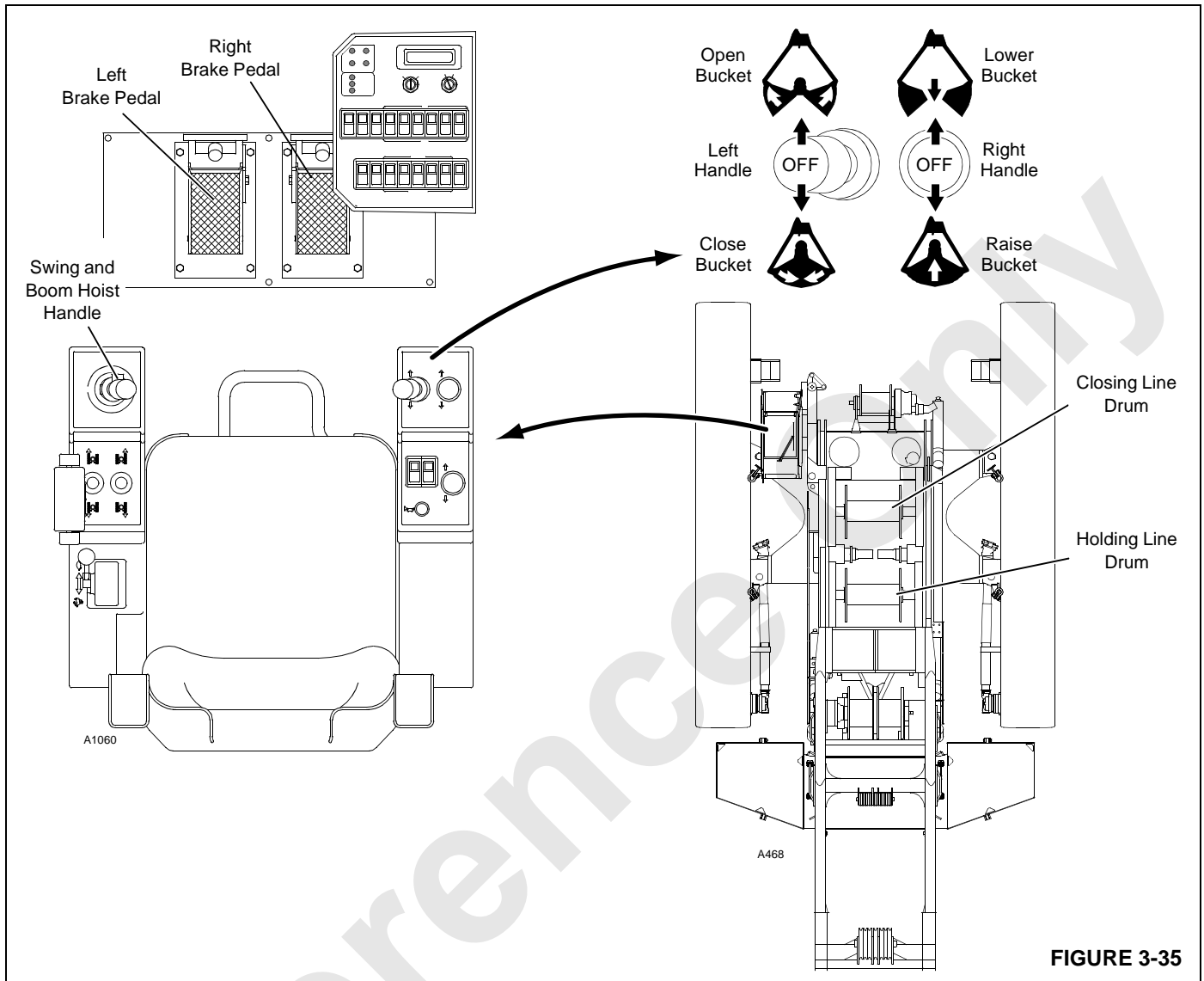


FIGURE 3-35

Clamshell Operation with 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 3-34 for identification of the clam controls and drums.

Operating Options

There are only 2 ways to operate in clamshell. The difference between the two is in how the bucket is opened.

- Confirm CLAM mode for OPTION A.

- Confirm CLAM 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 CLAM 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 clam mode.

Synchronized Control Options

There are only 2 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 must 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 till the bucket's weight is totally 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.

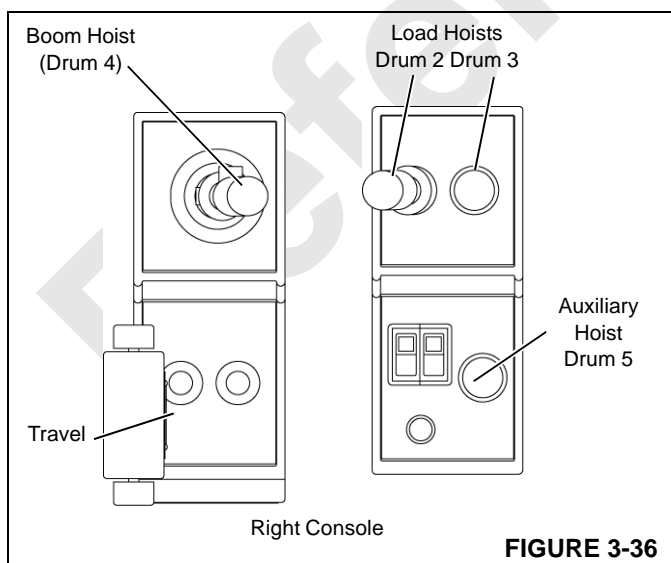


FIGURE 3-36

Drum 5 Operation (Boom Hoist Diverted)

General

The following instructions describe operation of Drum 5 when hydraulic oil from the boom hoist circuit is used to power the auxiliary drum. See Figure 3-36 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 Drum 4 park. **Drum 5 and boom hoist (Drum 4) cannot be operated at same time.**
3. Turn off Drum 5 park.
4. Use Drum 5 handle to raise and lower loads as follows:

Move handle to REAR to RAISE the load. The brake releases and speed increases in relation to handle movement.

Release handle to CENTER to STOP the drum. Speed decreases to off and the brake applies to stop the drum and hold it in position.

Move handle to FRONT to LOWER the load. The brake releases and speed increases in relation to handle movement.

The brake will spring apply to stop the drum if power is lost.

5. Either of other two load drums – right or left (Drum 2 or 3) – can be operated at same time as Drum 5.
6. If it becomes necessary to operate boom hoist, turn on Drum 5 park and turn off Drum 4 park. Drum 4 can then be operated to raise and lower 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 3-24 and how to switch between operation of boom hoist (Drum 4) and 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 3-36 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 Travel park. **Drum 5 and travel cannot be operated at same time.**
3. Turn off Drum 5 park.
4. Use Drum 5 handle to raise and lower loads as follows:

Move handle to REAR to RAISE the load. The brake releases and speed increases in relation to handle movement.

Release handle to CENTER to STOP the drum. Speed decreases to off and the brake applies to stop the drum and hold it in position.

Move handle to FRONT to LOWER the load. The brake releases and speed increases in relation to handle movement.

The brake will spring apply to stop the drum if power is lost.

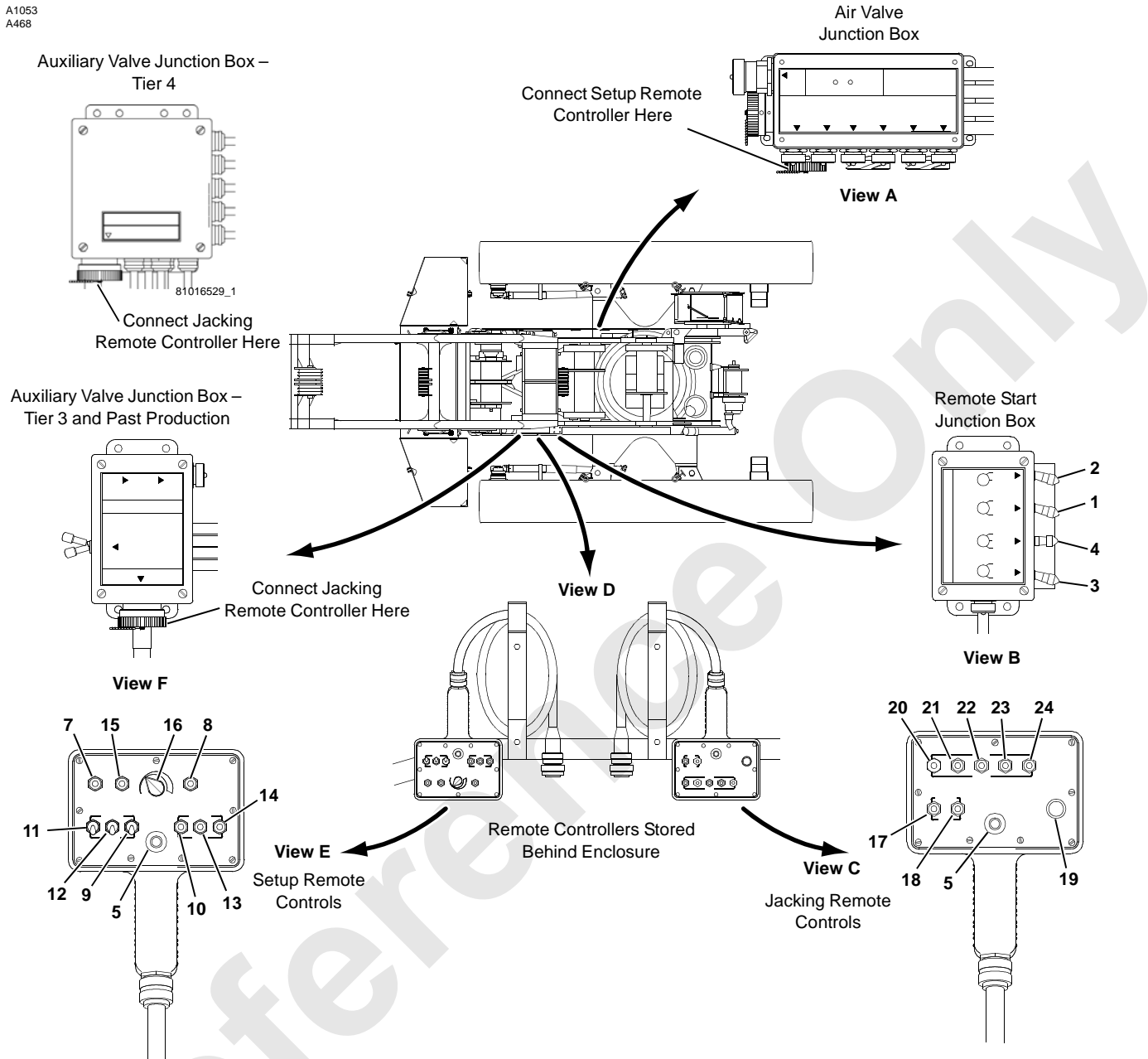
5. Either of other two load drums – right or left (Drum 2 or 3) – can be operated at same time as Drum 5.
6. If travel is required, turn on Drum 5 park and turn off travel park. The crane can then be traveled.

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 3-24 and how to switch between operation of boom hoist (Drum 4) and luffing hoist (Drum 5).

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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	Number not used
7	Gantry Cylinders Switch
8	Boom Butt Cylinder Switch

Item	Description
9	Backhitch Pins Switch
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
17	Rear Rotating Frame Pins Switch
18	Front Rotating Frame Pins Switch

Item	Description
19	Level Warning Light
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 3-37

REMOTE CONTROLS

General



WARNING

Read Instructions!

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

Crush Hazard!

To prevent personnel from being crushed by moving parts:

- Keep unauthorized personnel clear of crane while operating remote controls.
- Use a signal person to warn personnel that they must stay clear of 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 (Figure 3-37, View D). The remote start controls are located on the junction box near the batteries on the right side of the crane (Figure 3-37, View B).

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 shown in Figure 3-37, Views A and F.

NOTE: On Crane Serial Number 2251337 and newer:

- 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

Additionally on Crane Serial Number 2251337 and newer meeting EN 13000:2010 requirements:

- 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 3-37 for the following controls.

1. Engine Run/Stop Switch

Move toggle UP or DOWN to START and RUN engine; see start switch (2).

Move toggle to OPPOSITE position while engine is running to STOP engine.

2. Engine Start Switch

Move toggle UP to START engine; **release toggle as soon as engine starts.**

CAUTION

Starter Motor Damage!

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

If the engine does not crank, move run/stop switch (1) to the opposite position.

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

3. Engine Speed Switch

Move toggle UP and hold to increase engine speed to 1,500 rpm during start-up.

Move toggle DOWN (spring returns to this position) to decrease engine speed to idle (or to speed setting of throttle in cab or on remote controls whichever is greater).

4. Hydraulic Disconnect Switch (Rotating Frame Quick-Disconnect)

NOTE: Knob on toggle must be pulled out before toggle can be moved in either direction from off.

Move toggle UP to ENGAGE hydraulic disconnect.

CENTER toggle (spring returns to this position) to turn OFF (stop engaging or disengaging hydraulic disconnect).

Move toggle DOWN to DISENGAGE hydraulic disconnect.

CAUTION

Seal Damage!

Prevent damage to hydraulic disconnect seals during operation.

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

- Counterweights removed.
- Boom lowered onto blocking so boom hoist rigging is slack.

5. Power Switch

Press button to TURN ON power to remote control switches.

Release button to TURN OFF power to remote control switches.

6. Number not used

7. Gantry Cylinders Switch

Hold toggle UP to EXTEND gantry cylinders to raise gantry.

CENTER toggle (spring returns to this position) to turn OFF (stop extending or retracting gantry cylinders).

Hold toggle DOWN to RETRACT gantry cylinders to lower gantry.

8. Boom Butt Cylinder Switch

Hold toggle UP to EXTEND boom butt cylinder to raise butt.

CENTER toggle (spring returns to this position) to turn OFF (stop extending or retracting boom butt cylinder).

Hold toggle DOWN to RETRACT boom butt cylinder to lower butt.

9. Backhitch Pins Switch

Hold toggle UP to DISENGAGE backhitch pins.

Hold toggle DOWN (spring returns to this position) to ENGAGE backhitch pins.

10. Boom Hinge Pins Switch

Hold toggle UP to DISENGAGE boom hinge pins.

CENTER toggle (spring returns to this position) to turn OFF (stop engaging or disengaging boom hinge pins).

Hold toggle DOWN to ENGAGE boom hinge pins.

11. Upper Counterweight Pins Switch

12. Lower Counterweight Pins Switch

Hold toggle UP to DISENGAGE counterweight pins.

Move toggle DOWN (spring returns to this position) to ENGAGE counterweight pins.

13. Right Crawler Frame Pins Switch

14. Left Crawler Frame Pins Switch

Hold toggle UP to DISENGAGE crawler frame pins.

CENTER toggle (spring returns to this position) to turn OFF (stop engaging or disengaging crawler frame pins).

Hold toggle DOWN to ENGAGE crawler frame pins.

15. Rigging Winch Switch

Hold toggle UP to PAY OUT wire rope from rigging winch.

CENTER toggle (spring returns to this position) to turn OFF (stop rigging winch).

Hold toggle DOWN to HAUL IN wire rope to rigging winch.

16. Speed Control

Turn knob CLOCKWISE/pull handle DOWN to INCREASE speed of all items controlled by setup remote.

Turn knob COUNTERCLOCKWISE/push handle UP to DECREASE speed of all items controlled by setup remote.

17. Rear Rotating Frame Pins Switch

18. Front Rotating Frame Pins Switch

Hold toggle UP to DISENGAGE rotating frame pins.

CENTER toggle (spring returns to this position) to turn OFF (stop engaging or disengaging rotating frame pins).

Hold toggle DOWN to ENGAGE rotating frame pins.

19. Level Warning Light

GLOWS RED and a beeper comes on when rotating frame is 3° out of level.



WARNING

Collapsing Hazard!

Avoid serious injury or death to personnel and damage to crane!

Keep rotating frame as level as possible while jacking. The jacking cylinders are not self leveling. Operator must keep carbody level while jacking.

Operating jacking cylinders with rotating frame more than 3° out of level can result in structural damage to jacking cylinders and possible collapse of rotating frame.

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 toggle UP to EXTEND rotating frame jacking cylinder to raise corresponding corner of rotating frame.

CENTER toggle (spring returns to this position) to turn OFF (stop extending or retracting rotating frame jacking cylinder).

Hold toggle DOWN to RETRACT rotating frame jacking cylinder to lower corresponding corner of rotating frame.

24. All Rotating Frame Jacking Cylinders Switch

Hold toggle UP to EXTEND all jacking cylinders at same time.

CENTER toggle (spring returns to this position) to turn OFF (stop extending or retracting rotating frame jacking cylinders).

Hold toggle DOWN to RETRACT all jacking cylinders at same time.

Reference Only

PROGRAMMABLE CONTROLLER CALIBRATION PROCEDURES

General

To ensure proper operation of the crane functions, the pressure senders and controls must be properly calibrated as described below.

Pressure Sender Calibration

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 6 months.
- When 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 actual system pressure. See Note regarding replacing a pressure sender at the end of this procedure.

To calibrate pressure senders, proceed as follows:

1. Access diagnostic screens by pressing limit bypass switch while scrolling up with scroll switch.
2. Scroll until control calibration screen (Figure 3-38) appears.



FIGURE 3-38

3. Stop engine (leave ignition and cab power switches on), turn limit bypass key clockwise and hold. It is normal for yellow operating limits light to come on during this procedure.
4. Calibration will not start if engine is running and following screen appears. Likewise, calibration stops and following screen appears if engine is started during calibration.



FIGURE 3-39

5. Repeat step 3.

6. When calibration starts, following screen appears to indicate percent of completion as shown Figure 3-40. It takes approximately 1 minute to complete process.



FIGURE 3-40

7. When calibration is complete, start screen in Figure 3-38 reappears.
8. Check the data bank in the upper right corner of the screen. If a pressure sender/pump failed the test, the fail item(s) binary number(s) is displayed.

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 & Luffing Drums)
32	4	System Pressure (Travel/Drum 9 on MAX-ER)
64	5	System Pressure (Left Travel)
128	0	System Pressure (Independent Luffing)

NOTE: Before replacing a pressure sender, do the following:

- Perform pressure sender calibration steps.
- Attach an accurate hydraulic pressure gauge to the quick-coupler at the suspect pressure transducer (see Section 2 of the Service Manual).
- If pressure appears on the gauge, bleed the corresponding system so the gauge reads zero pressure.
- Repeat calibration steps and check pressure on the display in the cab with the engine running at idle – the display reading and the gauge reading should be the same.
- 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 6 months.

To calibrate the controls, proceed as follows:

1. Access diagnostic screens by pressing limit bypass switch while scrolling up with scroll switch.
2. Scroll until control calibration screen (Figure 3-41) appears.

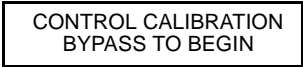


FIGURE 3-41

3. Increase engine speed to high idle and press limit bypass switch.

NOTE: It is normal for yellow operating limits light to come on during this procedure.

4. Calibration process does not start if engine is not at high idle. Calibration process stops if engine speed is decreased during calibration. In either case the screen in Figure 3-42 appears.



FIGURE 3-42

5. Repeat step 3.
6. When calibration process starts, the percent of completion screen appears as shown in Figure 3-43. It takes approximately 2 minutes to complete process.



FIGURE 3-43

7. When calibration is complete, start screen in Figure 3-41 reappears.
8. Check the data bank in the upper right corner of the screen. If a control/pump failed the test, the fail item(s) binary number(s) is displayed.

Table 3-4 Controls Binary Numbers

Binary No.	Pump No.	Description
1	1	Main Hoist
2	2	Boom & Luffing Drums
4	3	Swing Right
8	3	Swing Left
16	4	Drum 9 on MAX-ER

DIGITAL DISPLAY READINGS

General

The digital display and selector (see “D4. Digital Display and Selector Switch” on page 3-14) allow the operator to monitor three groups of crane information: operating conditions, operating limits, and system faults.

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

To display diagnostic operating conditions listed in Table 3-5, depress limit bypass switch while scrolling up with selector. To turn off the diagnostic operating conditions, depress limit bypass while scrolling down with selector or turn off cab power.

See Table 3-8 for a list of abbreviations and notes used in the tables. See Drum Identification for identification of the drums.

NOTE: This topic identifies display readings for all modes and configurations the 2250 can be used in (to include MAX-ER). Some of the display readings identified will not appear until the corresponding mode or configuration is selected.

Also, some display readings may appear even though the crane is not equipped with the corresponding attachment. In these cases the display reading is meaningless.

Display readings for optional items are marked with an asterisk (*).

Selecting Display Language

The display can be viewed in English or one of several foreign-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:

1. Depress limit bypass switch.
2. Turn crane mode selector key to “confirm” position.

Repeat the steps until the screen displays the desired language.

Operating Conditions

Table 3-5 lists operating conditions which can be displayed and the normal operating range of each.

When an operating condition is selected (such as ENGINE SPEED), the current status of the condition displays (see Figure 3-44).




FIGURE 3-44

Operating Limits

Table 3-6 lists operating limits which can be displayed.

When one or more operating limits is reached, the operating limit alert (yellow light and buzzer in cab) turns on to warn the operator. At the same time, the operating limit display immediately appears (see Figure 3-45) and automatically scrolls through the names of the limits, stopping at each for approximately three seconds.



FIGURE 3-45

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 two things happen:

1. Name of limit appears on display.
2. Cause of 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.

NO FAULT appears on the display (see Figure 3-46) when there are no limits.

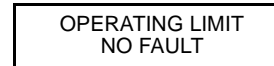


FIGURE 3-46

System Faults

Table 3-7 lists system faults which can be displayed.

When one or more system faults occur, the system fault alert (red light and beeper in cab) turns on to warn the operator. At the same time, the system fault display immediately appears (see Figure 3-47) and automatically scrolls through the names of the faults, stopping at each for approximately three seconds.



FIGURE 3-47

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 two things happen:

1. Name of fault appears on display.
2. Cause of 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.

NO FAULT appears on the display (see Figure 3-48) when there are no faults.

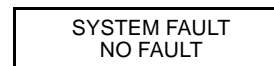


FIGURE 3-48

**Table 3-5
Operating Conditions**

Listed below are the operating conditions which 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.
* AUX ENGINE OIL PRESS		
ENGINE SPEED	RPM	Low idle to high idle in revolutions per minute.
* AUX ENGINE SPEED		
AIR PRESSURE	PSI	120 - 132 psi (8 - 9 bar).
ENGINE TEMPERATURE	DEG F	See Engine Manual for specifications.
* AUX ENGINE TEMP		
MACHINE LEVEL FRONT	DEG IN	Each screen displays two numbers. First number is angle (+ or - degrees) that crane is out of level in indicated direction from horizontal. Second number is approximate amount (inch) of blocking needed to level crane in required direction.
MACHINE LEVEL RIGHT		
BOOM ANGLE	DEG	Degrees boom is positioned above horizontal.
* BOOM ANGLE LUFF ANGLE	DEG	Degrees boom is positioned above horizontal. Degrees luffing jib is positioned above horizontal.
* BOOM TO LUFF JIB ANG	DEG	Degrees between centerline of boom and centerline of luffing jib.
* CTWT UP BHITCH DOWN XX.X	—	Indicates position of counterweight (UP, DOWN) and back hitch loading during MAX-ER 225, 400, or 2000 operation.
CLAM CLOSING PRESS	PSI	See Clamshell Operation instructions for procedure to adjust pressure.
CRANE MODE (Name of Mode)	—	See Crane Mode Selector instructions for procedure to select and confirm 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 diagnostic screens, depress limit bypass switch and scroll down or stop and restart engine.

HYDRAULIC TANK TEMP	DEG F	Oil temperature varies depending on load and ambient temperature. Will not accurately read temperature less than approximately 90°F (32°C).
* AUX HYD TANK TEMP		
HYDRAULIC TANK PRESS	PSIA	7 - 18 psia (0,5 - 1,2 bar absolute) depending on filter condition and oil temperature.
HYDRAULIC TANK LEVEL	%	75 - 100% of oil remaining in tank.
DRUM (10 screens)	2 Rows of Numbers in Multiple Display Screens	Numbers are used to monitor operation of programmable controller and system functions. See Diagnostics Display instructions in this Section of the manual for detailed explanation of these screens. Crane Care Customer Service will request these numbers when troubleshooting crane.
SWING		
AUX SWING		
TRACKS		
A1, A2, A3 D1, D2, D3		
MXR	2 Rows of Numbers	Numbers are used to monitor operation of programmable controller and system functions for MAX-ER 2000 only . See Diagnostics Display instructions in this Section of the manual for detailed explanation of screen.
PROG M000000.0DP	—	Computer Program Version. Crane Care Customer Service will request these numbers when troubleshooting crane problems.
CON 00000000000	—	Computer and Crane Configuration Code. Crane Care Customer Service will request these numbers when troubleshooting crane problems.

* = Optional

Table 3-6
Operating Limits

Listed below are the limits which 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 will 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.
* PAWL IN [1]	Corresponding drum does not lower or stops lowering.	Disengage pawl. It may be necessary to hoist slightly before pawl will disengage.
PAWL OUT [1] or FUNCTION NOT PARKED [2]	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 [2]	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 [3]	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 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.
* 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.

Display Reading	Function Response	Corrective Action
* 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 1 in (25 mm) 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 load slowly and smoothly.
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 (Crane Serial Number 2251337 and Newer 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 4 seconds.	Brakes and clutches of all drums on main shaft are applied . Fault can not be cleared until crane is shutdown and restarted.

* = Optional

Table 3-7 System Faults

Listed below are the faults which turn on the system fault alert (red light and beeper) in the operator's cab. When the alert comes on, scroll to SYSTEM FAULT group of digital display to determine which fault has been reached; take corrective action.

Display Reading	Cause of Fault	Function Response
* AUX SYS HYD FILTER [4]	Plugged filter. Filter differential pressure above 40 psi (2,8 bar).	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	Sender output voltage 0.0 volts or above 9.7 volts.	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.
* LUFF JIB ANGLE SENDER		
LOW AIR PRESSURE	Manifold air pressure below 90 psi (6,2 bar).	If air pressure continues to drop, load drum parking brakes will apply.
HYD TANK LEVEL	Less than 75% level.	Stop and check oil level - fill 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 volts. Differential pressure between left/right side strap cylinders is 1,200 psi (83 bar). 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 volts	Handle commands disabled.
IO BOARD FAULT n [2]	<p>CPU not communicating with I/O board <i>n</i>, where:</p> <p>1 – first I/O board after the CPU</p> <p>2 – second I/O board after the CPU</p> <p>4 – third I/O board after the CPU</p> <p>8 – fourth I/O board after the CPU</p> <p>Failure of more than one board is indicated by an <i>n</i> value that is the sum of the <i>n</i> values associated with each board (I.e. if <i>n</i>=6, the second and third I/O boards after the CPU may have failed)</p>	<p>Check for 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 <i>n</i> does not change, the problem is most likely in the motherboard or the CPU board. Reference troubleshooting procedures in Folio 2238.</p>

* = Optional

Table 3-8

Table Notes		Abbreviation	Definition
*	Optional item. AUX identifies engine and hydraulic components for auxiliary engine on.	+	Plus
[1]	Past production.	-	Minus
[2]	Current production.	%	Percent
[3]	Maximum angle at which boom will stop varies with each attachment. See Boom Stop Adjustment in Section 4 of the Crane Service Manual for maximum angle at which boom stops.	A1	Handle Inputs
[4]	It is normal for AUX SYS HYD FILTER fault to come on at start-up when oil in auxiliary hydraulic tank is cold. Alert should turn off as oil temperature rises to normal.	A2	Pump Control Outputs
		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 and MAX-ER 225 or 400	MAX-ER 2000	50,000 lb Clam
1	Front Load Drum	No Drum Available	Front Load Drum
2	Rear or Right Rear Load Drum	Boom Hoist	Full Width Rear Load Drum
3	Left Rear Load Drum or Mast Hoist (MAX-ER)	Rear Load Drum with Luffing Hoist	—
4	Boom Hoist	Mast Hoist	Boom Hoist
5	Luffing Hoist	Luffing Hoist or Rear Load Drum or Auxiliary Drum without Luffing Hoist	Tagline
9	—	Front Load Drum	—

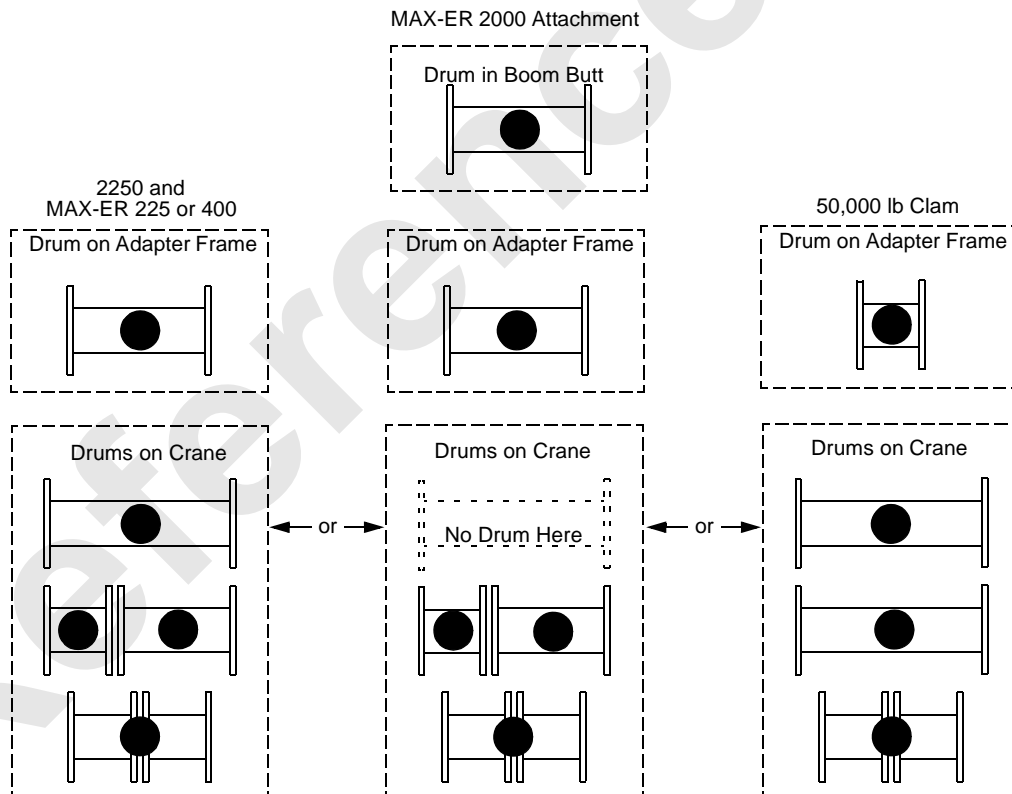


FIGURE 3-49

DIAGNOSTIC DISPLAY

General

To activate the diagnostic display screens, depress top end of limit bypass rocker or turn key clockwise (hold) and scroll up. Once this step is performed, release rocker or key and scroll up and down through the diagnostic screens in addition to the normal operating screens. To deactivate the diagnostic screens, depress top end of limit bypass rocker or turn key clockwise (hold) and scroll down. The normal operating screens will remain active.

The diagnostic display provides information about the status of all main crane components as well as the controller inputs and outputs during operation. The diagnostic screens contain:

- 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 programmer's screen (A2).

NOTE: See Figure 3-49 and Figure 3-50 for drum and pump identification.

Drums 1, 2, and 3 (Crane Load Drums)

-- 1 --	-- 2 --	-- 3 --	-- 4 --	
-- 5 --	-- 6 --	-- 7 --	-- 8 --	DRUM X

1. Handle command in percent from 0% neutral (+ raise, - lower) to ±100%. For certain operating conditions the handle command is set to neutral by the controller even if the handle is not in neutral.
2. Pump command in percent from neutral (+ raise, - lower).
3. Motor command in percent (0% max displacement, 100% min displacement).
4. Measured drum speed in rpm (+ raise, - lower).
5. Command to parking 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.
9. X = Corresponding drum number appears.

Drum 4 (Boom Hoist)

-- 1 --	-- 2 --	-- 3 --	-- 4 --	
-- 5 --	-- 6 --			DRUM X

1. Handle command in percent from neutral (+ raise, - lower). For certain operating conditions the handle command is set to neutral by the controller even if the handle is not in neutral.
2. Pump command in percent from neutral (+ raise, - lower).
3. Motor command in percent (0% max displacement, 100% min displacement).
4. Measured drum speed in rpm (+ raise, - lower).
5. Command to parking brake (1 release, 0 apply).
6. Measured pump system pressure (port B) in psi.

NOTE: X = Corresponding drum number appears.

Drum 5 (Luffing or Auxiliary Hoist)

-- 1 --	-- 2 --	-- 3 --	-- 4 --	
-- 5 --	-- 6 --			DRUM X

1. Handle command in percent from neutral (+ raise, - lower). For certain operating conditions the handle command is set to neutral by the controller even if the handle is not in neutral.
2. Pump command in percent from neutral (+ raise, - lower).
3. Motor command in percent (0% max displacement, 100% min displacement).
4. Measured drum speed in rpm (+ raise, - lower).
5. Command to parking brake (1 release, 0 apply).
6. Measured pump system pressure (port B) in psi.

NOTE: X = Corresponding drum number appears.

Drum 9 (MAX-ER 2000 Load Drum)

__ 1 __	__ 2 __	__ 3 __	__ 4 __
__ 5 __	__ 6 __	DRUM X	

1. Handle command in percent from neutral (+ raise, - lower). For certain operating conditions the handle command is set to neutral by the controller even if the handle is not in neutral.
2. Pump command in percent from neutral (+ raise, - lower).
3. Motor command in percent (0% max displacement, 100% min displacement).
4. Measured drum speed in rpm (+ raise, - lower).
5. Command to parking brake (1 release, 0 apply).
6. Measured pump system pressure (port B) in psi.

NOTE: X = Corresponding drum number appears.

Swing (Crane)

__ 1 __	__ 2 __	__ 3 __	__ 4 __	__ 5 __
__ 6 __	__ 7 __	__ 8 __	SWING	

1. Handle command in percent from neutral (+ right, - left). For certain operating conditions the handle command is set to neutral by the controller even if the handle is not in neutral.
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.

NOTE: Banks 5-7 appear only on current production cranes without a swing lock.

5. Measured swing brake pressure (0-750 psi)
6. MAX-ER 2000 shorting plug status:
 - 0 = MAX-ER 2000 enabled
 - 1 = MAX-ER 2000 shorting plug installed
 - 2 = MAX-ER 225 enabled
 - 4 = MAX-ER 225 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 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)

__ 1 __	__ 2 __	__ 3 __	__ 4 __
__ 5 __	__ 6 __	__ 7 __	TRACK

1. Right handle command in percent from neutral (+ forward, - backward). For certain operating conditions the handle command is set to neutral by the controller even if the handle is not in neutral.
2. Right pump command in percent from neutral (+ forward, - backward).
3. Left handle command in percent from neutral (+ forward, - backward). For certain operating conditions the handle command is set to neutral by the controller even if the handle is not in neutral.
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 parking break (1 release, 0 engage).

Mast Accumulator

__ 1 __	__ 2 __
__ 3 __	ACCUM

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)

__ 1 __	__ 2 __	__ 3 __	__ 4 __	__ 5 __
__ 6 __	__ 7 __	__ 8 __	__ 9 __	MXR

1. Tray Level Indicator (+ = degrees high on right side or - = degrees low on left side).
2. Backhitch Load (US Tons + = tension, and - = compression).
3. MAX-ER Switches (see below).

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 both 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 volts).
 - 32 = Right rod side pressure transducer out of range (below 0.6 or above 9.0 volts).
 - 64 = Differential pressure (one side taking 2100 psi more than other side).
 - 128 = Piston pressure transducer out of range (below 0.6 or above 9.0 volts).
5. **Current Production:** MAX-ER Controller Communication Status: 0 = Good. Any other number indicates a problem with MAX-ER controller communication to the crane controller. Contact Manitowoc Crane Care.
Past Production: Proportional Cylinder Command: 0 = Off and 254 = On.
6. Right Strap Cylinder Rod Side Pressure (0-3,000 psi [0-207 bar]).
7. Left Strap Cylinder Rod Side Pressure (0-3,000 psi [0-207 bar]).

8. Strap Cylinder Piston Side Pressure (0-3,000 psi [0-207 bar]).
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 Volts) and 255 (10 Volts). The diagnostic screen A1 displays this number for each of the control handles/pedals. The normal operating outputs of the handles range from:

- Approximately 38 (1.5 Volts) to 120 (4.7 Volts) 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 Volts) to 215 (8.5 Volts) 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 – 5.3 volts). In the neutral range, the screen reads 0.

1	_2_	_3_	_4_	_5_	
6	_7_				A1

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)

Disregard information in this screen. For factory programmer's use only	A2
--	----

D1 and D2 (Digital Outputs and Inputs)

The status of the digital outputs from the controller and the inputs to the controller is displayed in several banks in screens D1 and D2. Each bank can indicate the state of up to eight individual digital inputs or outputs.

1	_2_	_3_	_4_	_5_	
6	_7_	_8_			D X

1. 1 - 8 = Bank number.

NOTE: X = Corresponding digital screen number (1 or 2) appears.

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 – 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 3-9 and Table 3-10 in this section.

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 3-11. In the corresponding row the identifier numbers that are ON (active) in the bank are shaded black.

Use Table 3-9 and Table 3-10 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 3-11. 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 3-10, Bank 3. In this example, 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 3-9 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 3-11. 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, etc.), 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 3-9 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 Freefall 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 Freefall Front Console LED
2	Drum 3 Freefall 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 3-10 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 & 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 3-11
8-Bit Binary System

	1	2	4	8	16	32	64	128
1								
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7								
8								
9								
10								
11								
12								
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36								
37								
38								
39								
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41								
42								
43								

	1	2	4	8	16	32	64	128
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	1	2	4	8	16	32	64	128
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129								

Dark shaded boxes indicate ON; white boxes OFF.

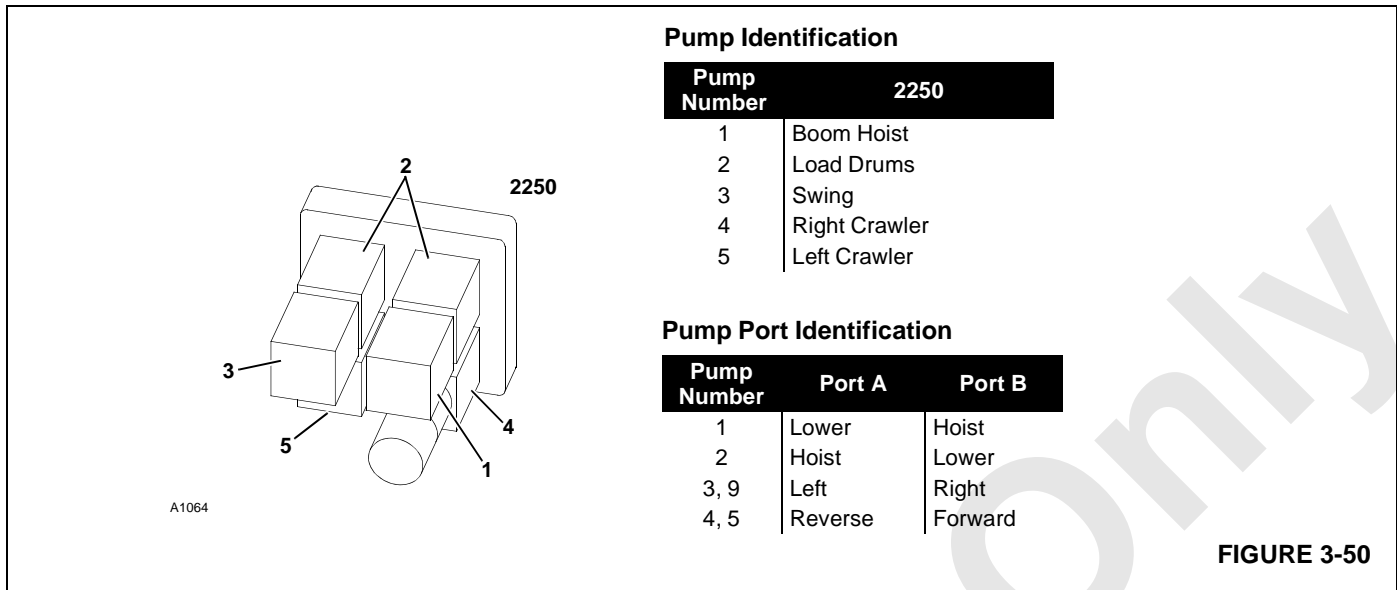
Table 3-11
8-Bit Binary System (continued)

	1	2	4	8	16	32	64	128
130								
131								
132								
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134								
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136								
137								
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164								
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167								
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171								
172								

	1	2	4	8	16	32	64	128
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	1	2	4	8	16	32	64	128
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Dark shaded boxes indicate ON; white boxes OFF.



ENGINE DIAGNOSTICS (CUMMINS QSX15 ENGINE)

General

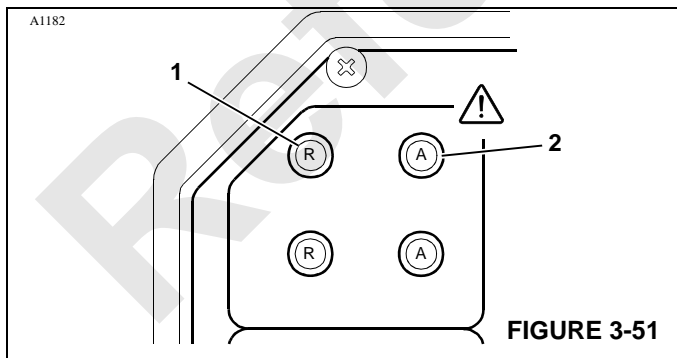
The Cummins QSX15 Engine has two types of fault codes:

- 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 red engine stop light and yellow engine warning light on the front console. Inactive faults can only be read with electronic service tool supplied by the engine manufacturer.

Diagnostic Lights

The engine diagnostic lights are mounted on the front console in the operator's cab as shown in Figure 3-51.



1. Engine Stop Light

When on, the red engine stop light indicates the need to **stop engine as soon as safely possible** and correct the fault.

CAUTION Engine Damage!

If possible, lower lifted loads and then stop engine as soon as possible when red engine stop light comes on. Permanent damage can occur if engine is run while red Engine Stop light is on. Do not run engine until fault is corrected.

2. Engine Warning Light

When on, the yellow engine warning light indicates that engine can be run but the fault should be corrected as soon as possible.

3. High Exhaust System Temperature — Tier 4 Only

See Figure 3-52 and page 3-15 for details.

4. DPF ON — Tier 4 Only

See Figure 3-52 and page 3-15 for details.

5. DPF Regeneration Inhibit — Tier 4 Only

See Figure 3-52 and page 3-15 for details.

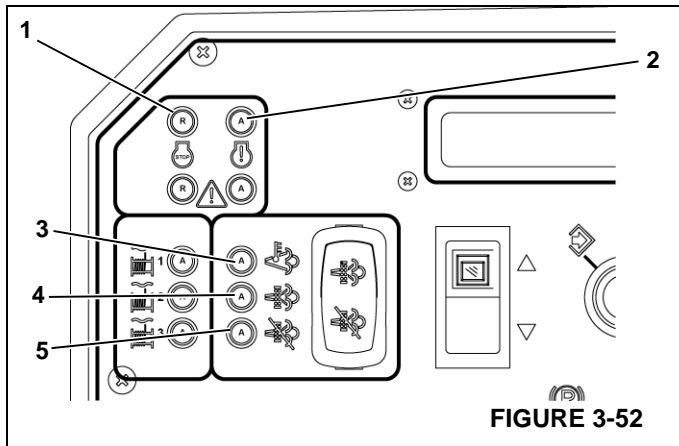


FIGURE 3-52

Engine Off Diagnostics

To identify active faults, proceed as follows. A laminated list of fault codes is located in the operator's cab.

1. STOP engine.
2. Move run/stop/run key switch to either RUN position to turn on display screen.
3. Move hand throttle from low speed to high speed and back to low speed three times within five seconds.
4. If no active faults exist, red engine stop and yellow Engine Warning lights come on but don't flash.
5. If active faults exist, following occurs:
 - a. Yellow engine warning light flashes indicating that a fault code is about to be flashed.
 - b. There is a 1 to 2-second pause.
 - c. Red Engine Stop light flashes a three-digit code to show which active fault has been detected (see Figure 3-53 for example). There is a 1 to 2-second pause between each number.
 - d. When code is finished flashing in red, there is a 1 to 2-second pause and yellow Engine Warning light flashes again.
 - e. Same fault code flashes a second time before advancing to next code.

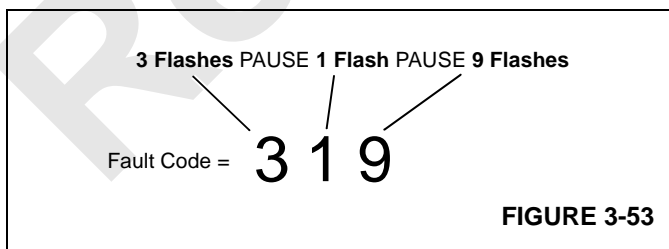


FIGURE 3-53

DRUM INTERLOCK

General

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.

Drum interlock cannot be used on 3-drum cranes.

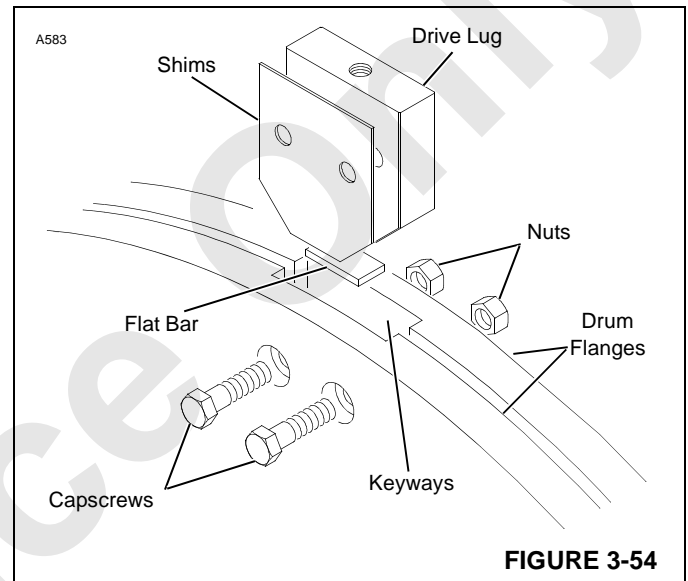


FIGURE 3-54

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 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.

For drum interlock operation in the free-fall mode, reroute the drum working brake air lines as shown in Figure 3-56.

Operate the drums in FREE-FALL mode as follows:

- Use 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 drive lug.**

Full-Power Mode

Use drum interlock in the full-power mode when the added security of dual parking 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 parking brakes stop 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 TANDUM DRUM mode. In the tandem mode, the crane's programmable control automatically selects the left hand control handle (right drum) as the active handle. The other handle is inoperable.

WARNING Falling Load Hazard!

Avoid possibility of death or serious injury to personnel.

Land all loads so load lines are slack before installing drive lug or disconnecting air lines.

Installing Drum Interlock

1. Land load on both drums so wire rope is slack.
 2. Remove load line from drum not to be used.
 3. Operate drums to line up keyways in drum flanges as shown in Figure 3-54.
 4. Install flat bar and drive lug in keyways as shown in Figure 3-54.
- Use shims as necessary so drive lug is snug in keyways.
- Apply thread-locking compound to screw threads, fasten nuts to screws, and securely tighten nuts so they cannot loosen.
5. Modify the drum working brake air lines as described below to allow drum interlock operation (see Figure 3-56, 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 air lines between brake chambers and treadle valves.
- b. Install tee (1) in air line (B) with nuts (2) and ferrules (3).

- c. Connect air line (C) to tee (1) with nut (2) and ferrule (3).
- d. Securely fasten female connector (4) and plug (5) to free end of air line (A) with nut (2) and ferrule (3).
- e. Make sure all fittings are tight to prevent air leaks.

WARNING Falling Load Hazard!

Be aware of which working brake pedal is active when operating with drum interlock in free-fall mode.

Working brake must be applied to stop load when drum control handle is released to off; otherwise, load will lower uncontrolled.

Death or serious injury to personnel can result.

Removing Drum Interlock

1. Land load on both drums so wire rope is slack.
2. Fully release both drum working brake pedals to exhaust air from air lines between brake chambers and treadle valves.
3. Remove drive lug, shims, and flat bar from keyways as shown in Figure 3-54. Store all parts.

If the drive lug is seized to the keyways, a bar and bolt can be used to jack the drive lug out of the keyways as shown in Figure 3-55.

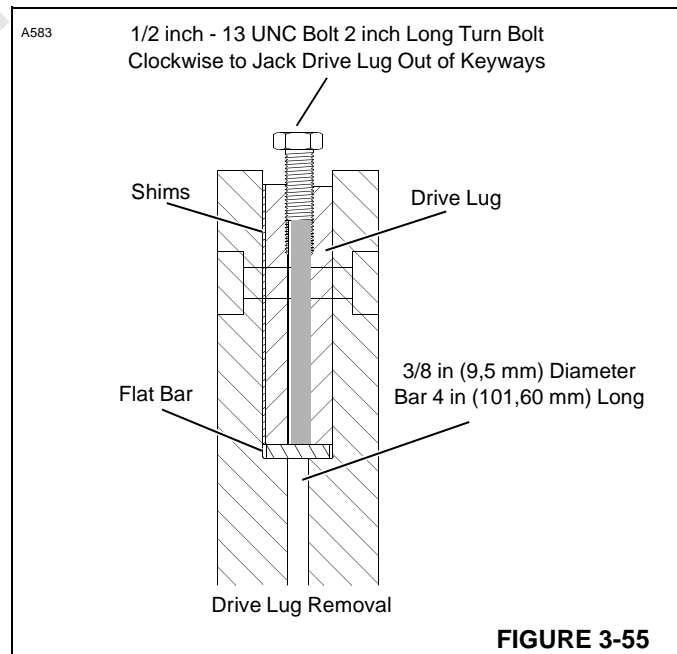
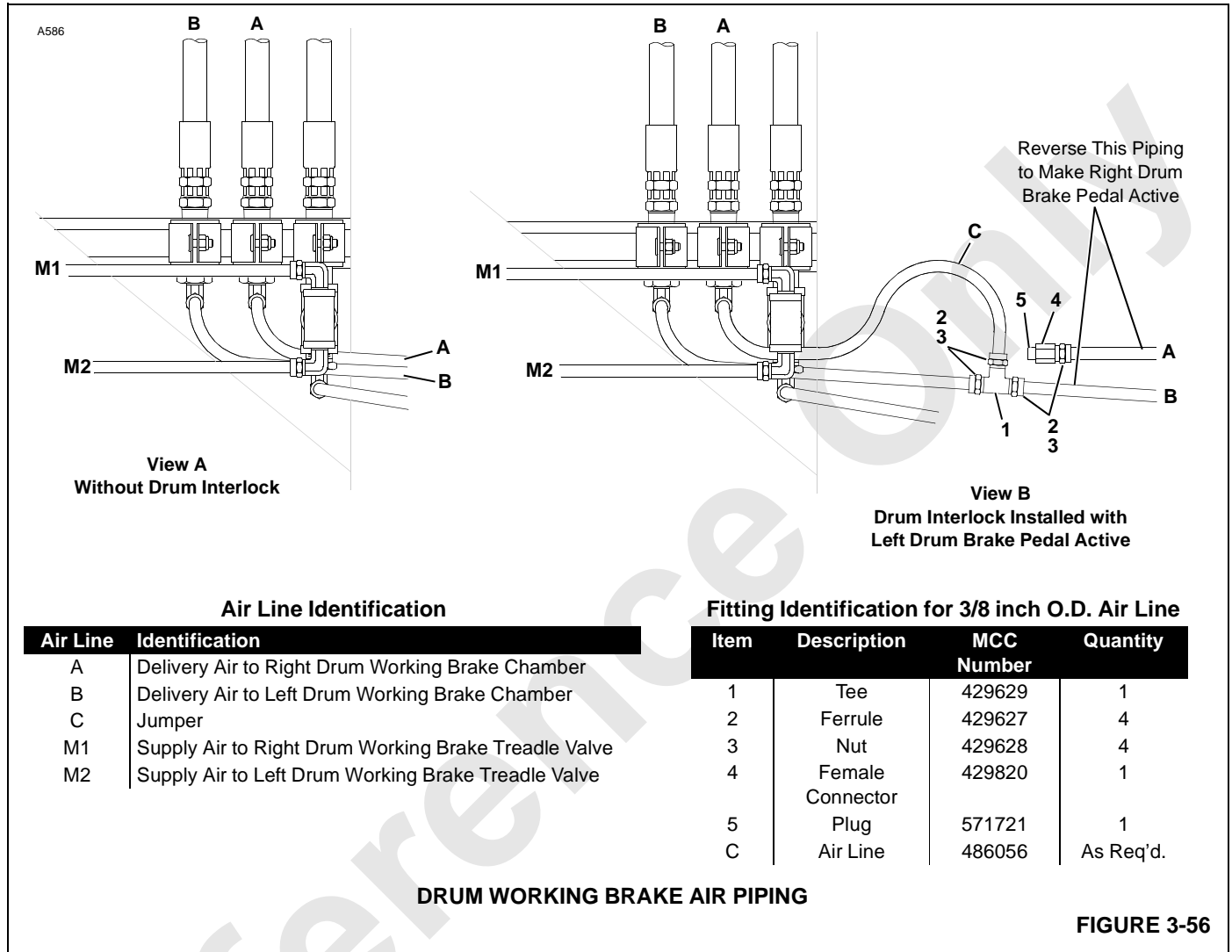


FIGURE 3-55

4. Remove air fittings and reroute air lines so they are connected as shown in Figure 3-56, View A.
5. Make sure all fittings are tight to prevent air leaks.
6. Install load line on other drum if necessary.



3

SWING SPEED/TORQUE ADJUSTMENT

General

Swing speed and torque can be adjusted to suit operator needs.

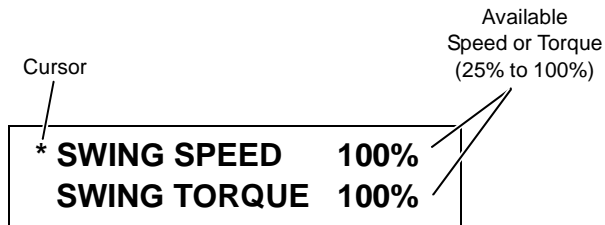


FIGURE 3-57

Adjustment

To adjust swing speed or swing torque, proceed as follows:

1. Stop swinging and apply swing parking brake (park upper with rocker on control console).
2. Access diagnostic screens (Figure 3-57):
 - a. Depress limit bypass button or turn limit bypass key clockwise and scroll up (with selector next to display screen).
 - b. Once step 2a is performed, scroll up at least one screen, release button or key, and scroll up or down through diagnostic screens until swing speed/swing torque screen appears.
3. Rotate crane mode selector back-and-forth from center position to SELECT position until cursor (*) appears next to SWING SPEED.
4. Scroll up and down to change swing speed to desired percentage between 25% and 100%.
5. Repeat steps 3 and 4 for SWING TORQUE.
6. Rotate crane mode selector back-and-forth from center position to SELECT position until cursor (*) disappears.
7. Adjustment is complete. The selected swing speed and torque will remain in computer memory, even after engine is stopped.
8. If desired, turn off diagnostic screens:
 - a. Depress limit bypass button or turn limit bypass key clockwise.
 - b. Once step 8a is performed, scroll down at least one screen and release button or key.

Stopping engine will also turn off 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 swing past the programmed limit. The operator can swing in the opposite direction.

The system consists of the following components (see Figure 3-58):

- **Swing Sensor** — Electronically monitors swing speed and direction and sends corresponding electric signals to the crane's programmable controller.
- **Crane Mode Selector** — Used to turn the swing limits on and off.
- **Digital Display** — Contains the swing limiter programming screens.
- **Programmable Controller** — 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** — Apply the swing parking brake to stop the rotating bed if the programmed swing limits fail for any reason.



WARNING

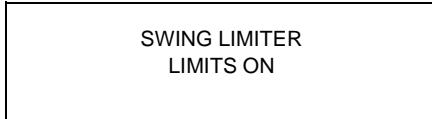
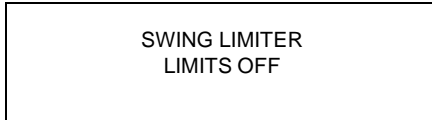
Operator Aid!

Swing limiter is a safety device designed to stop rotating bed (prevent boom or rotating bed from swinging into job site obstructions) in event operator fails to stop rotating bed from swinging in normal manner. Any other use of 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 diagnostic screens on digital display by depressing scroll up and limit bypass switches at the same time.
2. Scroll through diagnostic screens until either of following screens appears.



3. To TURN OFF swing limits:
- Turn crane mode selector to SELECT position. An asterisk * will appear to left of SWING LIMITER line.
 - Scroll up or down to LIMITS OFF.
 - Turn crane mode selector to SELECT position. Swing limits will be turned off and asterisk will disappear.
 - Remove limit switch actuators.

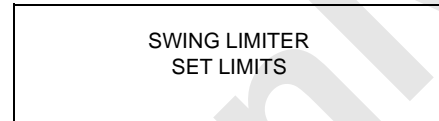
CAUTION

Avoid Shock Load Damage to Boom and Jib!

Remove limit switch actuators before operating crane with swing limiter system turned off.

Limit switch will apply swing parking brake when either actuator is contacted if this step is not performed. Crane rotating bed will stop abruptly, possibly causing shock load damage to boom and jib.

4. To SET LIMITS:
- Remove limit switch actuators if they will interfere with desired programmed limits.
 - Make sure crane's swing motion is stopped at any position between desired swing limits.
 - Turn crane mode selector to SELECT position. An asterisk * will appear to left of SWING LIMITER line.
 - Scroll up or down to SET LIMITS.



NOTE: The programmed swing limits have an accuracy of ± 1.5 degrees of rotation (approximately ± 0.5 ring gear tooth).

- Swing rotating bed to desired right or left position and bring rotating bed to smooth stop. **Do not swing beyond desired limit.**
- Swing rotating bed in opposite direction and bring rotating bed to a smooth stop at desired position. **Do not swing beyond desired limit.**
- Scroll up to LIMITS ON to activate selected limits.
- Turn crane mode selector to SELECT position. Swing limits will remain on and asterisk will disappear.
- Install and adjust limit switch actuators.

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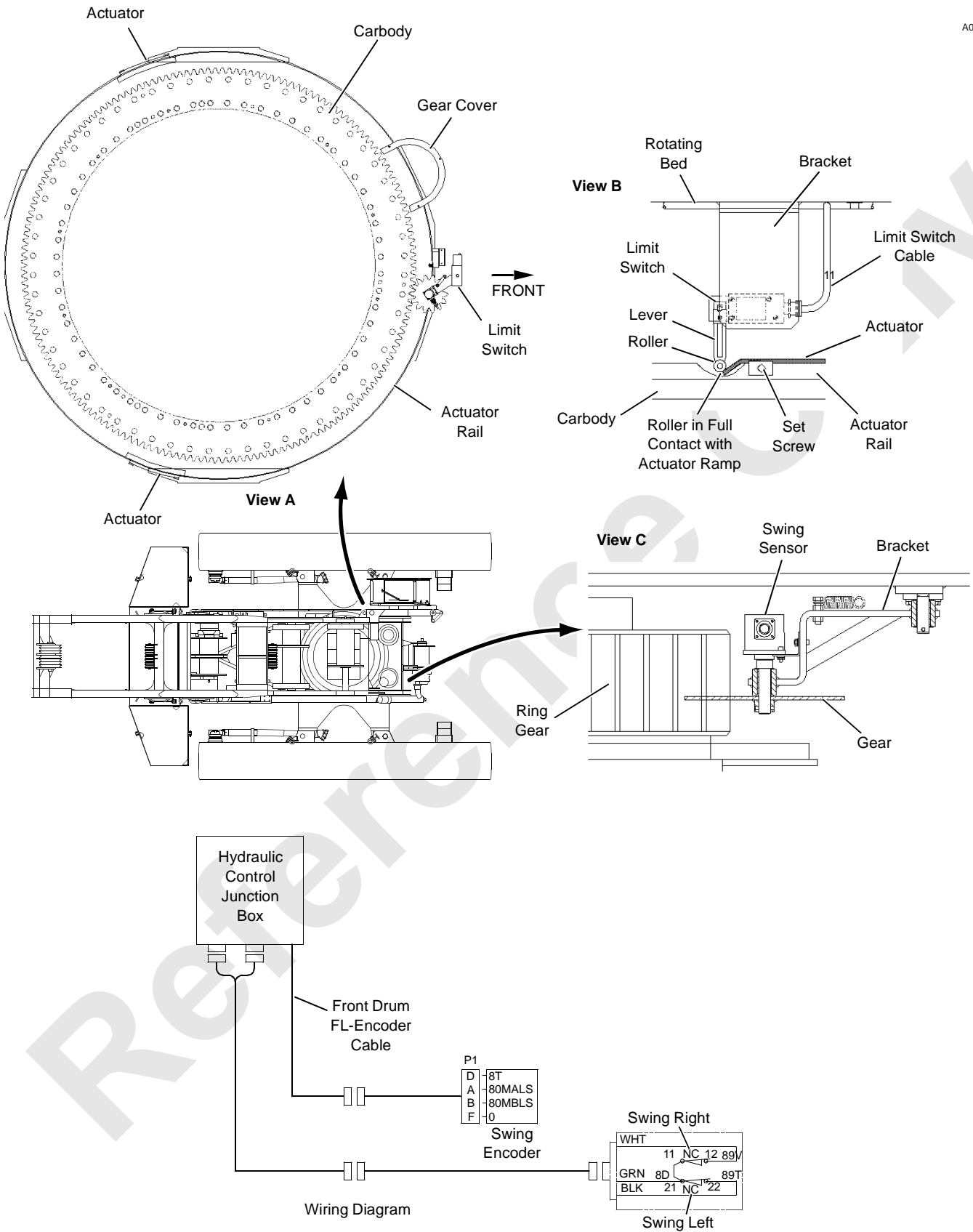


FIGURE 3-58

Swing Limit Switch Adjustment

See Figure 3-58 for 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 limit switch lever so roller is in full contact with actuator ramp (View B).
2. Remove both limit switch actuators from actuator rail.
3. Program swing limits.
4. Swing rotating bed in either direction to programmed right or left swing limit.
5. Engage swing lock.
6. Place actuator on rail (View B) — to right of limit switch for swing right limit or to left of limit switch for swing left limit — so actuator just lightly contacts limit switch roller.
Do not trip limit switch open while performing this step.

7. Securely tighten setscrews to secure actuator.
8. Swing rotating bed to programmed swing limit in opposite direction and repeat steps 3 – 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 (i.e., crane 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.

Operator, if you are unable to swing away from actuators in 2-3 attempts, stop and move crane away from dangerous area before trying to swing again.

Reference Only

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SWING DRIVE DISCONNECT OPERATION

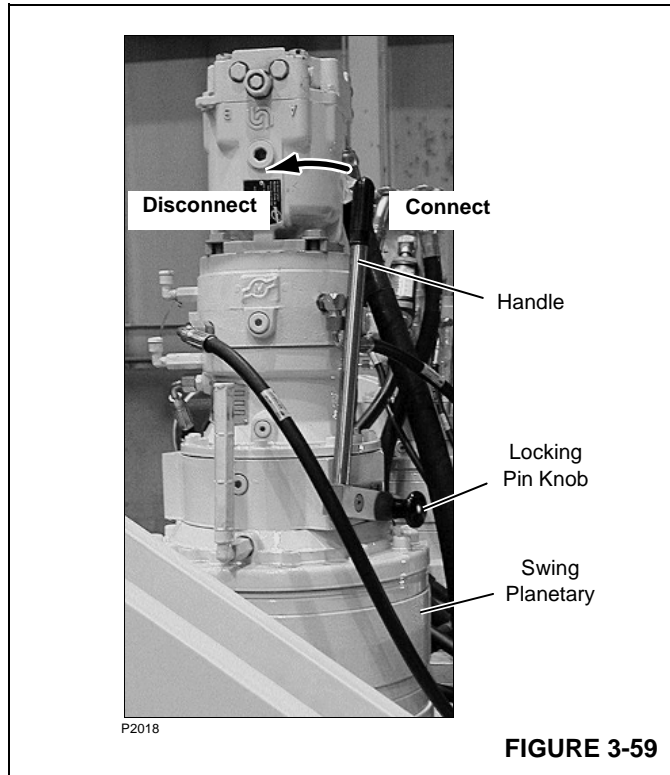


FIGURE 3-59

General

The 2250 has one or two swing drives. This topic contains instructions for disconnecting and connecting the swing drives on the crane.

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 crane so the rear faces wind direction.
2. Compare expected wind velocities to wind limits indicated in Wind Conditions.
3. Lower boom to angle indicated or to ground as required to prevent equipment damage.

CAUTION Equipment Damage!

Before disconnecting swing drives, make sure boom will not strike power lines, buildings, or other stationary objects while crane is weather vaning.

To prevent equipment damage, sufficient clear area must be available for crane to weather vane.

4. Be sure there is sufficient clearance for boom to swing without striking other objects.

Disconnecting Crane Swing Drive

See Figure 3-59 for following instructions.

1. Pull out locking pin knob.
2. Rotate handle fully to left (when facing handle).
3. Release locking pin knob.
4. Check that handle is locked in position.
5. Repeat above steps for second swing drive.

Connecting Crane Swing Drive

See Figure 3-59 for following instructions.

1. Pull out locking pin knob.
2. Rotate handle fully to right (when facing handle).
3. Release locking pin knob.
4. Check that handle is locked in position.
5. Repeat above steps for second swing drive.

PILE DRIVING SYSTEM CONTROLS

General

See Figure 3-60 for the location of the components.

This topic identifies the location and function of the hydraulic components Manitowoc 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 65 gallons (246 liters).

CAUTION

Pump Damage!

Hydraulic tank shut-off valve must be open when engine is operating to prevent spotter system pump cavitation.

A hydraulic tank shut-off valve is located at bottom rear of tank where suction hose exits. Valve handle must be OPENED (in line with hose) before operating 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 pump is mounted on and driven by the 2250 swing pump.

The pump is a gear type with a flow rating of 42 gpm (159 liters/min) at 3,000 rpm, when 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 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 four sections:

- 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 tank.
- The inlet section has a relief valve which limits system pressure to 3,000 psi (207 bar).
- 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 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 cylinders in position and allow oil flow to customer supplied spotter system control valve. When enabled, work station valves A or B direct oil flow to customer supplied cylinders. Return oil from cylinders flows through system filter and back to tank.
- The end cap routes return oil back to the inlet section or to spotter system.

Spotter System Dump Valve

Spotter switch is a 2-position on/off switch, mounted on left wall of cab. The spotter switch controls the operation of 2-position dump valve. When spotter switch is ON, the green spotter light comes ON. The dump valve closes to allow oil flow from directional control valve to spotter system control valve. When switch is placed in OFF position, green spotter light goes OFF. The dump valve opens to allow oil flow through the system filter and back to tank.

NOTE: When one or both directional control valves are operating, oil available to operate spotter system is greatly reduced.

Cylinder Operating Controls

The controls are 3-position, handle-operated electrical valves which provided variable control of the customer supplied cylinders.

Handle A controls forward and reverse operation of the A work section of the directional control valve. Handle B controls forward and reverse operation of the B work section of the directional control valve. Exact operation of the controls depends upon how the customer connects the hydraulic lines to the cylinders.

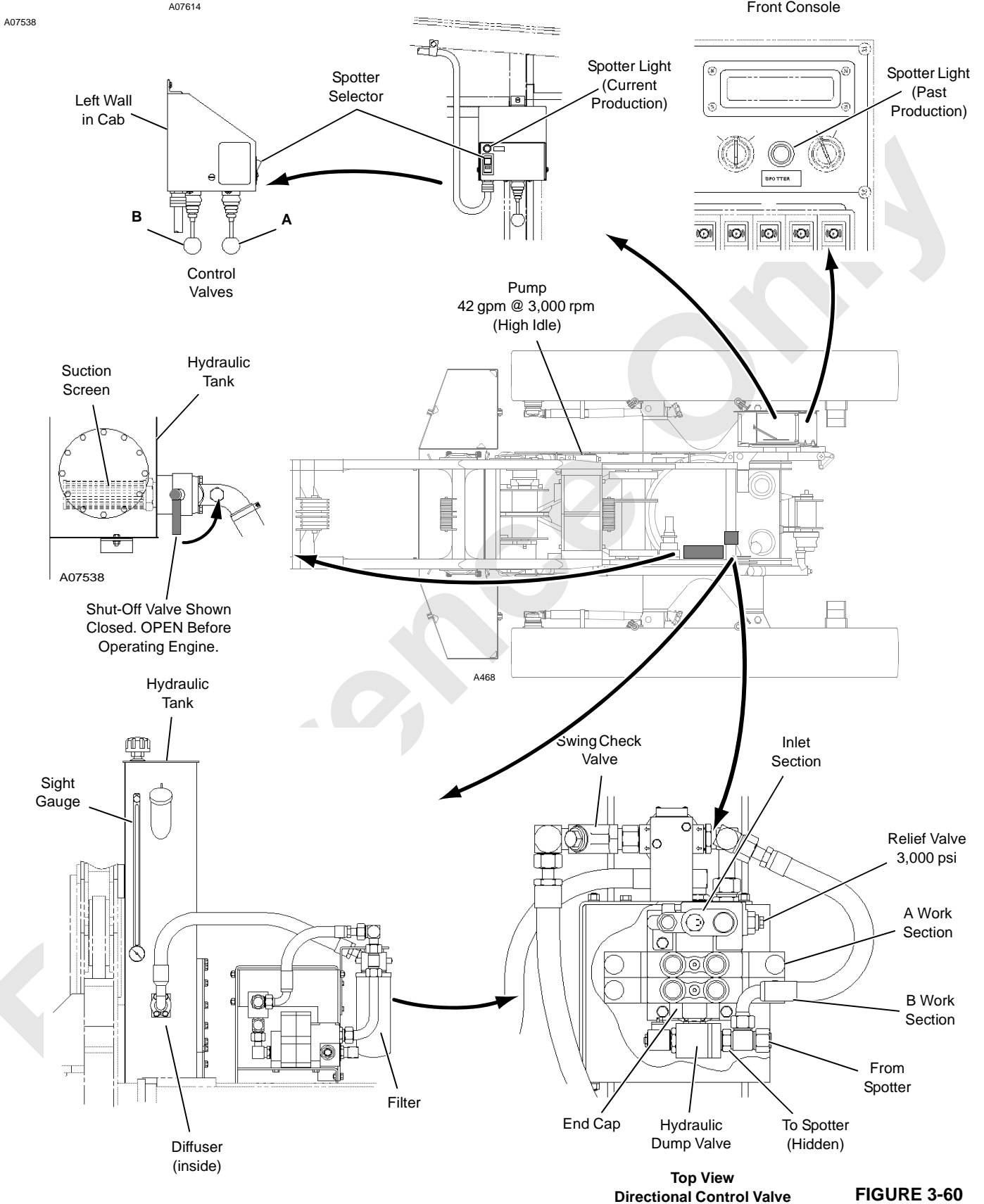
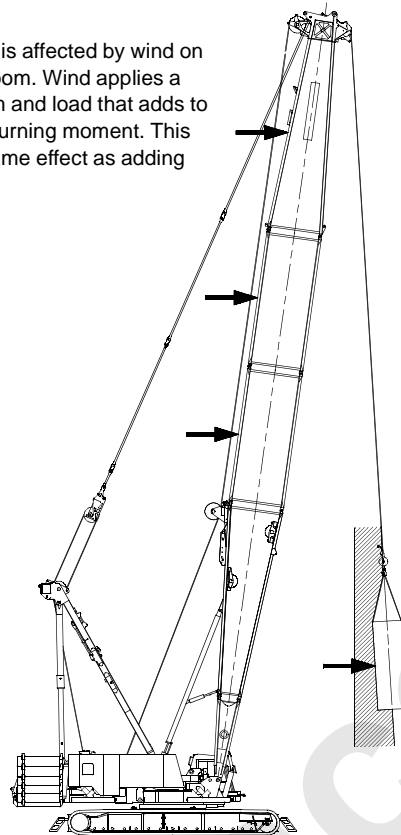


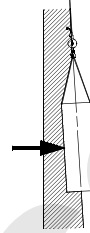
FIGURE 3-60

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 load radius. This condition can result in an overload hazard, possibly causing the crane to tip or the boom to collapse.

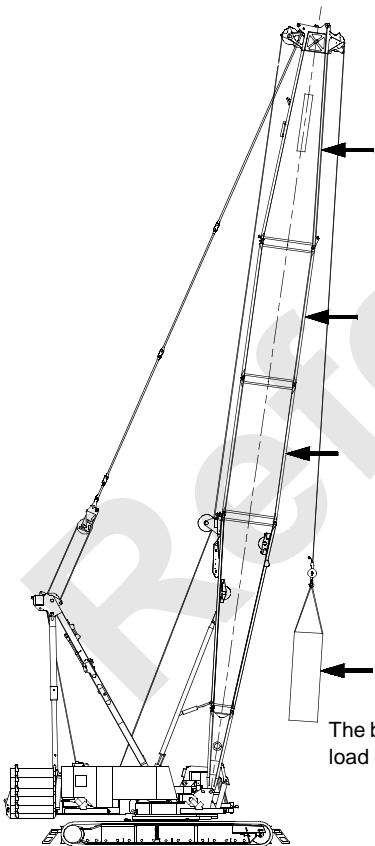
To avoid this hazard, reduce operating speeds and load.



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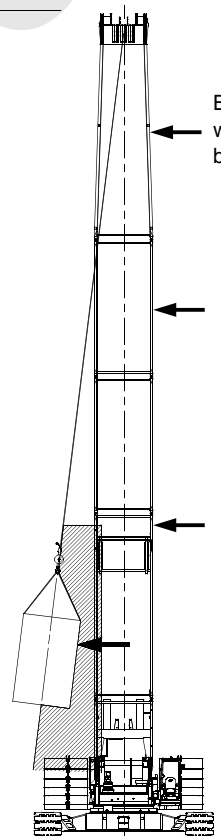
Backward stability is affected by wind on the front of the boom. This condition is especially dangerous when the boom is at or near the maximum angle when operating without load.

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



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

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



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

To avoid this hazard, reduce operating speeds and load.

FIGURE 3-61

WIND CONDITIONS

General

Wind adversely affects lifting capacity and stability as shown in Figure 3-61. The result could be loss of control over the load and crane, even if the load is within the crane's capacity.



WARNING

Tipping Crane Hazard!

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

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

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

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 affect on the load.

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

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

For wind conditions specific to this crane and its attachments, see the Wind Conditions publication at the end of this section or, if applicable, the Capacity Charts provided with this crane and its attachments.

COLD WEATHER HEATER PACKAGE

General

The optional cold weather heater package preheats critical machinery and lubricant sumps during cold weather shutdown. See FIGURE 3-62 continued for heater components.

When operated in an arctic climate — outside temperature continuously below 0°F (-18°C) and -30°F (-34°C) — the crane should be equipped with the heaters identified in this topic and lubricated with the lubricants listed in Section 5.

CAUTION

Machinery Damage!

Operating in an arctic climate without heaters can damage machinery during cold weather start-up due to lack of lubrication.

Heater package described in this section may not provide adequate protection when operating below -30°F (-34°C). Contact Crane Care Customer Service at factory for recommendations.

CAUTION

Hydraulic Pump Damage!

To prevent damage to pumps, warm hydraulic oil to 60°F (16°C) minimum before operating crane in an arctic climate.

Heaters

The heaters operate on 240 volt AC (single phase) (standard cab) or 120 volt AC (single phase) (elevated cab) electrical power supplied through an external power supply. The heater package includes the following:

Qty	Description	Std Cab	Elev Cab
1	Engine Coolant, 4000 watt	240V	240V
1	Engine Oil Sump, 300 watt	240V	240V
2	Hydraulic Oil Tank, 500 watt	240V	120V or 240V
2	Battery Pads, 75 watt	240V	120V
1	Control Console	240V, 150 watt	120V, 125 watt
1	Brake Pedal, 250 watt	240V	120V

NOTE: Cranes with an elevated cab are not equipped with brake pedal heater.

In addition to heaters, the following items are provided:

- Air dryer (see separate publication in Vendor Manual provided with crane).
- Thermostatic controlled radiator fans. Fans are off until the coolant temperature is at least 170°F (77°C). The thermostat turns on the fans at 180°F (82°C).

Thermostats

Thermostats turn the heaters on and off at the temperatures listed below.

Heater	Heater On	Heater Off
Hydraulic Oil Reservoir	60°F (16°C)	80°F (27°C)
Engine Coolant (Past Production)	100°F (38°C)	120°F (49°C)
Engine Oil Sump (Past Production)	60°F (16°C)	80°F (27°C)
Battery Pads	50°F (10°C)	60°F (16°C)
Controls and Brakes	50°F (10°C)	60°F (16°C)

Turning Heaters On

1. If power supply is disconnected, proceed as follows:
 - a. Check that main circuit breaker and each heater circuit breaker is off.
 - b. Check that external power supply is off.



WARNING

Electrocution Hazard!

Severe electric shock can cause death or serious injury. Crane owner/user must make provisions for turning off electrical power supply before connecting power supply cord to crane.

- c. Connect external power supply cord to crane.
 - d. Turn on external power supply.
2. Turn on main circuit breaker.
 3. Turn on each heater circuit breaker.

Turning Heaters Off

1. Turn off each heater circuit breaker.
2. Perform remaining steps only if power supply cord will be disconnected or electrical system is being serviced:
 - a. Turn off main circuit breaker.
 - b. Turn off external power supply.
 - c. Unplug power supply cord from crane.

Component Identification for Figure 3-62

Item Description		Item Description		Item Description	
Past Production — Standard Cab		Current Production — Elevated Cab		Current Production — Standard Cab	
1b	Power Supply Receptacle- 3P4W 50A, 125/250 VDC	1a	Power Supply Receptacle- 4P3W 100A, 250VDC	1b	Power Supply Receptacle- 3P4W 50A 125/250 VDC
2	Circuit Breaker Load Center	2	Circuit Breaker Load Center	2	Circuit Breaker Load Center
17a	Main Breaker (50 amp)	18a	Main Breaker (50 amp)	19a	Main Breaker (50 amp)
17b	Brake Pedal (Treadle) Heater Breaker (15 amp)	18b	Control Console Heater Breaker (15 amp)	19b	Engine Coolant Heater Breaker (20 amp)
17c	Engine Coolant and Engine Oil Heater Breaker (15 amp)	18c	Battery Pad Heaters Breaker (15 amp)	19c	Treadle Valve Heater, Front Control Console Heater Breaker (15 amp)
17d	Hydraulic Reservoir Heaters Breaker (15 amp)	18d	Engine Coolant, Oil Heater Breaker (20 amp)	19d	Hydraulic Reservoir Heaters, Engine Oil Heater, Battery Pad Heaters Breaker (15 amp)
17e	Control Console, Battery Pad Heaters Breaker (15 amp)	18e	Hydraulic Reservoir Heaters Breaker (15 amp)		
		18f	SPARE		
Past and Current Production — Standard and Elevated Cabs					
3	Controls Thermostat	9	Battery Thermostat		
4	Controls Heater	10	Battery Heater (two places)		
5	Brake Pedal Valve Thermostat	11	Engine Oil Heater		
6	Brake Pedal Valve Heater ¹ (15 amp)	12	Engine Coolant Heater ²		
7	Hydraulic Oil Thermostat (under cover)	13	Engine Oil Thermostat		
8	Hydraulic Oil Heaters	14	Radiator Fan Switch		
		15	Air Dryer		
¹ Not provided on some cranes		² Heater has built-in thermostat			

Breaker Arrangements

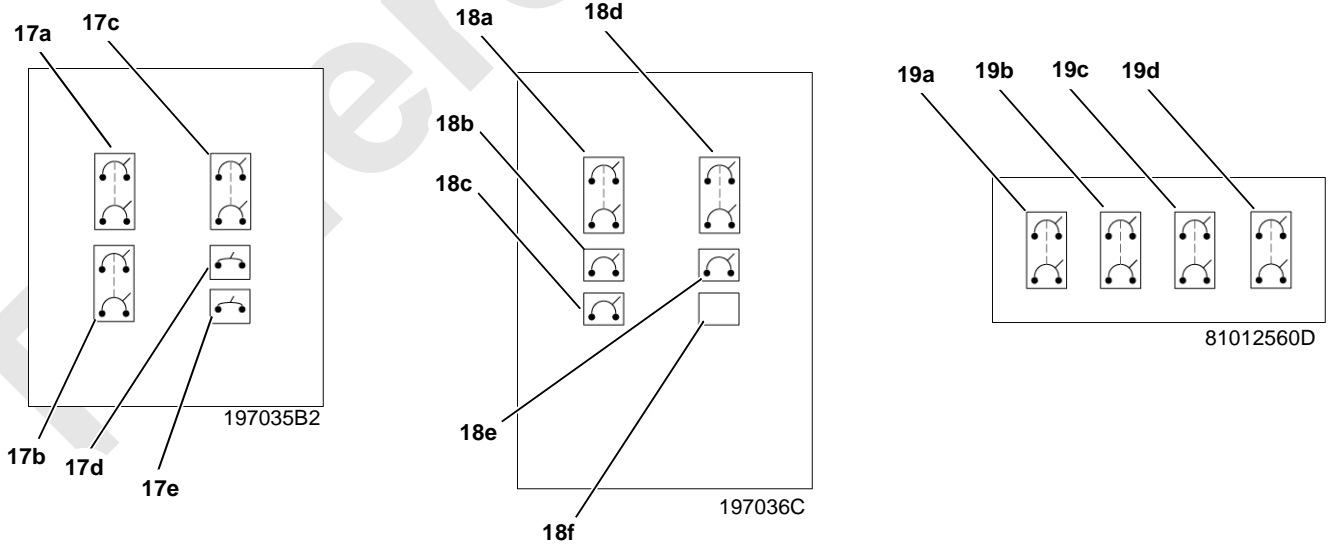


FIGURE 3-62

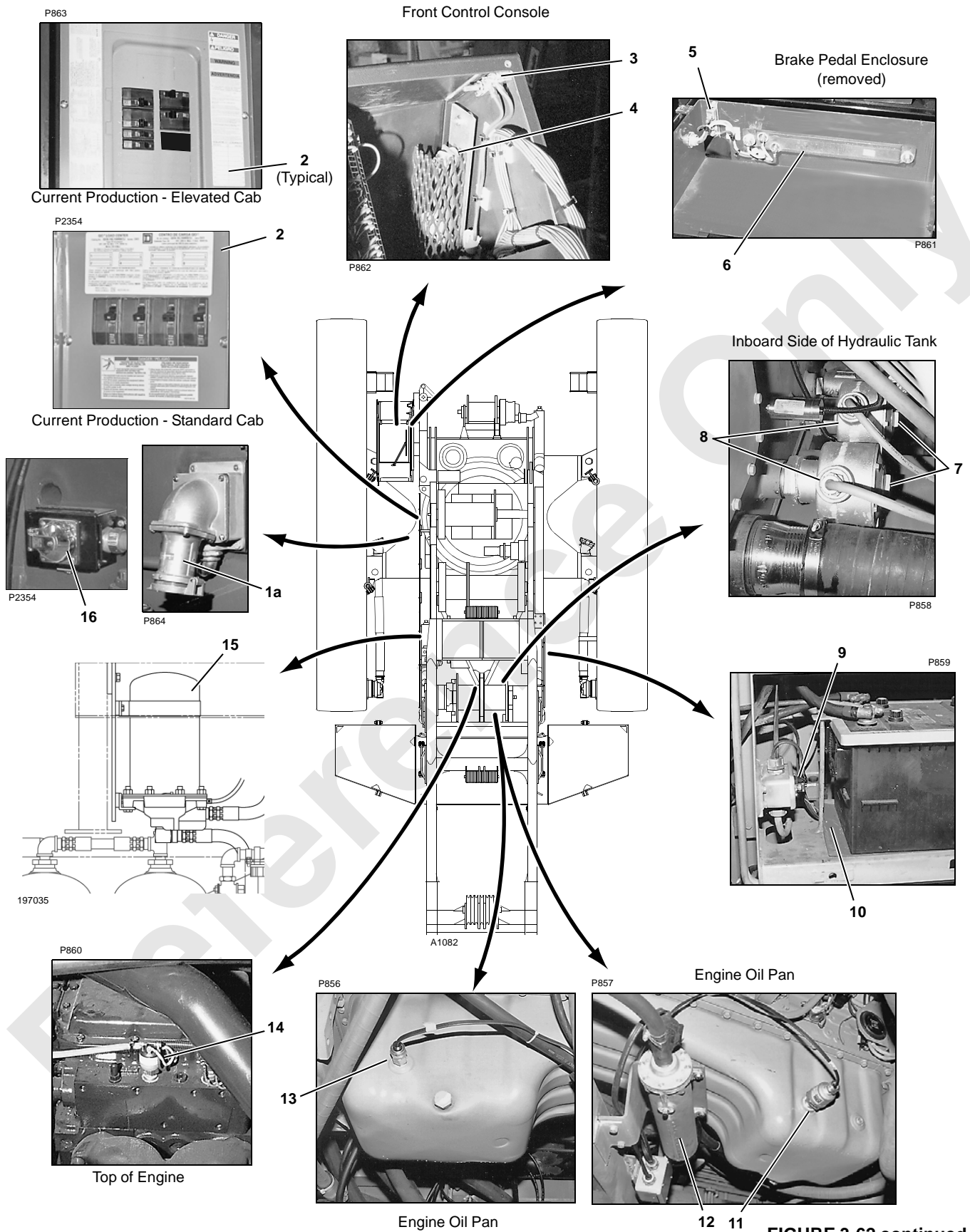


FIGURE 3-62 continued

PREPARATION FOR COLD WEATHER

Crane Limitations

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

Dynamic loads (impact and shock) can affect the steels used in Manitowoc cranes when operating in cold weather. Dynamic loads are created by traveling, sudden application and release of load, and duty-cycle operations (dragline, clamshell, magnet, container handling, concrete bucket placement).

To prevent possible damage to the crane and its attachment when operating during cold weather Manitowoc recommends:

- -5°F (-21°C) to -22°F (-30°C) — 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, crane should be de-rated 25%.
- -23°F (-31°C) to -40°F (-40°C) — De-rate crane by 40% for all lift operations. Halting all lifts should be considered. Duty-cycle operation is prohibited.
- Below -40°F (-40°C) — All operation (lift and duty-cycle) is prohibited except in extreme emergencies, and then only with approval from a competent engineer who has de-rated the crane accordingly.

Wire Rope

The wire rope manufacturers indicate that wire rope will not become brittle in temperatures down to -30°F (-34°C). Lubrication may be a problem, however. During extreme 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 40°F (4°C) requires the use of a cold weather starting aid.



DANGER

Engine Explosion Hazard!

The crane engine has an air intake pre-heater, do not spray any combustible starting aid (ether) into air intake.

Pre-heater will ignite ether resulting in a severe explosion and/or burns.

Coolant and Oil Pan Heaters

A 120 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 40°F to 50°F (4°C to 10°C). Contact the nearest engine dealer for availability and installation of the heaters.

Engine heaters must be unplugged when engine is running to prevent 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 -35°F (-37°C). A mixture of 60% antifreeze and 40% water will provide freeze protection to approximately -60°F (-51°C). 100% antifreeze will freeze at -10°F (-23°C).

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.

Be aware that:

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

Engine Oil

See engine manufacturer's manual for recommendations.

Fuel Oil

See engine manufacturer's manual for recommendations.

Gear Oil

Hydraulic Cranes

Use a gear oil which 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:

- 75W-90 below -10°F (-23°C)
- 80W-90 above -10°F to 100°F (-23°C to 38°C)
- 85W-140 above 100°F (38°C)

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 30°F (17°C) warmer than ambient air temperature. Each heater is equipped with an extension cord for connection to an owner furnished electric power supply.

Hydraulic tank heaters must be unplugged when engine is running to prevent hydraulic system from overheating.

Change the oil in the hydraulic system to ISO Grade 15 when the expected ambient temperature will remain at 32°F (0°C) or below.

Change the oil in the hydraulic system to ISO Grade 46 when the expected ambient temperature will remain above 32°F (0°C).

Air System

Install the optional air dryer available from Manitowoc.

Frequently inspect the moisture ejector at the air tanks for proper operation. The moisture ejector has a heater which 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

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SECTION 4

SET-UP AND INSTALLATION

RIGGING DRAWINGS

For boom and jib rigging drawings that apply to your crane, see end of this section.

OPTIONAL ATTACHMENTS

If applicable, instructions for optional attachments that apply to your crane are located at the end of this section.

GENERAL SAFETY

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



WARNING

Avoid Death or Serious injury!

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



WARNING

Tipping/Overload Hazard!

Avoid tipping crane over or collapsing mast:

- Assemble and disassemble crane on a firm, level, uniformly supporting surface.
- Keep crane level when operating carbody jacks.



WARNING

Avoid Falling Off Crane and Boom!

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

Use sturdy owner furnished ladders or aerial work platforms to gain access to areas which cannot be reached from ladders or steps provided with crane.



WARNING

Moving Parts/Pinch Points!

Avoid death or crushing injury during crane assembly and disassembly:

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

**KEEP UNAUTHORIZED PERSONNEL
WELL CLEAR OF CRANE.**



WARNING

Falling Load Hazard!

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

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

CRANE ORIENTATION

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

FACT™ COMPONENTS

The 2250 is equipped with the following FACT™ components for assembly and disassembly (see Figure 4-1):

- Hydraulically actuated pins for connecting crawlers to carbody.
- Hydraulically actuated pins for connecting rotating bed to adapter frame.
- Hydraulic disconnect for connecting hydraulic circuits between rotating bed and under carriage.

- Hydraulic cylinders for raising and lowering gantry (installing and removing counterweights).
- Hydraulically actuated pins for connecting crane counterweight to rear of rotating bed.

ASSEMBLY AND DISASSEMBLY NOTES

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

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

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

ASSIST CRANE REQUIREMENTS

The 2250 without self-erect requires an assist crane to assemble and disassemble it.

The assist crane must be capable of lifting the rotating bed, which is the heaviest load to be lifted.

- See Table 4-1 in this section for shipping data.
- See Lifting Assembly Drawing at the end of this section for lifting instructions.

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 2250, the selected boom and jib length, movement of trucks with trailers, and movement of an assist crane.

Place blocking on a flat, firm foundation that will support the load placed on them. Do not place blocking in holes, on rocky ground, or on extremely soft ground.

If necessary, use steel plates under the blocking to properly distribute loading. Blocking and steel plates must be:

- Free of defects.
- Strong enough to prevent being crushed or bent.
- Of sufficient size to prevent settling under load.

Contact Crane CARE Customer Service at factory 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 must 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.

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. If your crane has ladders, see instructions in this section.

Do not use top of boom or jib as walkways.

CRANE WEIGHTS

See Crane Weights in Section 1 of this manual for overall weight of the crane and individual weights of components.

RETAINING CONNECTING PINS

Connecting pins are retained in various ways:

- Snap pins.
- Quick-release pins.
- Cotter pins.
- Keeper plates with cap screws and lock washers.

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

MISCELLANEOUS LOOSE PARTS BOX

Miscellaneous loose parts are shipped in a job box with the crane. The box contains standard items that are part of every crane (i.e., crawler shim kit, touch-up paint, spacers) as well as optional items (i.e., wind speed assembly, warning light assembly, aircraft warning light, cold weather cap and receptacle, mirror assemblies). A decal on the inside of the box lid indicates the parts that should be included in the box (see Figure 4-2).

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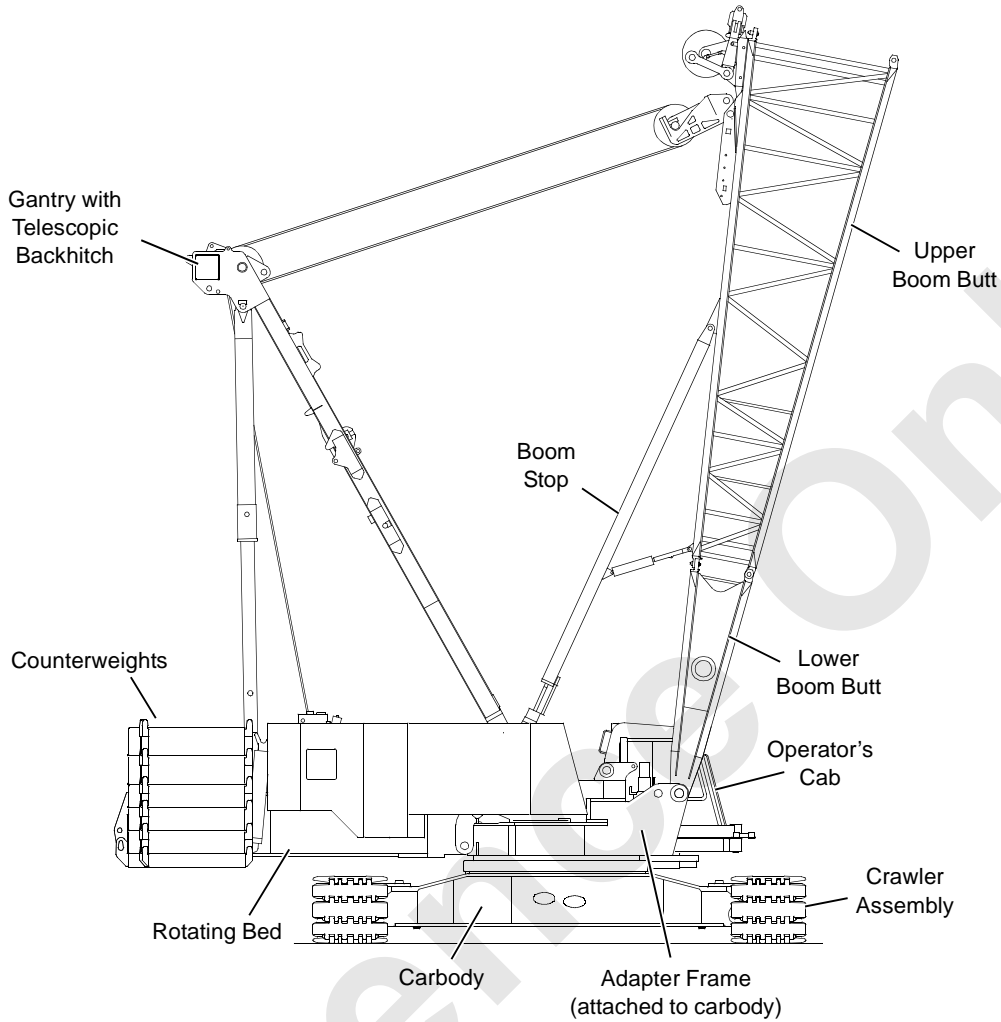


FIGURE 4-1

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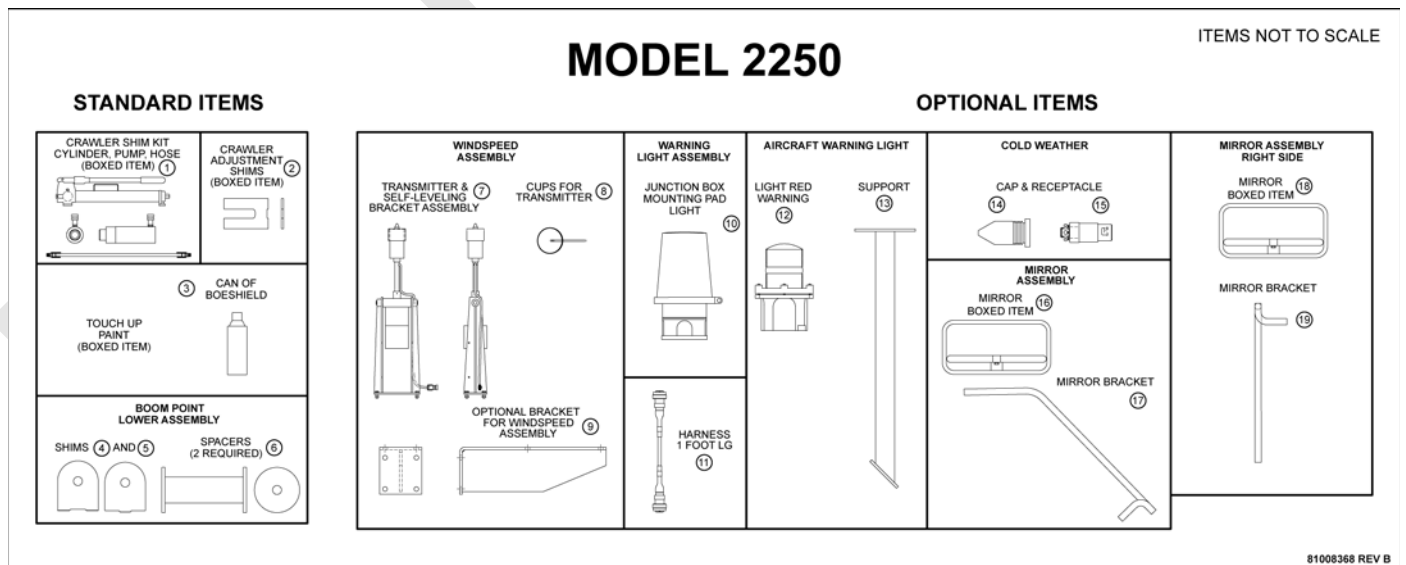


FIGURE 4-2

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 in Section 1 of this manual. For the dimensions of boom and jib sections, see the Range Diagram in your Capacity Chart Manual.

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

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

Use nylon tie-downs to secure components as shown in Figure 4-3, View A.

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

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

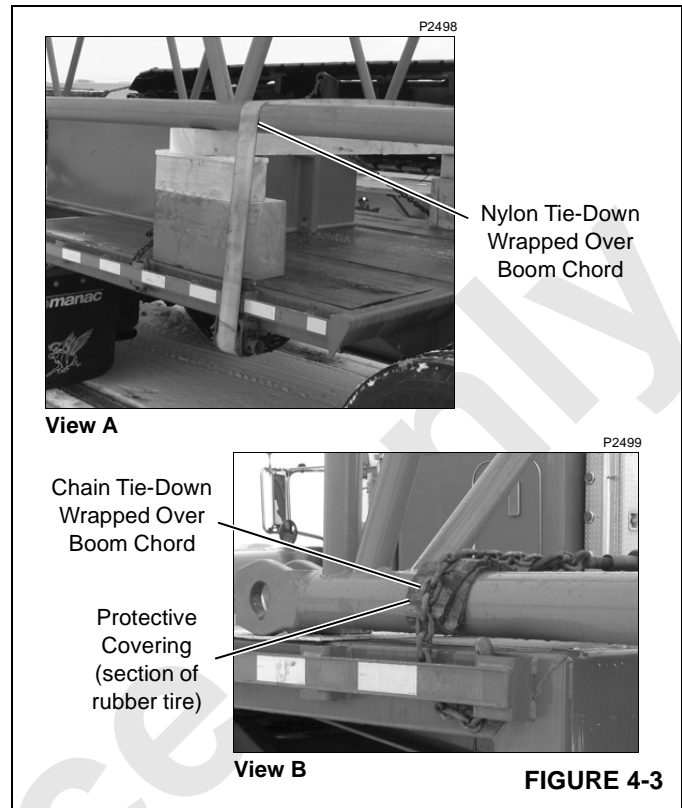
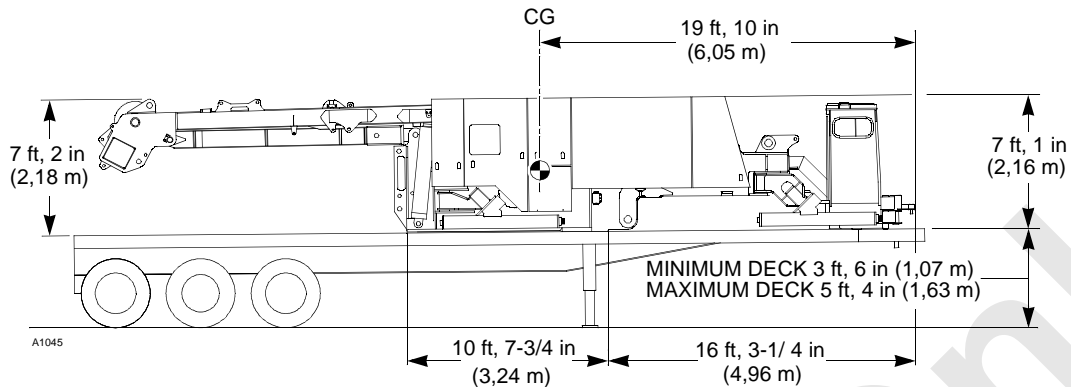


FIGURE 4-3

COMPONENT WEIGHTS

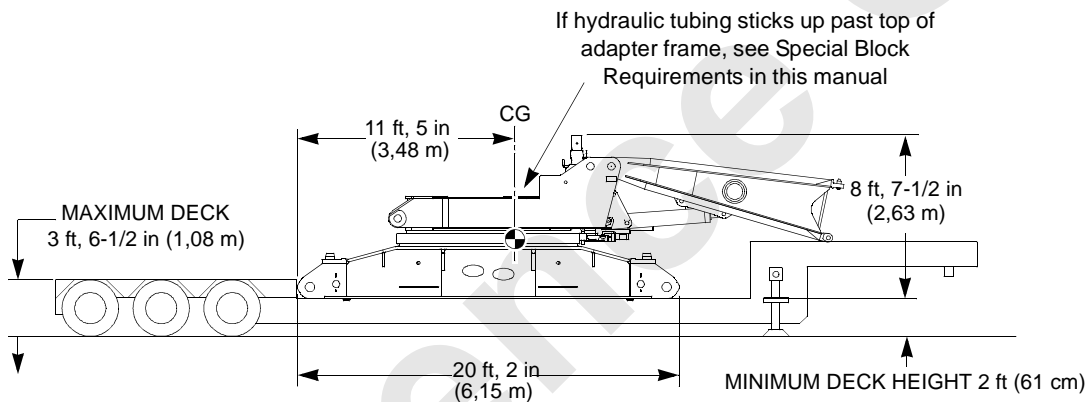
Table 4-1

Trailer Arrangement	Component	Weight lb (kg)
A	Rotating bed with Operator's Cab, Gantry, Equalizer, and Unequal Split Rear Drums without Lagging and Wire Rope	80,000 (36 287)
	Optional Items:	
	Front Drum without Lagging or Wire Rope ADD Ringer Prep with Two Full Width Drums and Lagging without Wire Rope ADD	6,200 (2 812) 9,500 (4 309)
B	Under Carriage with Carbody and Adapter Frame, Turntable Bearing, One Swing Drive, 12 ft (3,66 m) Lower Butt, and Boom Butt Handling Cylinder	64,400 (29 211)
	Optional Items:	
	Luffing Hoist with Wire Rope ADD Ringer or MAX-ER Prep Second Swing Drive ADD	4,800 (2 177) 1,800 (816)
C	Crawler Assembly with 48 in (1,22 m) Treads EACH	55,700 (25 265)
D	30 ft (9,14 m) Boom Top with 9 Sheave Lower Boom Point, Wire Rope Guide, and Basic Straps	12,700 (5 761)
	Additional Items:	
	Two Counterweight Side Boxes ADD FOR EACH One Counterweight Side Box ADD	15,500 (7 031) 20,000 (9 072)
E	28 ft (8,53 m) Upper Boom Butt with Wire Rope Guide, and Boom Stop	11,450 (5 194)
	Additional Items:	
	Two Counterweight Side Boxes ADD FOR EACH 30 USt (27.22 t) Assembly Block ADD	15,500 (7 031) 2,000 (907)



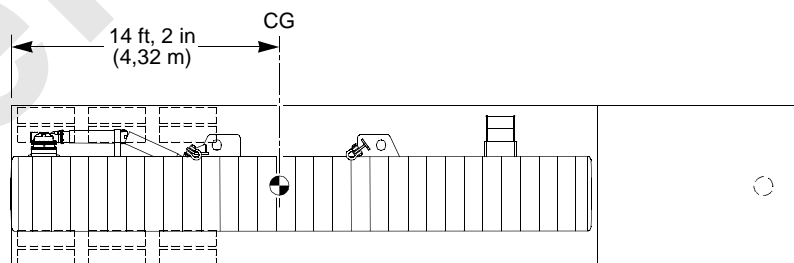
LOAD: 43 ft, 2 in (13,16 m) LONG x 9 ft, 10 in (3,0 m) WIDE x 7 ft (2,13 m) HIGH

View A



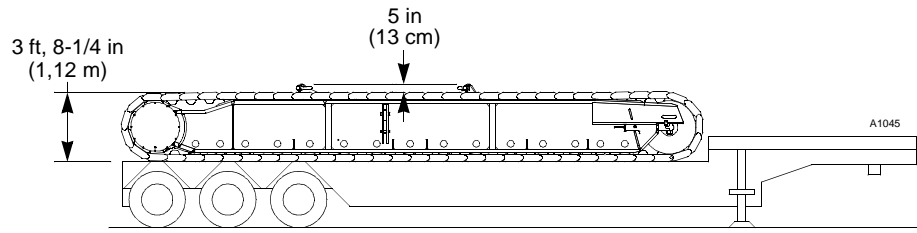
LOAD: 28 ft, 11 in (8,81 m) LONG x 9 ft, 8 in (2,95 m) WIDE X 8 ft, 7-1/2 in (2,63 m) HIGH

View B



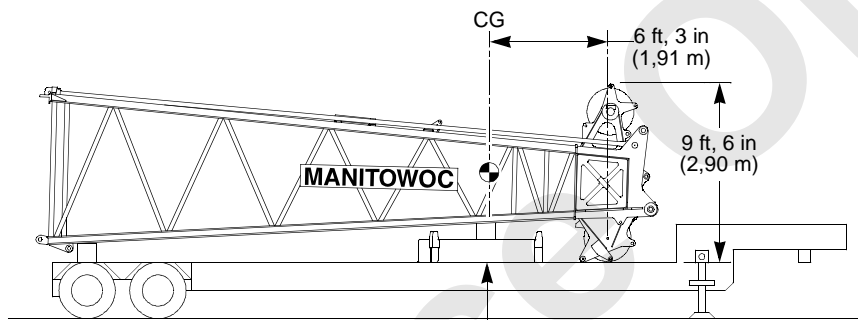
View C₁

FIGURE 4-4



LOAD: 30 ft, 9 in (9,37 m) LONG x 7 ft, 3 in (2,21 m) WIDE x 4 ft, 1-1/2 in (1,26 m) HIGH

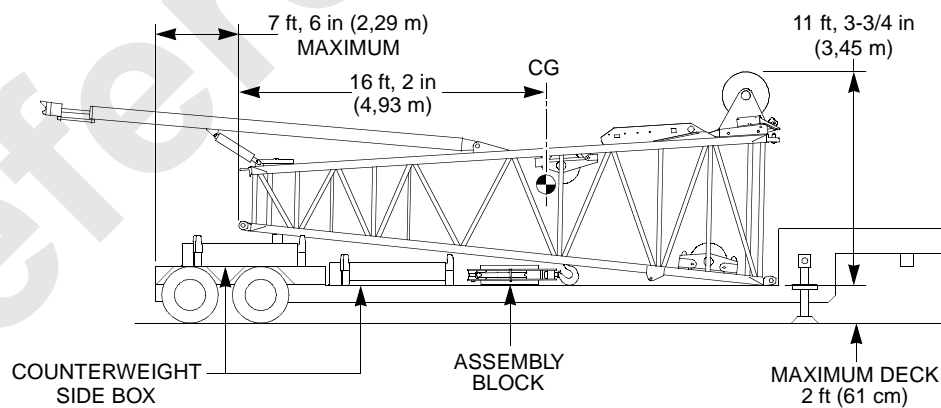
View C₂



COUNTERWEIGHT
SIDE BOX

LOAD: 33 ft (10,06 m) LONG x 8 ft, 6 in (2,59 m) WIDE X 9 ft, 6 in (2,90 m) HIGH

View D



COUNTERWEIGHT
SIDE BOX

ASSEMBLY
BLOCK

MAXIMUM DECK
2 ft (61 cm)

LOAD: 39 ft, 2 in (11,94 m) LONG x 8 ft, 6 in (2,59 m) WIDE x 11 ft, 4 in (3,45 m) HIGH

View E

FIGURE 4-5

SPECIAL BLOCKING REQUIREMENTS

General

CAUTION

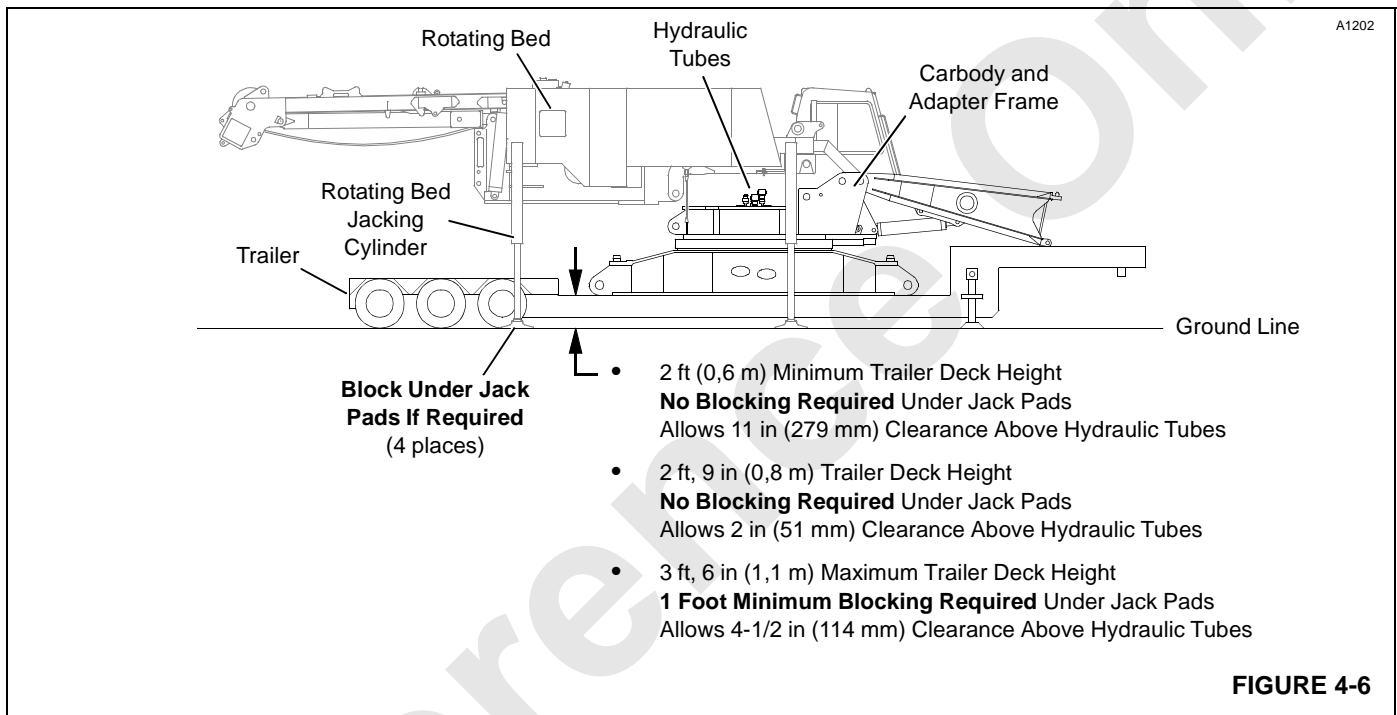
Failing to observe precautions in this section will result in damage to hydraulic tubes extending out of rotating bed adapter frame.

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 six inches (152 mm) higher than normal.

Blocking

During crane assembly and disassembly, it may be necessary to block under the jacks 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 – see Figure 4-6 for details.



UNDER CARRIAGE 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 asterisk * in Figure 4-7).

Failing to perform this step will cause Loud noises to come from under carriage when turning (cutting) the crawlers or swinging the rotating bed over the corner of the crawlers.

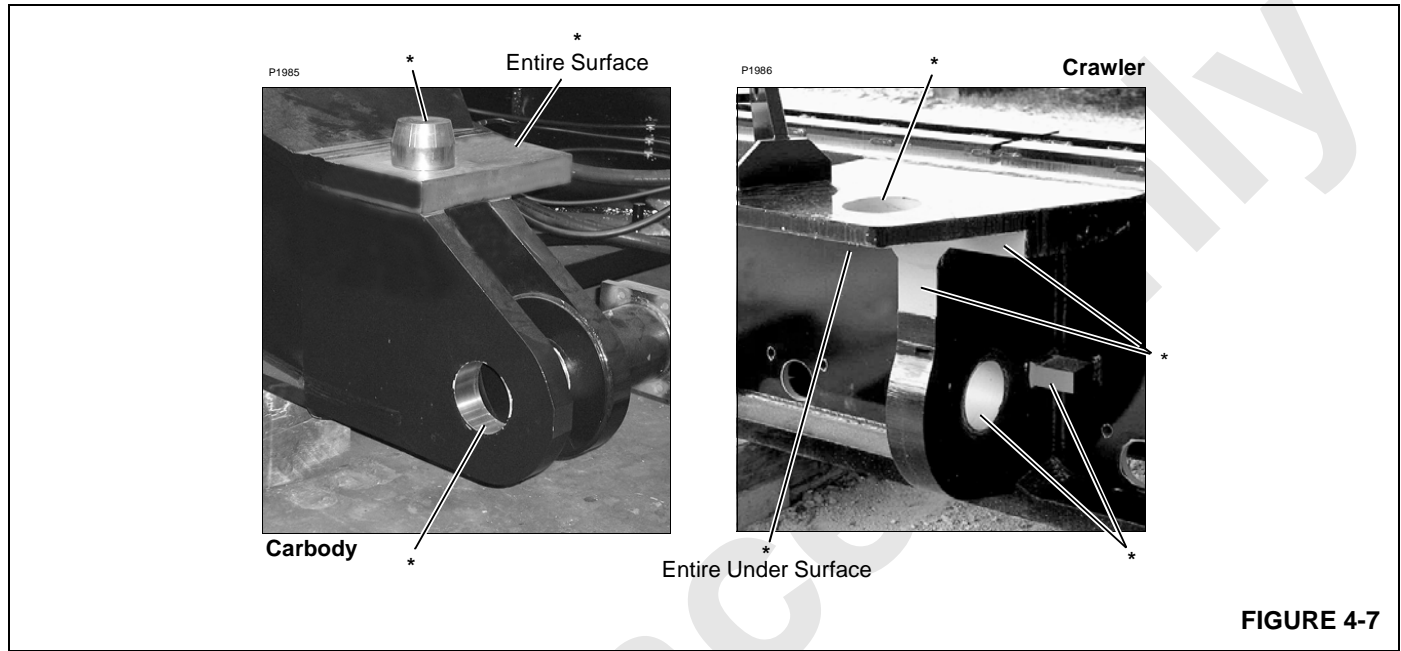


FIGURE 4-7

CRANE ASSEMBLY — WITHOUT SELF-ERECT

Operating Controls

In order to assemble and disassemble the crane with the FACT components, the engine must be running and crane SETUP mode must be selected and confirmed.

The gantry cylinders, hydraulic disconnect, rotating frame pins, and crawler pins are controlled by switches on the jacking and setup remote controls.

See Section 3 in this manual for identification and operation of all controls.

Pre-Start Checks

Make the following checks before starting the engine upon arrival at the assembly site. See Section 3 for starting instructions.

Engine

1. Check for leaks.
2. Check fuel, oil, and coolant levels.
3. Repair or refill as required.

Gear Boxes

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

Hydraulic System

1. Check for leaks.
2. Check level.
3. Repair or refill as required.
4. Make sure hydraulic shut-off valve is open.

NOTE: Use 1-1/8 in, 6 x 25 extra improved plow steel (minimum) wire rope.

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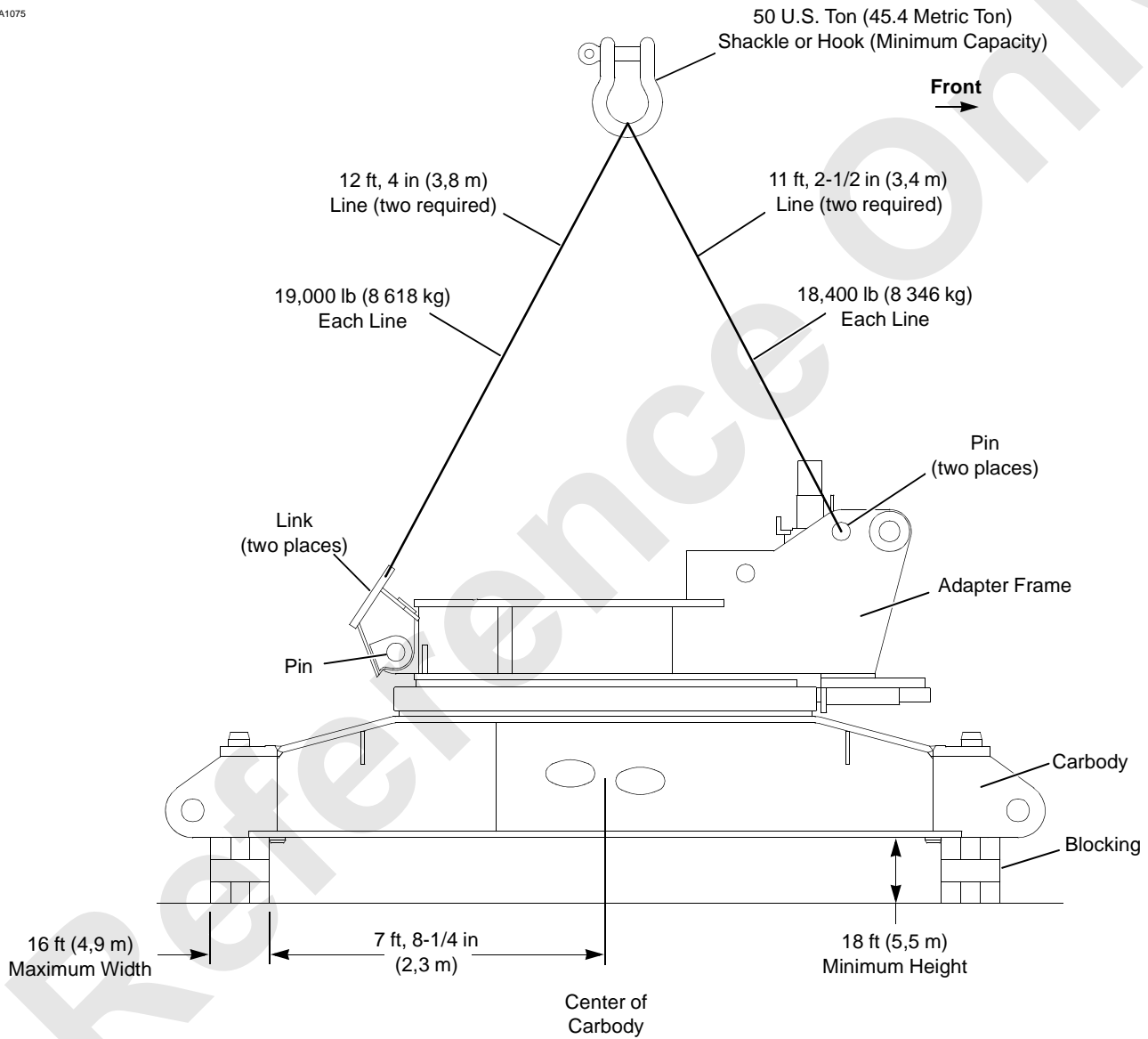


FIGURE 4-8

Remove Adapter Frame and Carbody from Trailer

See Figure 4-8 for following procedure.

1. Position trailer carrying adapter frame and carbody.
2. Attach links to rear of adapter frame. Insert pins at front of adapter frame.
3. Rig adapter frame for lifting.

NOTE: Owner is responsible for complying with rigging specifications shown in Figure 4-8.



WARNING

Lifting more than carbody and adapter frame could cause structural damage and injury.

4. Lift adapter frame and carbody clear of trailer.
5. Remove trailer

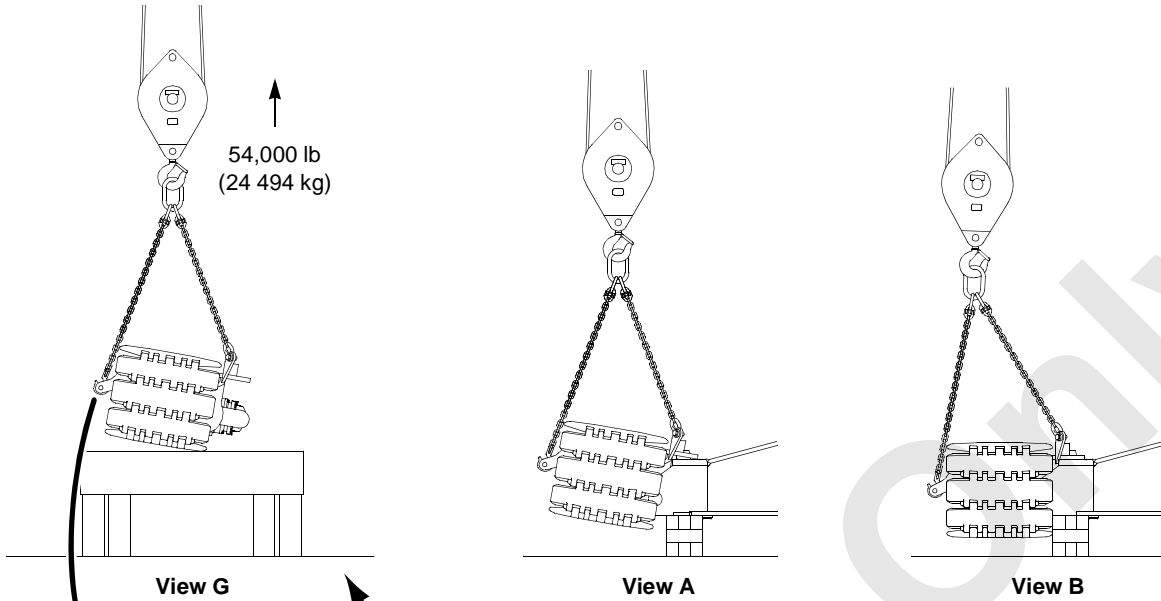
CAUTION

Structural Damage!

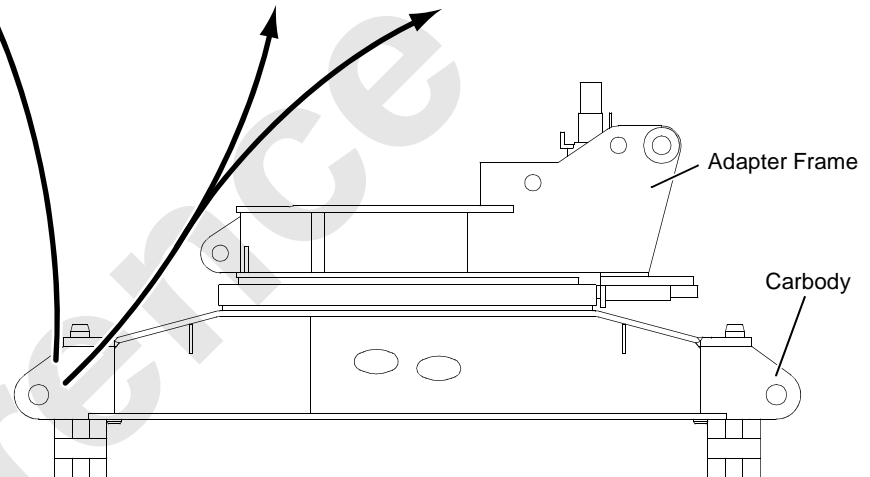
Adapter frame and carbody will be damaged if improperly blocked. Block adapter frame and carbody to dimensions shown.

6. Place blocking under adapter frame and carbody at locations and dimensions shown.
7. Slowly lower adapter frame and carbody onto blocking.
8. Remove links and pins and store for later use.

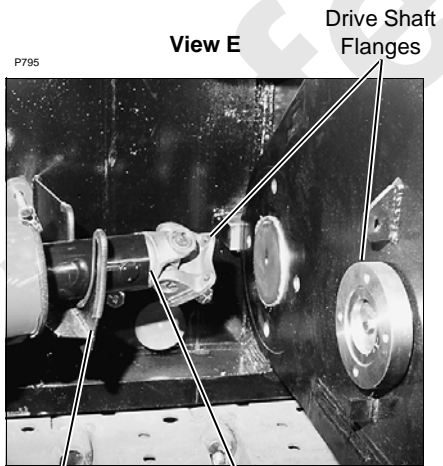
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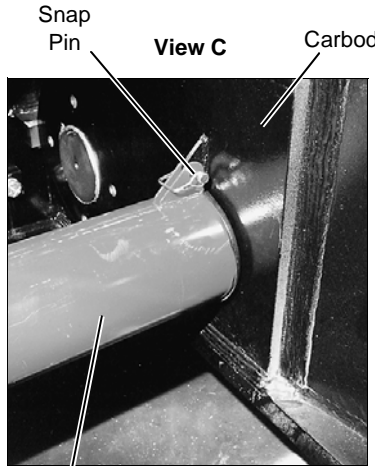
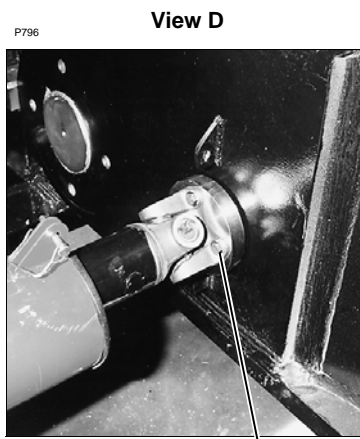
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Supporting Bracket

Crawler Drive Shaft Stored

Flange Screws (4 places)

Drive Shaft Guard

FIGURE 4-9

Install Crawlers

1. Position trailer carrying crawler along desired side of carbody (Figure 4-9, View G).

NOTE: Crawlers must be installed with drive shaft at rear of carbody (end with drive shaft flanges as shown in Figure 4-9, View E).

2. Swing assist crane so hook is centered over crawler.
3. Connect crawler handling chain assembly to hook of assist crane.

NOTE: Crawler handling chain assembly is available from the factory. If other handling chains are used, they must have adequate capacity to safely lift the crawler assembly.

4. Connect three legs of chain assembly to lifting lugs on crawler frame (Figure 4-9, View F).
5. Lift crawler clear of trailer.

NOTE: Crawler will hang at an angle which allows top connecting holes in crawler to easily engage top pins in carbody (Figure 4-9, View A).

6. Remove trailer.
7. Swing crawler by hand, as required, so drive shaft is at rear of carbody (end with drive shaft flanges as shown in Figure 4-9, View E).
8. Lower crawler and swing as needed to engage top connecting holes in crawler frame with top connecting pins in carbody (Figure 4-9, View A).
9. After top holes engage pins, continue to lower crawler until chains are slack. At this point, bottom connecting holes will be in line with crawler frame pins (Figure 4-9, View B).
10. If equipped with manual crawler frame pins, install and retain them at this time. If equipped with hydraulic crawler frame pins (Figure 4-10, View A), pins cannot be installed until after rotating bed is installed.
11. Lift crawler drive shaft off supporting bracket (Figure 4-11, View E), extend shaft, and align holes in drive shaft flange (Figure 4-9, View D).
12. Insert flange screws and torque to 74 ft-lb (100 N•m) (Figure 4-9, View D).



DANGER

Rotating Drive Shaft Hazard

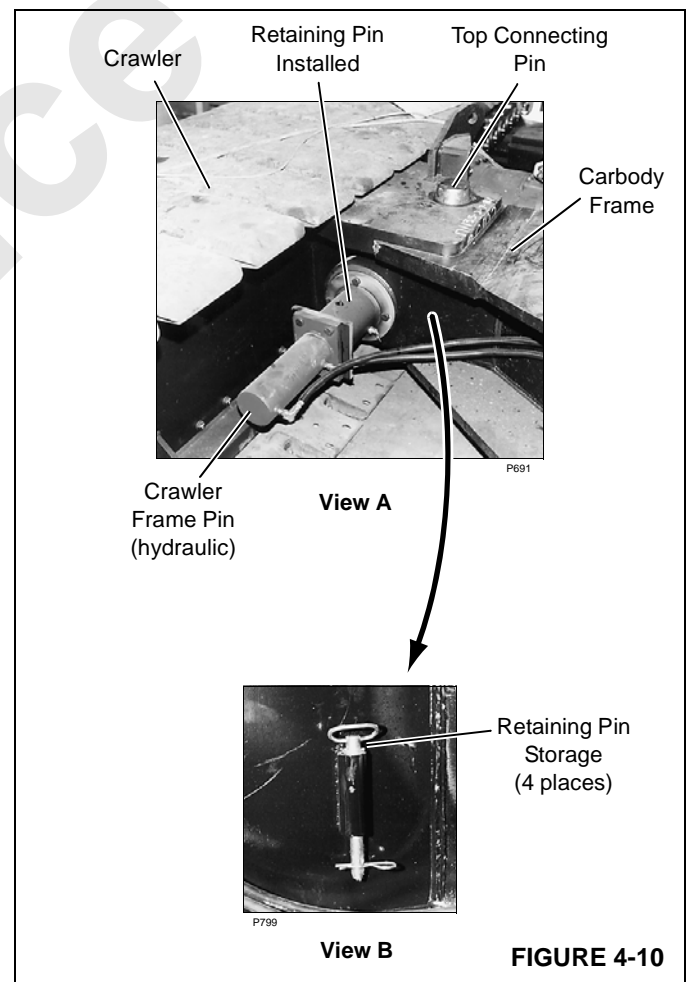
Crawler drive shaft rotates at high speed. To prevent death or serious injury:

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

13. Slide drive shaft guard over drive shaft (Figure 4-9, View C) and pin guard to carbody.

14. Unhook handling chain assembly from lugs on crawler frame.

15. Repeat procedure for other crawler.



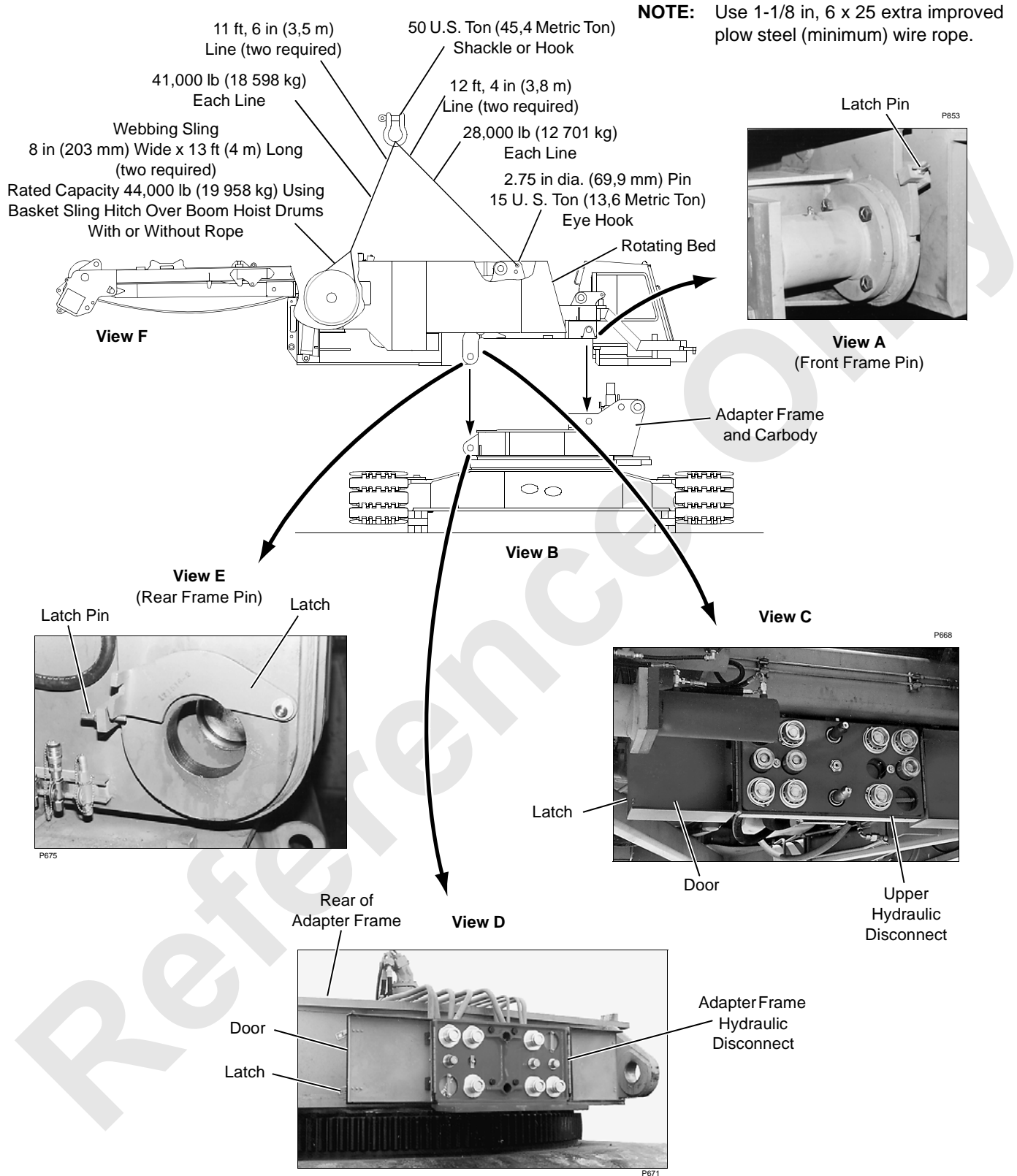


FIGURE 4-11

Install Rotating Bed

1. Position trailer carrying rotating bed next to adapter frame and carbody.
2. Unlatch and open doors of hydraulic disconnects on adapter frame (Figure 4-11, View D) and on rotating bed (Figure 4-11, View C).
3. Attach assist crane to rotating bed (Figure 4-11, View F).

NOTE: Owner is responsible for complying with minimum rigging specifications shown in Figure 4-11.

- a. Place webbing slings around boom hoist drums (two places), using basket sling hitch.
 - b. Attach to wire ropes.
 - c. Pin eye hook to rotating bed (two places).
 - d. Attach to wire ropes.
 - e. Attach wire ropes (four) to shackle or hook on assist crane.
4. If equipped, make sure front and rear frame connecting pin latches are held open with latch pins (Figure 4-11, Views A and E).
 5. Remove tie-down strap (if provided).
 6. Lift rotating bed from trailer. Remove trailer.



WARNING

Lifting more than rotating bed could cause structural damage and injury.

7. Move rotating bed into position above adapter frame.
8. Lower rotating bed until front and rear mounting holes line up.
9. Turn power switch in operator's cab to ON. *Do not start engine.*
10. At remote controls on right side of rotating frame, engage hydraulic disconnect.
11. Connect block-up limit electric cable to terminator plug on adapter frame (Figure 4-12, View B).
12. If equipped with hydraulic frame connecting pins, proceed as follows:
 - a. At remote controls on right side of rotating frame, start engine.
 - b. Engage front and rear frame connecting pins with switches on setup remote control.
 - c. Retain frame connecting pins with latches and secure latches with latch pins (Figure 4-12, View A and C)
13. If equipped with manual tapered frame connecting pins, install and retain them. See Tapered Mounting Pin Installation in this section.
14. If equipped with hydraulic crawler frame pins (Figure 4-10, View A), engage them with switches on setup remote control and install retaining pins.
15. Disconnect electric cable and air lines from storage points on right side of rotating bed and connect to plug and quick-couplers on right side of adapter frame (Figure 4-12, View C).
16. Turn off engine.

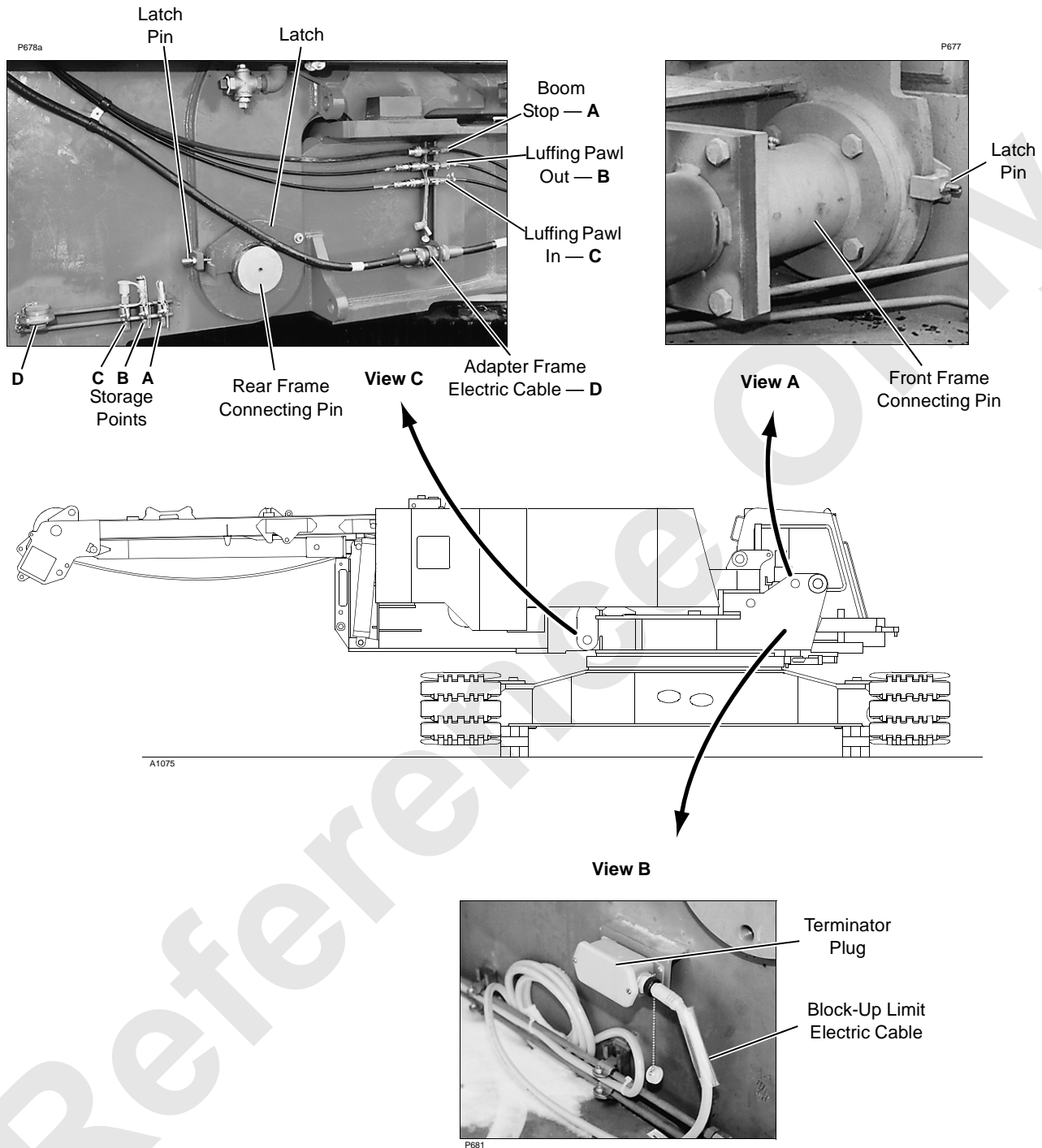


FIGURE 4-12

A445

OPERATOR'S CAB POSITIONS

Stored Position
when Adapter
Frame is Attached

Pin Cab
Platform Here

Clamp Cab Support
Beam Here

Adapter Frame

Pin Outer Hole in Cab
Support Beam Here

SEE VIEW A

Intermediate Position for
Mounting/Dismounting

Store Pin
Here

Clamp Cab
Platform Here

Unclamp Cab
Support Beam Here

Pin Inner Hole in Cab
Support Beam Here

Pin Outer Hole in Cab
Support Beam Here

DISENGAGE
Pin

VIEW A

ENGAGE
Pin

ENGAGE
Clamp

VIEW B
Typical 2 Places

Stored Position
When Adapter
Frame
is Not Attached

Pin Cab
Platform Here

Pin Outer Hole in Cab
Support Beam Here

Tie-down
Strap

CAUTION

Equipment Damage!

Ensure clamp does not interfere with cab when cab is swung to stored position.

Window breakage will occur.

Operating Position

Store Pin
Here

Clamp Cab
Platform Here

Clamp Cab Support
Beam Here
SEE VIEW B

DISENGAGE
Clamp

FIGURE 4-13

Remove Blocking

1. Swing rotating bed to position shown in Figure 4-14.



DANGER

Do not swing rotating bed until both crawlers are installed. Crane could tip over backward.

2. Attach links to lifting lugs on crawler assembly (Figure 4-14, View A).
3. Hook assist crane to links.

NOTE: Owner is responsible for complying with minimum rigging specifications shown in Figure 4-14.

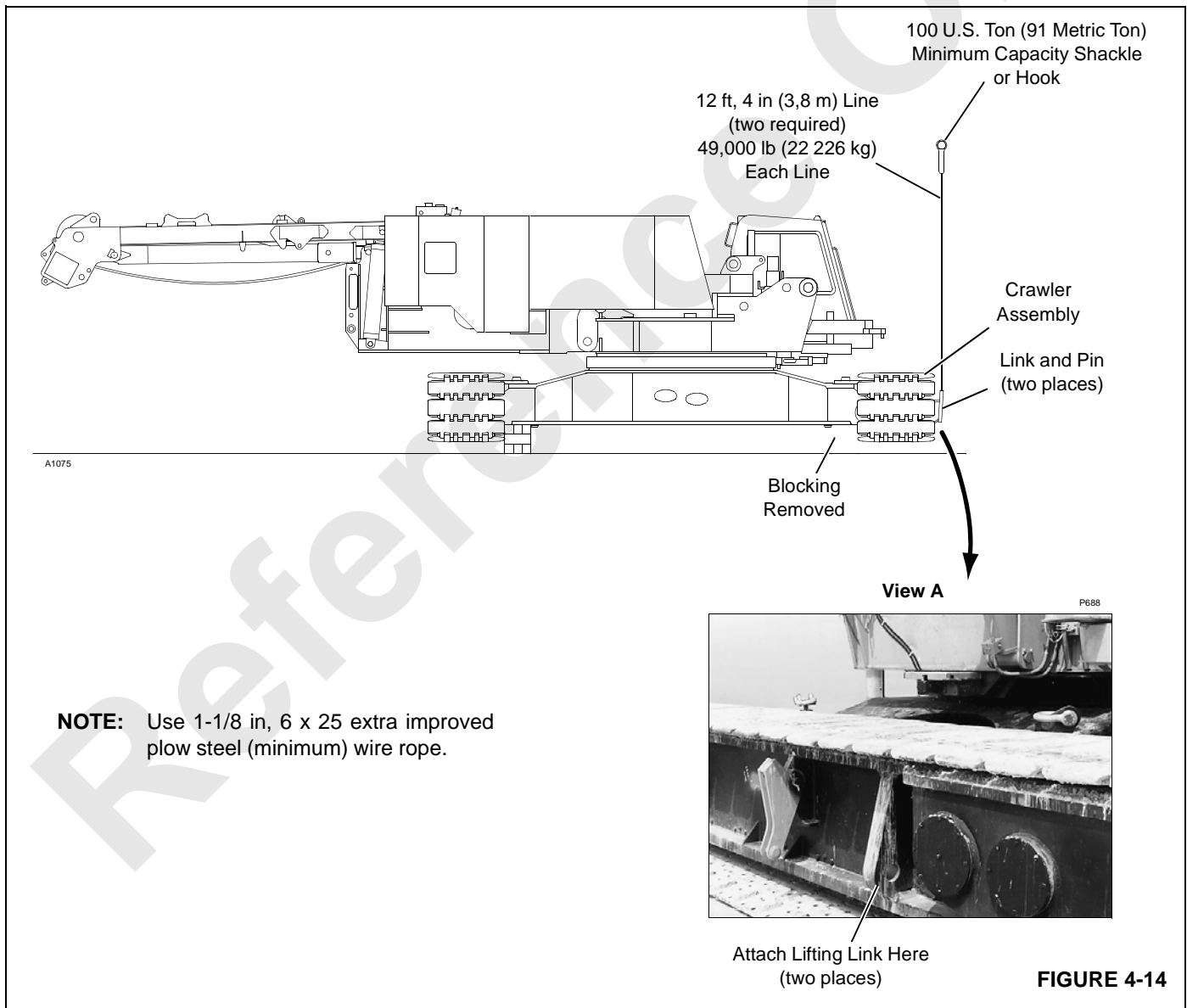
4. Using assist crane, lift crane off blocking.

5. Remove blocking.
6. Lower crane so that crawler is resting on the ground.
7. Remove links and pins.
8. Swing rotating bed 180°.
9. Repeat steps 2 – 7 to remove blocking on opposite side.
10. Store links and pins.

Position Cab

See Figure 4-13 for the following procedure.

1. Swing operator's cab to operating position.
2. Pin support beam in position.
3. Clamp cab in position.



NOTE: Use 1-1/8 in, 6 x 25 extra improved plow steel (minimum) wire rope.

FIGURE 4-14

Reference Only

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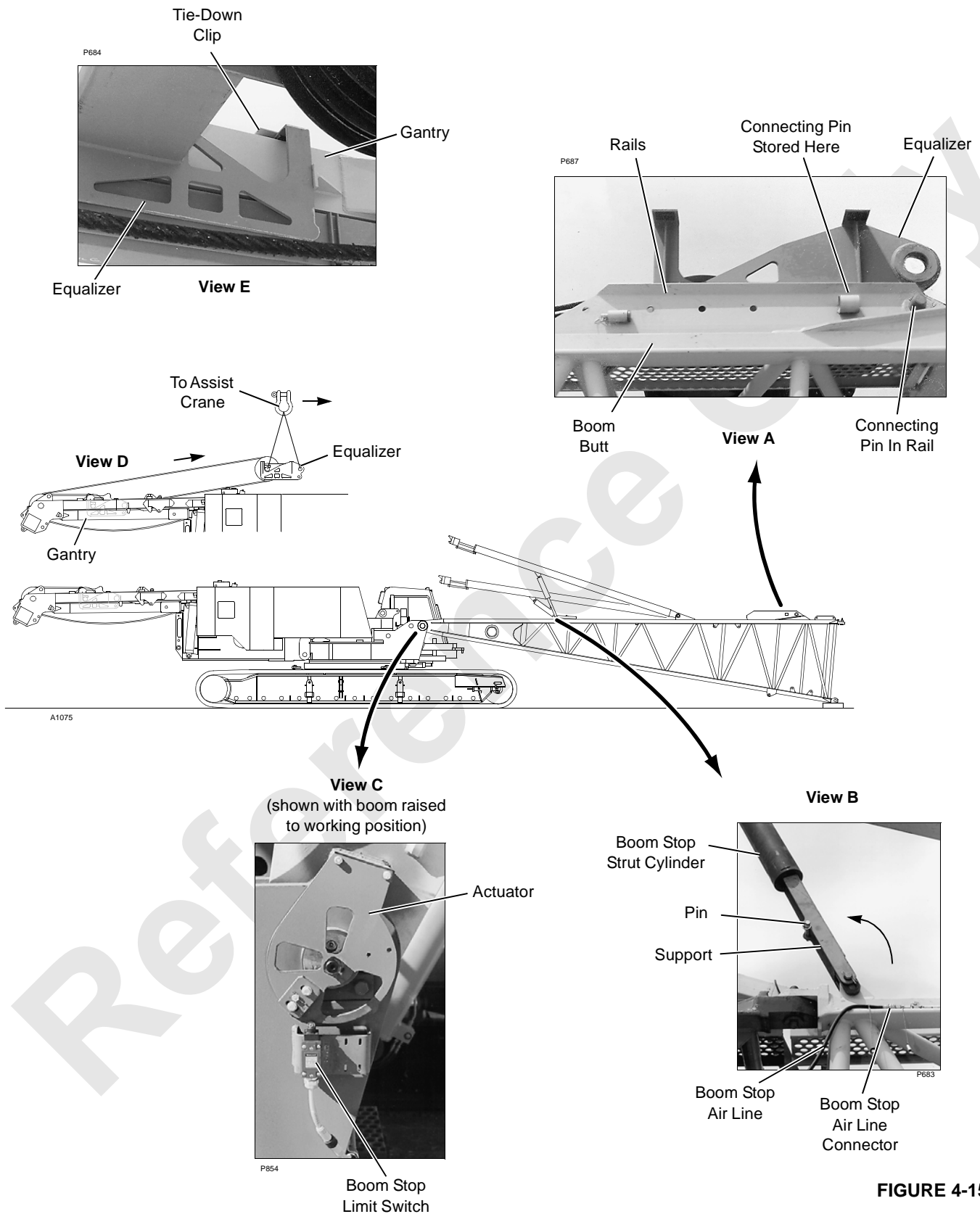


FIGURE 4-15

Install Counterweight

See Counterweight Installation and Removal in this section.

Install Boom Butt

1. Hook assist crane to boom butt. Lift butt from trailer.
2. Move butt into position so that holes in butt line up with holes in adapter frame.
 - Insert shims as needed to center boom butt and limit side play to 1/8 in (3,2 mm).
 - Install boom hinge pins, either manually or with switch on setup remote control (if equipped with hydraulic pins).
3. Lower boom butt onto blocking.
4. Join air line quick-couplers on boom butt to provide air supply to boom stop cylinders (Figure 4-15, View B).

Boom stop tubes will rise when this step is performed.

5. Swing supports for boom stop strut cylinders up to operating position. Pin in place (Figure 4-15, View B).
6. Install boom stop actuator (Figure 4-15, View C). See Boom Stop Limit Switch in Section 4 of the Crane Service Manual for installation and adjustment instructions.

Connect Equalizer to Boom Butt

1. Attach slings from hook of assist crane to equalizer. *Attach slings in such a manner that equalizer cannot tip when lifted.*
2. Slowly lift and slide equalizer forward until it is clear of tie-down clips on gantry (Figure 4-15, View E).
3. Raise equalizer with assist crane while paying out boom hoist wire rope from 2250 (Figure 4-15, View D).
4. Slowly travel assist crane toward end of boom butt while continuing with step 3. ***Do not allow boom hoist wire rope to become fouled on boom hoist drums.***
5. Continue with steps 3 and 4 until equalizer is over rails on boom butt.
6. Lower equalizer onto rails and pin to holes in end of rails (Figure 4-15, View A).
7. Disconnect assist crane.

Raise Gantry

See Gantry Raising and Lowering in this section.

Attach Boom

See Boom Rigging Guide in this section.

DISASSEMBLY — WITHOUT 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. For trailer loading requirements, see Shipping Data in this section.

Disconnect Boom Butt from Boom

See Boom Rigging Guide in this section.

Lower Gantry

See Gantry Raising and Lowering in this section.

Store Equalizer on Gantry

1. Attach slings from hook of assist crane to equalizer. *Attach slings in such a manner that equalizer cannot tip when lifted.*
2. Tighten lifting slings just enough to support equalizer and unpin equalizer from rails on boom butt (Figure 4-15, View A).

Store pins in holders on side of rails.

3. Lift equalizer clear of rails.
4. Slowly travel assist crane toward end of gantry while hauling in boom hoist wire rope on 2250. ***Do not allow boom hoist wire rope to become fouled on boom hoist drums.***
5. Continue with step 4 until equalizer is over gantry.
6. Lower equalizer onto gantry and slide equalizer under tie-down clips (Figure 4-15, View E).
7. Disconnect assist crane.

Remove Boom Butt

1. Disconnect block-up limit electric cord from cable reel on boom butt and connect to terminator plug on adapter frame (Figure 4-12, View B).
2. Unpin and lower boom stop strut cylinder supports (Figure 4-15, View B) onto boom butt.
3. Disconnect boom stop air line from quick-coupler on right side of boom butt (Figure 4-15, View B). ***Boom stop tubes will lower when this step is performed.***
4. Support boom butt with slings from assist crane.
5. Either remove boom hinge pins (if manual) or disengage pins with switch on setup remote control (if hydraulic).
6. Remove boom butt.

Remove Counterweight

See Counterweight Installation and Removal in this section.

Place Crane on Blocking

1. Swing rotating bed perpendicular to crawlers (Figure 4-14).
2. Attach links to lifting lugs on crawler assembly (Figure 4-14, View A).
3. Hook assist crane to crawler assembly.

NOTE: Owner is responsible for complying with minimum rigging specifications shown on Figure 4-14.

4. Using assist crane, lift one side of 2250 so crawler is off ground.
5. Insert blocking under carbody as specified in Figure 4-8.
6. Lower 2250 onto blocking.
7. Remove links and pins.
8. Swing rotating bed 180°.
9. Repeat steps 2 – 7 to place blocking on opposite side.
10. If equipped with hydraulic crawler frame pins, remove and store retaining pins (Figure 4-9, View A and B) and disengage crawler frame pins with switches on setup remote control.

Visually check that crawler frame pins are fully disengaged. If any pin fails to disengage, proceed as follows:

- a. Pump grease into grease fitting on piston cover plate (Figure 4-16) while holding crawler frame pin switch at DISENGAGE position for 10 seconds.
- b. If pin does not disengage, remove plug from piston cover plate and measure position of piston. When fully retracted, the piston is 10-1/8 in (257 mm) from outside of cover.
- c. If dimension is less, remove cover plate and using bar and hammer, rap piston until it is fully retracted (check dimension). Replace piston cover plate.

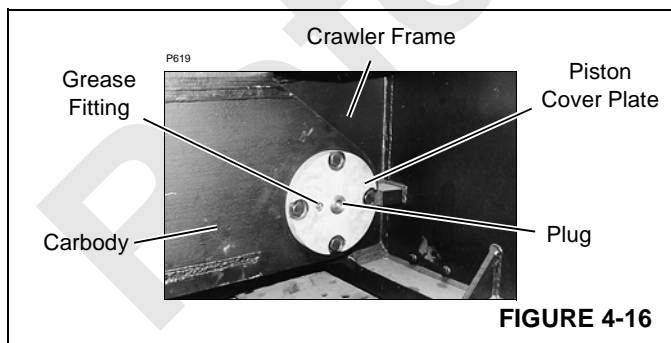


FIGURE 4-16

Lift Rotating Bed onto Trailer

1. Move cab out to intermediate position to provide adequate clearance for removing rotating bed.

2. At remote controls on right side of rotating frame, disengage hydraulic disconnect.
3. On right side of adapter frame, uncouple electric cable and air lines (Figure 4-12, View C) and connect to storage points.
4. Attach assist crane to rotating bed as specified in Figure 4-11, View B.

NOTE: Owner is responsible for complying with rigging specifications shown in Figure 4-11.

5. Position trailer next to carbody. Block loosely under trailer to prevent it from tipping.
6. Support rotating bed with assist crane.
7. If equipped with hydraulic frame connecting pins, proceed as follows:
 - a. Pull latch pins (Figure 4-11, View A and E) and pivot latches up. Lock latches in raised position with pins.
 - b. At remote controls on right side of rotating frame, start engine.
 - c. Disengage front and rear frame connecting pins with switches on setup remote control. *Visually check that all four pins are fully disengaged.*
8. If equipped with manual tapered frame connecting pins, remove and store them. See Tapered Mounting Pin Installation in this section.
9. Stop engine.
10. Carefully lift rotating bed from adapter frame and carbody and place on trailer.
11. Secure rotating bed to trailer.
12. Close and latch doors of hydraulic disconnect (Figure 4-11, View C and D).
13. Swing operator's cab to storage position (Figure 4-13) and pin in place.
14. Attach tie-down strap (if provided) to secure operator's cab to rotating bed.

Remove Crawlers

1. Position empty trailer along desired side of adapter frame and carbody.
2. Connect crawler handling chain assembly to hook of assist crane.

NOTE: Crawler handling chain assembly is available from the factory. If other handling chains are used, they must have adequate capacity to safely the crawler assembly.

**DANGER****Rotating Drive Shaft Hazard**

Crawler drive shaft rotates at high speed. To prevent death or serious injury:

- Do not attempt to disconnect drive shaft until crane has been parked and engine stopped.
-
3. Unpin drive shaft guard (Figure 4-9, View C) and slide guard back.
 4. Remove flange screws from drive shaft flange (Figure 4-9, View D). Store screws in flange.
 5. Retract crawler drive shaft and place drive shaft on supporting bracket (Figure 4-9, View E).
 6. Connect three legs of chain assembly to lugs on crawler frame (Figure 4-9, View B and F).
 7. If equipped with manual crawler frame pins, remove them (store in carbody holes after crawler is removed).
 8. Lift crawler. Crawler will tilt as it is lifted off top connecting pins (Figure 4-9, View A).

9. Remove crawler from carbody and place on trailer (Figure 4-9, View G).
10. Unhook handling chain assembly from lugs on crawler frame.
11. Repeat steps for other crawler.

Lift Adapter Frame and Carbody on Trailer

1. Close and latch doors of adapter frame and carbody hydraulic disconnect (Figure 4-11, View D).
2. Position empty trailer next to adapter frame and carbody. Block loosely under trailer to prevent it from tipping.
3. Attach link to rear of adapter frame. Insert pins at front of adapter frame (Figure 4-8).
4. Rig adapter frame and carbody for lifting.

NOTE: Owner is responsible for complying with rigging specifications shown in Figure 4-8.

5. Lift adapter frame and carbody from blocking and carefully place on trailer.
6. Remove links and pins.
7. Secure to trailer.
8. Store links and pins.

TAPERED MOUNTING PIN INSTALLATION

General

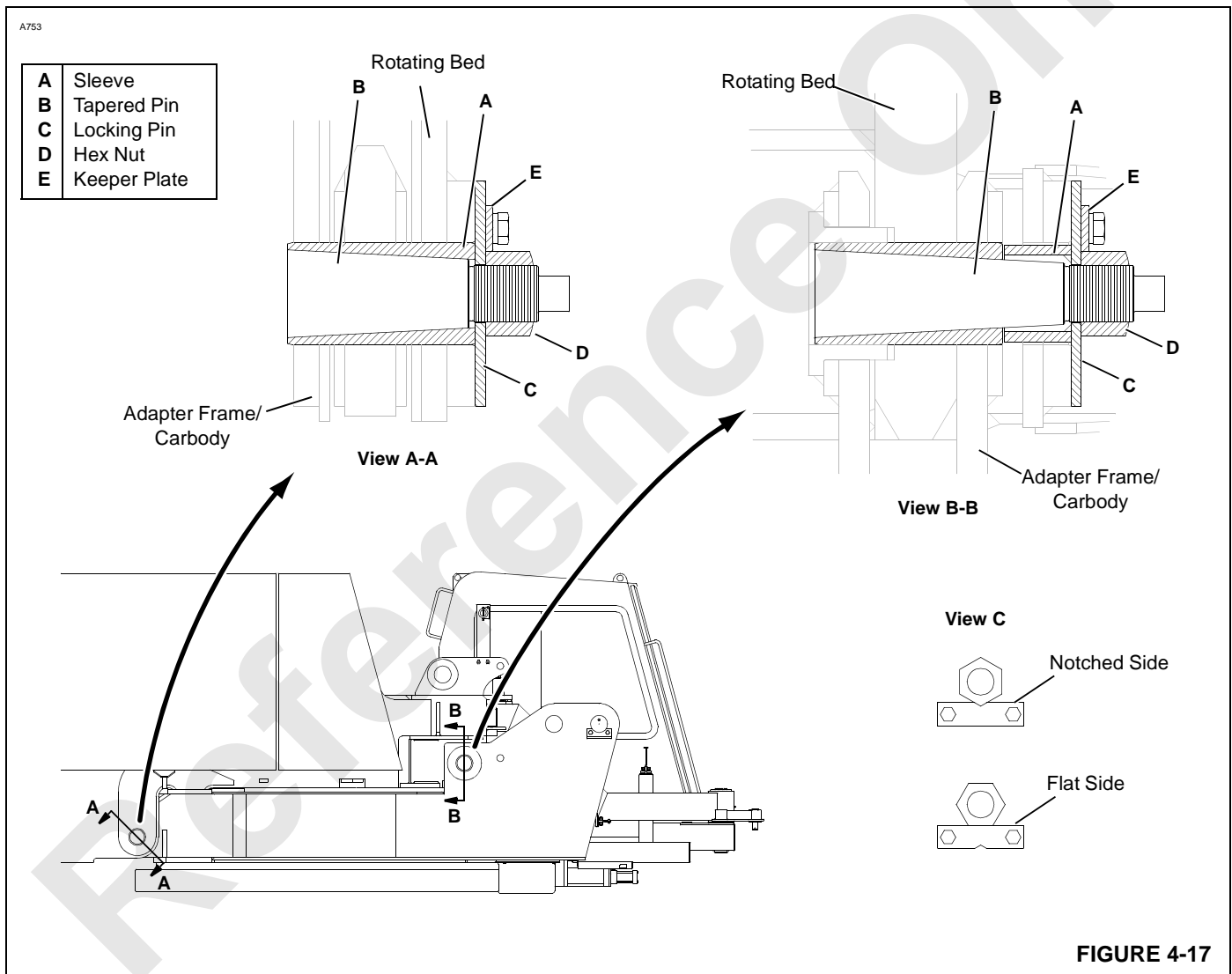
Tapered mounting pins may be used instead of hydraulic pins to attach the rotating bed to the adapter frame/carbody. If equipped with tapered mounting pins, these instructions supplement the rotating bed installation instructions in this section.

Mounting Pin Installation

Install the mounting pins after the rotating bed has been lifted into position and the front and rear mounting holes have been aligned (Figure 4-17).

1. Insert sleeves for tapered pins into front and rear mounting holes. Insert tapered pins.
2. Apply Never-Seez (or equivalent) to threads on pins.
3. Install lock plates. Tighten hex nut on each pin to 1,000 ft-lb (1356 Nm) minimum.
4. Install keeper plates so that flat or notched surface engages and holds hex nuts in place (View C). Tightening or backing off nuts slightly may be necessary to install plates.

Continue crane assembly as instructed in Assembly in this section.



Reference Only

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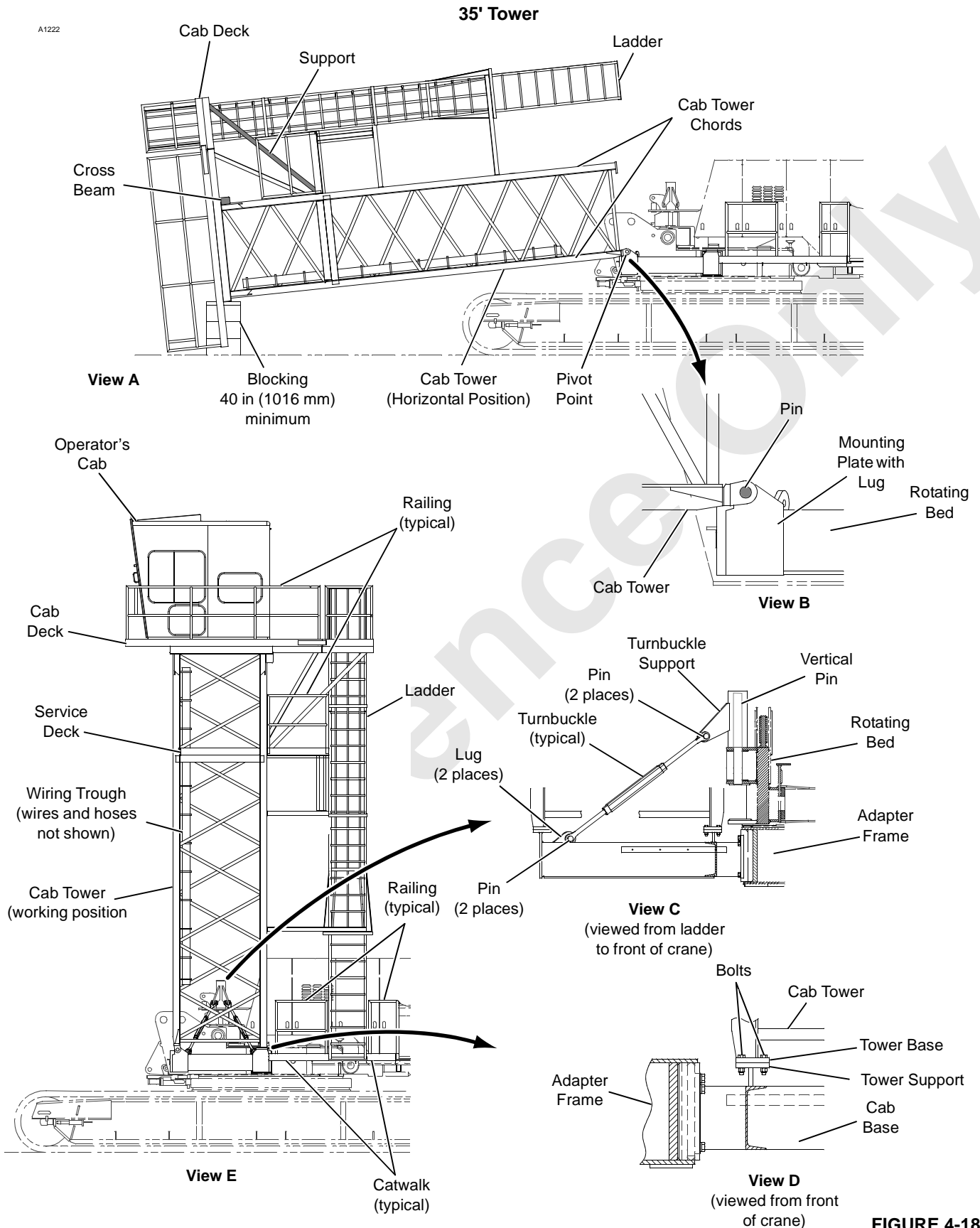


FIGURE 4-18

ELEVATED CAB ASSEMBLY - 35 FT TOWER

General

This section provides assembly and removal instructions for the elevated cab option.

The elevated cab shall be installed and removed by experienced personnel trained in the erection of construction cranes. These personnel shall **read and become thoroughly familiar with instructions in this section and in the Operator's Manual supplied with crane before attempting to install or remove cab tower.**

The installation/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 movement of an assist crane required to install and remove parts.

Safety

The crane rotating bed must be properly supported before beginning 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

Attach Cab Tower to Crane

See Figure 4-18 for the following procedure.

- Using slings, shackles, and other rigging as needed, lift tower from trailer. **Lift on chords, not ladder or tower cross members.**
- Align tower base with mounting plate on rotating bed (View B).
- Insert and retain pins (View B).
- Lower tower top onto blocking 40 in (1016 mm) minimum (View A).
- Bolt support first to tower chord and then to deck (View A).

NOTE: For first installation, align support with deck and drill holes in deck to match location of bolt holes in support.



WARNING Crushing Hazard!

Prevent death or serious injury as cab tower is raised!

- Stay out from under cab tower.
- Keep fingers or other body parts away from tower base and mounting plate.

- Using slings and shackles attached to cross beam (View A), slowly raise cab tower to working position, allowing it to pivot on pins.
- As cab tower nears vertical, allow tower to rest on cab base mounting plate and align bolt holes (View D).
- Bolt tower to mounting plate (View D).
- Stiffen tower with turnbuckles (View C):
 - Slide turnbuckle support over vertical pin mounted on rotating bed.
 - Pin turnbuckle to lugs on turnbuckle support and tower.
 - Tighten turnbuckles evenly to stiffen tower.

Install Catwalks and Railings

- Install catwalks and railings as shown in Figure 4-18:
 - Right side of crane.
 - Left side of crane.
 - Service deck.
 - Cab deck.

Install Operator's Cab

- Using four point connection, hook assist crane to lugs on top of operator's cab.
- Lift operator cab into position on cab deck.
- Align bolt holes in cab with bolt holes in cab deck.
- Attach cab to deck with bolts (12 places).

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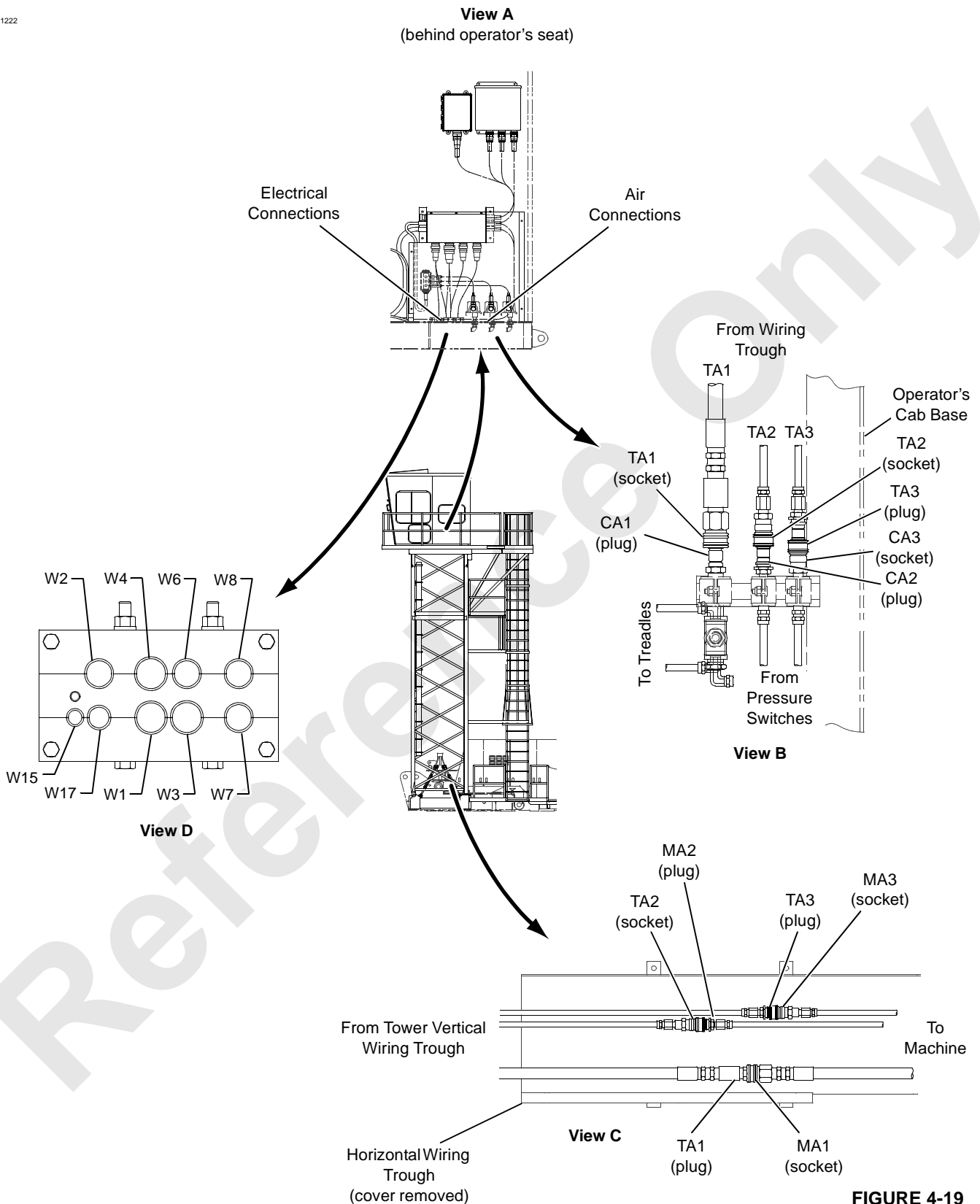
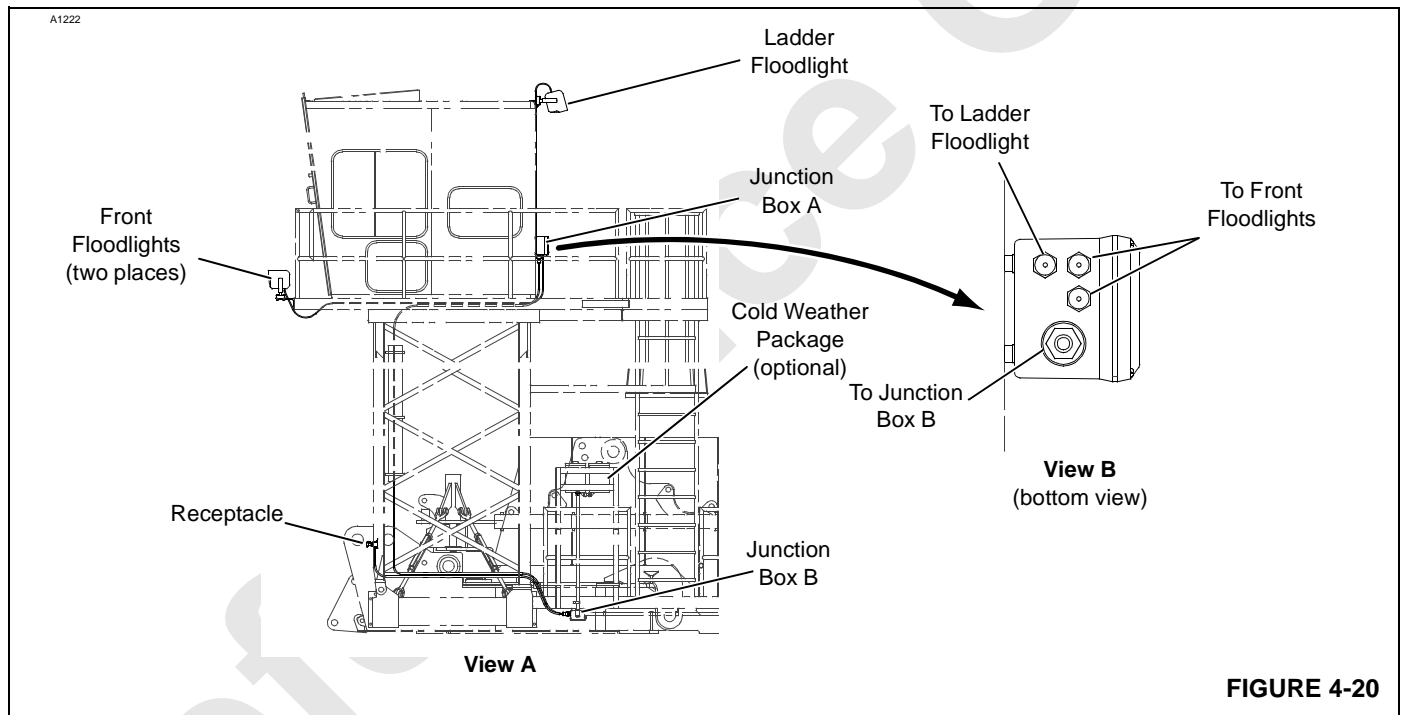


FIGURE 4-19

Make Cab-to-Machine Connections

Cab tower is shipped with piping and wiring installed in vertical wiring trough. Connections to cab can be made from service deck. Connections to machine are made in horizontal wiring trough at base of tower.

1. If necessary, remove cover from horizontal wiring trough.
2. Make air piping connections (Figure 4-19). All air hoses have quick disconnects.
 - a. At service deck, connect hoses TA1, TA2, and TA3 from wiring trough to connectors CA1, CA2, and CA3, respectively, on air manifold (View B).
 - b. At horizontal wiring trough, connect hoses TA1, TA2, and TA3 to connectors MA1, MA2, and MA3, respectively, on machine (View C).
3. Make electrical connections (Figure 4-19).
 - a. At service deck, connect electrical cables from wiring trough to terminals at cable bulkhead (View D). Cable numbers match terminal numbers.
 - b. At horizontal wiring trough, connect electrical cables from wiring trough to cables from machine. Cables have matching numbers.
4. Connect cab exterior lighting to junction boxes (Figure 4-20).
 - a. Connect cable from wiring trough to junction box A on back of cab (View B).
 - b. If necessary, plug front floodlights and ladder floodlight into junction box A (View B).
 - c. Connect cable from wiring trough to junction box B under catwalk (View A).
 - d. Plug receptacle and cold weather package (if provided) into junction box B (View A).



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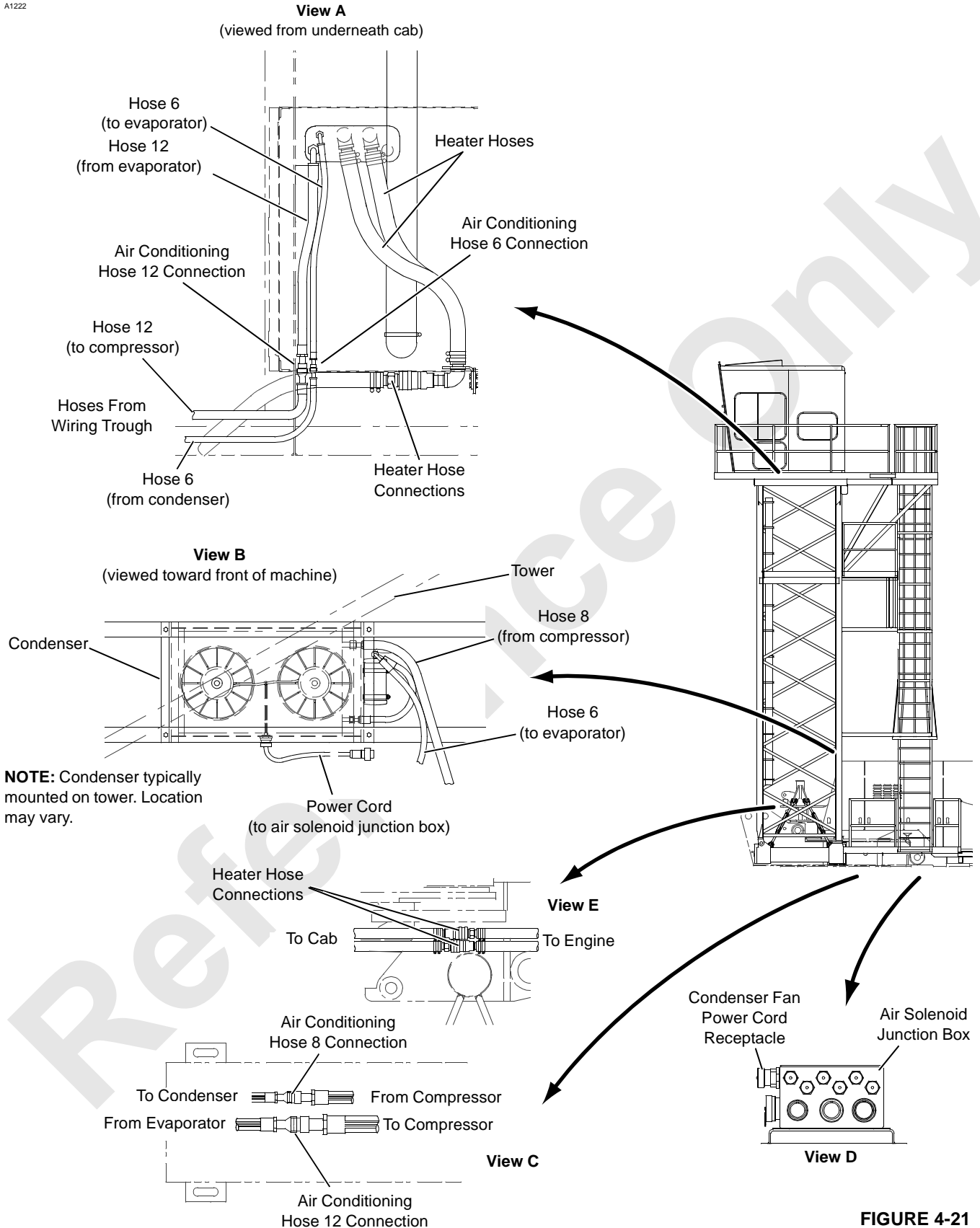


FIGURE 4-21

5. Make air conditioning system connections (Figure 4-21). Air conditioning hoses have quick disconnects.
 - a. At service deck, connect heater hoses from wiring trough to heater hoses from cab (View A).
 - b. At service deck, connect air conditioning hoses 6 and 12 to hoses 6 and 12 from cab (View A).
 - c. At base of tower, connect air conditioning hoses 8 and 12 to hoses 8 and 12 from machine (View C).
 - d. At base of tower, connect heater hoses from tower to heater hoses from machine (View E).
 - e. Connect power cord from condenser fans (View B) to terminal on air solenoid junction box (View D).
 - f. Charge air conditioning system according to instructions in manual provided by manufacturer.
- d. Remove railings and catwalks.
5. Using slings and shackles attached to cross beam (Figure 4-18, View A), support tower in working position. **Do not lift tower.**
6. Remove tower turnbuckles (Figure 4-18, View C):
 - a. Loosen turnbuckle nuts.
 - b. Unpin turnbuckles from lugs.
 - c. Slide turnbuckle support off vertical pin.
7. Remove bolts holding tower to mounting plate (Figure 4-18, View D).
8. Slowly lower tower from working position to horizontal position, allowing it to pivot forward on pins. Allow cab deck to rest on ground or blocking (Figure 4-18, View A).
9. Unhook assist crane from cross beam.
10. Using slings, shackles, and other rigging as needed, hook assist crane to tower. **Lift on chords, not ladder or tower cross members.**
11. Remove pins from tower base (Figure 4-18, View B).
12. Lift tower away from crane and store.

Removing Elevated Cab

1. Discharge refrigerant from air conditioning system according to instructions in manual provided by manufacturer.
2. At base of tower, disconnect and stow following:
 - Power cord from condenser fans (Figure 4-21, View B) to terminal on air solenoid junction box (View D). Install dust cap.
 - Heater hoses (Figure 4-21, View E).
 - Air conditioning hoses 8 and 12 (Figure 4-21, View C).
 - Electrical cable, receptacle and cold weather package (if provided) from junction box B under catwalk (Figure 4-20, View A).
 - Electrical cables (tower) from machine cables.
 - Tower air hoses from machine air hoses (Figure 4-19, View C).
3. At service deck, disconnect and stow the following:
 - Heater hoses (Figure 4-21, View A).
 - Air conditioning hoses 6 and 12 (Figure 4-21, View A).
 - Electrical cable from junction box A on back of cab (Figure 4-20, View B).
 - Electrical cables from terminals on bulkhead at cab base (Figure 4-19, View D).
 - Air hoses from air manifold at base of cab (Figure 4-19, View B).
4. Remove cab:
 - a. Remove bolts holding cab to deck (12 places).
 - b. Using four point connection, hook assist crane to lugs on top of operator's cab.
 - c. Lift cab off deck and set to side.

DRUM SPACER/LAGGING INSTALLATION

General

This section identifies the drum spacer and 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 4-22)
- Unequal Split Rear Drum (Figure 4-23)
- Equal Split Rear Drum (Figure 4-24)

NOTE: All drums are viewed from the rear.

Torque Values

Apply Loctite 242 (or equivalent thread-locking adhesive/sealant) to threads of Lebus fasteners and torque to 500 ft. lbs. (678 N•m).

Torque spacer nuts to 60 – 75 ft. lbs (81 – 102 N•m) oiled with light engine oil.

Installation of Mast Self-Erecting Wire Rope

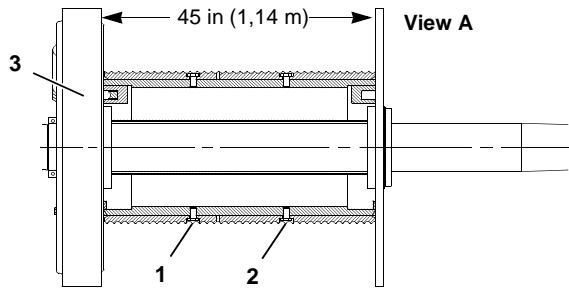
NOTE: See Wire Rope Installation and Maintenance in Section 5 of the Crane Service Manual for wire rope anchoring and spooling procedure.

See Figure 4-23 for the following procedure.

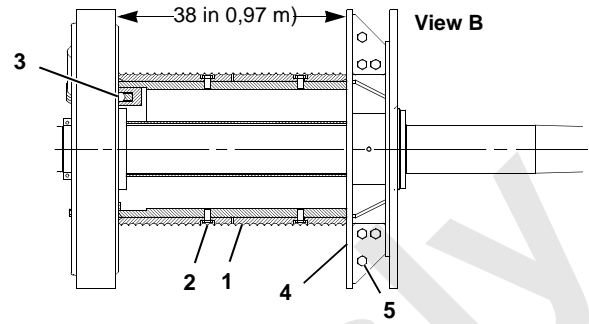
1. Anchor wire rope to left rear drum.
2. Tightly wrap 1st layer of wire rope onto left rear drum.
3. Install drum spacer over 1st layer of wire rope so spacer is tight against outboard drum flange (Figure 4-23).
4. Wrap wire rope onto drum until drum is full.

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2250 Front Drum



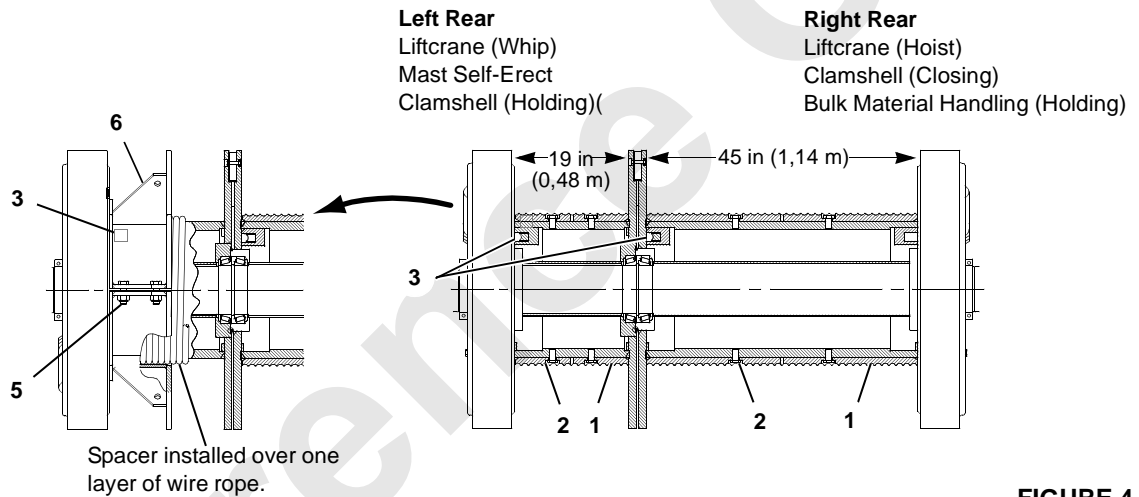
View A
Clamshell (Optional Holding)
Bulk Material Handling (Closing)



View B
Liftcrane (Optional Hoist or Whip)
Container Handling (Auxiliary)

FIGURE 4-22

2250 Unequal Split Rear Drum



Left Rear

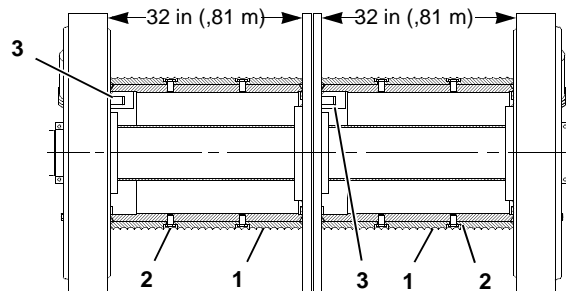
Liftcrane (Whip)
Mast Self-Erect
Clamshell (Holding)(

Right Rear

Liftcrane (Hoist)
Clamshell (Closing)
Bulk Material Handling (Holding)

FIGURE 4-23

2250 Equal Split Rear Drum



Left Rear

Container Handling (Hoist)
Clamshell (Holding)(

Right Rear

Container Handling (Hoist)
Clamshell Closing)(

FIGURE 4-24

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.

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 necessary signals to the operator in the cab.

These personnel shall read and become thoroughly familiar with instructions in this 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 6 of the Operator's Manual for identification and location of all operating controls.

Handling Counterweight

An assist crane is required to handle the counterweights and assemble them on the ground. See Figure 4-25 for the weights of individual components.

The 2250 can install and remove its own upper counterweight using the gantry as a lifting device. The 2250 must be in the following configuration for counterweight handling:

- Crane (with crawlers installed) on firm, level surface.
- Boom butt removed.
- Boom hoist wire rope reeved properly through gantry and equalizer sheaves and anchored to boom hoist drums as shown on Boom Rigging Drawing.
- Equalizer stored on gantry.
- Gantry fully lowered.

Lifting Lug Identification



WARNING

Falling Load Hazard!

Do not exceed specified capacity of lifting lugs specified below. Lifting lugs may break, allowing counterweight to fall.

Lower Tray

Lift the lower tray at four lifting lugs (L1, Figure 4-25, View B). The lifting lugs are designed for lifting only the lower tray. **Do not attempt to lift lower tray at lifting lugs when center box or side boxes are installed.**

Center Box

Lift the center box at two lifting lugs (L2, Figure 4-25, View C). The lifting lugs are designed for lifting only the center box. **Do not attempt to lift center box with lower tray attached.**

Side Box

Lift the side boxes at two connecting pins (L3, Figure 4-25, View E). **Do not attempt to lift more than two side boxes at a time.**

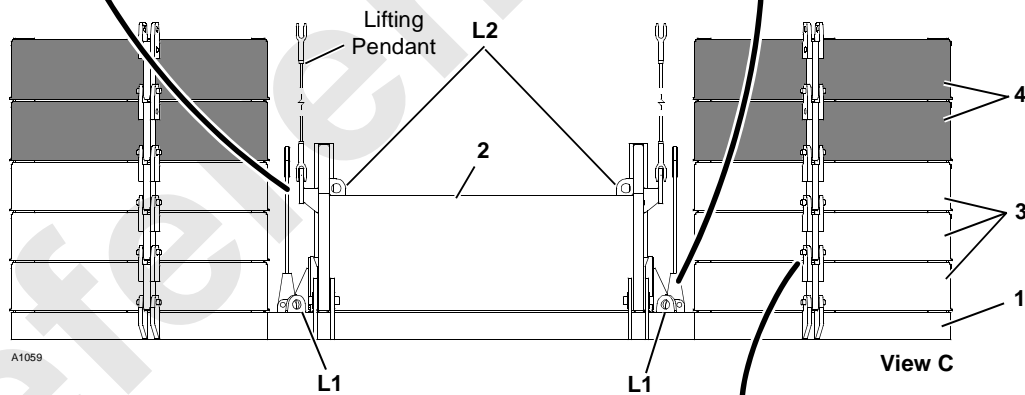
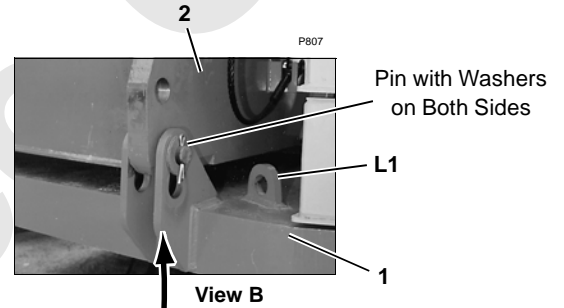
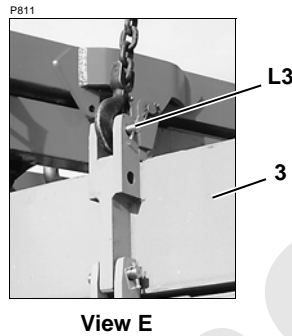
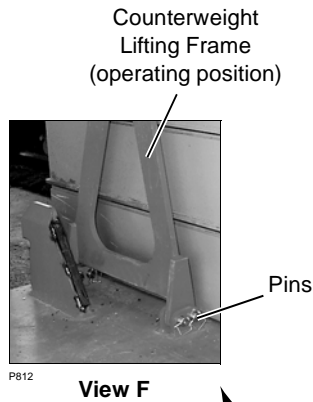
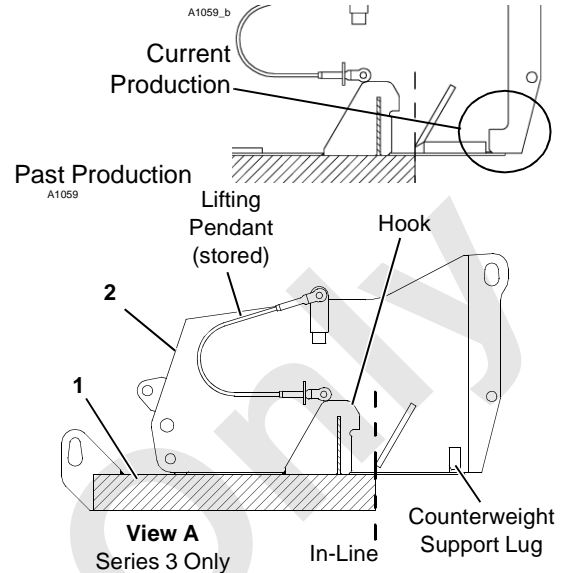


WARNING

Falling Load Hazard!

At installation and removal of upper counterweight, inspect counterweight support lugs on center box for cracks or other damage (see Figure 4-25, View A). The lugs are important structural components that hold the counterweight on the upperworks. If cracks develop, they could lead to unexpected structural failure of center box, allowing counterweights to fall of crane.

COUNTERWEIGHT REQUIREMENT				
Item	Description	Series 1	Series 2	Series 3
1	Lower Tray 38,775 lb (17 588 kg)	1	1	1
2	Center Box 37,000 lb (16 783 kg)	1	1	1
3	Side Box 15,500 lb (7 031 kg)	3 Both Sides	3 Both Sides	3 Both Sides
4	Side Box 20,000 lb (9 072 kg)	0	1 Both Sides	2 Both Sides
TOTAL WEIGHT		169,200 lb (76 748 kg)	209,214 lb (84 898 kg)	249,264 lb (113 064 kg)



LIFTING POINTS		
Item	Description	Qty.
L1	Lifting Lug — Lower Tray	4
L2	Lifting Lug — Center Box	2
L3	Lifting Pin — Side Box	2

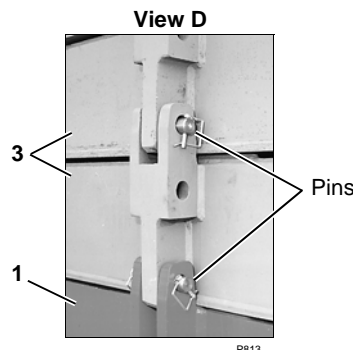


FIGURE 4-25

4

Assembling Upper Counterweight (Series 1 and 2)

Assemble complete counterweight assembly on ground as shown in Figure 4-25.

1. If lowered for shipping, raise counterweight lifting frame and pin in operating position (View F).
2. Lift center box into position on lower tray and align connecting holes.
3. Pin center box to lower tray (View B). **Be sure to install washers and cotter pins.**
4. Lift required number of side boxes into position on lower tray and align connecting holes.
5. Pin side boxes to lower tray and to each other (View D). **Be sure to install safety pins.**

Assembling Upper Counterweight (Series 3)



WARNING

Falling Load Hazard!

Series 3 counterweight assembly must be installed and removed in two stages.

Do not attempt to install or remove Series 3 counterweight assembly as a complete unit. Lifting pendants, links, or lugs may break allowing counterweight assembly to fall.

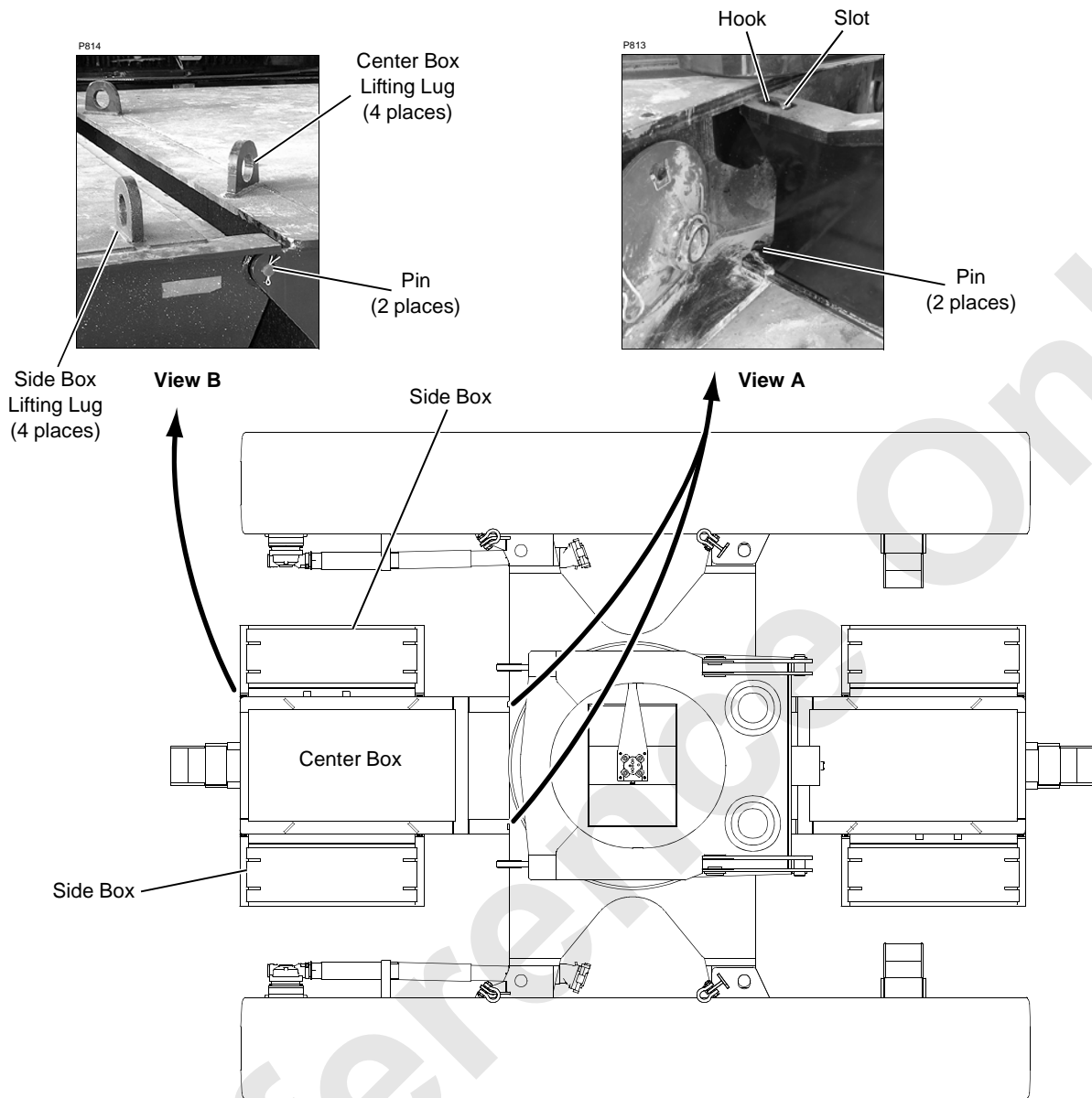
See detailed installation and removal instructions later in this section.

1. If lowered for shipping, raise counterweight lifting frame and pin in operating position (View F).
2. Lift center box into position on lower tray so center box is positioned as shown in View A. **Do not pin center box to lower tray.**

This step is required to ensure that counterweight support lugs on center box do not contact hooks on lower tray when center box is lifted onto crane.
3. Lift required number of side boxes into position on lower tray and align connecting holes.
4. Pin side boxes to lower tray and to each other (View D). **Be sure to install safety pins.**

Reference Only

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	Carbody Counterweights Required	Weight Each lb (kg)	Total Weight lb (kg)
Series 2	2 Center Boxes	30,000 (13 608)	60,000 (27 216)
	4 Side Boxes	15,000 (6 804)	120,000 (54 431)

FIGURE 4-26

Installing/Removing Counterweight



WARNING

Moving Part Hazard!

Stay off counterweight while gantry is being raised and lowered. Do not climb onto counterweight until gantry is at rest on gantry cylinders.

Do not stand between counterweight and crane while counterweight is being installed. Never go under counterweights until they are pinned to crane.

Tipping Hazard!

To prevent crane from tipping:

- Install carbody counterweight before installing upper counterweight.
- Remove upper counterweight before removing carbody counterweight.

Requirements

The 2250 can install and remove its own upper counterweight using the gantry as a lifting device. An assist crane must be used to install or remove carbody counterweight (Series 2 and Series 3 configurations).

Workers must stand on upper counterweight to gain access to handling links on gantry. They may have to climb onto upper counterweight to engage and disengage handling links.

Carbody counterweight, if required, must be installed before installing upper counterweight.

It will be necessary to travel the crane in either direction to align the handling links when installing and removing upper counterweight. For this reason, the following steps must be taken if the 2250 is equipped with a fully rigged boom:

1. Lower boom onto blocking at least six inches high.
2. Pin equalizer to rails on boom butt.
3. Disconnect straps from equalizer (see Boom Rigging Guide).
4. Disconnect boom butt from boom.
5. Pay out load lines as crane is traveled.

Installing Carbody Counterweight (Series 2 and 3)

Carbody counterweight are required for the Series 2 and Series 3 configurations. **Install carbody counterweight, as follows, before installing upper counterweight.**

See Figure 4-26 for following procedure.

1. Swing rotating bed over side of crawlers.
2. Using 4-leg chain sling from assist crane, lift center box into position at either end of carbody.
3. Engage slots in top of center box with hooks on carbody as shown in View A.
4. Lower center box until bottom connecting holes line up.
5. Install connecting pins (View A). *Be sure to install cotter pins to retain connecting pins.*
6. Remove chain sling.
7. **For Series 3 only:**
 - a. Using 4-leg chain sling from assist crane, lift either side box into position (View B) and pin to center box.
 - b. Remove chain sling.
 - c. Repeat step 7a and 7b for other side box.
8. Repeat steps 1-7 at other end of carbody.

Removing Carbody Counterweight (Series 2 and 3)

Remove upper counterweight before removing carbody counterweight. Then remove carbody counterweight, as follows.

The following procedure assumes that the boom, to include the butt, is removed and that the equalizer is stored on the gantry.

See Figure 4-26 for following procedure.

1. Swing rotating bed over side of crawlers.
2. For Series 3 only:
 - a. Remove side box connecting pins (View B).
 - b. Using 4-leg chain sling from assist crane, lift side box clear of center box and lower onto ground or transport vehicle.
 - c. Remove chain sling.
 - d. Repeat steps 2a-2c for other side box.
3. Remove center box connecting pins (View A).
4. Using 4-leg chain sling from assist crane, lift center box clear of hooks on carbody.
5. Lower center box to ground or onto transport vehicle.
6. Repeat steps 1-5 at other end of carbody.

Series 1 and Series 2 Upper Counterweight (Shading Indicates Series 2 Configuration)

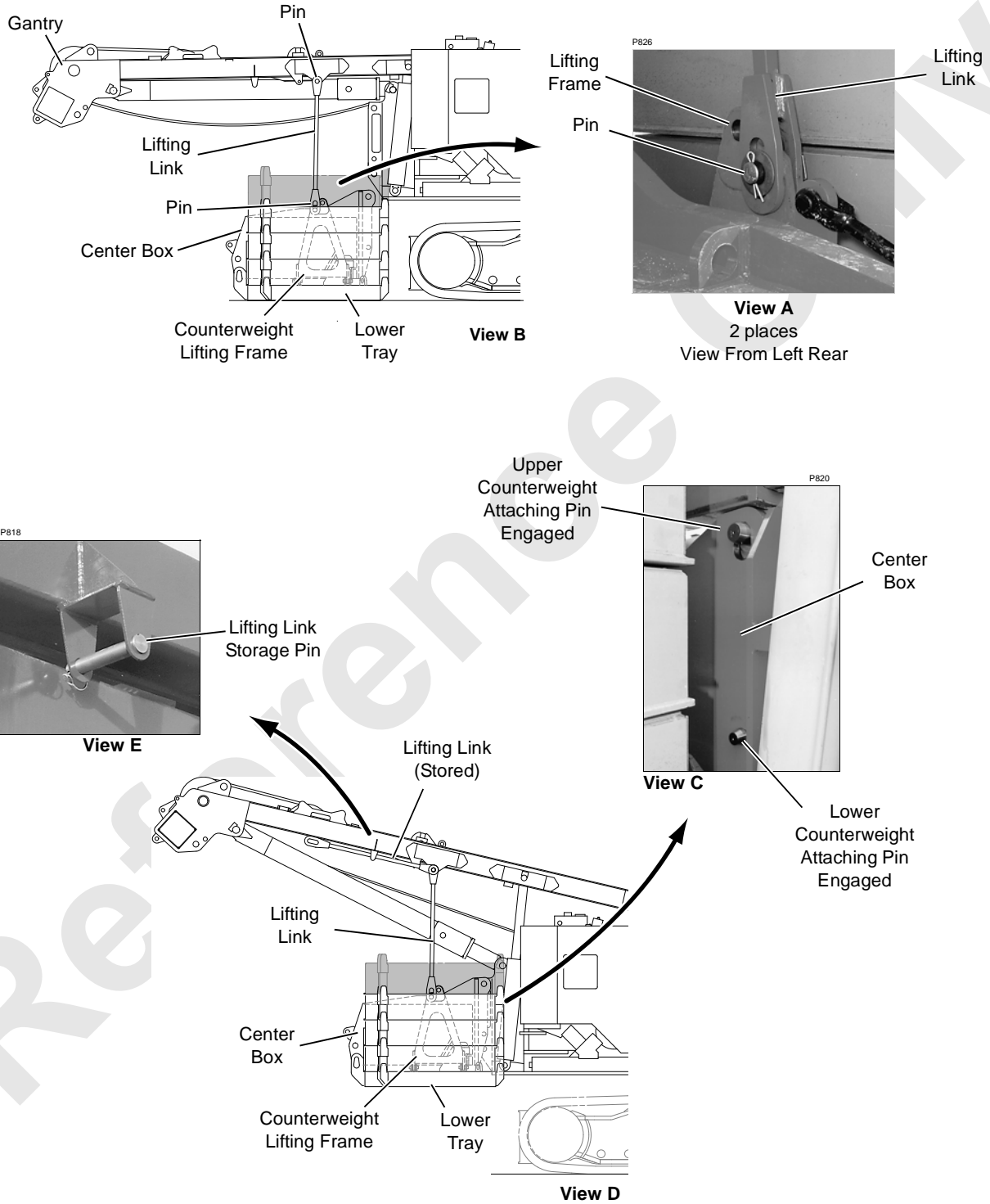


FIGURE 4-27

Installing Upper Counterweight (Series 1 and 2)**WARNING****Tipping Hazard!**

To prevent crane from tipping:

- Install carbody counterweight before installing crane upper counterweight.
- Remove crane upper counterweight before removing carbody counterweight.

See Figure 4-27 for following procedure.

1. If crane will be rigged as a Series 2, **install Series 2 carbody counterweight before installing upper counterweight.**
2. Position crane so it is in line and centered with assembled counterweight (View B).
3. Fully lower gantry (see Gantry Raising/Lowering topic in this section).
4. Lower lifting links from stored position and pin to counterweight lifting frame. Links must be pinned to **rear holes** in lifting frames (View A).

CAUTION**Link Damage!**

Handling links and lower tray links must be in line and vertical before raising counterweight.

5. Disengage upper and lower counterweight attaching pins (View C) with switch on setup remote control. Switches for pins must be held in disengaged position until counterweight is in position.

CAUTION**Gantry Damage!**

Pay out boom hoist wire rope as needed if gantry wire rope becomes tight while raising counterweight.

6. Raise gantry and counterweight assembly with switch on setup remote control until gantry raising cylinders are fully extended (View D).

Counterweight will tilt slightly forward with top attaching holes on center counterweight box ahead of lower holes.

NOTE: If upper counterweight attaching holes are above mating holes in rotating bed, lower gantry cylinders until holes are aligned.

7. Engage upper counterweight attaching pins (View C). *Visually check that pins are engaged.*
8. Slowly lower gantry until lifting links are loose in their slots.
9. Engage lower counterweight attaching pins (View C). *Visually check that pins are engaged.*
10. Unpin lifting links from lifting frame and store lifting links on gantry (View E).
11. Fully raise gantry (see Gantry Raising/Lowering topic in this section).
12. Boom butt can now be attached to boom and boom assembly completed.

Removing Upper Counterweight (Series 1 and 2)

Remove upper counterweight first, then remove carbody counterweight.

The following procedure assumes that the boom, to include the butt, is removed and that the equalizer is stored on the gantry.

See Figure 4-27 for following procedure.

1. Fully lower gantry and remove lifting links from stored position (View D).
2. Pin lifting links to counterweight lifting frame. Links must be pinned to **rear holes** in lifting frames (View A).
3. Disengage lower counterweight attaching pins (View C).
4. Raise gantry and counterweight until counterweight is supported by lifting links and upper attaching pins are loose in slots.
5. Disengage upper attaching pins (View C).
Keep pins disengaged until center box is clear of rotating bed.
6. Lower gantry until counterweight rests on ground.
7. Continue lowering gantry until lifting links are loose in slots.
8. Unpin lifting links from lifting frame. Raise lifting links and store on gantry (View E).
9. Fully raise gantry (see Gantry Raising/Lowering topic in this section).

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Series 3 Counterweight Installation

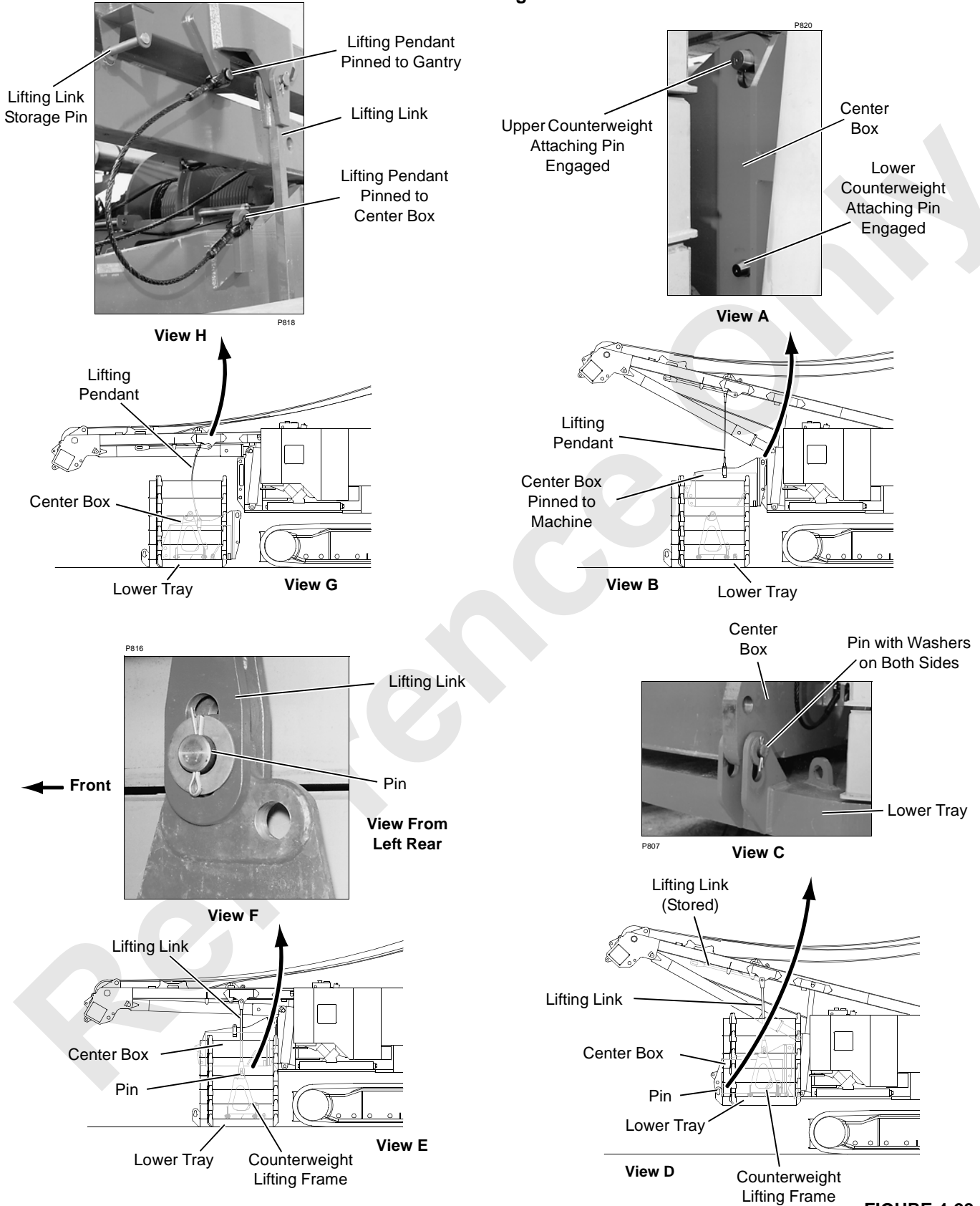


FIGURE 4-28

Installing Upper Counterweight (Series 3)

Unless otherwise specified, see Figure 4-28 for following procedure.

1. **Install carbody counterweight before installing upper counterweight.**
2. Position crane so it is in line and centered with assembled counterweight (Figure 4-28, View G).
3. Fully lower gantry (see Gantry Raising/Lowering topic in this section).
4. Lower lifting links from stored position (Figure 4-28, View H).
5. Attach lifting pendants (stored on the side of the center box) to lugs on gantry (Figure 4-28, View H).
6. Disengage upper and lower counterweight attaching pins (Figure 4-28, View A) with switch on setup remote control. Switches for pins must be held in disengaged position until counterweight is in position.
7. Raise gantry and center box with switch on setup remote control until gantry raising cylinders are fully extended (Figure 4-28, View B).

Center box will tilt slightly forward with top attaching holes on center box ahead of lower holes.

NOTE: If upper center box attaching holes are above mating holes in rotating bed, lower gantry raising cylinders until holes are aligned.

8. Engage upper counterweight attaching pins (Figure 4-28, View A). *Visually check that pins are engaged.*
9. Slowly lower gantry until lifting pendants are slack.

Make sure lifting links don't bind against counterweight components.

10. Engage lower counterweight attaching pins (Figure 4-28, View A). *Visually check that pins are engaged.*
 11. Unpin lifting pendants from gantry and store on center box (Figure 4-25, View A).
 12. Lower gantry until cylinders are fully retracted.
- Make sure lifting links don't bind against counterweight components.**
13. Travel machine so it is in line and centered with lifting frames on lower tray (Figure 4-28, View E).
 14. Pin lifting links to **front holes** in lifting frames (Figure 4-28, View F).

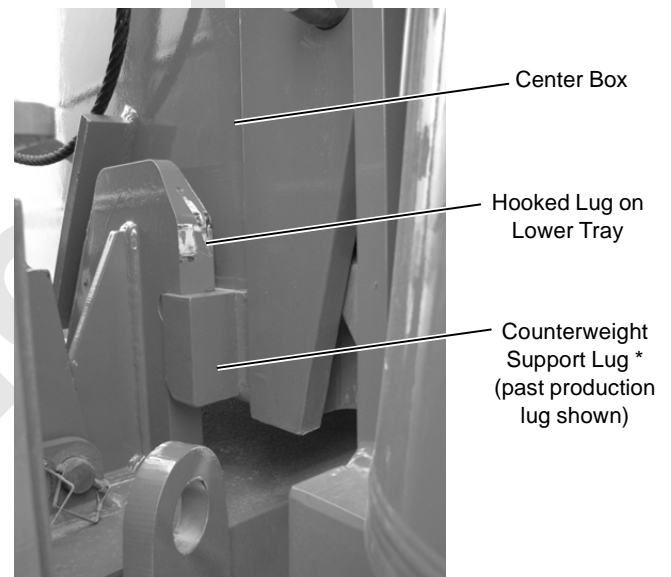
CAUTION

Link Damage!

Handling links and lower tray links must be in line and vertical prior to raising counterweight; otherwise, links can be damaged.

15. Raise gantry and remaining counterweight assembly with switch on setup remote control until pin holes in lower tray line up with holes in center box. Install pins and washers (Figure 4-28, View C).
16. Slowly lower gantry until lifting links are loose in slots.

Hooked lugs on front of lower tray will be engaged with counterweight support lugs on center box (see Figure 4-29).



* On current production, the support lug is an integral part of the counterweight plate work. On past production, the lug is welded onto the plate work.

FIGURE 4-29

17. Unpin lifting links from lifting frame and store lifting links on gantry (Figure 4-28, View H).
18. Fully raise gantry (see Gantry Raising/Lowering topic in this section).
19. Boom butt can now be attached to boom and boom assembly completed.

Removing Upper Counterweight (Series 3)

Remove upper counterweight first. Then remove carbody counterweight.

Unless otherwise specified, see Figure 4-28 for following procedure.

1. Fully lower gantry and remove lifting links from stored position.
2. Pin lifting links to counterweight lifting frame. Links must be pinned to **front holes** in lifting frames (Figure 4-28, View F).
3. Slowly raise gantry until lower tray contacts bottom of center box (Figure 4-25, View A). Remove pins connecting center box to lower tray.
4. Lower gantry until counterweight is on ground and lifting links are loose in slots. Unpin lifting links from lifting frame (Figure 4-28, View F).
5. Attach lifting pendants, stored on the side of the center box, to lugs on gantry (Figure 4-28, View H).
6. Disengage lower counterweight attaching pins (Figure 4-28, View A).
7. Raise gantry and center box until upper counterweight is supported by lifting links and upper attaching pins are loose in slots (Figure 4-28, View A).
8. Disengage upper attaching pins (Figure 4-28, View A).
Keep pins disengaged until center box is clear of rotating bed.
9. Lower gantry until center box is on lower tray or on blocking and lifting pendants are slack.
10. Unpin lifting pendants from gantry and store on center box (Figure 4-25, View A).
11. Raise lifting links and store on gantry (Figure 4-28, View H).

Disassembling Counterweight

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 lifting frame with an outside assist.
2. Remove two inside pins from lifting frame (store pins in lugs on lower tray).
3. Lower lifting frame (toward outside) onto lower tray.
4. Repeat steps for other lifting frame.

COUNTERWEIGHT INSTALLATION AND REMOVAL — WITH AUXILIARY ENGINE

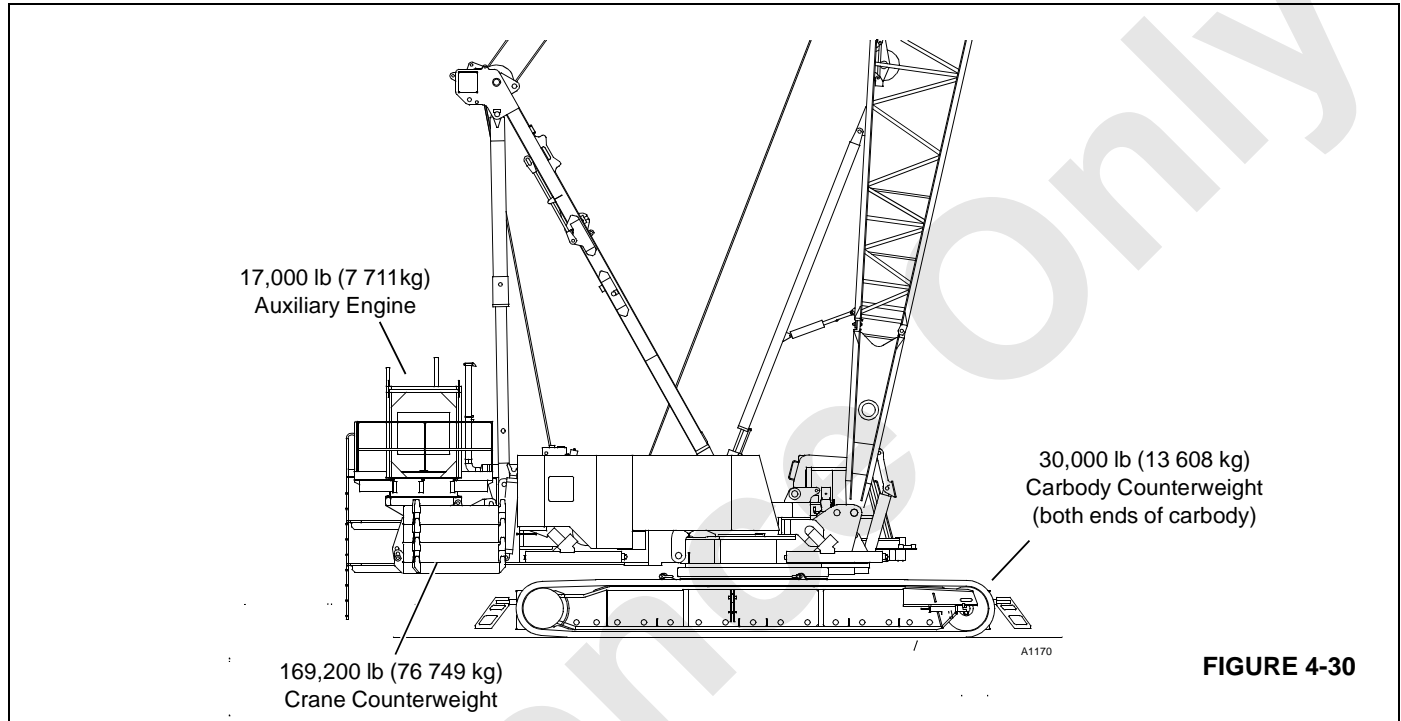
General

Operation with the auxiliary engine installed as shown in Figure 4-30 requires installation of Series-1 crane counterweights and Series-2 carbody counterweights.

Installing Counterweights and Auxiliary Engine

Install counterweights and auxiliary engine in following order:

- FIRST, install crane and carbody counterweights as instructed in this section.
- SECOND, install auxiliary engine **after** carbody counterweights are installed.



Removing Counterweights and Auxiliary Engine

Remove counterweights and auxiliary engine in following order:

- FIRST, remove auxiliary engine **before** removing carbody counterweights.
- SECOND, remove crane and carbody counterweights. as instructed in this section.

WARNING Tipping Hazard!

To prevent crane from tipping:

- Install carbody counterweights before installing auxiliary engine.
- Remove auxiliary engine before removing carbody counterweights.

GANTRY RAISING AND LOWERING — WITHOUT BOOM BUTT HANDLING CYLINDER

General

This section contains gantry raising and lowering instructions for cranes NOT equipped with a boom butt handling cylinder.

When the crane is equipped with only the boom butt, **an assist crane is required to raise and lower gantry**. The assist crane and all rigging must be able to handle 15,000 lb (6 804 kg).

When the crane is equipped with fully rigged boom, an assist crane is not required to raise and lower gantry.

Figure 4-32 shows a crawler crane. The procedures in this section also apply to truck cranes.

Gantry raising and lowering requires two people:

- One to operate the boom hoist control in crane cab.
- A second to operate the remote controls from *ground level*, to observe the raising or lowering procedure, and to provide necessary signals to the crane operators.

These personnel shall read and become thoroughly familiar with instructions in this section before attempting any procedure. Contact Crane CARE Customer Service at the factory for assistance if any procedure is not understood.

The gantry assembly has a telescopic backhitch which provides three positions (see Figure 4-32):

- FULLY RAISED which is the position for all load handling operations.
- INTERMEDIATE which is the 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 which is the position for transporting the crane and for handling some boom lengths (see Boom Rigging Drawing for boom handling conditions).

The gantry cylinders and backhitch pins are controlled with switches on the crane setup remote control. See Section 3 of this manual for identification and location of all 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 4-32, View A) stops the boom butt

when the boom stop tubes are approximately 1 in (25 mm) from bottoming out (boom butt at approximately 89°).

When the boom stop tubes are approximately 1 in (25 mm) 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.

If for some reason, the backhitch pins cannot be engaged/disengaged when the boom stop tubes are approximately 1 in (25 mm) from bottoming out, it will be necessary to bypass the setup boom stop and boom up slightly. When performing this step **DO NOT ALLOW BOOM STOP TUBES TO BOTTOM OUT. Damage to boom stop tubes and boom butt will occur.**



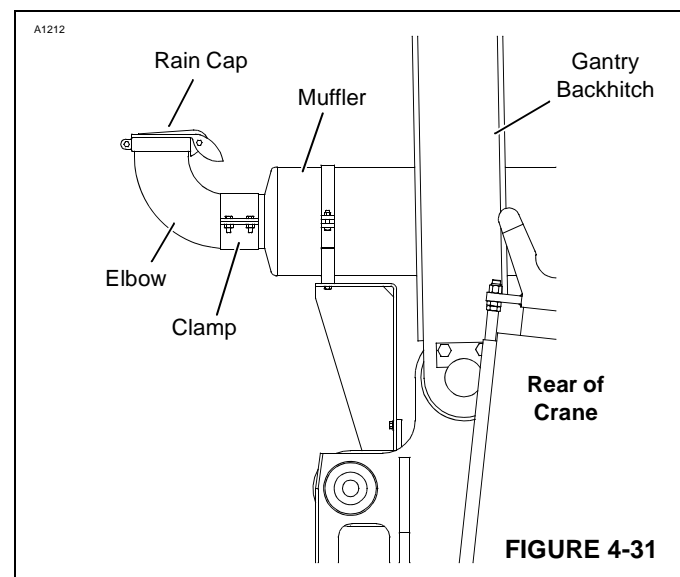
DANGER Crush Hazards!

- Do not raise or lower gantry until all personnel are off top of crane and counterweights. Gantry can fall onto personnel.
- Do not lift loads, to include assembly block, when gantry is in intermediate position. Gantry will rise allowing boom butt and load to fall violently.

CAUTION

When equipped with a Cummins N14-C525E engine, gantry backhitch pins will hit exhaust elbow (Figure 4-31) when gantry is raised and lowered.

To prevent damage, remove clamp, exhaust elbow, and rain cap before you raise or lower gantry.



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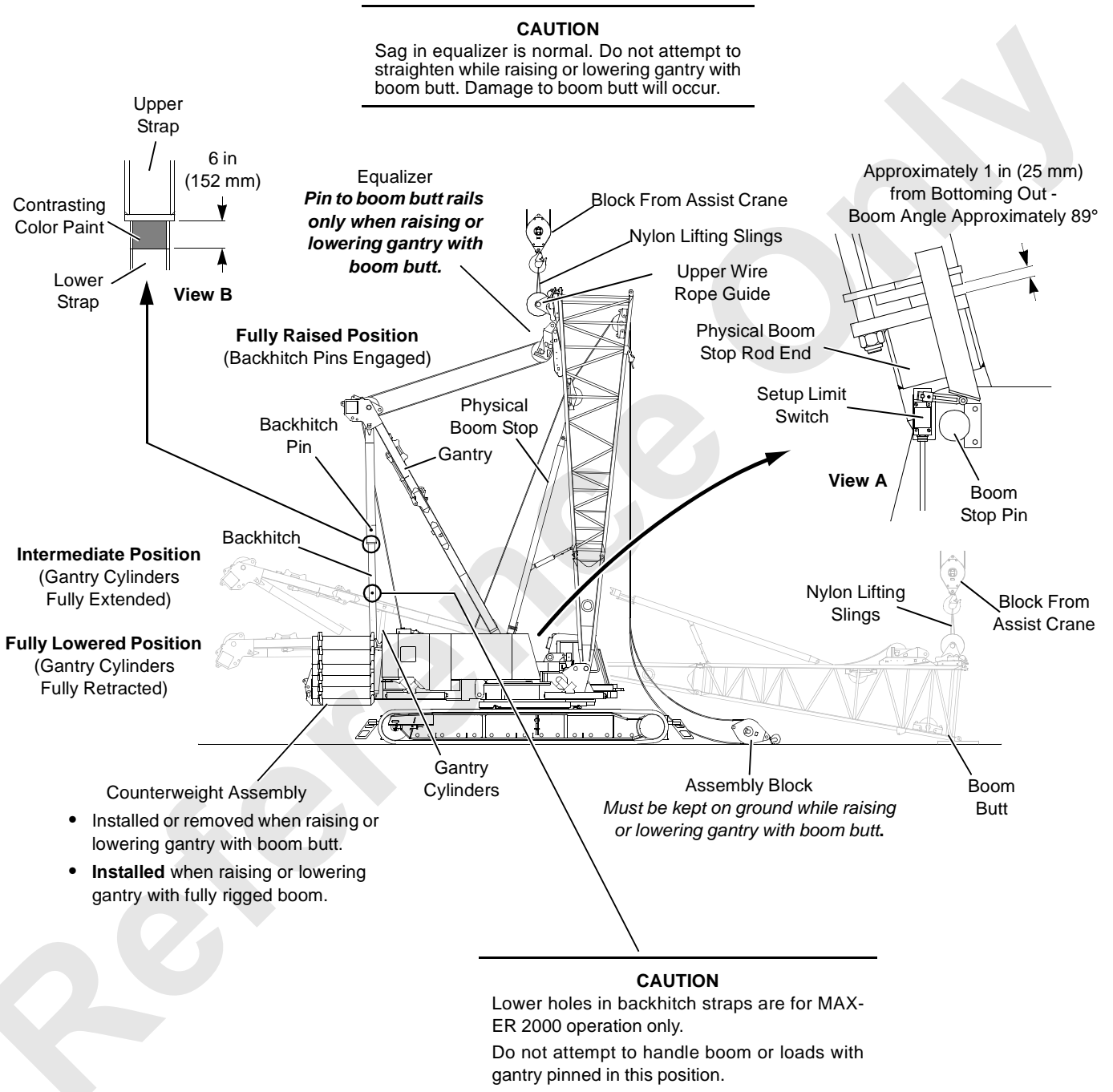


FIGURE 4-32

Raising and Lowering Gantry with Boom Butt

Requirements for Raising and Lowering Gantry with Boom Butt

See Figure 4-32 for following procedure.

1. Crane on a firm level surface.
2. For truck crane, rotating bed and carrier in line with boom butt over rear of carrier.

DANGER Crush Hazard!

For truck crane, do not swing over side of carrier on rubber when counterweight is installed or when gantry is lowered with or without counterweights installed. Crane will tip.

3. Boom butt pinned to crane as shown on Boom Rigging Drawing and resting on blocking at ground level.
4. Physical boom stops installed.
5. Boom hoist wire rope reeved properly through gantry and equalizer sheaves and anchored to boom hoist drums as shown in Boom Rigging Drawing.
6. Equalizer pinned to boom butt rails.
7. Counterweights either installed or removed.
8. Assembly block, if installed, *kept on ground* while raising or lowering gantry.

Raising Gantry with Boom Butt

See Figure 4-32 for following procedure.

1. Connect crane setup remote control to air valve junction box on left side of rotating bed.
2. Turn on cab power switch and start crane engine.
3. Select and confirm SETUP mode with crane mode selector or turn on crane setup switch (past production) in operator's cab.
4. Attach hook from assist crane to upper wire rope guide shaft with *nylon lifting slings*.
5. Fully extend gantry cylinders with switch on remote control to raise gantry to intermediate position.

DANGER Crush Hazard!

Do not attempt to raise boom butt with boom hoist control until step 6 is performed. Boom butt will rise part way, gantry will rise, and then boom butt and gantry will fall violently.

6. Raise boom butt to 60° with assist crane.
7. Disengage backhitch pins with switch on remote control. Hold backhitch pins switch in disengaged position until contrasting color paint is visible on backhitch straps.
8. Raise boom butt with crane boom hoist control (boom up). Pay out load line from assist crane as butt rises.
9. Boom butt will stop rising when physical boom stops are approximately 1 in (25 mm) from bottoming out as shown in View A and then gantry should rise.

NOTE: If the gantry does not rise when the boom butt stops, depress bypass switch in operator's cab.

Then continue to raise the gantry with extreme caution. Watch boom stop tubes while gantry rises. **DO NOT ALLOW BOOM STOP TUBES TO BOTTOM OUT. Damage to boom stop tubes and boom butt will occur.**

The backhitch lower straps are painted a contrasting color (View B) to alert the operator when the backhitch is approximately 6 in (152 mm) from being fully extended.

Watch the backhitch while raising the gantry. *SLOW DOWN boom hoist speed when contrasting color is reached.*

CAUTION

Boom Butt Damage

Use care while raising boom butt during step 10. If either backhitch pin fails to engage before physical boom stops bottom out, **STOP**. Correct problem: pin damaged or air/electric fault.

Overtensioning boom rigging can result in structural damage to boom butt.

10. Continue to raise gantry. Backhitch pins automatically snap into engagement with upper holes when backhitch is fully extended; *stop raising gantry at this point.*

11. *Visually check that both pins are fully engaged.* If either pin fails to engage, raise boom butt *slightly* with boom hoist control to engage pins.

DO NOT ALLOW BOOM STOP TUBES TO BOTTOM OUT. Damage to boom stop tubes and boom butt will occur.

12. Fully retract gantry cylinders with switch on remote control.
13. Lower boom butt to ground with assist crane. Pay out boom hoist wire rope at same time.
14. Unhook load block from assist crane and remove slings from wire rope guide shaft.
15. Fully retract gantry cylinders with switch on remote control.
16. Select and confirm desired operating mode with crane mode selector or turn off crane setup switch (past production) in operator's cab.
17. Unplug crane setup remote control from junction box and store remote control.

Lowering Gantry with Boom Butt

See Figure 4-32 for following procedure.

1. Connect setup remote control to air valve junction box on left side of rotating bed.
2. Turn on cab power switch and start crane engine.
3. Select and confirm SETUP mode with crane mode selector or turn on crane setup switch (past production) in operator's cab.
4. Lower boom butt to ground.
5. Attach hook from assist crane to upper wire rope guide shaft with *nylon lifting slings*.
6. Fully extend gantry cylinders with switch on remote control.
7. Raise boom butt with boom hoist control (boom up) until physical boom stops are approximately 1 in (25 mm) from bottoming out as shown in View A.

Haul in load line on assist crane so load block follows butt as it rises.



DANGER

Crush Hazard!

Do not disengage backhitch pins until backhitch is tensioned as described in step 7. Gantry and butt can fall violently.

8. Disengage backhitch pins with switch on remote control. Hold backhitch pins switch in disengaged position until gantry has been lowered 3 – 4 in (76 – 102 mm) in step 10.

CAUTION

Boom Butt Damage!

Use care while raising boom butt during step 9. If either backhitch pin fails to disengage before physical boom stops bottom out, **STOP**. Correct problem: pin damaged or air/electric fault.

Overtensioning boom rigging can result in structural damage to boom stops or boom butt.

9. *Visually check that both pins are disengaged.* If either pin fails to disengage, raise boom butt *slightly* with boom hoist control to disengage pin.

It may be necessary to depress bypass switch in crane cab while performing this step.

Watch boom stop tubes while gantry rises. **DO NOT ALLOW BOOM STOP TUBES TO BOTTOM OUT. Damage to boom stop tubes and boom butt will occur.**

10. Boom down to lower gantry until it comes to rest on gantry cylinders.
11. Lower boom butt to 60° with crane boom hoist control and STOP. Pay out load line from assist crane as butt lowers.

CAUTION

Boom Butt Damage!

Do not lower boom butt with assist crane until step 11 is completed. Damage to boom butt can result.

12. Lower boom butt to ground with assist crane. Pay out boom hoist wire rope at same time with crane boom hoist control.



DANGER

Crush Hazard!

Do not attempt to lower boom butt to ground with boom hoist control. Boom butt will lower part way, gantry will rise, and then boom butt and gantry will fall violently.

13. Retract gantry cylinders with switch on remote control to lower gantry until cylinders are fully retracted. Pay out boom hoist wire rope to keep rope slack as gantry lowers.

14. Unhook load block from assist crane and remove slings from wire rope guide shaft.
15. Select and confirm desired operating mode with crane mode selector or turn off crane setup switch (past production).
16. Unplug crane setup remote control from junction box and store remote control.

Raising and Lowering Gantry with Fully Rigged Boom

Requirements for Raising and Lowering Gantry with Fully Rigged Boom

See Figure 4-32 for following procedure.

1. Crane on firm level surface.
2. For truck crane, carrier leveled on extended outriggers with tires off ground.
3. Fully rigged boom resting on blocking at ground level.



DANGER Crush Hazard!

For truck crane, do not attempt to raise boom from ground or lower boom to ground until carrier is supported and level on extended outriggers. Crane will tip.

4. Equalizer *not pinned* to boom butt rails.
5. Counterweights installed.

Raising Gantry with Fully Rigged Boom

See Figure 4-32 for following procedure.

An assist crane is not required when the crane is equipped with fully rigged boom. The boom hoist control in the operator's cab is used to raise and lower the gantry.

1. Connect crane setup remote control to air valve junction box on the left side of the rotating bed.
2. Turn on cab power switch and start crane engine.
3. Select and confirm SETUP mode with crane mode selector or turn on crane setup switch (past production) in operator's cab.
4. Fully extend gantry cylinders with switch on remote control to raise gantry to intermediate position.

CAUTION

Gantry or Boom Damage!

Do not attempt to raise gantry until gantry cylinders are fully extended. Structural damage to gantry or boom will occur.

5. Disengage backhitch pins with switch on remote control. Hold backhitch pins switch in disengaged position until contrasting color paint is visible on lower backhitch straps.
6. Boom up to raise gantry.

NOTE: The backhitch lower straps are painted a contrasting color (View B) to alert the operator when the backhitch is approximately 6 in (152 mm) from being fully extended.

Watch the backhitch while raising the gantry. *SLOW DOWN boom hoist speed when contrasting color is reached.*

7. Raise gantry until boom is 3 – 4 in (76 – 102 mm) off blocking. Raising boom off blocking will ensure that backhitch is fully extended.
8. Backhitch pins will automatically snap into engagement with upper holes when backhitch is fully extended; *stop raising gantry at this point.*
9. *Visually check that both pins are fully engaged.* If either pin fails to engage, determine cause of problem: pin damaged or air/electric fault.
10. Lower boom onto blocking.
11. Fully retract gantry cylinders with switch on remote control.
12. Select and confirm desired operating mode with crane mode selector or turn off crane mode switch (past production).
13. Unplug crane setup remote control from junction box and store remote control.

Lowering Gantry with Fully Rigged Boom

See Figure 4-32 for following procedure.

1. Connect crane setup remote control to air valve junction box on the left side of the rotating bed.
2. Turn on cab power switch and start crane engine.
3. Select and confirm SETUP mode with crane mode selector or turn on crane setup switch (past production) in operator's cab.
4. Fully extend gantry cylinders with switch on remote control.

CAUTION**Gantry Damage!**

Make sure gantry cylinders are fully extended. Cylinders must be used to fully lower gantry. Attempting to fully lower gantry with boom hoist rigging will cause gantry to fall violently. Structural damage to gantry or boom will occur.

CAUTION**Gantry or Boom Damage!**

Do not disengage backhitch pins until backhitch is tensioned as described in step 6. Gantry can fall violently. Structural damage to gantry or boom will occur.

5. Raise boom 3 – 4 in (76 – 102 mm) off blocking; this step will ensure that backhitch is properly tensioned.
6. Disengage backhitch pins with switch on remote control. Hold backhitch pins switch in disengaged position until gantry has been lowered 3 – 4 in (76 – 102 mm) in step 9.
7. *Visually check that both pins are fully disengaged.* If either pin fails to disengage, determine cause of problem: pin damaged or air/electric fault.
8. Boom down to lower gantry until it comes to rest on gantry cylinders (boom will lower onto blocking first, then gantry will lower).
9. Retract gantry cylinders with switch on remote control to lower gantry until cylinders are fully retracted. Pay out boom hoist wire rope to keep rope slack as gantry lowers.
10. Select and confirm desired operating mode with crane mode selector or turn off crane mode switch (past production).
11. Unplug crane setup remote control from junction box and store remote control.

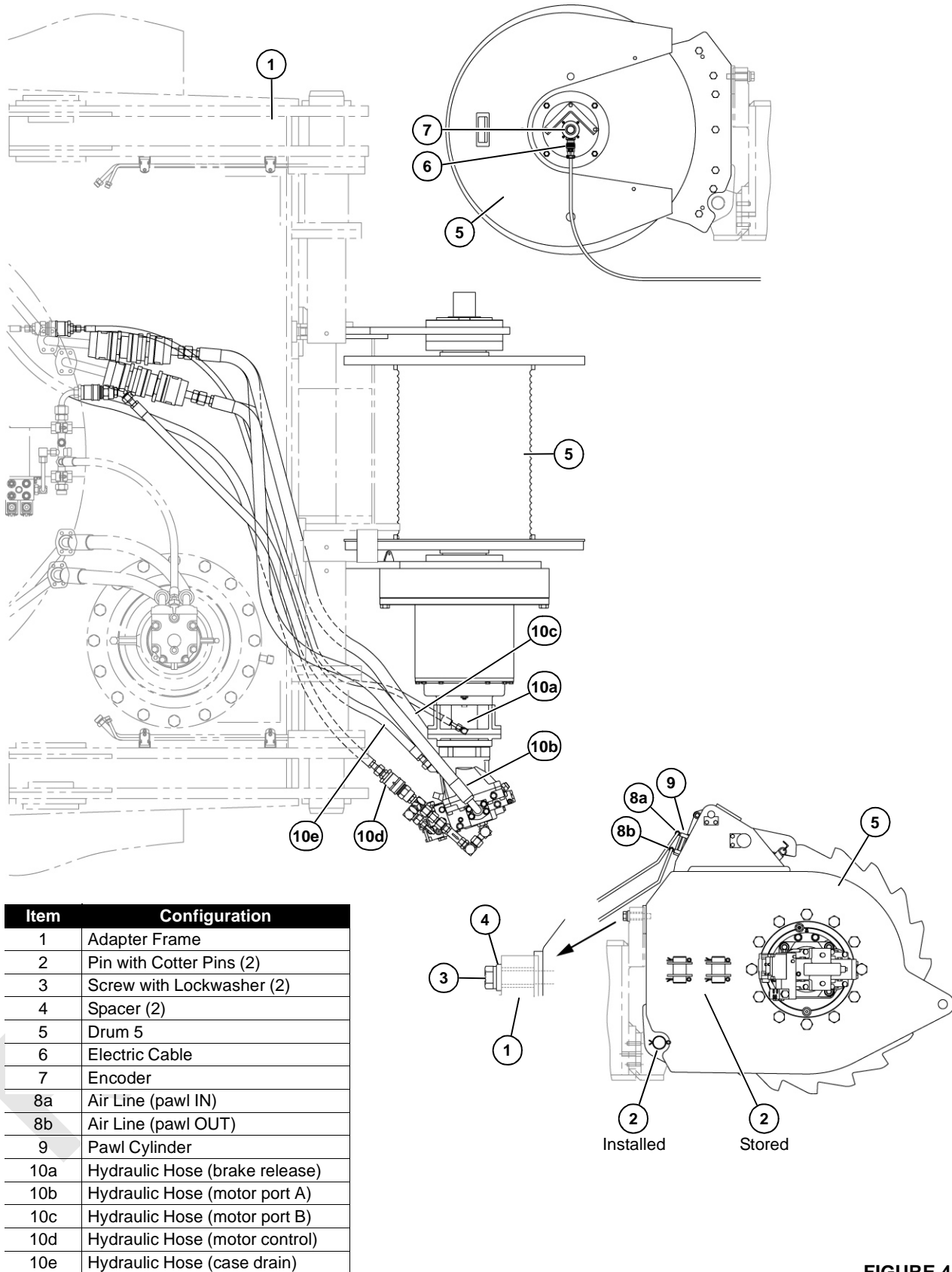


FIGURE 4-33

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.

See *Figure 4-33*

Drum 5 Installation

1. Attach 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 lockwashers (3), and spacers (4) from storage on the drum.
4. Lift the drum into position at the front of adapter frame (1).
5. Align the mounting holes and install pins (2).
6. Install spacers (4) in the top mounting holes in the adapter frame.
7. Apply Loctite® #271 to the threads of screws (3).
8. Install screws with lockwashers (3).
9. Tighten screws (3) to 180 ft-lb (244 Nm).
10. Connect electric cable (6) from the adapter frame junction box to encoder (7) on the left end of the drum.
 - Remove the dust caps from the plug and the receptacle.
 - Thoroughly clean all dirt and moisture from the plug and the receptacle before connecting them.
11. Connect two air lines (8a and 8b) from the adapter frame to drum pawl cylinder (9).
 - Thoroughly clean all dirt and moisture from the air line fittings before connecting them.
 - Top port of cylinder is pawl IN (engaged).
 - Bottom port of 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 the nipples.
 - Thoroughly clean all dirt and moisture from the couplers and the nipples before connecting them.
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 4-33*

1. Spool the wire rope onto the drum and secure it.
2. Reverse the installation steps to remove the drum.
3. Store pins (2) in the brackets on the side of the drum.
4. Store screws with lockwashers (3) and spaces (4) in the holes in the drum.

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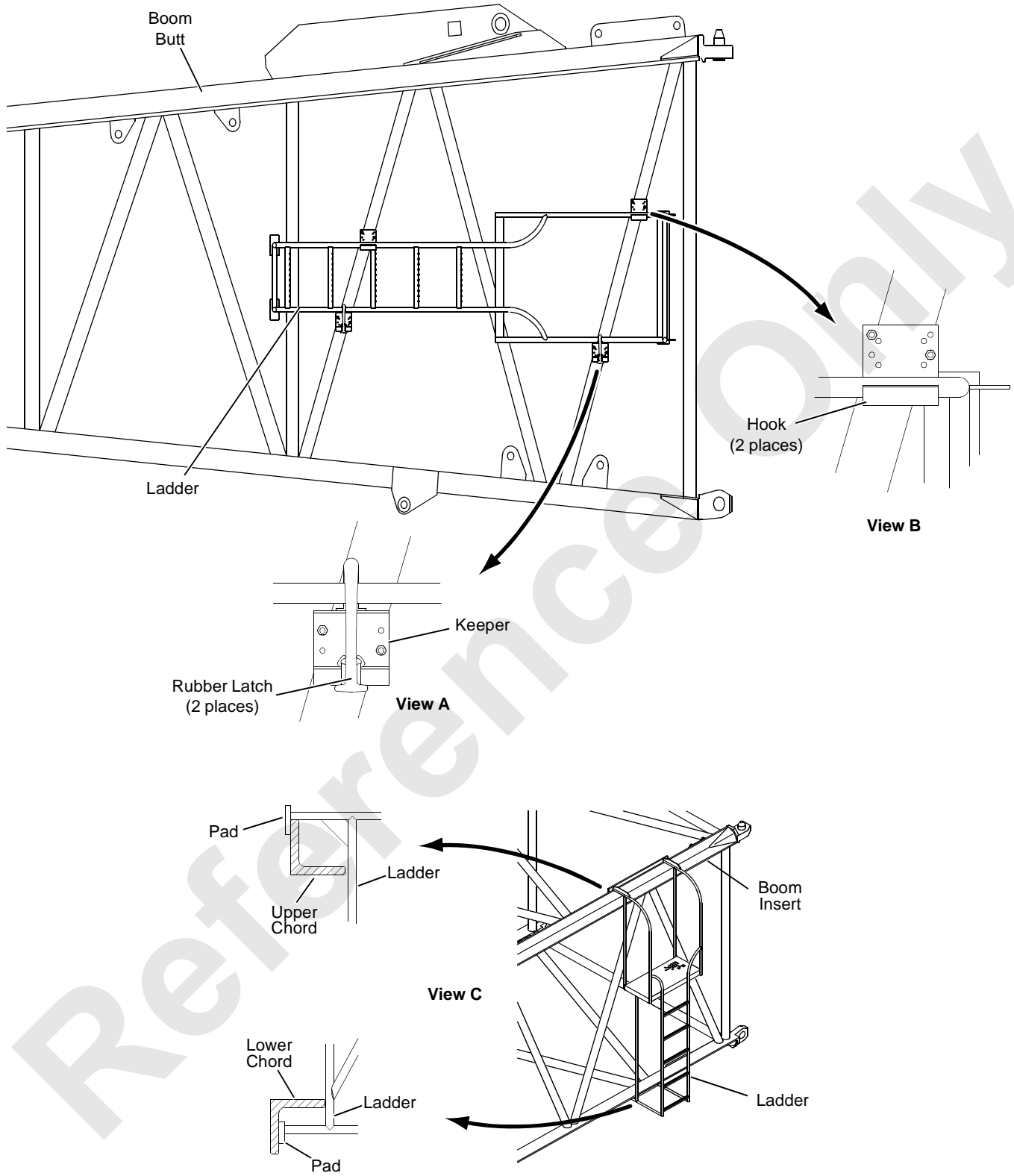


FIGURE 4-34

BOOM LADDER ASSEMBLY — WITH #44 BOOM



WARNING

To Prevent Serious Injury or Death:

- Limit load on ladder to 300 lb (136 kg).
- Avoid improper use. This ladder is intended for use only on Manitowoc #44 boom inserts. Any other use is prohibited.
- Use ladder for boom assembly/disassembly and maintenance only when boom is horizontal.
- Make sure ladder is properly secured to insert.
- When climbing ladder, hands shall be free of any objects. Objects which cannot be carried in pockets or tool belts shall be lifted into place onto ladder platform prior to climbing ladder.
- Stand only on platform. Do not stand on cross braces.

General

Two ladders are installed inside the boom butt, one on either side as shown in Figure 4-34. The ladders are designed for use in assembly/disassembly and maintenance of #44 boom sections and components. Each ladder weighs approximately 18 lb (8 kg).

Removal from Boom Butt

It is recommended that two people remove ladder from boom butt: one person inside butt to unlatch and lift ladder and another person outside of butt to help guide ladder out of butt. Use the following procedure:

1. Lower boom onto blocking at ground level. **Boom sections must be horizontal.**
2. Unhook rubber latches (Figure 4-34, View A).
3. Lift ladder up and out of hooks.
4. Guide ladder through lacings to outside of boom butt.

Installation on Boom Inserts

Lift ladder to desired outside location on insert so that upper pad is securely hooked over backside of upper chord and lower pads rest firmly against lower chord (Figure 4-34, View C).

Ladder must hang vertically against boom insert when in use.

Storage In Boom Butt

It is recommended that two people store ladder in boom butt: one person outside of butt to help guide ladder into butt, and another person inside butt to lift ladder and latch it in position. Use the following procedure:



WARNING Falling Load Hazard!

Ladders must be properly stored to prevent them from falling out of butt when boom is raised.

1. Hang ladder rails over hooks inside butt (Figure 4-34, View B).
2. Pull rubber latches tightly over lower rail and latch in keepers (Figure 4-34, View A).
3. Ensure ladder cannot move once latched in place.

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

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 in Figure 4-35. Otherwise, an assist crane is required.



DANGER Tipping Hazard!

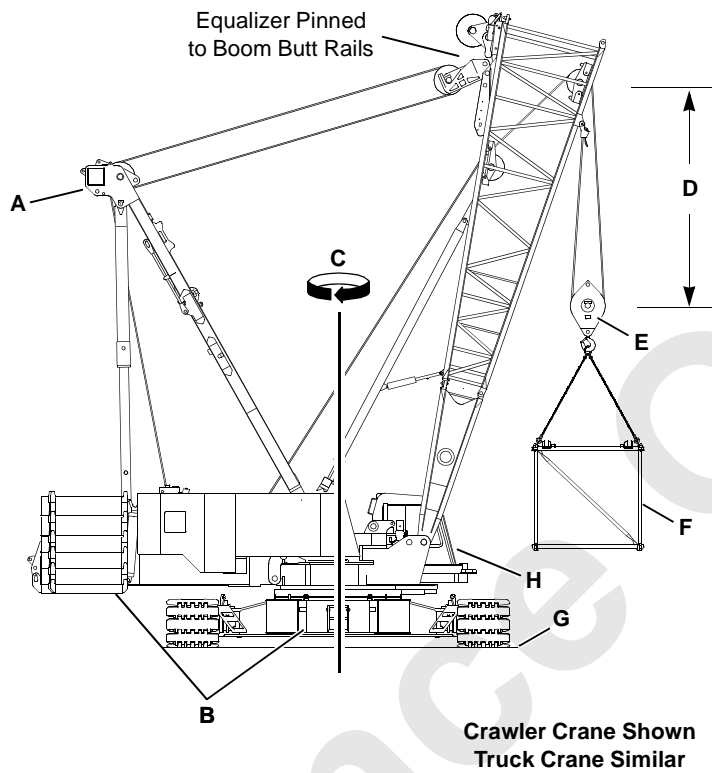
To prevent crane from tipping or boom butt from collapsing, do not exceed maximum lifting capacity and radius given in Figure 4-35.

CAUTION

Avoid Damage to Boom Rigging!

Do not exceed minimum block distance given in Figure 4-35. Hoisting block higher than specified can result in damage to wire rope and sheaves.

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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	17 ft (5,2 m) Minimum Block Clearance	17 ft (5,2 m) Minimum Block Clearance
E	30 USt (27,2 t) Rigging Block with 2-Part Hoist Line	30 USt (27,2 t) Rigging Block with 2-Part Hoist Line
F	Capacity limited to 60,000 lb (27 216 kg) at 20 ft (6,1 m) Radius	Capacity limited to 49,000 lb (22 226 kg) at 22 ft (6,7 m) 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 4-35

Blocked Crawler Requirement

To prevent the crawler crane from tipping, some boom and jib lengths must be raised and lowered over end blocked crawlers. See the capacity charts for blocked crawler requirements and Crawler Blocking Diagram in Capacity Chart Manual for instructions.

DANGER
Tipping Hazard!

For crawler cranes, do not attempt to raise or lower boom and jib from or to ground until ends of crawlers are blocked, if required. Otherwise, crane will tip.

Extended Outriggers

To prevent truck crane from tipping, the outriggers must be fully extended and the carrier leveled to raise and lower all boom and jib combinations from and to ground – over rear of carrier. See Liftcrane Boom and Liftcrane Jib Capacity Charts for boom and jib raising and lowering limitations.

See the Outrigger Operating Controls and Operation in Carrier Operator's Manual for outrigger instructions.

DANGER
Tipping Hazard!

For truck crane, do not attempt to raise or lower boom and jib from or to ground – over rear of carrier – until outriggers are fully extended and carrier is level.

Handling Components

Handle boom sections with care to avoid damaging 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!

Lifting lugs on each insert are designed only for lifting that insert. Do not attempt to lift two or more inserts with lifting lugs on one insert. Lifting lugs may break allowing inserts to fall.

When lifting lugs are not used:

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

Handling Boom

See the table in Boom Rigging Assembly Drawing for boom handling instructions.

Rigging Assembly Drawings

Boom and jib components (top, inserts, straps, pendants) must be assembled in proper sequence according to Figure 4-43, 4-44, or 4-45 and the Boom and Jib Rigging drawings at the end of this section.

Identifying Boom Sections, Straps, and Pendants

Boom sections are marked for proper identification as shown in Figure 4-36, View A.

Straps and links are marked for proper identification as shown in Figure 4-36, View B.

Pendants are marked for proper identification as shown in Figure 4-36, View C.

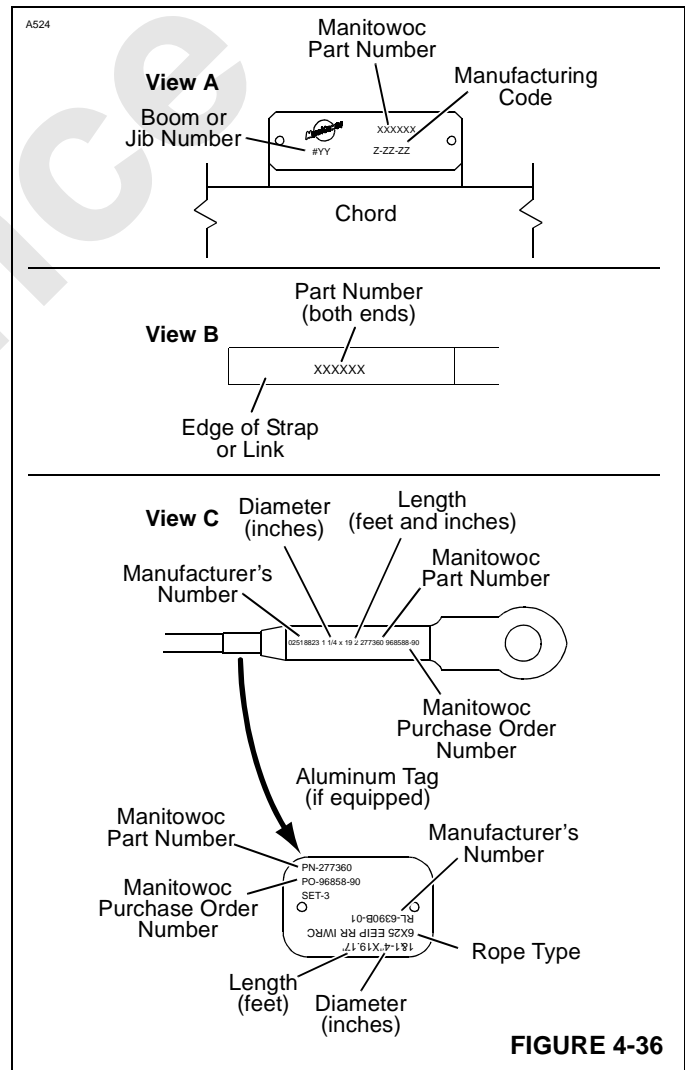


FIGURE 4-36

Identifying Inserts

Depending on boom length and type of boom, the boom sections must be installed in the following sequence:

- Boom Butt
- then any 10 ft (3,0 m) Insert
- then any 20 ft (6,1 m) Inserts
- then any 40 ft (12,2 m) Heavy Inserts (#44A)
- then any 40 ft (12,2 m) Standard Inserts
- then any 40 ft (12,2 m) Light Inserts
- then 40 ft (12,2 m) Transition Insert (long reach boom only)
- then Boom Top

See Figure 4-37 for identification of the heavy, standard, and light inserts.

! WARNING
Tipping Crane Hazard!
Collapsing Boom Hazard!

Boom and jib sections must be assembled in proper sequence according to Figure 4-43, 4-44, or 4-45 and Boom and Jib Rigging Assembly drawings at the end of this section.

Crane can tip or structural failure can occur if inserts are not installed in proper sequence.

Removable Lacings

The 20 ft (6,1 m) and standard 40 ft (12,2 m) inserts are equipped with removable diagonal lacings. This design feature allows the lacings to be removed so that 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. **It is users responsibility to securely fasten blocking and jib sections so sections cannot move during shipment.**

Prior to operating the crane after removing the jib sections and all blocking, the removable diagonal lacings must be reinstalled:

1. Thoroughly clean all dirt from mating surfaces between lacings and supports on inserts.

2. Reinstall proper number of removable lacings in each insert with bolts and stop nuts as shown in Figure 4-38.
3. Securely tighten nuts.

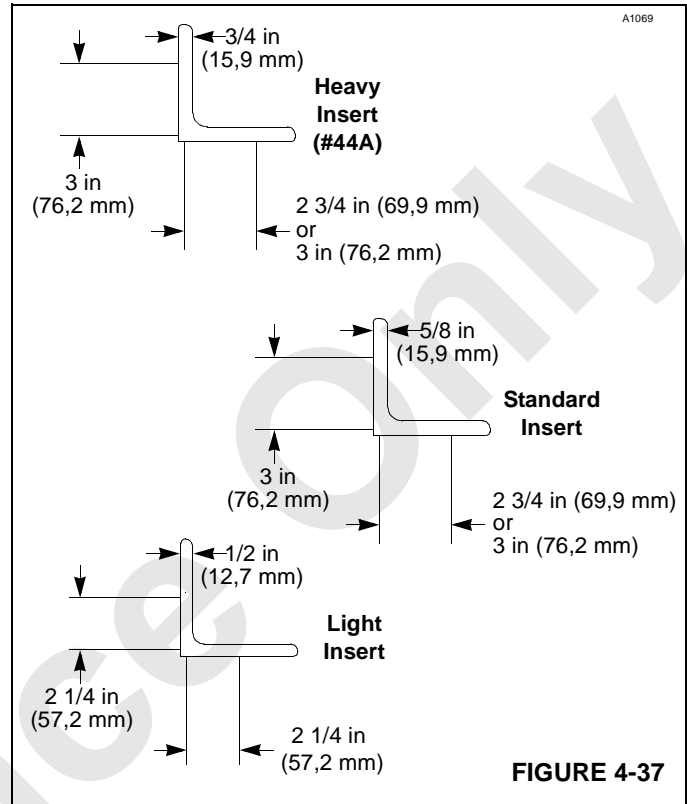


FIGURE 4-37

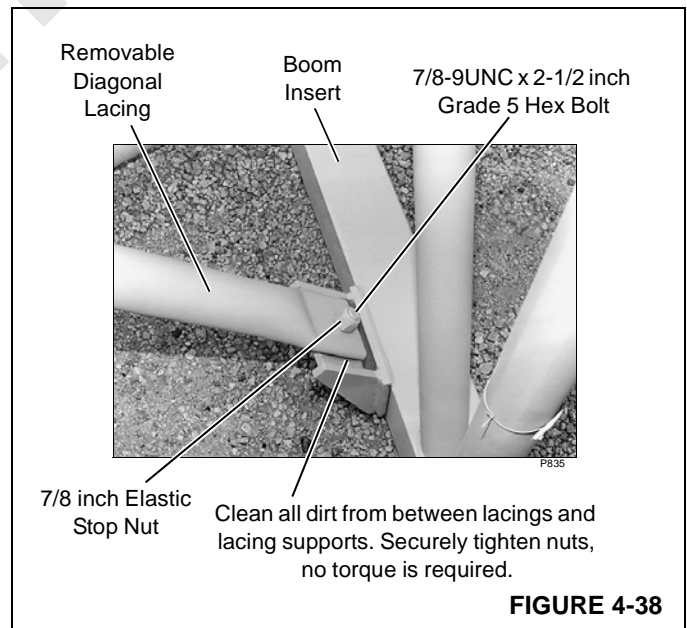


FIGURE 4-38

Reference Only

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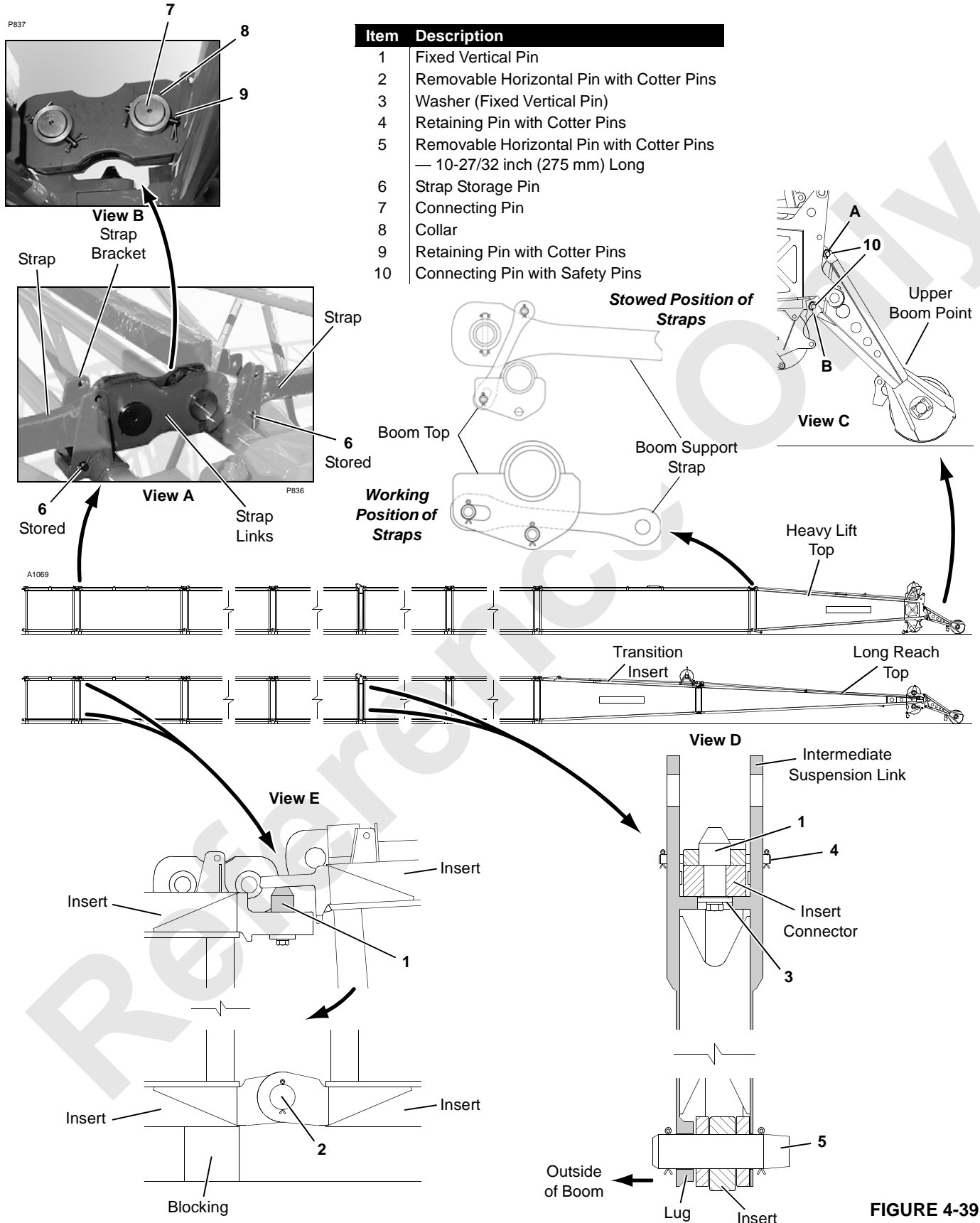


FIGURE 4-39

Boom Installation

General

1. Before starting to assemble boom, determine following:
 - Is intermediate suspension required for selected boom length? If so, intermediate suspension links must be installed at proper location between boom inserts. See Figure 4-43, 4-44, and 4-45 for installation location.
 - Will a fixed jib be installed? If so, backstay pendant links must be installed at proper location between inserts (#44 Heavy Lift only). See Jib Assembly Drawing for installation location. **Note that backstay pendant links are identical to intermediate suspension links.**
2. The boom inserts are equipped with plastic wire rope guards that are installed at the factory. Do not over tighten mounting screws. Guards must be free to slide in mounting slots to allow for thermal expansion and contraction of the plastic.
3. Read all notes on Boom Rigging Assembly drawing. **Shortest inserts must be installed next to boom butt.**
- c. Lower insert until bottom connector holes are aligned and install removable horizontal pins (2, Figure 4-39, View E).
- d. Block under bottom chords at top end of insert.
2. If your boom length requires intermediate suspension, install intermediate suspension link on top end of required insert as follows. See Figure 4-43 and 4-45 for intermediate suspension requirements.
 - a. Lift intermediate suspension link into position on either side of insert.
Lug at bottom connecting hole in link must be toward outside of boom (View D).
 - b. Engage hole in link with washer (3, View D) on underside of insert connector.
 - c. Install retaining pin (4, View D) through holes on butt side of link to prevent link from falling off insert.
 - d. Repeat steps 2a – 2c for link on other side of insert.
 - e. Proceed to install next boom insert (steps 1b – 1d). **Replace standard horizontal connecting pin with 10-27/32 in (275 mm) long pin (5, View D) supplied with link.**



WARNING

Collapsing Boom Hazard!

To prevent death or serious injury, do not stand on, inside, or under boom sections during assembly. Always stand outside of boom sections when installing connecting pins.

Assemble Boom Sections

The boom sections have FACT™ connectors:

- The top connectors are joined by fixed vertical pins that hook into holes in the adjacent section (Figure 4-39, View E).
- The bottom connectors are joined by removable horizontal pins (Figure 4-39, View E).

Assemble the inserts, starting with the inserts closest to the boom butt and moving toward the boom top.

See Figure 4-39 for following procedure.

1. Assemble boom inserts in proper sequence, as follows, starting at butt end of boom:
 - a. Place first insert on blocking at least 6 in (152 mm) high.
 - b. Lift next insert into position and engage top connector holes with fixed vertical pins (1, View E).
3. Repeat steps 1b – 1d until all inserts all installed.
 - Make sure light insert(s) are installed next to boom top for heavy lift boom or next to tapered insert for long reach boom.
 - For long reach boom, tapered insert must be installed next to boom top.
4. Install boom top, heavy lift or long reach, in same manner inserts were installed.

NOTE: The above procedure is identical for installing the pendant links required for fixed jib installation on the #44 heavy lift boom.

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 4-39 for following procedure.

1. Remove storage pin (6, View A) retaining links and strap to strap bracket.
2. Store storage pin (6, View A) in bottom hole in strap bracket.
3. Rotate strap links forward and pin to adjacent strap (View B).

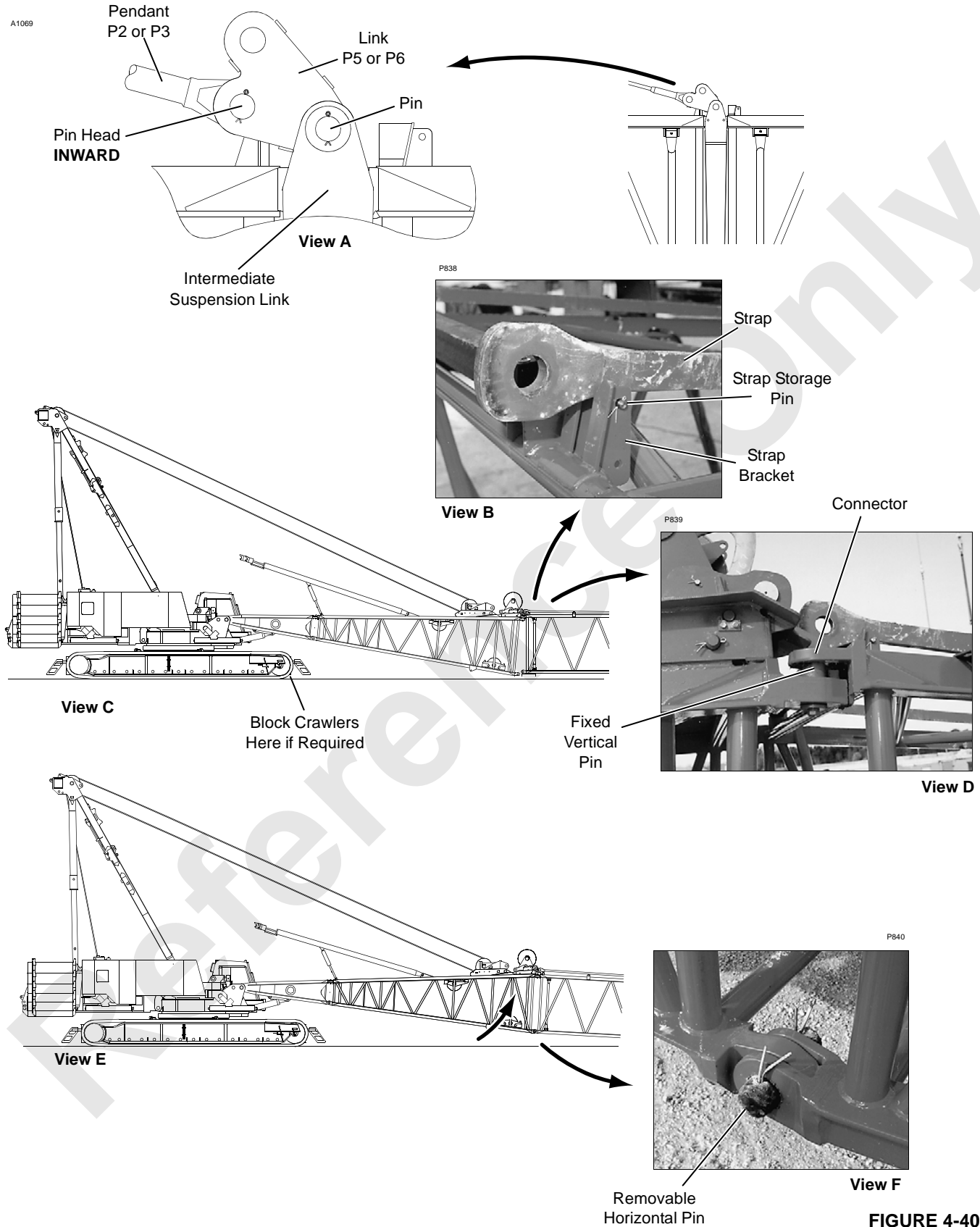


FIGURE 4-40

Install Intermediate Suspension Pendants

If required, install intermediate suspension pendants as follows. See Figure 4-43, 4-44, and 4-45 for the required length and installation sequence of the pendants.

The pendants are furnished in matched sets of two and must be installed in matched sets.

See Figure 4-40 for following procedure.

1. Pin pendant links (L5 or L6, View A) to intermediate suspension links. **Links must be positioned exactly as shown.**
2. Pin pendants (P2 or P3, View A) to pendant links (L5 or L6) and lay pendants along top of boom. **Head of pendant pins must face inward.**
3. Install remaining pendants — in proper sequence — and lay pendants along top of boom. **Head of pendant pins must face inward.**

Install Upper Boom Point

If required, install upper boom point as follows:

1. Lift upper boom point into position at end of boom top.
2. Align upper connecting holes (A, Figure 4-39, View C) and install connecting pins (10).
3. Rest boom point on ground.
4. Install lower connecting pins in holes (B) when boom is raised.

Install Jib

If required, install jib.

Upper boom point must be removed prior to jib installation. See Jib installation instructions in this section.

Connect Boom Butt to Boom

1. Perform following steps at end of both straps on boom section adjacent to boom butt (Figure 4-41, View B):
 - a. Unpin strap from storage position.
 - b. Lift end of strap clear of strap bracket.
 - c. Install strap storage pin in storage hole.
 - d. Rest strap on storage pin.

NOTE: Wire rope guide on end of boom butt will hit straps if step 1 is not performed before attempting to pin boom butt to boom. **Damage could result.**

2. Remove assembly block and store wire rope on load drum.

See Figure 4-40 for remaining steps.

3. Position crane so boom butt is in-line with boom (View C).
4. Travel forward slowly, swing, and boom up and down as required to align fixed vertical pins in butt with top connector holes in insert (View D).



DANGER

Tipping Hazard!

Prevent crane from tipping:

- For crawler cranes, do not attempt to raise or lower boom and jib from or to ground until ends of crawlers are blocked, if required.
- For truck crane, do not attempt to raise or lower boom and jib from or to ground — over rear of carrier — until outriggers are fully extended and carrier is level.

5. Check appropriate capacity chart to see if crawlers must be blocked to raise boom. If so, proceed as follows:
 - a. Mark ground at center of both front rollers or rear tumblers, depending on which end is closer to boom. See Crawler Blocking Diagram for blocking requirements.
 - b. Lower boom to disengage top connecting pins.
 - c. Slowly travel several feet in reverse.
 - d. Place required blocking on ground at points marked in step 5a (View C).
 - e. Repeat step 4 while traveling onto blocking.
6. Slowly boom up only enough to align bottom connector holes in butt with bottom connector holes in insert (View E).

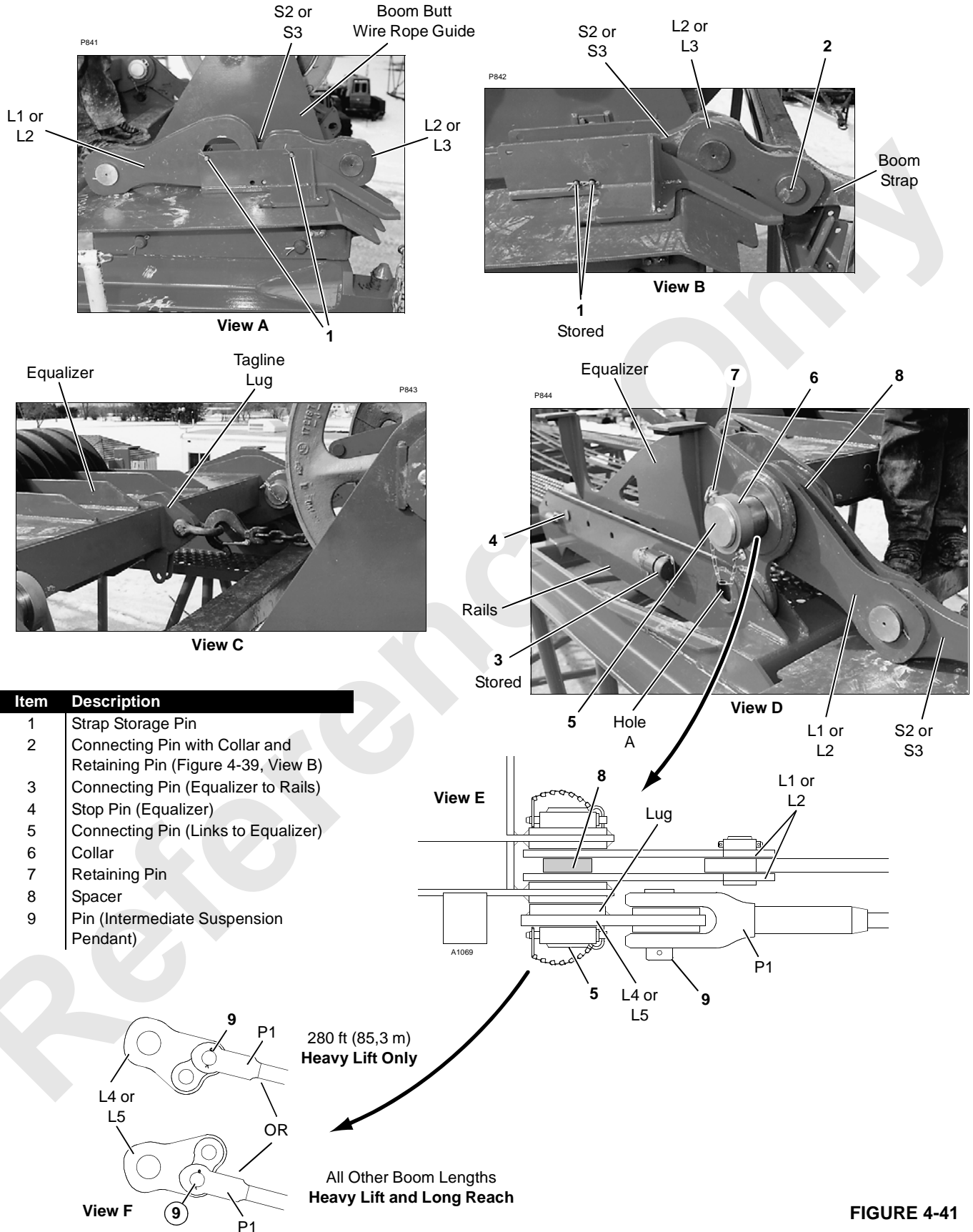


WARNING

Moving Part Hazard!

Prevent serious crushing injury:

- Do not stand inside boom while installing connector pins — **STAND OUTSIDE BOOM.**
7. Install removable horizontal pins (View F).
 8. Boom down enough to slacken boom hoist wire rope so equalizer rests on rails.



Item	Description
1	Strap Storage Pin
2	Connecting Pin with Collar and Retaining Pin (Figure 4-39, View B)
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 4-41

Connect Straps and Pendants to Equalizer

Unless otherwise specified, see Figure 4-41 for following procedure.

The straps and links used to connect the boom straps to the equalizer are stored on the boom butt wire rope guide as shown in Figure 4-41, View A. To connect the boom straps to the equalizer, proceed as follows:

1. Remove strap storage pins (1, View A) securing links and straps to boom butt wire rope guide.
2. Store strap storage pins (1, View B).
3. Rotate links (L2 or L3, View B) forward and pin to boom straps on boom section next to boom butt. See Figure 4-39, View B for strap-to-link pinning detail.
4. Attach a tagline to lug on front of equalizer (View C). The tagline is required to pull equalizer forward when connecting links to equalizer. One of three methods can be used:
 - Chain sling from another crane. Route chain sling around bottom of center sheave in boom butt wire rope guide.
 - Load line from load drum. Route load line over top and around bottom of center sheave in boom butt wire rope guide. Connect to equalizer lug with a socket and wedge.
 - Lever operated hoist.
5. Pull equalizer forward with tagline just enough to loosen connecting pins (3, View D) in boom handling holes (A) between equalizer and rails.
6. Install stop pins (4, View D) in equalizer rail holes closest to end of equalizer. **Stop pins must be installed to**

prevent equalizer from accidentally sliding back on rails during link assembly.

7. Remove connecting pins (3, View D) from holes (A) and store in holders on side of rails.
8. Rotate links (L1 or L2, View D) to rear and pin to equalizer. Use tagline to position equalizer as required. **Spacer (8) must be installed between links (L1 or L2).**
9. If equipped with intermediate suspension, proceed as follows:
 - a. Pin links (L4 or L5, View E) to equalizer. **Lug on links (L4 or L5) must face inward and links must be positioned as shown in (Figure 4-41, View F).**
 - b. Pin intermediate suspension pendants (P1, View E) to links (L4 or L5). **Head of pins (9) must face inward and pendants must be pinned to proper holes as shown in Figure 4-41, View F.**
10. While holding equalizer with tagline, remove stop pins (4, View D) from holes in rails and store in holders on side of rails.
11. Slacken tagline to allow equalizer to slide back as far as it will go.
12. Disconnect tagline from equalizer.

Install Load Line

See Load Line Reeving in this section for proper routing and reeving of the of the load lines to the upper and lower boom points.

The load lines must be properly routed through the load sensing sheaves as shown in the reeving diagrams.

Install Block-Up Limit Control and Connect Electric Wiring

Install block-up limit components as shown in Figure 4-42 and in Block-up Limit Control Assembly Drawing at the end of this section.

- Connect electric cable from cable reel in boom butt to junction box in boom top.
- Connect electric cable from front of crane to cable reel.

- Connect electric cables from limits switches to junction box in boom top.
- Adjust block-up limit switches according to instruction in Section 5 of Crane Service Manual.
- Connect electric cables from load sensing sheaves to junction box in boom top. See Indicator Assembly Drawing at the end of this section.
- Check RCL operation and calibration as instructed in separate Rated Capacity Indicator/Limiter Operation publication.

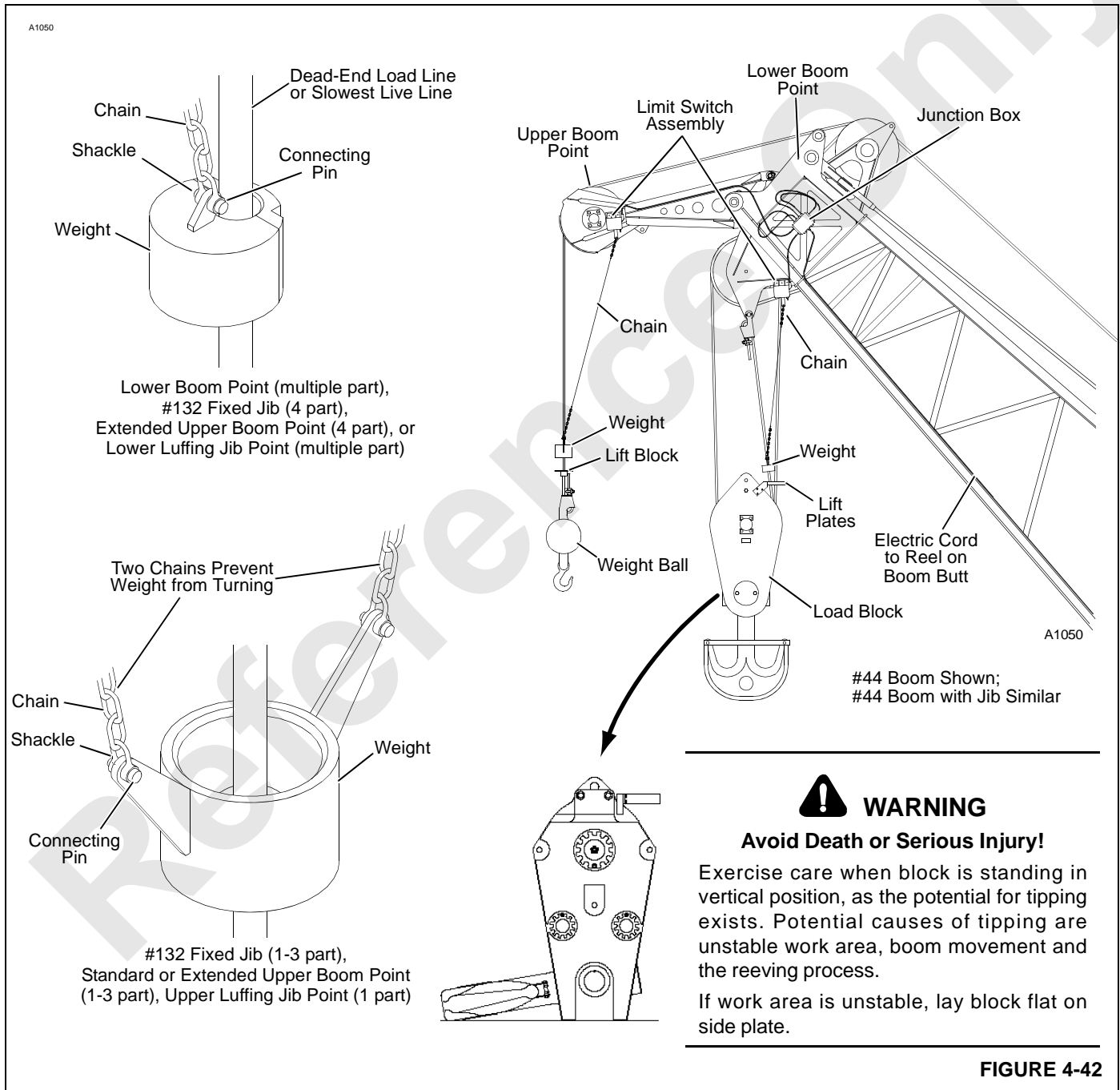


FIGURE 4-42

Boom Removal

Lower Boom

1. Prepare crane and boom as follows:
 - a. Position crane in disassembly area.
 - b. If required per capacity chart, travel crawler front rollers or rear tumblers onto blocking.
See Crawler Blocking Diagram in Capacity Chart Manual for blocking requirements.
OR extend outriggers and level carrier.



DANGER

Tipping Hazard!

Prevent crane from tipping:

- For crawler cranes, do not attempt to raise or lower boom and jib from or to ground until ends of crawlers are blocked, if required.
 - For truck crane, do not attempt to raise or lower boom and jib from or to ground – over rear of carrier – until outriggers are fully extended and carrier is level.
2. Lower boom and jib (if equipped) onto blocking at ground level.
 - a. If equipped with a jib, **disconnect jib stop pendants before jib point contacts ground, or damage will result.**
 - b. If equipped with an upper boom point, **remove lower connecting pins (10, Figure 4-39, View C) from holes B before boom point contacts ground, or damage will result.**
 - c. As boom nears ground, place blocking at least 6 in (152 mm) high under bottom chords at connecting pins between boom top and first insert or between transition insert and adjacent insert.

Remove Block-Up Limit Control

1. Disconnect boom electrical cord from cable reel on boom butt and connect cord to junction box on rotating bed (Figure 4-12, View B).
2. Remove block-up limit assembly and spool electrical cord onto reel on boom butt.

Remove Load Block and Weight Ball

Disconnect load lines from load block and weight ball and spool load lines onto load drums.

Disconnect Straps and Pendants from Equalizer

Unless otherwise specified, see Figure 4-41 for following procedure.

1. Slacken boom hoist wire rope so equalizer is resting on boom butt rails.
2. Attach a tagline to lug on front of equalizer (View C). The tagline is required to pull equalizer forward when disconnecting links from equalizer. One of three methods can be used:
 - Chain sling from another crane. Route chain sling around bottom of center sheave in boom butt wire rope guide.
 - Load line load drum. Route load line over top and around bottom of center sheave in boom butt wire rope guide. Connect to equalizer lug with a socket and wedge.
 - Lever operated hoist.
3. Pull equalizer forward with tagline just enough to loosen connecting pins (5, View D).
4. Install stop pins (4, View D) in equalizer rail holes closest to end of equalizer. **Stop pins must be installed to prevent equalizer from accidentally sliding back on rails during link disassembly.**
5. Disassemble links (L1 or L2, View D) and, if equipped, links (L4 or L5, View E) from equalizer.
6. Store pins (5, View D) with spacers (8) in equalizer holes.
7. Install strap storage pins in storage holes under straps next to boom butt as shown in Figure 4-40, View B. This step is required to support straps when boom butt is disconnected from boom.
8. Disassemble links (L2 or L3, View B) from boom straps. Store connecting pins (2) in strap holes.
9. Position links (L1 or L2, View A), straps (S2 or S3), and links (L2 or L3) on boom butt wire rope guide and install strap storage pins (1) as shown.
10. While holding equalizer with tagline, remove stop pins (4, View D) from holes in rails and store in holders on side of rails.
11. Slacken tagline until boom handling holes in equalizer are in-line with holes (A, View D) in equalizer rails.
12. Remove connecting pins (3, View D) from storage holders and install pins in holes (A) to secure equalizer to rails.
13. Slacken tagline and disconnect from equalizer.

Disconnect Boom Butt From Boom

See Figure 4-40 for following procedure.

1. Slowly boom up until boom hoist wire rope is taut as shown in View E. **Do not attempt to lift boom with equalizer pinned to rails.**

**WARNING****Falling Boom Hazard!**

Do not attempt to remove horizontal pins in step 2 until boom hoist wire rope is taut, or boom butt and inserts will fall violently.

2. Remove horizontal pins between butt and adjacent insert (View F).
3. Slowly boom down to lower boom onto blocking at least 6 in (152 mm) high as shown in View C.
4. Continue to boom down to disengage fixed vertical pins (View D) from connectors in adjacent boom section.
5. Travel crane away from boom and lower boom butt to 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.

Remove Upper Boom Point

If equipped, remove upper boom point as follows:

1. Support upper boom point with lifting slings from crane.
2. Remove upper pins (10, Figure 4-39, View C) from holes A.
3. Remove upper boom point from boom top.

Remove Intermediate Suspension Pendants

If equipped, remove and store intermediate suspension pendants and links. See Figure 4-40, View A and Figure 4-41, View E.

Store Boom Straps

Perform following steps at each set of strap links between boom sections. See Figure 4-39, View A and B.

1. Support strap links so they cannot fall.
2. Unpin top end of strap links from adjacent strap. **Store connecting pin in hole in end of adjacent strap.**
3. Rotate strap links to rear onto strap bracket.
4. Install strap storage pins in top hole of all strap brackets to retain straps and links for shipping.

Disassemble Boom Sections

Start at boom top and work toward boom butt when disassembling inserts.

1. Attach lifting slings from crane to boom top.
2. Hoist so lifting slings are just taut.
3. Remove horizontal pins between boom top and adjacent insert.
4. Lift boom top away from insert.
5. Repeat steps 1 – 4 for each boom section.

Reference Only

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#44 HEAVY LIFT BOOM
Crawler Crane Only

Item	Description	Length
B1	Butt	40 ft (12,2 m)
	Lower Section	12 ft (3,7 m)
	Upper Section	28 ft (8,5 m)
B2	Top	30 ft (9,1 m)
B3	Insert	10 ft (3,0 m)
B4	Insert	20 ft (6,1 m)
B5	Insert, Standard	40 ft (12,2 m)
B6	Insert, Light	40 ft (12,2 m)
S1	Strap, Basic	31 ft, 1 in (9,5 m)
S2	Strap, Equalizer	2 ft, 8 in (0,8 m)
S3	Strap, Insert	9 ft, 5 in (2,9 m)
S4	Strap, Insert	19 ft, 5 in (5,9 m)
S5	Strap, Insert	39 ft, 5 in (12,0 m)
L1	Links, Equalizer	1 ft, 4 in (0,4 m)
L2	Links, Equalizer	8-1/2 in (216 mm)
L3	Links, Strap	7-1/16 in (179 mm)
L4	Link, Intermediate Suspension (Equalizer)	10-1/2 in (267 mm)
L5	Link, Intermediate Suspension (Insert)	11-1/2 in (292 mm)
P1	Pendant, Intermediate Suspension	9 ft, 9 in (3,0 m)
P2	Pendant, Intermediate Suspension	29 ft 5 in (9,0 m)
P3	Pendant, Intermediate Suspension	47 ft, 6 in (14,5 m)

* One insert (B5) and two straps (S5) can be used in place of two inserts (B4) and four straps (S4)

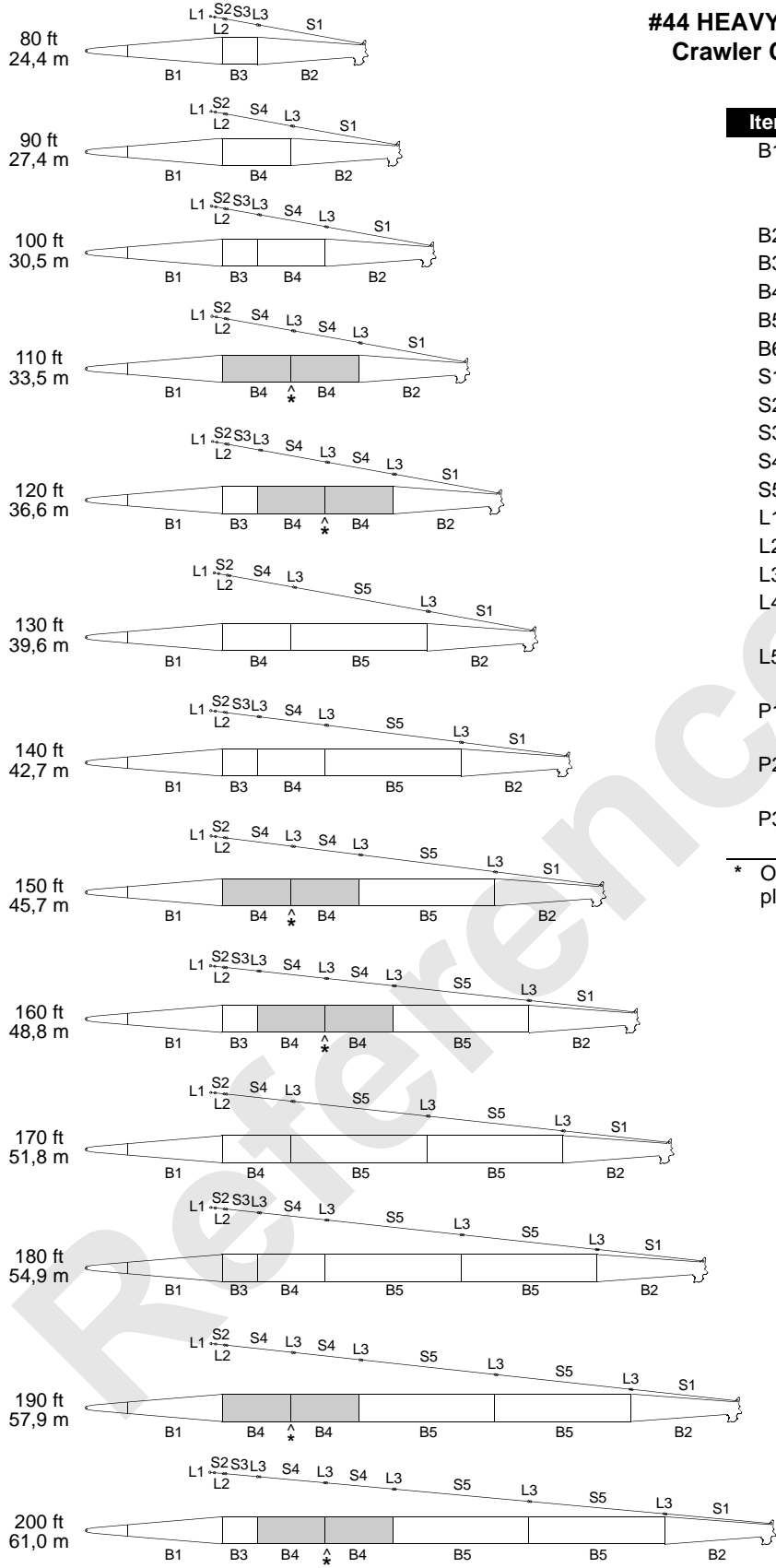


FIGURE 4-43

#44 HEAVY LIFT BOOM
Crawler Crane Only

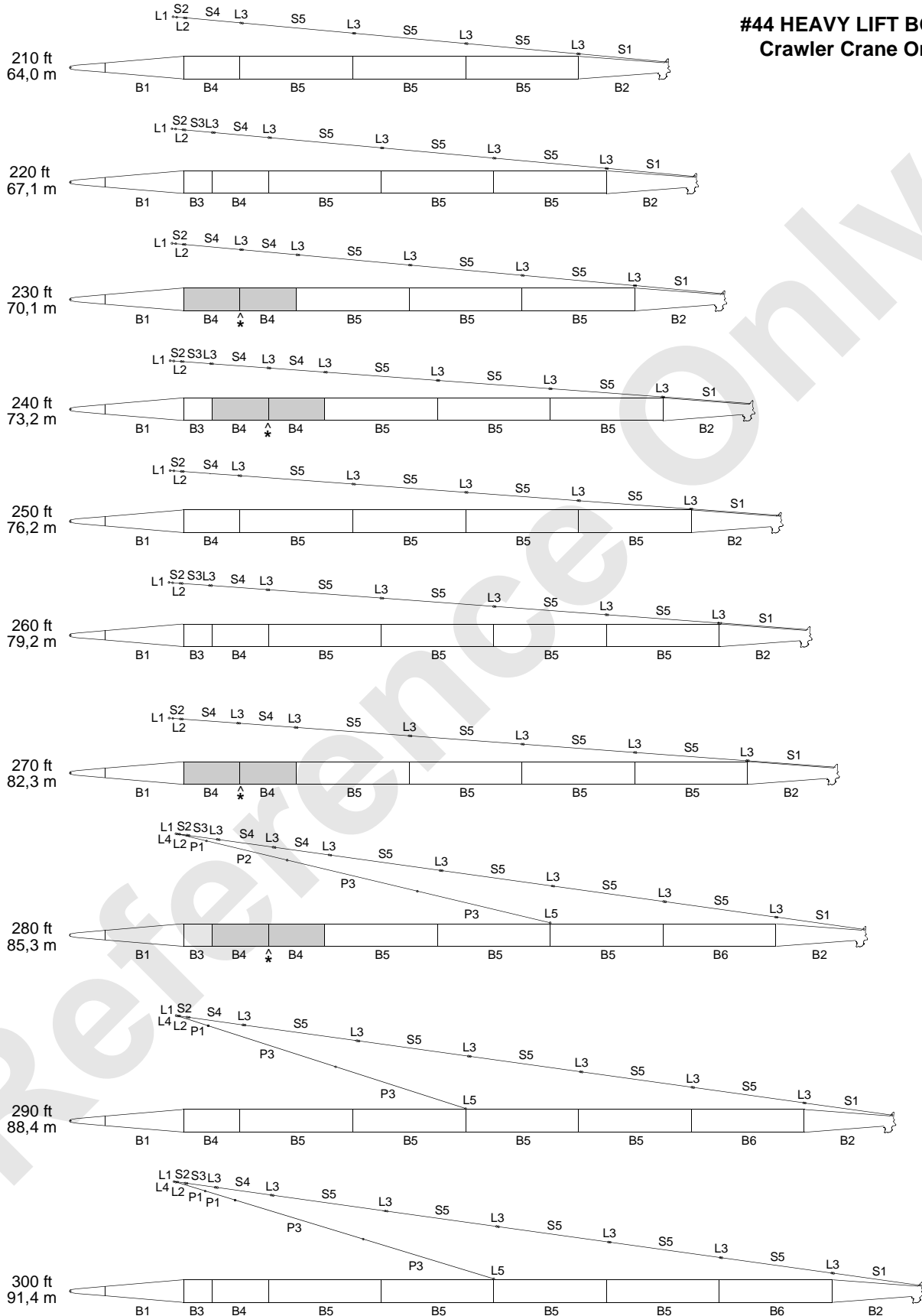
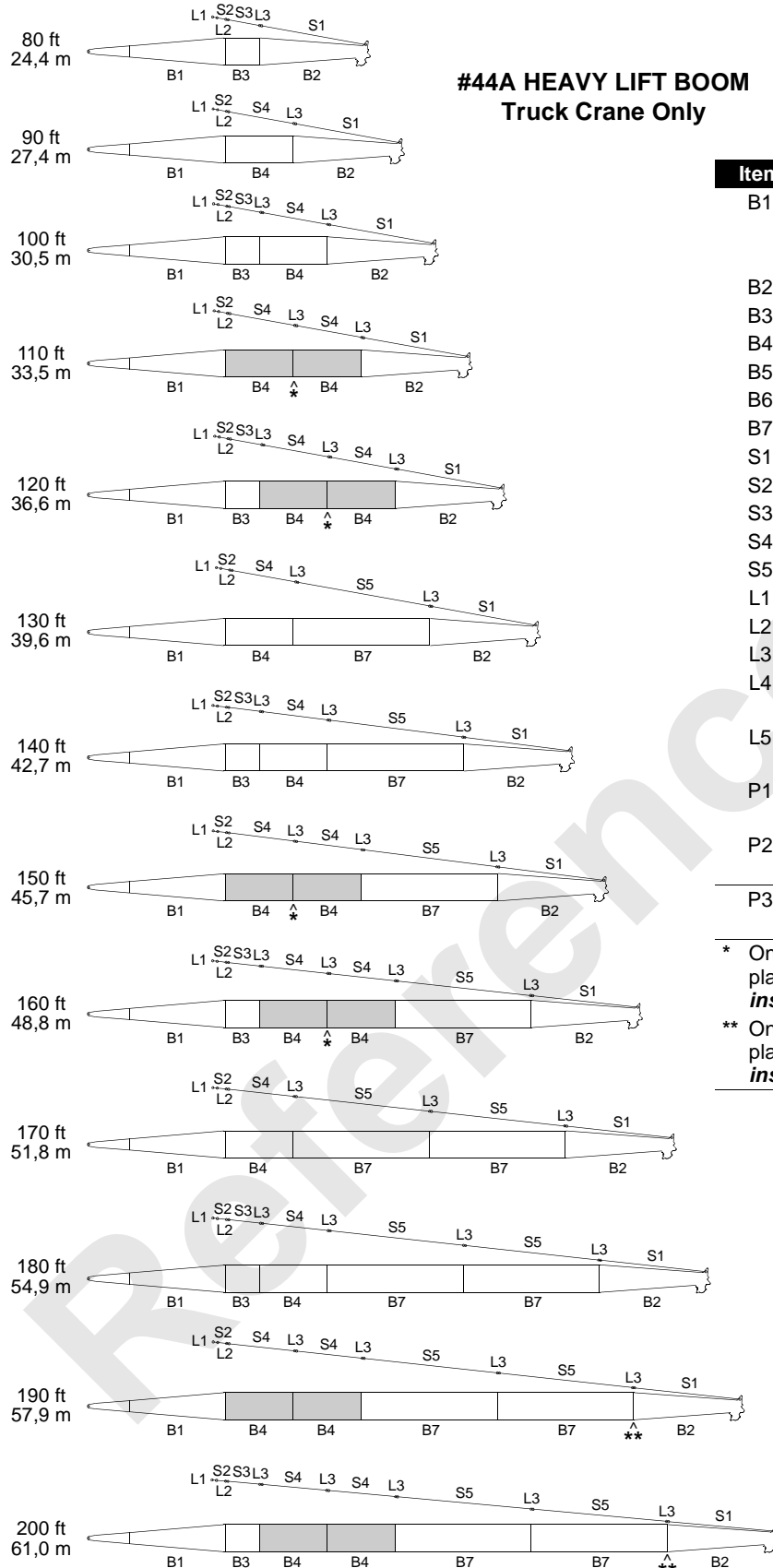


FIGURE 4-43 continued



Item	Description	Length
B1	Butt	40 ft (12,2 m)
	Lower Section	12 ft (3,7 m)
	Upper Section	28 ft (8,5 m)
B2	Top	30 ft (9,1 m)
B3	Insert	10 ft (3,0 m)
B4	Insert	20 ft (6,1 m)
B5	Insert, Standard	40 ft (12,2 m)
B6	Insert, Light	40 ft (12,2 m)
B7	Insert, Heavy	40 ft (12,2 m)
S1	Strap, Basic	31 ft, 1 in (9,5 m)
S2	Strap, Equalizer	2 ft, 8 in (0,8 m)
S3	Strap, Insert	9 ft, 5 in (2,9 m)
S4	Strap, Insert	19 ft, 5 in (5,9 m)
S5	Strap, Insert	39 ft, 5 in (12,0 m)
L1	Links, Equalizer	1 ft, 4 in (0,4 m)
L2	Links, Equalizer	8-1/2 in (216 mm)
L3	Links, Strap	7-1/16 in (179 mm)
L4	Link, Intermediate Suspension (Equalizer)	10-1/2 in (267 mm)
L5	Link, Intermediate Suspension (Insert)	11-1/2 in (292 mm)
P1	Pendant, Intermediate Suspension	9 ft, 9 in (3,0 m)
P2	Pendant, Intermediate Suspension	29 ft, 5 in (9,0 m)
P3	Pendant, Intermediate Suspension	47 ft, 6 in (14,5 m)

* 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 4-44

#44A HEAVY LIFT BOOM
Truck Crane Only

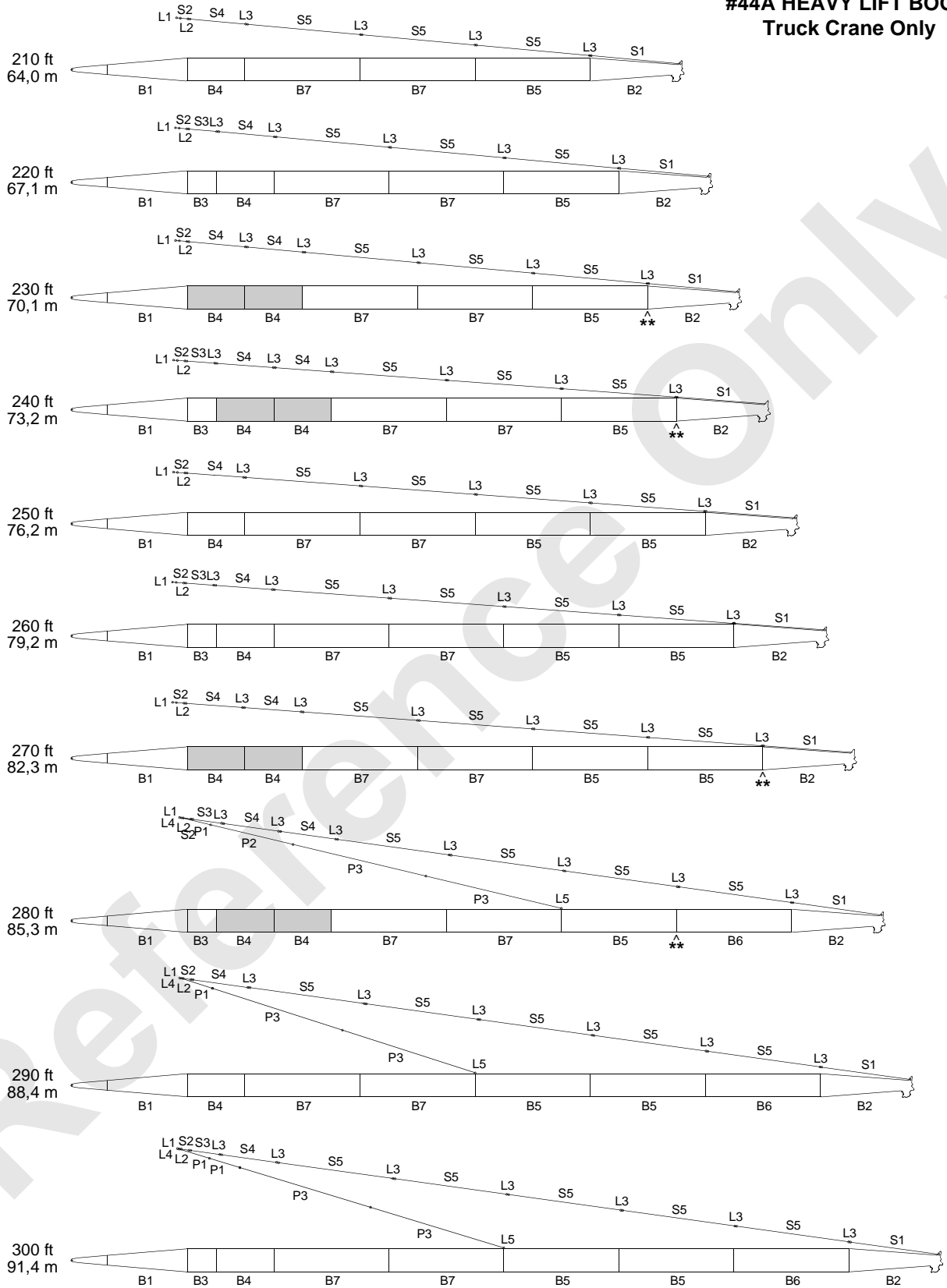


FIGURE 4-44 continued

#44 LONG REACH BOOM
Crawler Crane Only

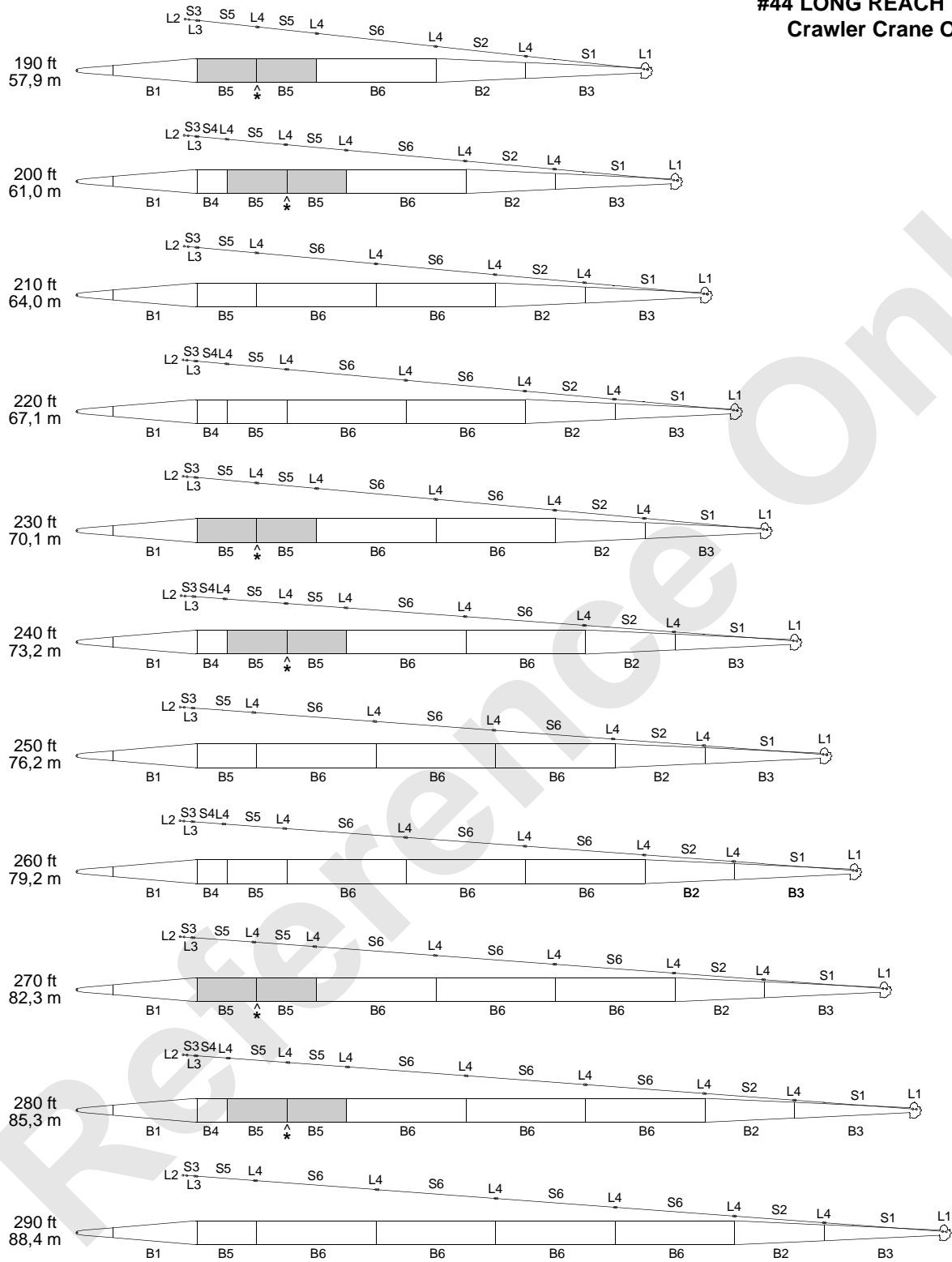


FIGURE 4-45

Item	Description	Size	Item	Description	Size
B1	Butt	40 ft (12,2 m)	S5	Strap, Insert	19 ft, 5 in (5,9 m)
	Lower Section	12 ft (3,7 m)	S6	Strap, Insert	39 ft, 5 in (12,0 m)
	Upper Section	28 ft (8,5 m)	L1	Links, Basic	1 ft, 3 in (0,4 m)
B2	Insert, Transition	40 ft (12,2 m)	L2	Links, Equalizer	1 ft, 4 in (0,4 m)
B3	Top	30 ft (9,1 m)	L3	Links, Equalizer	8-1/2 in (216 mm)
B4	Insert	10 ft (3,1 m)	L4	Links, Strap	7-1/16 in (179 mm)
B5	Insert	20 ft (6,1 m)	L5	Link, Intermediate Suspension (Equalizer)	10-1/2 in (267 mm)
B6	Insert, Standard	40 ft (12,2 m)	L6	Link, Intermediate Suspension (Insert)	11-1/2 in (292 mm)
B7	Insert, Light	40 ft (12,2 m)	P1	Pendant, Intermediate Suspension	9 ft, 9 in (3,0 m)
S1	Strap, Basic	39 ft, 5 in (12,0 m)	P2	Pendant, Intermediate Suspension	47 ft, 6 in (14,5 m)
S2	Strap, Transition	29 ft, 5 in (9,0 m)	P3	Pendant, Intermediate Suspension	29 ft, 5 in (9,0 m)
S3	Strap, Equalizer	2 ft, 8 in (0,8 m)			
S4	Strap, Insert	9 ft, 5 in (2,9 m)			

* 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.

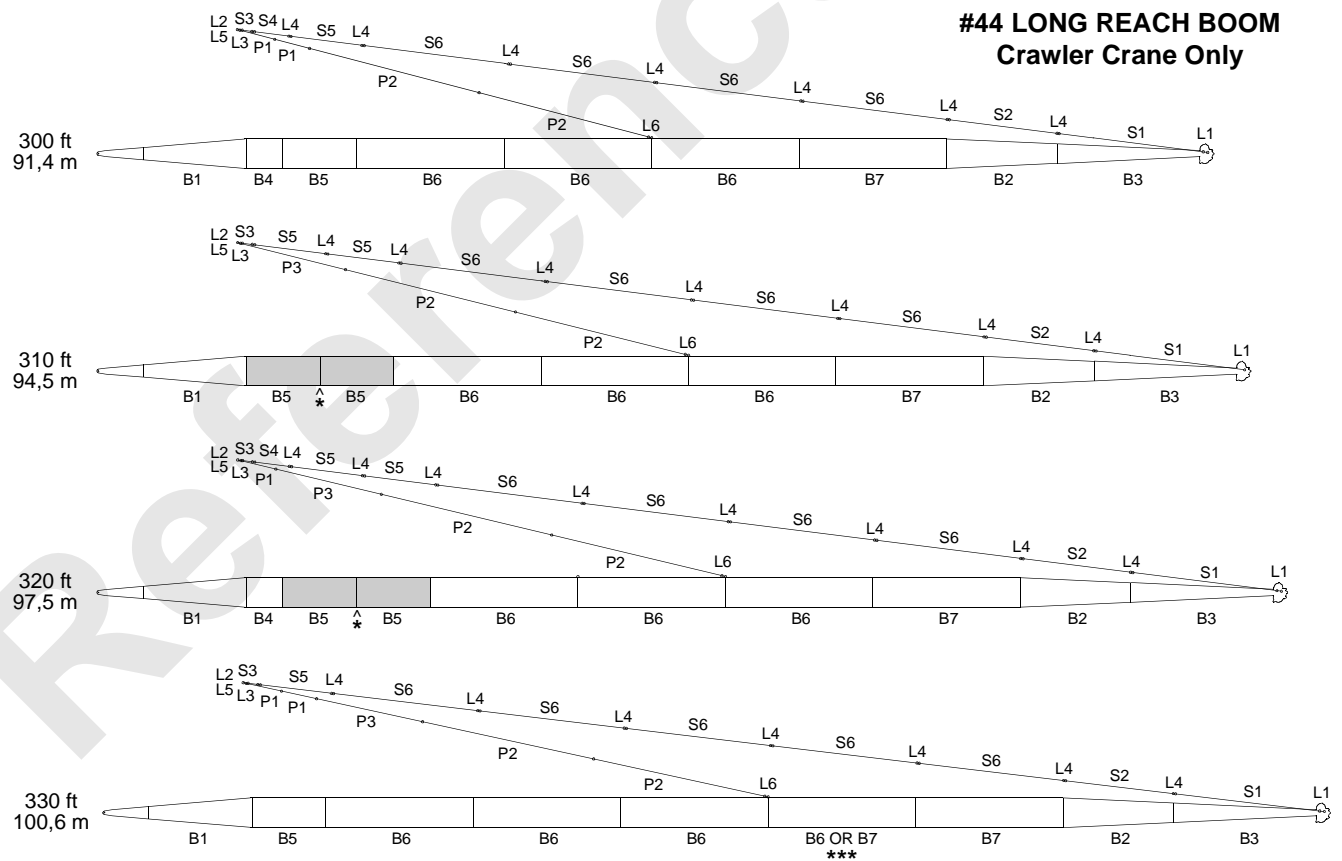


FIGURE 4-45 continued

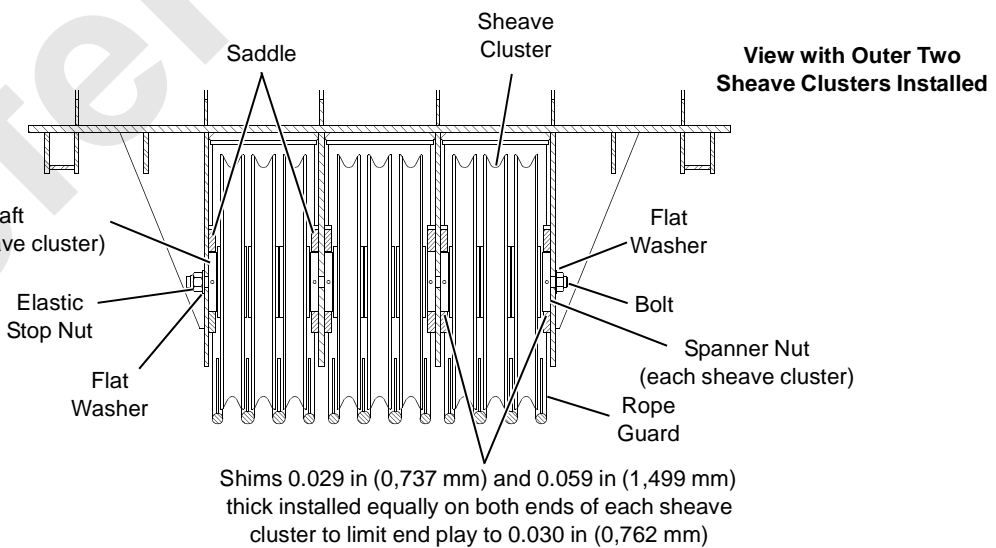
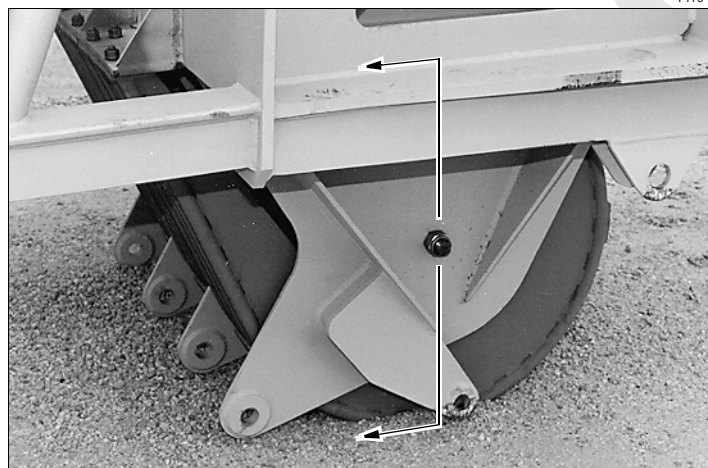
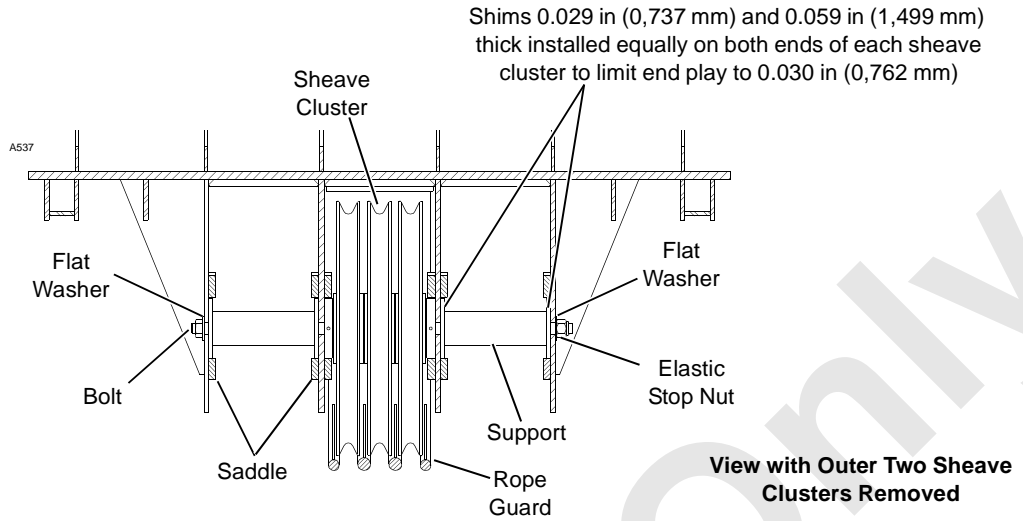


FIGURE 4-46

LOWER BOOM POINT SHEAVES

General

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 as shown in Figure 4-46.

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 Capacity Chart to determine which boom lengths require removal of the outer sheave clusters.



WARNING Tipping Crane Hazard!

Do not attempt to raise boom until outer two sheave clusters have been removed for boom lengths specified on Capacity Chart. Rear of crane will tip forward when boom is raised if this step is not performed.

Death or serious injury to personnel can result.

Removing Outer Two Sheave Clusters

Perform the following steps to remove the outer two sheave clusters:

- Prior to installing the boom top when assembling the boom or
 - Prior to lengthening the boom to a length that requires the outer two sheave clusters to be removed.
1. Position boom top or boom so rope guards are just touching ground.
 2. Remove screws fastening outer two rope guards to boom top.
 3. Raise boom top or boom until lower boom point is clear of rope guards.
 4. Remove and store rope guards.
 5. Position boom top or boom so center rope guard is just touching ground.
 6. Remove elastic stop nut and bolt.
 7. Push or pull both outer sheave clusters from lower boom point and store them.

8. Install a spacer on both sides of lower boom point in place of sheave clusters.
9. Install an equal thickness of shims on both ends of both spacers to limit side play to 0.030 in (0,762 mm).
10. Install bolt with flat washers and securely tighten elastic stop nut.

Installing Outer Two Sheave Clusters

Perform the following steps to install the outer two sheave clusters:

- Prior to installing the boom top when assembling the boom or
 - After shortening the boom to a length that allows use of the outer two sheave clusters.
1. Position boom top or boom so center rope guard is just touching ground.
 2. Remove elastic stop nut and bolt.
 3. Remove spacer and shims from both sides of lower boom point and store.
 4. Install an outer sheave cluster in saddles on both sides of lower boom point.
 5. Install an equal thickness of shims on both ends of both sheave clusters to limit side play to 0.030 in (0,762 mm).
 6. Install bolt with flat washers and securely tighten elastic stop nut.
 7. Assemble a rope guard over both sheave clusters.
 8. Securely fasten rope guards to 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.

Be sure to also fill cavities between bearing and seals with grease.

Adjusting Bearing End Play

Perform the following steps when assembling a sheave cluster:

1. Assemble three sheave assemblies to shaft.
2. Clean threads of shaft and spanner nut with solvent.
3. Apply Loctite TL277 or equivalent thread locking adhesive to threads of shaft.
4. Install spanner nut and tighten to 50 – 100 ft-lbs (68 – 136 N-m), to remove all bearing end play on shaft.

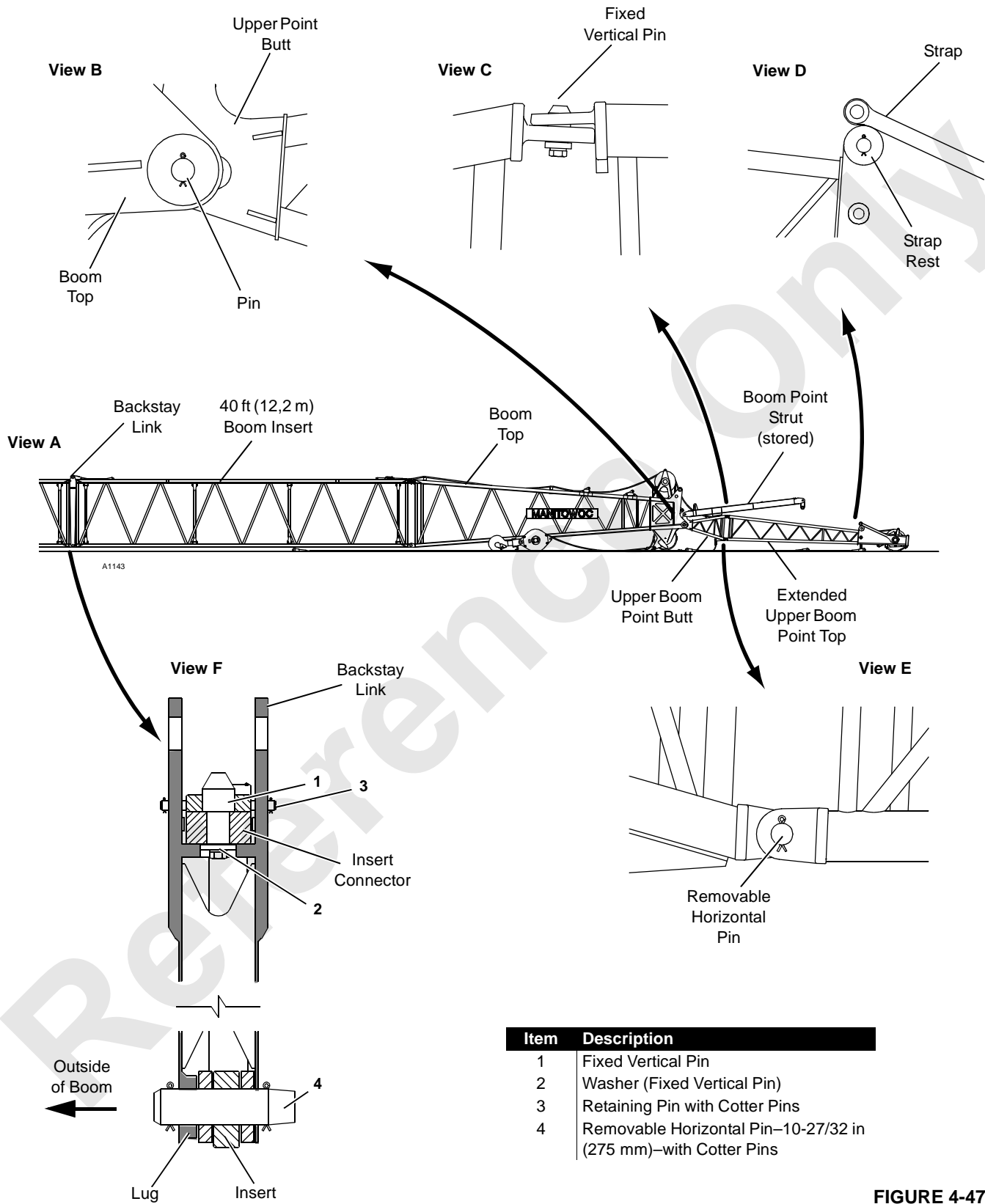


FIGURE 4-47

EXTENDED UPPER BOOM POINT RIGGING GUIDE

General

This topic contains installation and removal instructions for the extended upper boom point on the #44 boom with heavy lift top.

The extended upper boom point consists of a 5 ft (1,5 m) butt and a 20 ft (6,1 m) top, providing a basic length of 25 ft (7,6 m) as shown in Figure 4-47.

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 of this Manual for weights of extended upper boom point components.

Assembly Drawing

Extended upper boom point components (top, butt, pendants) must be assembled in proper sequence according to the following instructions and the Extended Upper Boom Point Assembly Drawing at the end of this section.

- See Figures 4-48 and 4-49 to determine quantity and length of pendants required.
- See applicable Liftcrane Boom Capacity Chart for boom length limitations.



WARNING

Collapsing Upper Boom Point Hazard!

To prevent death or serious injury, do not stand on, inside, or under extended upper boom point during assembly or disassembly. Always stand outside of extended upper boom point when installing or removing connecting pins.

Installing Extended Upper Boom Point

Prepare Boom

See Figure 4-47 for following procedure.

1. Lower boom to ground. Block if necessary.
2. Remove load line from upper boom point, if equipped.
3. Remove and store upper boom point.
4. Install upper point backstay links if not already installed. Upper point backstay links must be installed between boom inserts at the position shown in View A.
 - a. If necessary, separate boom inserts to provide space for installing links.
 - b. Lift backstay link into position on either side of

insert.

Lug at bottom connecting holes in link must be toward outside of boom. (View F).

- c. Lift backstay link upward and engage hole in link with washer (3, View F) on underside of insert connector.
- d. Install retaining pin (4, View F) through holes on butt side of link to prevent link from falling off insert.
- e. Repeat steps 4b–4d for backstay insert on other side of boom.
- f. Reconnect boom inserts.

Replace standard horizontal connecting pins with 10-27/32 in (275 mm) long pin (5, View F) supplied with backstay link.

Attach Extended Upper Boom Point

NOTE: The extended upper boom point strut is shipped in the stored position on the butt (Figure 4-47 View A).

CAUTION

Equipment Damage!

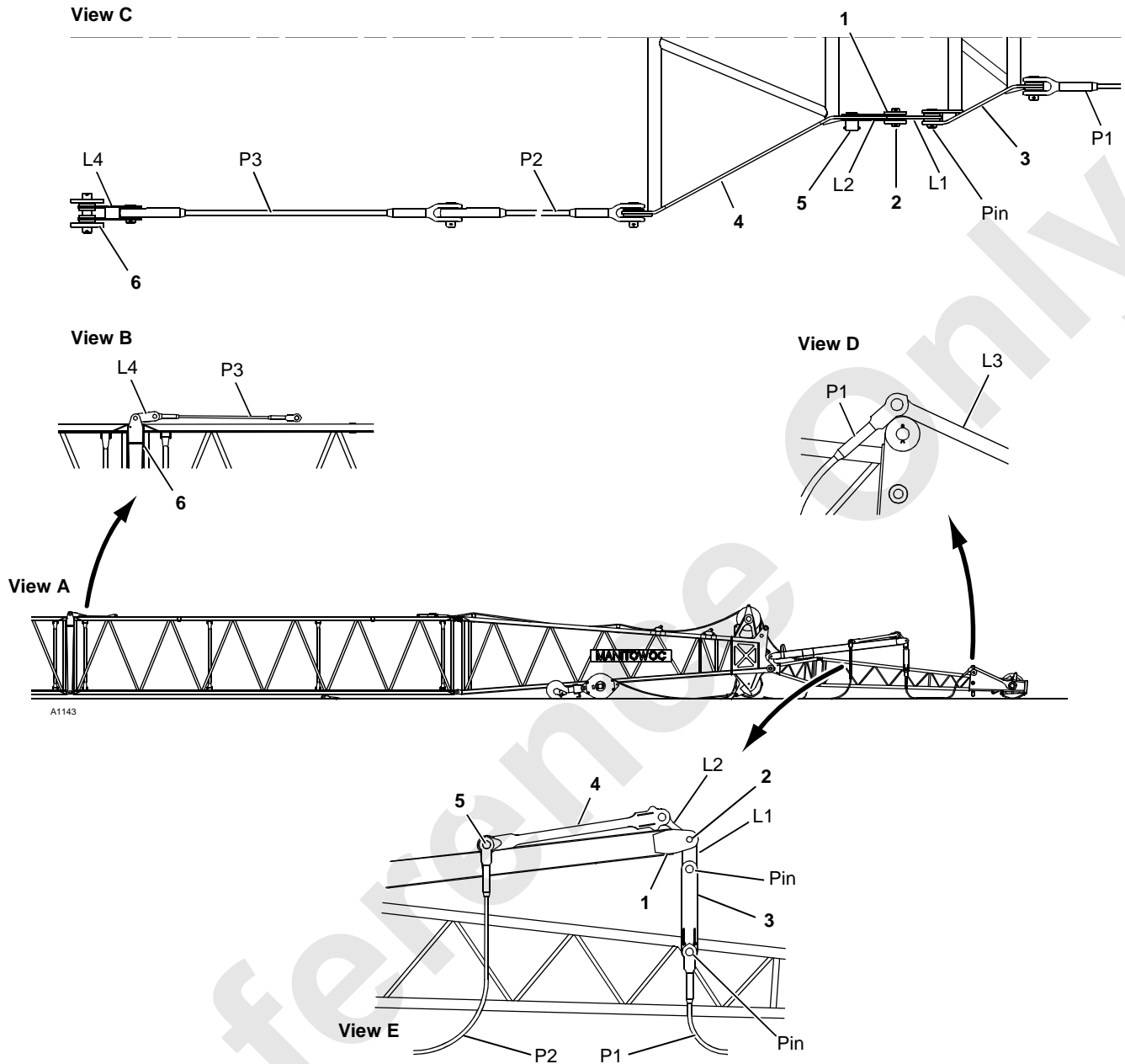
Straps dropping from strap rests will damage controls. Handle upper point with care so straps remain seated on rests (Figure 4-47, View C).

If extended upper boom point is shipped assembled:

1. Lift extended upper boom point into position at end of boom top.
2. Align holes in extended upper point butt with holes in boom top and install connecting pins (Figure 4-47, View B).
3. Make sure that pin heads on top are facing toward outside.

If extended upper point is shipped unassembled:

1. Lift extended upper boom point butt into position at end of boom top.
2. Align holes in extended upper point butt with holes in boom top and install connecting pins (Figure 4-47, View B). Install blocking under top of butt.
3. Lift top of extended upper point into position at top of butt and attach to butt. 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 (Figure 4-47, View C).
 - The bottom connectors are joined by removable horizontal pins (Figure 4-47, View E).
4. Make sure that pin heads on top are facing toward outside.



Item	Description	Item	Description
1	Extended Upper Boom Strut	L2	12 in (305 mm) Link
2	Pin	L3	54 in (1,4 m) Link
3	Spreader	L4	12 in (305 mm) Link
4	Spreader	P1	Extended Upper Boom Point Pendant 20 ft, 10 in (6,4 m)*
5	Pin with Collar	P2	Backstay Basic Pendant 65 ft 7 in (20,0 m)*
6	Backstay Link	P3	Backstay Pendant 7 ft, 4 in (2,2 m)*
L1	10 in (254 mm) Link		

* Two each required

FIGURE 4-48

Install Spreaders

See Figure 4-48, Views C and E for following procedure.

1. Using pin (2), pin links L1 and L2 to upper point strut (1).
2. Lift spreader (3) into position and pin to links L1. Allow spreader (3) to hang from strut top.
3. Lift spreader (4) into position and pin to links L2. Carefully lay spreader back on strut (1).

Install Pendants

See Figure 4-48 for following procedure.

NOTE: Pendants are furnished in matched sets of two and must be installed as matched sets — pendant on one side must match pendant on opposite side.

1. Pin upper point pendants P1 to links L1 (View E).
Pin other end of pendants P1 to links L3 on upper boom top (View D).
2. Pin links L4 to backstay links (6) (View B)
3. Pin pendants P3 to links L4 (View B).

4. Using pins (5), pin pendants P2 to lugs on spreader (4) (View E).

Lay pendants P2 on ground beside boom.

Raise Extended Upper Boom Point Strut

See Figure 4-49 for following procedure.

1. Using appropriate slings, attach hook from assist crane to top of extended upper boom point strut (View A).
2. Slowly lift extended upper boom point strut with assist crane until backstay pendants P2 have enough slack to be pinned to pendants P3. **Use extreme caution not to side load strut while lifting.**
3. Pin backstay pendants P2 to pendants P3.
4. Using assist crane, lower strut forward until pendants P3 are taut and supporting strut.
5. Unhook assist crane.

Connect Stop Pendant

1. Slowly raise boom until upper point is supported by backstay pendants P4 and upper point pendants P1.
2. Pin pendants P4 to lugs on upper point and lower boom point (Figure 4-49, View C).

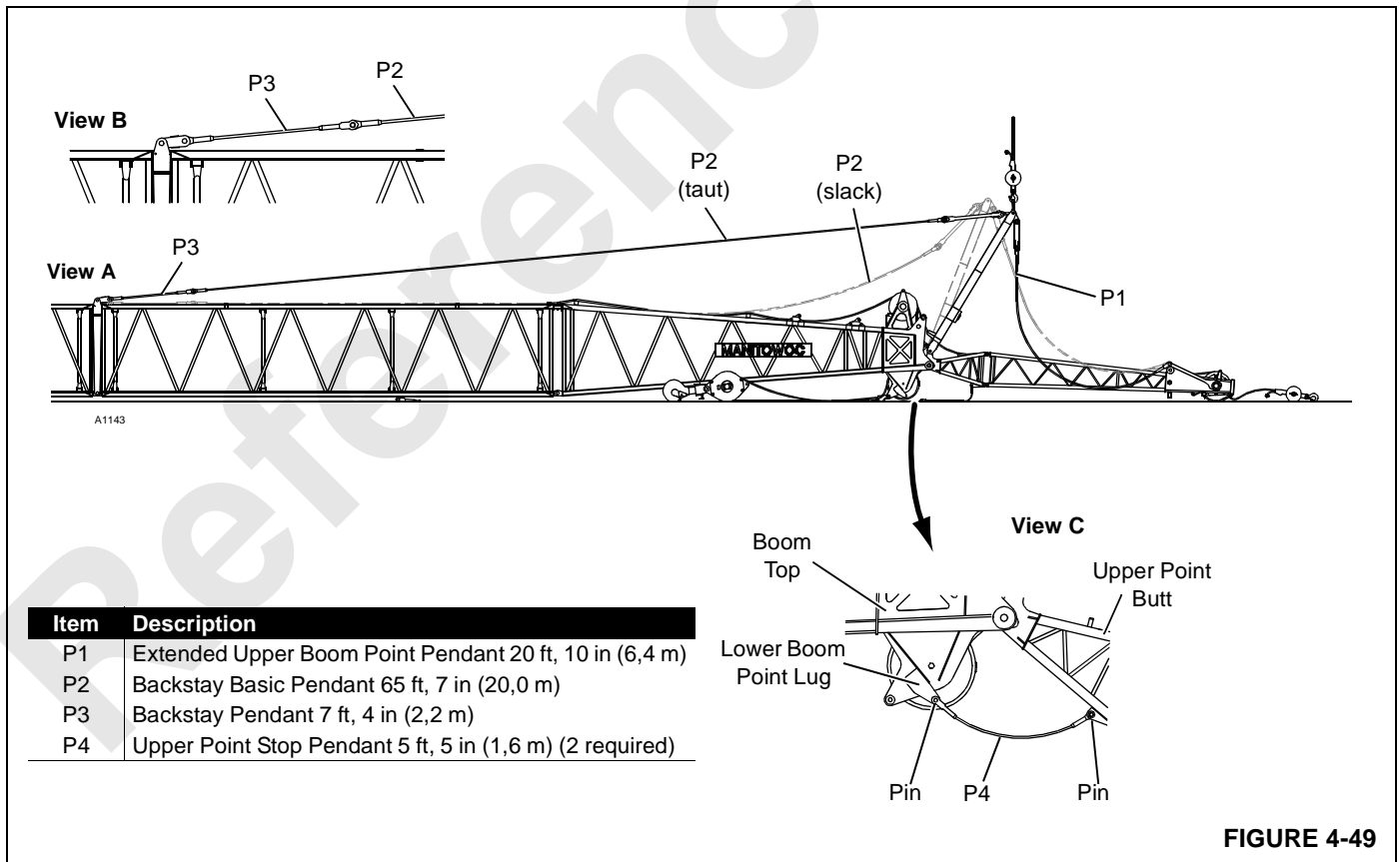


FIGURE 4-49

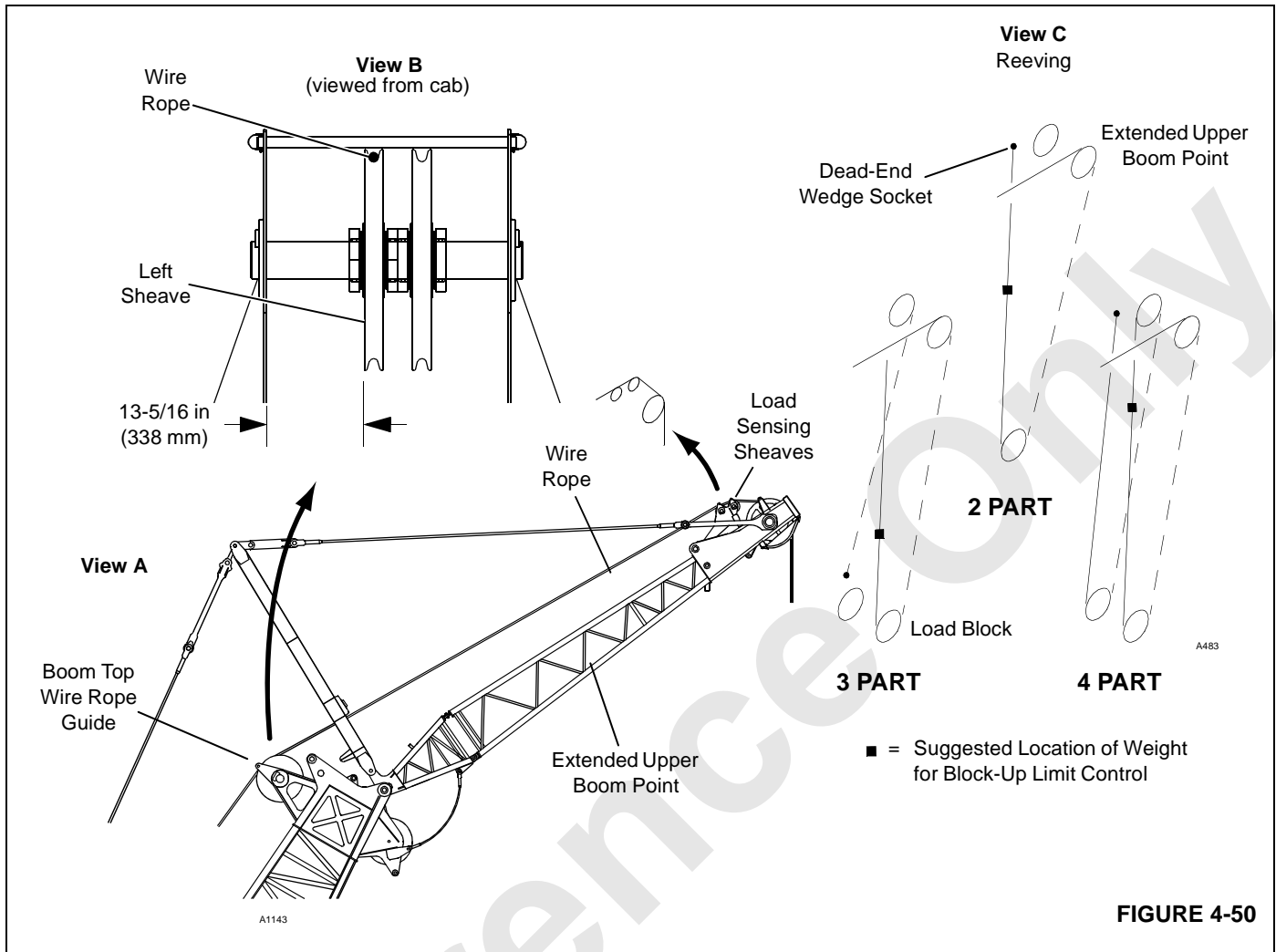


FIGURE 4-50

Install Load Line

See Figure 4-50 for proper routing and reeving of load line to extended upper boom point. Left guide sheave in boom top is used for routing load line to extended upper point. **Sheave must be positioned as shown in View B.**

Load lines must be properly routed through the 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 4-42 and in Block-up Limit Control Assembly Drawing at the end of this section.

- Connect electric cable from jib to junction box in boom top.

- Connect electric cable from limits switch to junction box in upper boom point.
- Adjust block-up limit switch according to instructions in Section 5 of Crane Service Manual.
- Connect electric cables from load sensing sheaves to junction box in boom top. See Indicator Assembly Drawing at the end of this section.
- Check RCL operation and calibration as instructed in separate Rated Capacity Indicator/Limiter Operation publication.

Removing Extended Upper Boom Point



DANGER

Collapsing Upper Point Hazard!

To prevent death or serious injury, do not stand on, inside, or under extended upper boom during disassembly. Always stand on outside of extended upper boom point when removing connecting pins.

Support extended upper boom point properly before removing pins. Block sections at connection points.

Lower Boom

CAUTION

Boom Point Stop Damage!

Do not allow extended upper boom point to touch ground until extended upper boom point stop pendants are disconnected.

1. Lower boom until extended upper boom point is approximately 1 ft (305 mm) from contacting ground.
2. Disconnect block-up limit electric cord in extended upper boom point and at junction boxes. Store cable.
3. Remove load line and block-up limit chains and weights from upper point.
4. Disconnect upper point stop pendants from lower boom point lugs (Figure 4-49, View C).
5. Lower boom and extended upper boom point onto blocking at ground level.

Lower Extended Upper Point Strut



WARNING

Falling Strut Hazard!

Do not disconnect backstay pendants until strut is supported and pendants are slack.

1. Using appropriate slings, attach hook from assist crane to top of extended boom point strut (Figure 4-49, View A).

2. Slowly bring strut back assist crane until backstay pendants P2 are slack and can be unpinning from pendants P3 (Figure 4-49, View A).

Be careful not to lift boom top or extended upper point.

Use extreme caution not to side load strut.

3. Disconnect backstay pendants P2 from pendants P3. Lay backstay pendants on ground along boom.
4. Slowly bring strut forward with assist crane and lower onto upper point butt (Figure 4-48, View E).

Use extreme caution not to side load strut while lowering.

5. Disconnect assist crane from strut.

Remove Pendants

1. Disconnect backstay pendants P2 from spreader (4) (Figure 4-48, View E).
2. Disconnect pendants P3 and links L4 (Figure 4-48, View B).
3. Coil backstay pendants.
Store pendants and links for future use.

Remove Spreaders

See Figure 4-48, Views C and E for the following procedure. An assist crane will be needed to remove the spreaders.

1. Unpin and remove spreader (4) from links L2.
2. Unpin and remove spreader (3) from links L1.
3. Unpin and remove links L1 and L2.

Remove Extended Upper Boom Point

1. If desired, unpin and remove extended upper boom point top from butt (Figure 4-47, Views C and E).
2. Unpin and remove extended upper boom point butt from boom top (Figure 4-47, View B).

Boom Handling Limitations (Travel speed not to exceed 1/2 mph (0.8 km/h))		
Maximum Boom Length feet (meters)	Boom Makeup (Notes 1, 2)	Maximum Suspended Weight at Boom Point pounds (kilograms)
100 (30,5)	Butt, Inserts, Top, Upper Boom Point	12,500 (5 670)
110 (33,5)	Butt, Inserts, Top, Upper Boom Point	9,000 (4 082)
120 (36,6)	Butt, Inserts, Top, Upper Boom Point	5,500 (2 495)
130 (39,6)	Butt, Inserts, Top, Upper Boom Point	3,000 (1 361)
140 (42,7)	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.

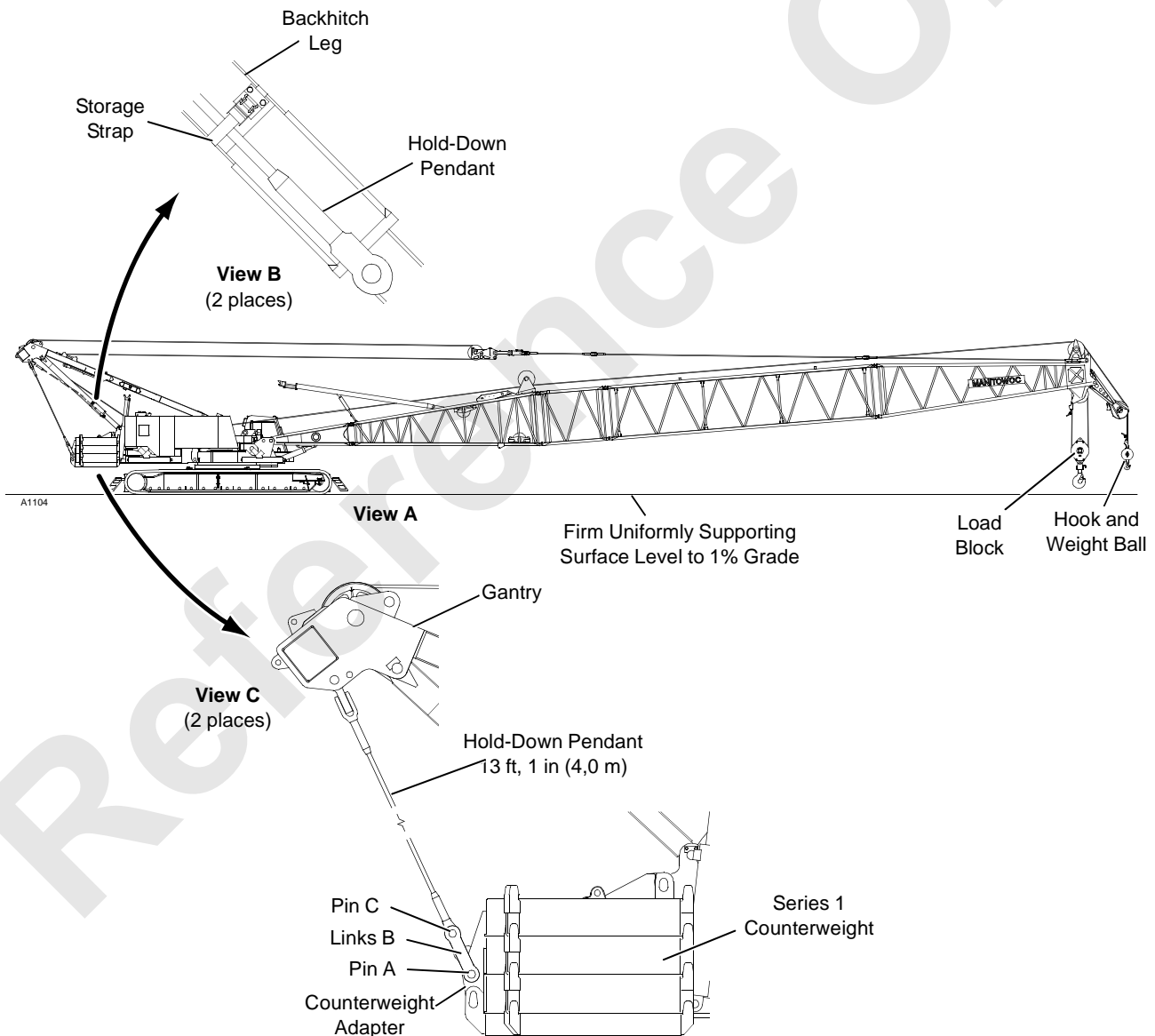


FIGURE 4-51

BOOM HANDLING — WITH INTERMEDIATE GANTRY POSITION

General

This topic contains travel instructions for cranes equipped with a gantry that can be raised to the intermediate position.

The intermediate gantry position provides minimum clearance for traveling with boom by lowering the crane's overall height to 23 ft (7 m).

- See Figure 4-51 for boom length and suspended weight limitations.
- See Gantry Raising and Lowering for raising and lowering instructions.



DANGER

Falling Boom Hazard!

Damage to or structural failure of hold-down pendants or gantry may cause boom to fall when gantry is in intermediate position.

- Boom length must not exceed 140 ft (42,7 m).
- Weight of load must not exceed maximum allowed for length of 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:

- 13 ft, 1 in (4,0 m) long hold-down pendants and associated links.
- No more than Series 1 counterweight installed.

Preparing Crane for Travel

1. Position crane on a firm level surface.
2. Lower boom onto blocking at ground level.
3. Reduce boom to desired length listed in Figure 4-51.
4. Fully lower gantry. See Lowering Gantry with Fully Rigged Boom for instructions.
5. Perform following steps on both sides of gantry (see Figure 4-51):
 - a. Using pin (A), pin links (B) to counterweight adapter (View C).
 - b. Open storage strap on backhitch leg (View B) and lower hold-down pendant from storage position.

- c. Using pin (C), pin hold-down pendant to links (B, View C).
- d. Be sure to install and open cotter pins.

6. Fully extend gantry raising cylinders to raise gantry. See Raising Gantry with Fully Rigged Boom for instructions.
7. Slowly boom up. Gantry will rise until hold-down pendants are taut, then boom will rise. **Avoid shock loading hold-down pendants.**
8. Raise suspended load, if any, off ground.

Traveling

1. Travel only on a firm, uniformly supporting surface that is level to within 1% grade.

NOTE: Boom may be raised higher than height of gantry if required for maneuvering: for example, turning a corner.

2. If traveling with suspended load, keep load off ground. **Do not drag load on ground.**

If necessary, carry load on a transport vehicle with sufficient capacity for weight of suspended load.

3. Do not travel faster than 1/2 mph (0.8 km/h)
4. Perform all travel functions — starting, turning, stopping — slowly and smoothly to avoid shock loading boom and gantry hold-down pendants.

Returning Crane to Normal Operation

1. Position crane on a firm level surface.
2. Lower load to ground.
3. Lower boom onto blocking at ground level.
4. Fully lower gantry. See Lowering Gantry with Fully Rigged Boom for instructions.
5. Perform following steps on both sides of gantry (see Figure 4-51):
 - a. Remove Pin C to unpin hold-down pendant from links (B, View C).
 - b. Securely connect hold-down pendant to backhitch leg with storage strap (View B).
 - c. Attach pin (C) in links (B).
 - d. If desired, leave links (B) and pins (A and C) attached to counterweight adapter for storage. Otherwise, remove links and pins and store them in a safe location for future use.
6. Increase boom to desired length.
7. Fully raise gantry. See Raising Gantry with Fully Rigged Boom for instructions.

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Reference Only

JIB INSTALLATION — #132 JIB

General

This topic contains installation and removal instructions for the #132 jib on the #44 boom with heavy lift or long reach top.

The jib consists of a 20 ft (6,1 m) butt and a 20 ft (6,1 m) top, providing a basic length of 40 ft (12,2 m). Inserts are available in 20 ft (6,1 m) lengths, allowing the jib to be lengthened to a maximum of 120 ft (36,6 m) as shown in Figure 4-55.

Jib offsets of 5, 15, and 30° are obtained by changing the length of jib backstay straps, links, and pendants as shown in Figure 4-49.

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. See Crane Weights in Section 1 of this manual for weights of jib components.



WARNING

Collapsing Jib Hazard!

To prevent death or serious injury, do not stand on, inside, or under jib during assembly or disassembly. Always stand outside of jib when installing or removing connecting pins.

Jib Assembly Drawing

Jib components (top, inserts, butt, pendants) must be assembled in proper sequence according to this topic and the Jib Rigging Drawing at the end of this section.

- See Figure 4-55 to determine quantity and length of inserts and pendants for various boom lengths.
- See applicable Jib Lifting Capacity Chart for boom and jib length limitations.

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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	Removable Horizontal Pin – 10-27/32 in (275 mm) – with Cotter Pins

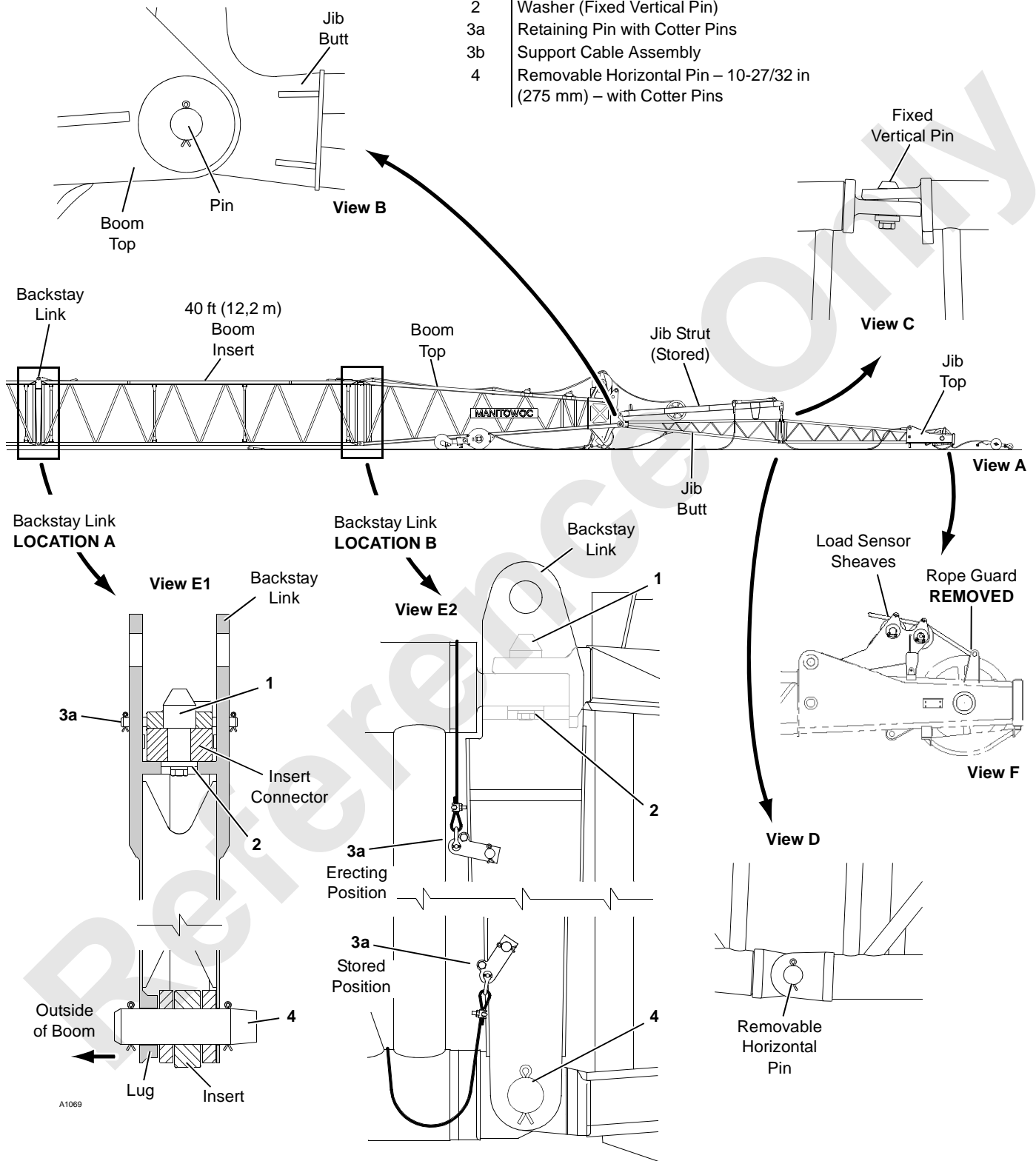


FIGURE 4-52

Prepare Boom

1. Lower boom to ground. Block if necessary.
2. Remove load line from upper boom point, if equipped.
3. Remove and store upper boom point (See Boom Rigging Guide in Crane Operator's Manual).
4. For long reach top only, install jib stop strut (8, Figure 4-53, View D). *Gussets on outside of strut must be toward ground.*
5. For heavy lift top only, install jib backstay links between boom sections at Location A or B, Figure 4-52. **See Jib Assembly Drawing for proper mounting location.**
 - a. If necessary, separate boom sections to provide space for links.
 - b. Lift a backstay link into position on either side of required insert.
Lug at bottom connecting holes in link must be toward outside of boom. (Figure 4-52, View E1).
 - c. Lift backstay link upward and engage hole in link with washer (2, Figure 4-52, View E1) on underside of insert connector.
 - d. For Location A, install retaining pin (3a, Figure 4-52, View E1) through holes on butt side of link to prevent link from falling off insert.

For Location B, move support cable assembly (3b, Figure 4-52, View E2) from stored position to erecting position to prevent link from falling off insert. If necessary, adjust cable length so bottom connecting holes are aligned when assist crane is disconnected.
 - e. Repeat steps 5b – 5d for backstay link on other side of boom.

- f. Reconnect boom inserts.

Replace standard horizontal connecting pins with 10-27/32 in (275 mm) long pins (4, Figure 4-52, View E) supplied with backstay links.

Install Jib Butt

NOTE: The jib strut is shipped in the stored position on the jib butt (Figure 4-52, View A).

1. Lift jib butt into position at end of boom top.
2. Align holes in jib butt with holes in boom top and install connecting pins (Figure 4-52, View B).

Install Jib Inserts

NOTE: The jib sections have FACT™ connectors.

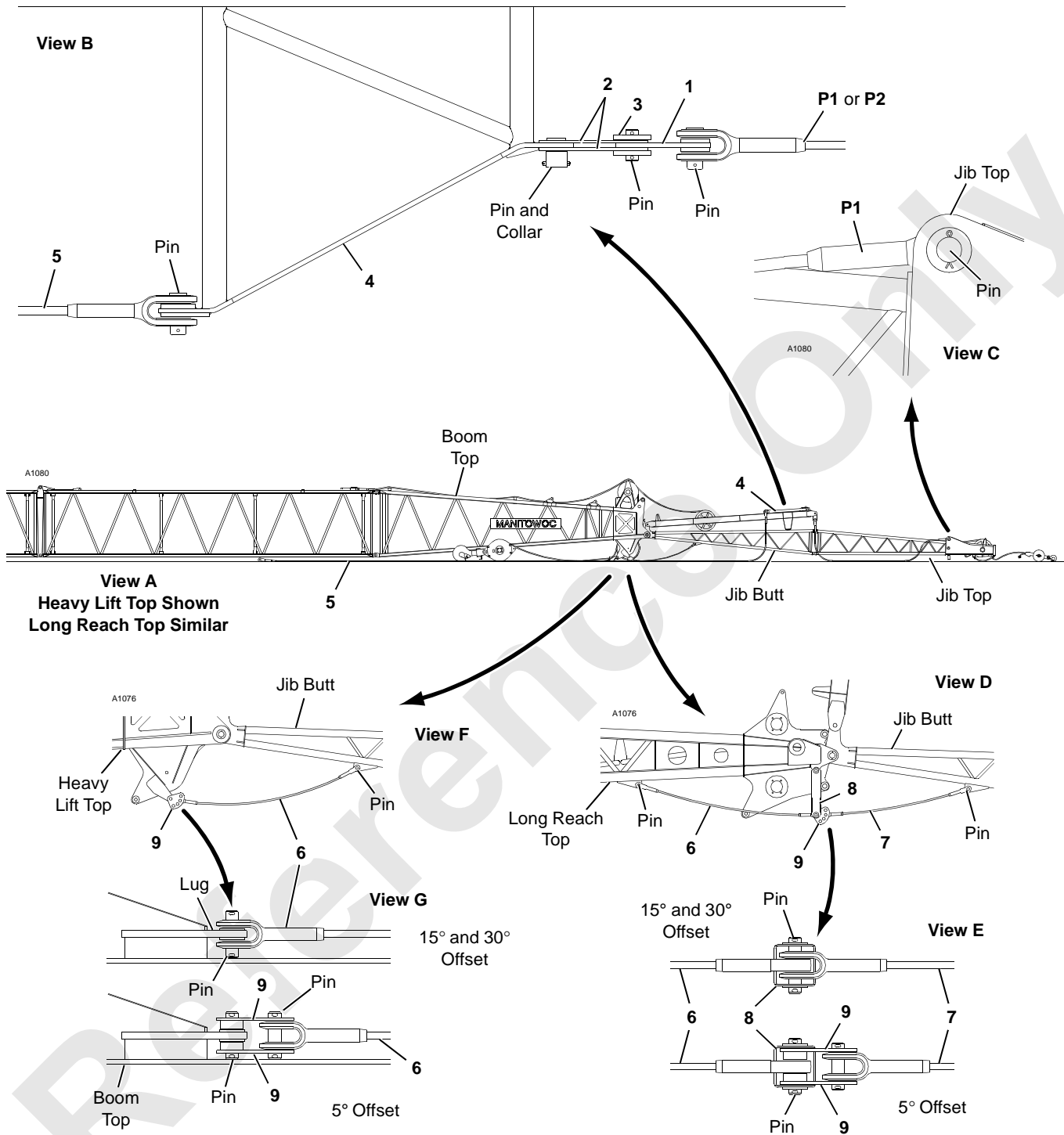
- The top connectors are joined by fixed vertical pins that hook into holes in the adjacent section (Figure 4-52, View C).
 - The bottom connectors are joined by removable horizontal pins (Figure 4-52, View D).
1. Pin desired length of jib inserts to butt. *Tapered end of pins must point inward.*
 2. Block inserts at ground level as assembly progresses.
Pin jib top to last insert or butt, depending on jib length.



WARNING **Falling Load Hazard!**

If jib top is equipped with load sensor sheaves (View F), **remove** and store rope guard.
Load line can be damaged and load can fall if this step is not performed.

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Item	Description	Item	Description
1	Link	6	Jib Stop Pendant 7 ft, 7 in (2,3 m)
2	Links	7	Jib Stop Pendant 6 ft, 0 in (1,8 m)
3	Jib Strut	8	Jib (Long Reach Top Only)
4	Spreader	9	Adjusting Link (5° Offset Only)
5	Basic Backstay Pendant 65 ft, 7 in (20 m)	P1, P2	See Figure 4-55 for Identification

FIGURE 4-53

Install Jib Pendants

NOTE: With the exception of the basic pendants, the jib pendants must be installed in the same sequence as the inserts as shown in Figure 4-55.

The jib pendants are furnished in matched sets of two and must be installed in matched sets — pendant on one side of insert must match pendant on other side of insert.

1. Pin basic jib pendants (P1, Figure 4-53, View C) to lugs on jib top.
2. If jib is longer than 40 ft (12,2 m), pin jib pendants (P2, Figure 4-55) to basic pendants (P1).
3. Pin links (1 and 2, Figure 4-53, View B) to jib strut (3).
4. Pin jib pendants (P1 or P2) to links (1) on jib strut as shown in Figure 4-53, View B.

Install Backstay Pendants

See Figure 4-53, View B for following procedure.

1. Lift spreader (4) into position and pin to links (2) on jib strut (3).
2. Lay spreader (4) on jib strut (3).
3. Pin basic backstay pendants (5) to spreader.
4. Lay basic backstay pendants (5) on ground along boom top.

Install Jib Stop Pendants and Links

Choose correct jib stop pendants and links for jib offset and boom top being used.

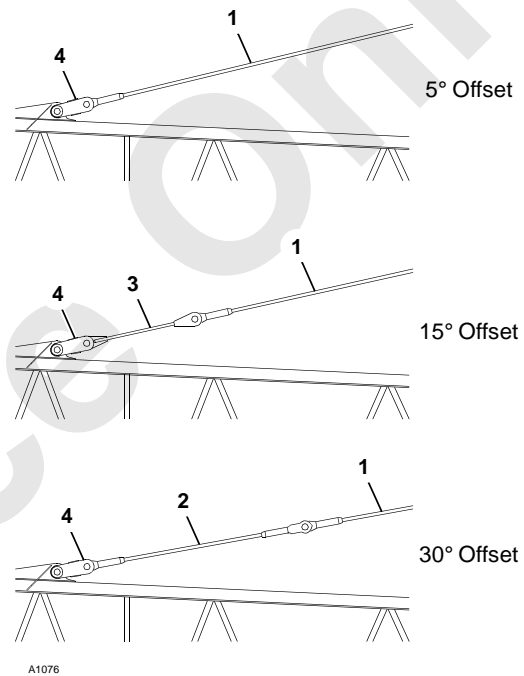
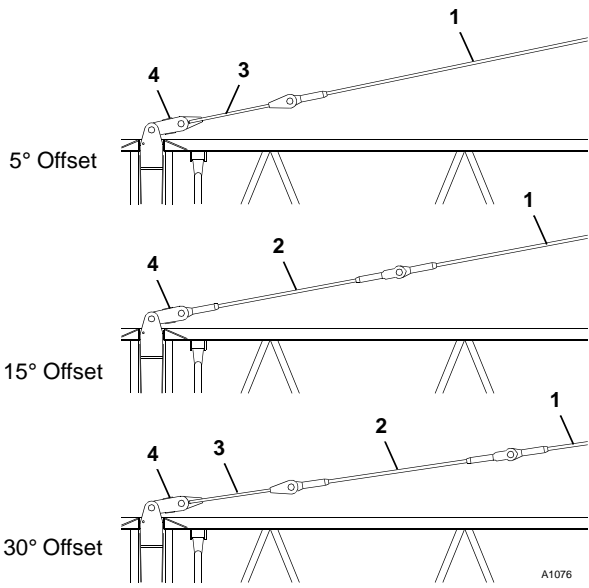
For **long reach boom top**, see Figure 4-53, Views D and E.

1. Pin jib stop pendants (6) to lugs on boom top.
2. Pin jib stop pendants (7) to lugs on jib butt.
3. Depending on jib offset, proceed as follows:
 - a. 5° – Pin pendants (6) and adjusting links (9) to strut (8). Do not pin pendants (7) to adjusting links (9) until after jib point is raised clear of ground (see Connect Jib Stop instructions later in this section).
 - b. 15° and 30° – Do not pin pendants (6 and 7) to strut (8) until after jib point is raised clear of ground (see Connect Jib Stop instructions).

For **heavy lift boom top**, see Figure 4-53, View F and G.

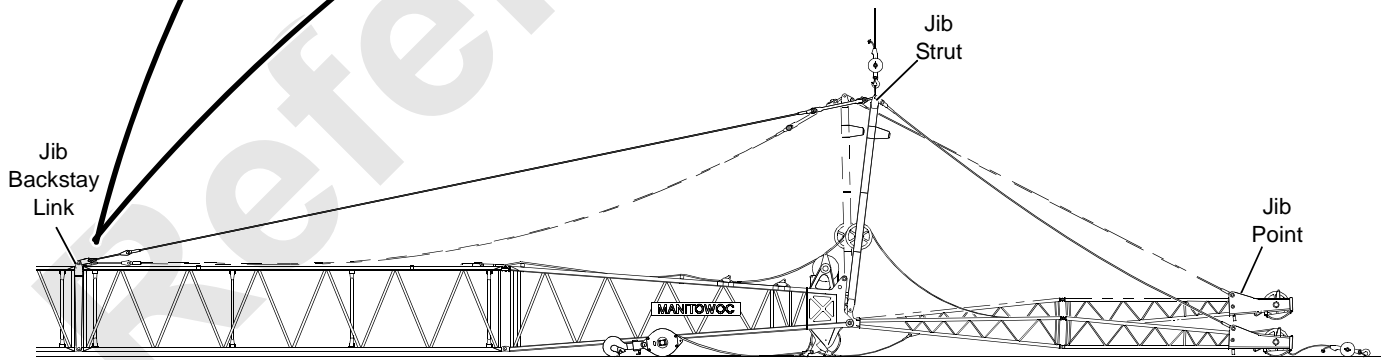
1. Pin jib stop pendants (6) to lugs on boom top.
2. Depending on jib offset, proceed as follows:
 - a. 5° – Pin adjusting links (9) to strut (8). Do not pin pendants (6) to adjusting links (9) until after jib point is raised clear of ground (see Connect Jib Stop instructions later in this section).
 - b. 15° and 30° – Do not pin pendants (6) to strut (8) until after jib point is raised clear of ground (see Connect Jib Stop instructions).

Item	Description
1	Basic Backstay Pendant 65 ft 7 in (20 m)
2	Backstay Pendant 7 ft, 4 in (2,2 m)
3	Link 3 ft, 8 in (1,1 m)
4	Link 12 in (0,3 m)



View B
Heavy Lift Top

View C
Long Reach Top



View A
Heavy Lift Top Shown
Long Reach Top Similar

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FIGURE 4-54

Raise Jib Strut

1. Determine pendants and links required for jib offset (2, 3, 4, Figure 4-54, View B or View C).
2. Pin pendants and links to backstay links (heavy lift top) or lugs on transition insert (long reach top).

NOTE: Backstay links (3, Figure 4-54, View B or View C), if used, must be adjacent to connecting links (4).

3. Using assist crane or fork-lift truck, lift jib point approximately 3 ft (0,9 m) off ground and block (Figure 4-54, View A).

Raising jib point provides enough slack to allow pinning backstay pendants.

4. Using appropriate slings, attach hook from assist crane to top of jib strut (Figure 4-54, View A).
5. Slowly lift jib strut over center with assist crane. *Use extreme caution not to side load strut while lifting.*
6. Pin jib backstay pendants (1) to links or pendants (2,3,4) previously pinned to lugs on transition insert (long reach top) or boom backstay links (heavy lift top) (Figure 4-54, View B or C).
7. Remove blocking from jib point and lower to ground.

Connect Jib Stop

1. Slowly raise boom until jib is supported by backstay and jib pendants.
2. For **long reach boom top** (Figure 4-53, Views D and E), proceed as follows depending on jib offset:
 - a. 5° – Pin pendants (7) to holes in adjusting links (9) which give **least pendant slack or some preload**.
 - b. 15° and 30° – Pin pendants (6 and 7) directly to strut (8).
3. For **heavy lift boom top** (Figure 4-53, Views F and G), proceed as follows depending on jib offset:
 - a. 5° – Pin pendants (6) to holes in adjusting links (9) which give **least pendant slack or some preload**.
 - b. 15° and 30° – Pin pendants (6) directly to strut (8).

Install Load Line

See Load Line Reeving in this section for proper routing and reeving of load lines to jib point.

Load lines must be properly routed through the 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 4-42 and in Block-up Limit Control Assembly Drawing at the end of this section.

- Connect electric cable from jib to junction box in boom top.
- Connect electric cable from limits switch to junction box in boom top.
- Adjust block-up limit switch according to instructions in Section 5 of Crane Service Manual.
- Connect electric cables from load sensing sheaves to junction box in boom top. See Indicator Assembly Drawing at the end of this section.
- Check RCL operation and calibration as instructed in separate Rated Capacity Indicator/Limiter Operation publication.

JIB REMOVAL — #132 JIB



DANGER

Collapsing Jib Hazard!

To prevent death or serious injury, do not stand on, inside, or under jib during disassembly. Always stand on outside of jib when removing connecting pins.

Support jib properly before removing pins. Block sections at connection points.

Lower Boom and Jib

CAUTION

Jib Stop Damage!

Do not allow jib point to touch ground until jib stop pendants are disconnected.

1. Lower boom until jib point is approximately 1 ft (0,3 m) from contacting ground.
2. Disconnect jib stop pendants (6 or 7, Figure 4-53, View D or F) from lugs on jib butt.
3. Lower boom and jib onto blocking at ground level.
4. Disconnect block-up limit electric cord from jib at cord in boom point and at junction box in jib point, and store cable on jib butt.

Connect block-up limit electric cable to jib to terminator plug on junction box in boom point (see Block-Up Limit Adjustment in Section 5 of the Service Manual).
5. Remove load line and block-up limit chains and weights from jib.

Lower Jib Strut

**WARNING****Falling Strut Hazard!**

Do not disconnect backstay pendants until strut is supported and pendants are slack.

1. Using assist crane or fork-lift truck, lift jib point approximately 3 ft (0,9 m) off ground and block (Figure 4-53, View A).

Raising jib point provides enough slack to allow removing backstay pendant pins.

2. Using appropriate slings, attach hook from assist crane to top of jib strut (Figure 4-53, View A).
3. Disconnect backstay pendants and links (Figure 4-53, View B or C) from backstay links (heavy lift boom top) or lugs on transition insert (long reach boom top). Lay pendants on ground along boom top.
4. Slowly rotate jib strut forward over center with assist crane and lower onto jib butt. Avoid lifting jib butt/boom top in process. *Use extreme caution not to side load strut while lowering.*
5. Disconnect assist crane from jib strut.
6. Remove blocking from jib point and lower to ground.

Remove Backstay Pendants

1. Disconnect backstay pendants (5) from spreader (4, Figure 4-53, View B).
2. Coil backstay pendants and store pendants and links for future use.

NOTE: Spreader (4) can be stored on jib strut for shipping.

Remove Jib Pendants

See Figure 4-53 for following procedure:

1. Disconnect jib pendants (P1 or P2) from links (1) on jib strut (3) and lugs on jib top.
2. Coil jib pendants and store for future use.

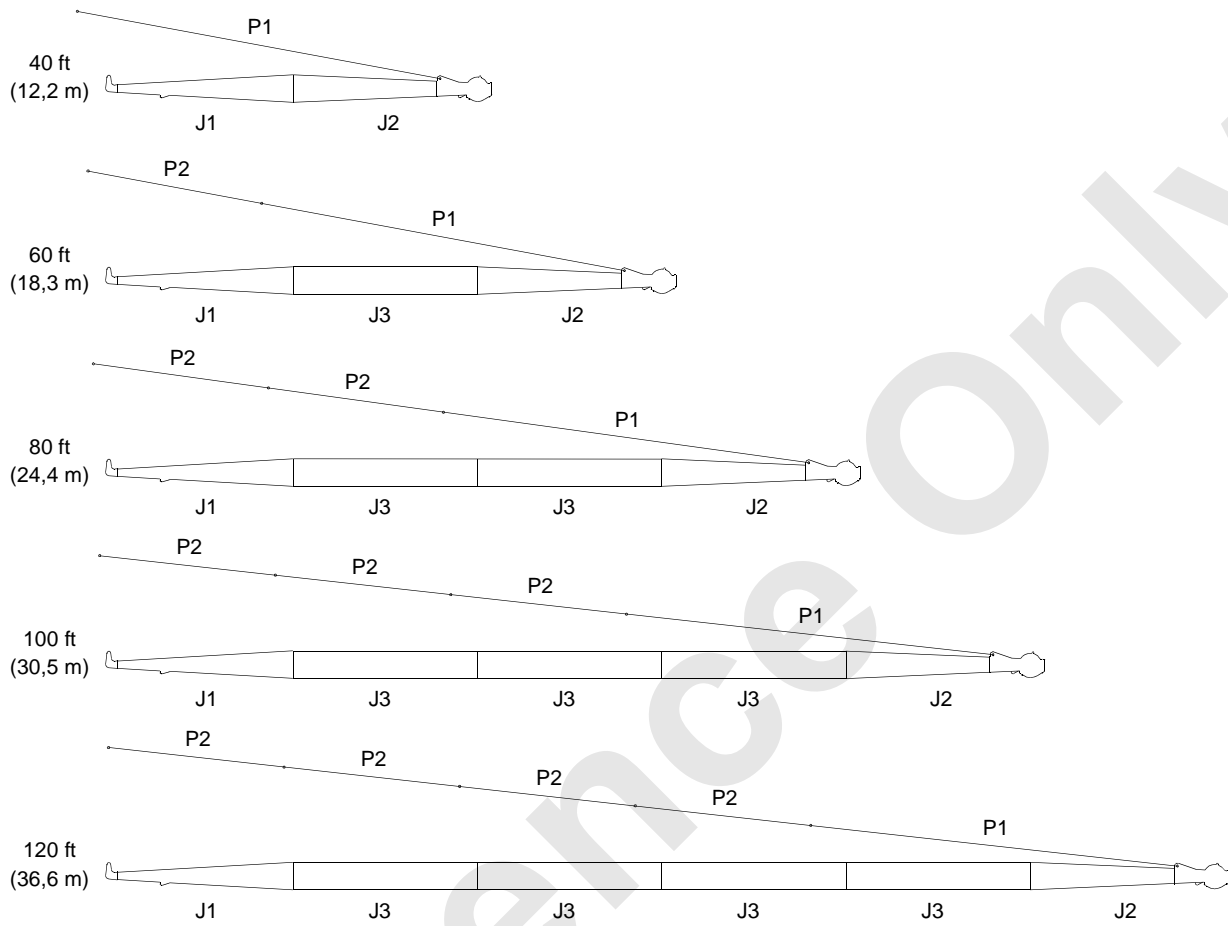
Remove Jib Top and Inserts

1. Unpin and remove jib top from jib butt or jib insert (Figure 4-52, View C and D).
2. Unpin and remove inserts from butt, as required (Figure 4-52, View C and D).

Remove Jib Butt

1. Remove jib stop pendants, links, and struts from between boom top and jib butt (Figure 4-53, View D or F).
2. Support jib butt with assist crane.
3. Unpin and remove jib butt from boom top (Figure 4-52, View B).

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Section	Type	Length	Pendant	Type	Length
J1	Jib Butt	20 ft (6,1 m)	P1	Basic Jib	40 ft (12,2 m)
J2	Jib Top	20 ft (6,1 m)	P2	Jib Insert	19 ft, 2 in (5,8 m)
J3	Jib Insert	20 ft (6,1 m)			

FIGURE 4-55

WIRE ROPE INSTALLATION

NOTE Wire rope manufacturer's recommendations take precedence over information in this section.

Wire Rope Storage

Store wire rope in coils or on reels off the ground or floor in a clean and dry indoor location. If outdoor storage is necessary, the wire rope must be covered with a protective wrapper. Keep the wire rope away from acids, fumes, and other corrosives. Keep the wire rope away from heat that can dry out the lubricant. If the storage period will be long, lubricate the wire rope and perform periodic inspection given in this section at least monthly.

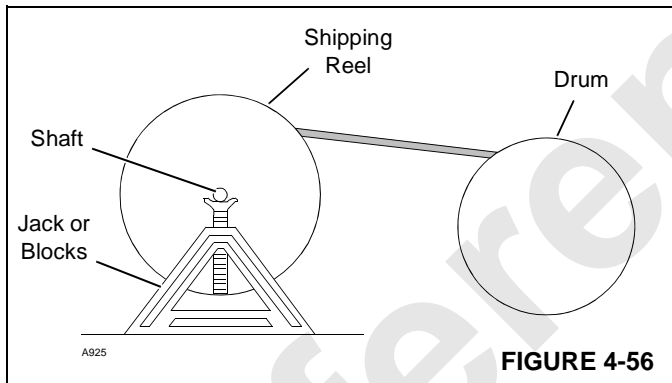
Removing Wire Rope from Shipping Reel

CAUTION!

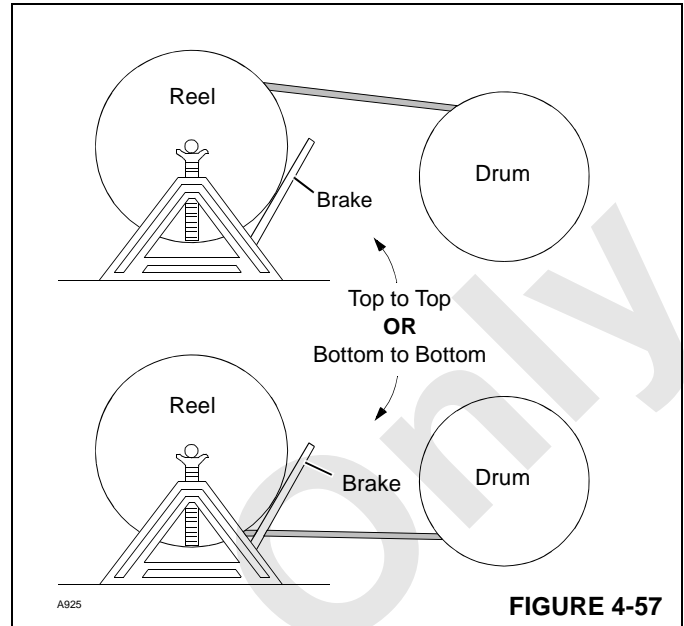
Wire Rope Damage!

Shipping reel must rotate when wire rope is unwound. Attempting to remove wire rope from a stationary reel can result in a "kinked" wire rope, and wire rope will be ruined.

1. Mount wire rope shipping reel on a shaft supported at both ends by jacks or blocks as shown in Figure 4-56.



2. Provide a brake at shipping reel (see Figure 4-57) so wire rope can be wound tightly onto drum.



3. Avoid a reverse bend when winding wire rope onto drum: wind from top of reel to top of drum or from bottom of reel to bottom of drum as shown in Figure 4-57.
4. Avoid dragging wire rope in dirt or around objects that can scrape, nick, cut, or crush wire rope.

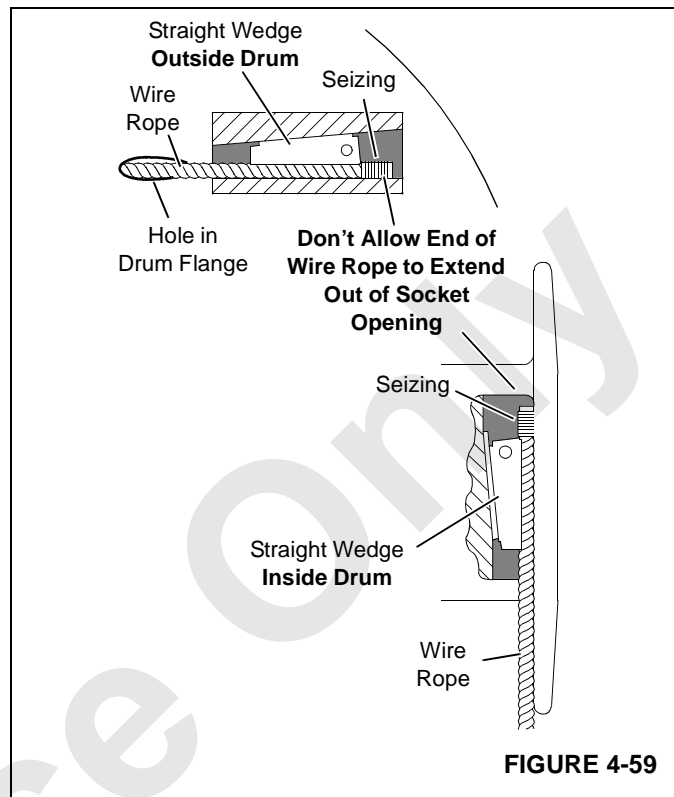
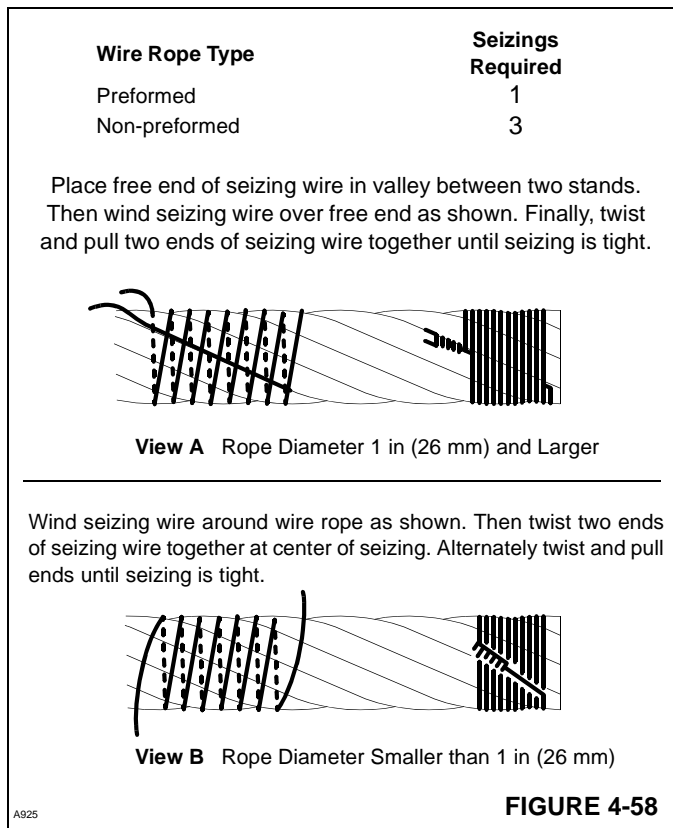
Seizing and Cutting Wire Rope

Apply tight seizings of annealed wire to the ends of all wire rope. If not done, the rope wires and strands may slacken. This action will result in overloading of some strands and underloading of others. Bird caging and breakage of the wire rope can occur.

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

See Figure 4-58 for:

- Number of seizings to be applied to the ends of wire rope and to both sides of the point where a cut will be made.
- Proper application method. Each seizing should be one rope diameter long.



Anchoring Wire Rope to Drum

See Figure 4-59 for following procedure.

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

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



WARNING!

Falling Load Hazard!

Wire rope can be pulled out of drum if following steps are not taken.

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

Winding Wire Rope onto Drum

See Drum and Lagging Chart in Capacity Chart Manual for correct size of drum lagging, if used.

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

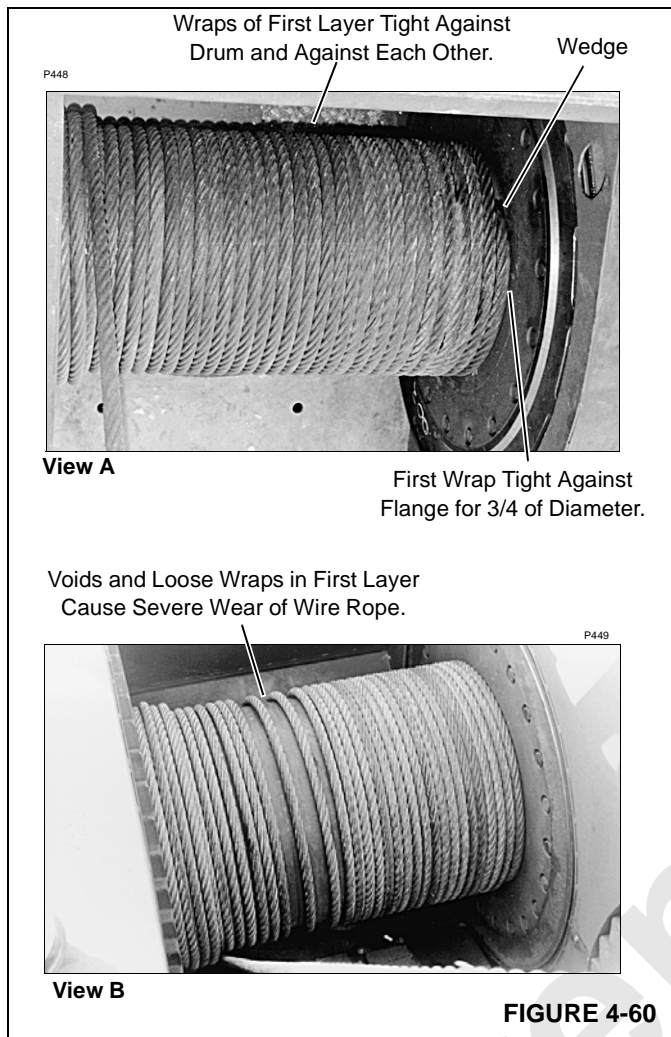
See Boom Rigging Drawing at end of this section for correct type, size, and amount of wire rope to be installed on boom hoist drums.

1. Carefully inspect drums and all rope guides, rollers, and sheaves for defects that can cause wire rope to wear or be cut. If defects cannot be fixed, replace faulty parts.
2. Apply tension to wire rope as it is wound slowly onto drum.

First wrap must be tight against drum flange for approximately three-fourths of drum diameter (see Figure 4-60).

3. Tap adjacent wraps against each other with a soft metal or wooden mallet.

Use extreme care not to put twists or turns in wire rope; allow rope to assume its natural lay.



CAUTION!

Wire Rope Damage!

Voids or spaced wraps in first layer (see Figure 4-60, View B) will permit movement and a wedging action with subsequent layers. Wedging action will cause crushing and abrasion of wire rope.

Never allow wire rope to “cross wind” on drums.

Anchoring Wire Rope to Socket and Wedge



WARNING

Falling Load Hazard!

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

See Figure 4-61 for following procedure.

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

Use a brass hammer to seat wedge and wire rope as deep into socket as possible.

5. Attach a wire rope clip to dead end of wire rope using one of the RIGHT methods shown. Rope clip will aid in preventing wire rope from being pulled out of socket.

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

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

! WARNING
Falling Load Hazard!

Wire rope can break if following precaution is not observed:

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

TL (Tail Length)

Standard 6 to 8 Strand Wire Rope

Minimum of 6 rope diameters, but not less than 6 in. (152mm)

Rotation Resistant Wire Rope

Minimum of 20 rope diameters, but not less than 6 in (152mm)

T (Rope Clip Nut Torque)

Wire Rope / Clip Size

inch (mm)	7/8 (22,23)	1 (25,4)	1-1/8 (28,58)	1-1/4 (31.75)
Torque				
* ft/lbs (kN/m)	225 (0,30)	225 (0,30)	225 (0,30)	360 (0,49)

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

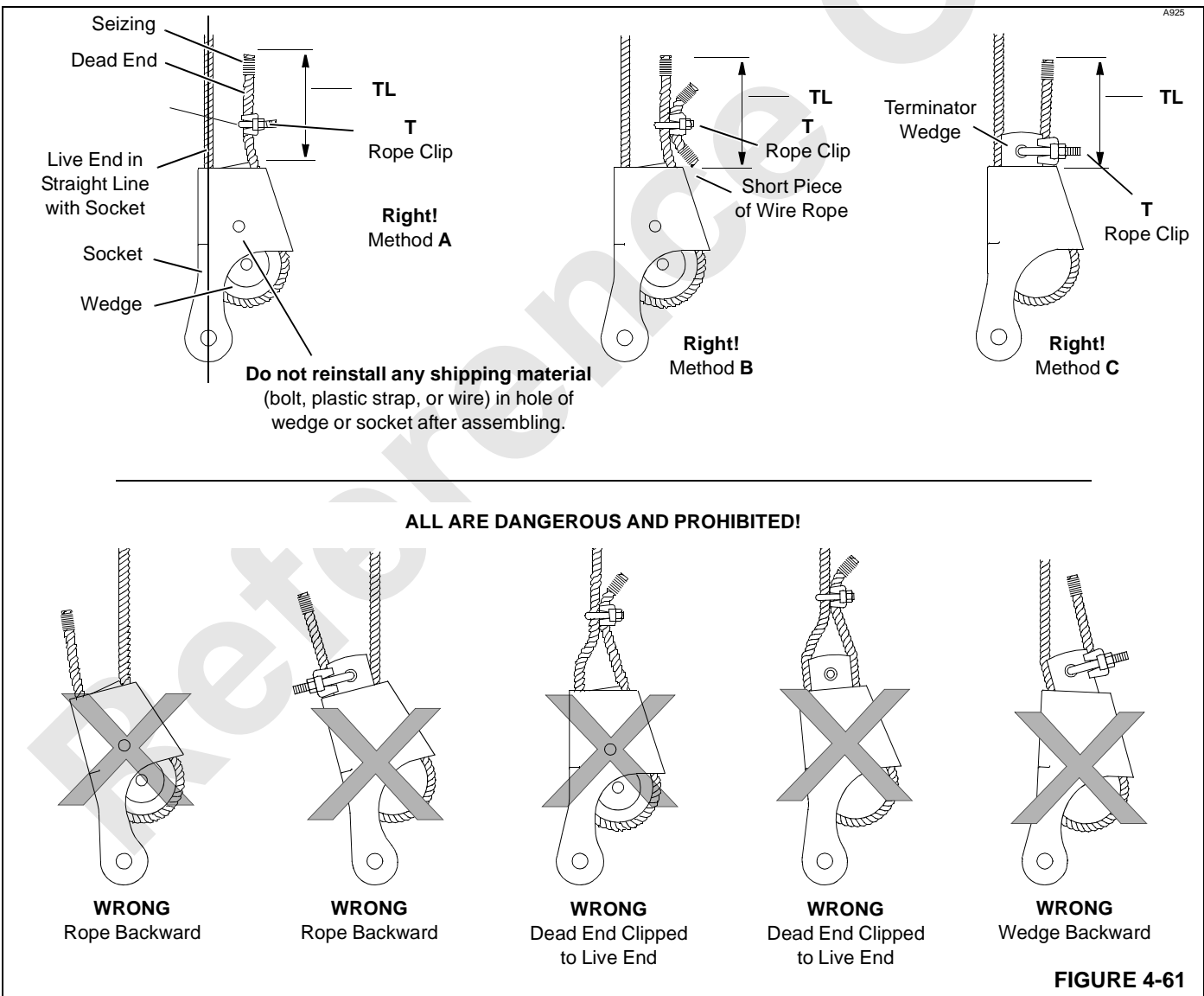


FIGURE 4-61

Breaking in Wire Rope

After installing a new wire rope, break it in by operating it several times under light load and at reduced speed. This practice allows the wire rope to form its natural lay and the strands to seat properly.

NOTE Wire rope will stretch during the break-in period, reducing the wire rope's diameter as the strands compact around the core.

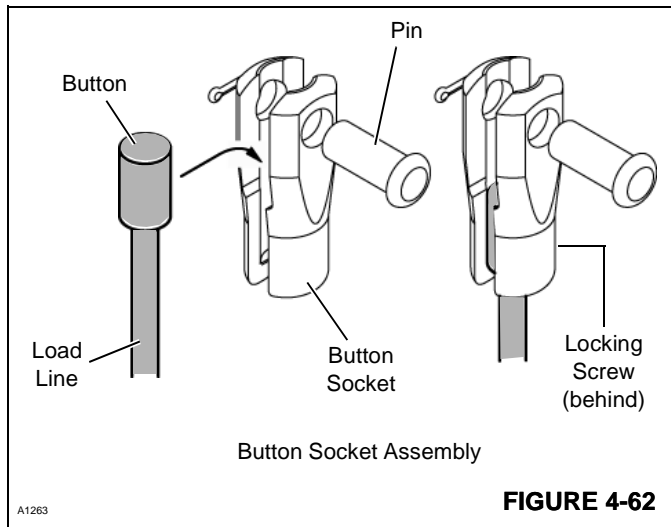
The dead wraps of wire rope on the drum can become slack during operation, even if the utmost care is used during installation of the wire rope. This slackening is caused by the normal stretch that occurs in a new wire rope under tension and periodically throughout the wire rope's life from release of the load.

When slackness is noted, tightly wind the dead wraps of wire rope onto the drum. If left uncorrected, a wedging action with subsequent layers will occur, and the resultant abrasion may cause broken wires in the dead wraps.

Anchoring Wire Rope to Button Socket

See Figure 4-62 for following procedure.

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



PAD EYE USAGE FOR WIRE ROPE REEVING

See Figure 4-63 for following procedure.

General

Some rotation-resistant wire rope supplied by Manitowoc is equipped with a No. 1.5 pad eye welded to the leading end of the wire rope.

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

Safety

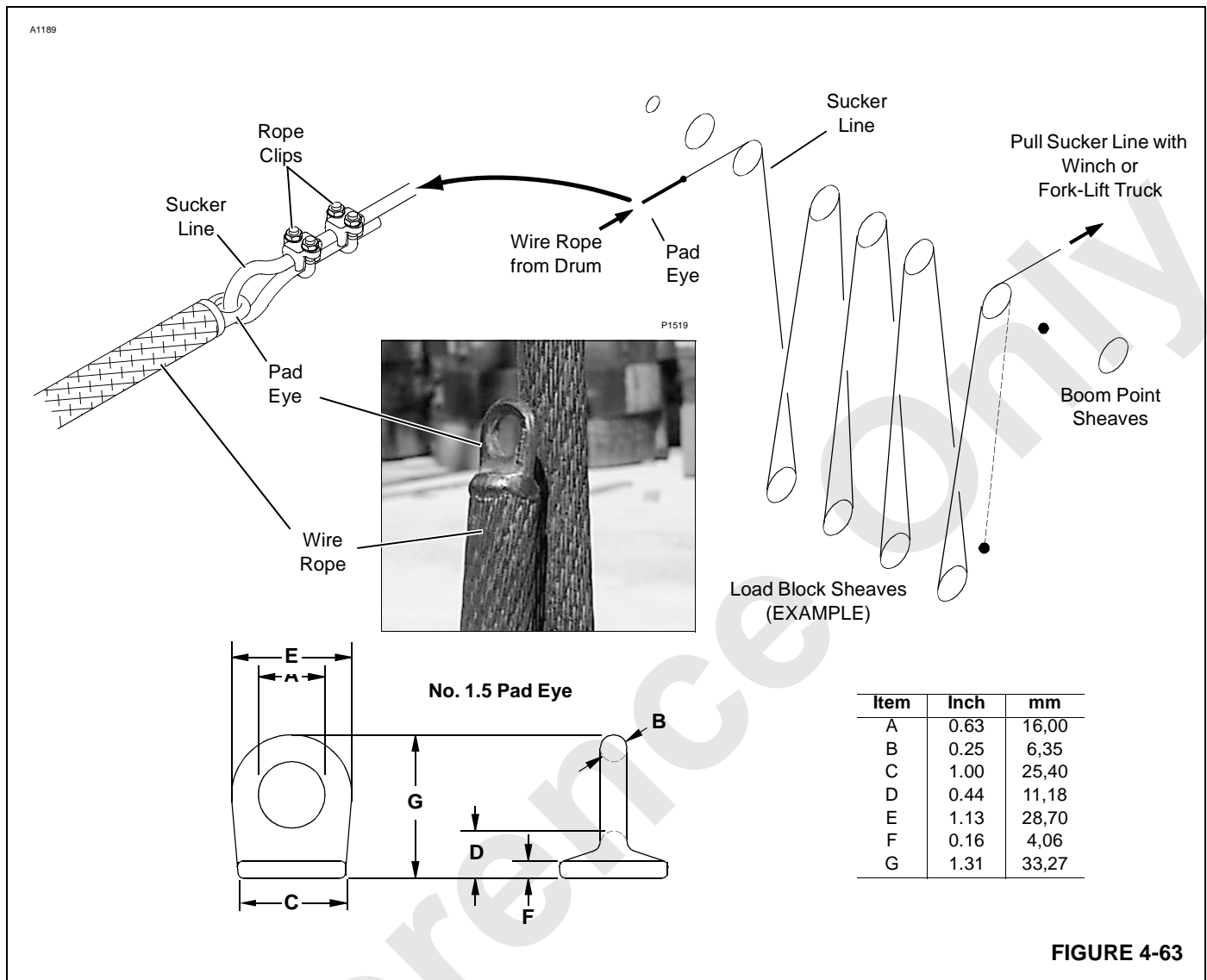
1. For No. 1.5 pad eye, do not exceed 1,000 lb (4.45 kN) single line pull.
2. Make sure sucker line and rope clips are rated for at least 1,000 lb (4.45 kN) line pull.
3. Inspect pad eye prior to each use. **Replace it if:**
 - Any original dimensions have changed .
 - Cracks or breaks exist in metal or weld.



WARNING Flying Part Hazard!

Pad eye on end of wire rope has been provided **for reeving purposes only**. Any other use is neither intended nor approved.

Pad eye can break and fly apart with considerable force if it is overloaded, not used properly, or not maintained properly.



LOAD LINE REEVING

Standard Liftcrane

Wire Rope Specifications

See Wire Rope Specifications Chart in Capacity Chart Manual for following information:

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

CAUTION

Wire Rope Damage!

Avoid wire rope damage from improper fleet angle or contact with adjacent parts. Do not hoist load block or hook and weight ball any closer to boom or jib points than specified on Range Diagram in Capacity Chart Manual.

Wire Rope Installation

See Wire Rope Installation in this section for following instructions:

- Anchoring wire rope to drums.
- Installing wire rope on drums.
- Anchoring wire rope to wedge sockets.

Load Block

The following load blocks are available from Manitowoc:

- 500 USt (454 t) – 16,500 lb (7 484 kg)
- 300 USt (272 t) with weight plates – 15,400 lb (7 484 kg)
- 100 USt (91 t) with weight plates – 9,800 lb (6 985kg)
- 60 USt (55 t) with weight plates – 4,425 lb (2 007kg)
- 30 USt (27 t) with weight plates – 3,500 lb (1 587 kg)
- 15 USt (14 t) swivel hook with weight plates – 1,900 lb (861 kg)

NOTE: Manitowoc recommends laced reeving as shown in this section. Using this type reeving will result in the least amount of block spin and load rotation. It is normal with this type 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 rope as close to center of block as possible to avoid rope damage.**

WARNING

Falling Load Hazard!

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

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

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

Universal Anchor Joint

The universal anchor joint on the #132 jib point (Figure 4-68) 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 universal anchor joint is not removed, load line will rub against anchor joint support when operating at high boom angles.**

Duplex Hook

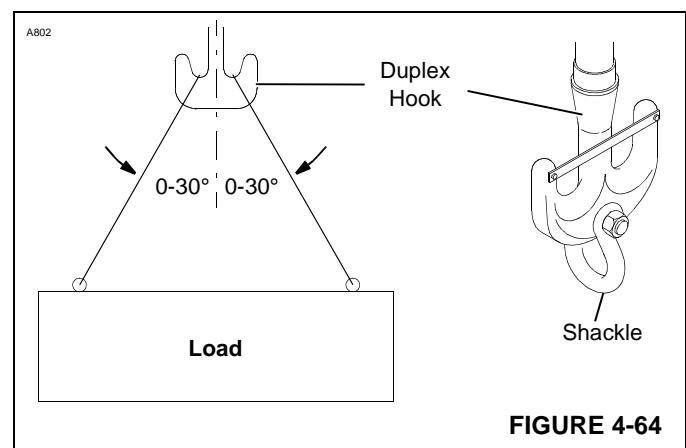
The duplex hook capacities are based on the lifting sling angles given in Figure 4-64. Attach the load so it is balanced equally on each ear of the hook. The duplex hook has a hole to which a shackle can be attached as shown in Figure 4-64.

WARNING

Falling Load Hazard!

Limit load to be handled with shackle to capacity of load block or shackle, whichever is less.

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



Guide Sheaves

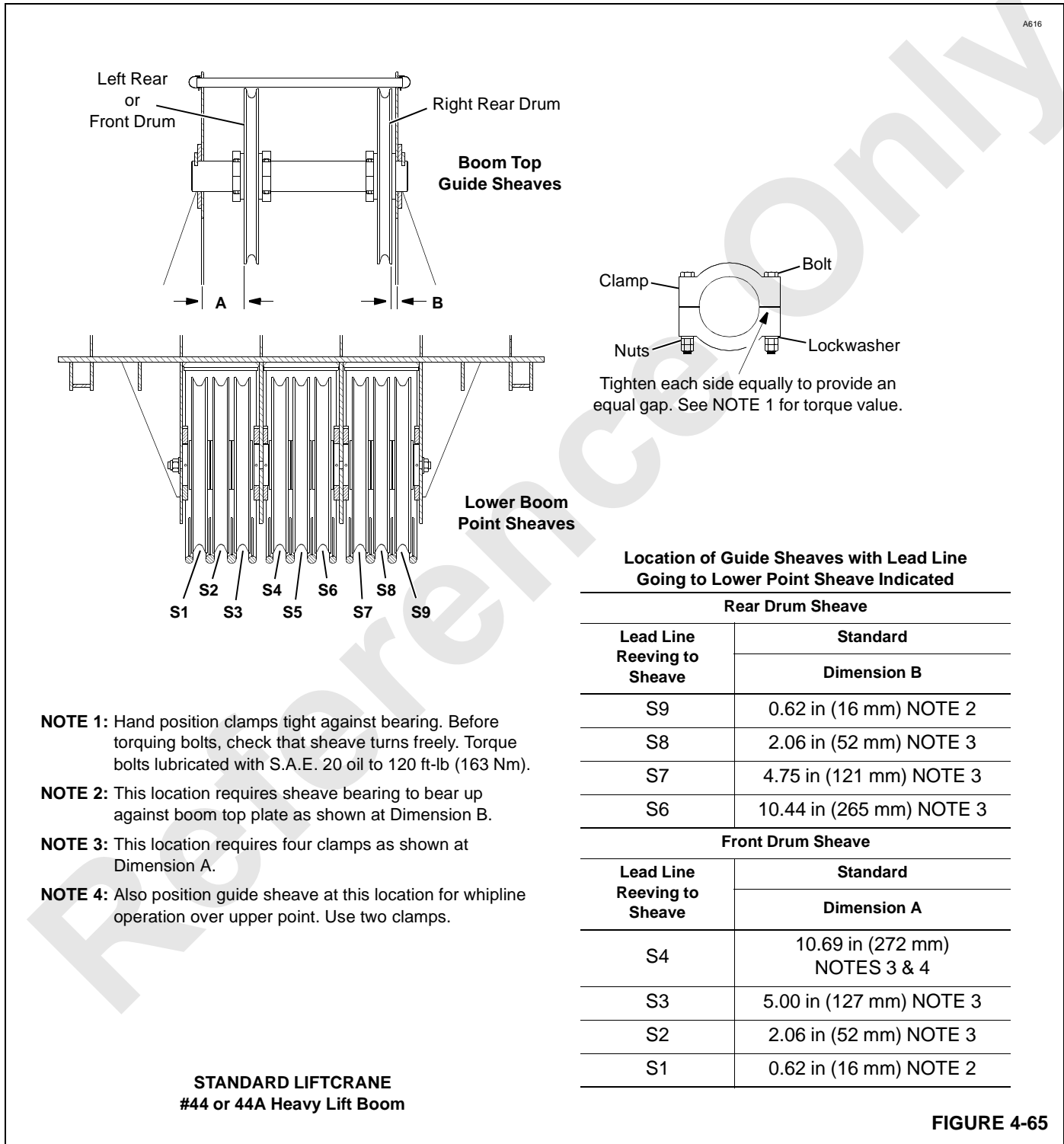
See Figures 4-65 and 4-66 for guide sheave identification.

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

Drum Spacers

See Drum Spacer/Lagging Installation in this section for installation of spacers on load drums.

Spacers are required on Ringer prepared cranes with 73 in (1,9 m) wide load drums. **Failing to install spacers can result in wire rope damage due to improper fleet angles.**

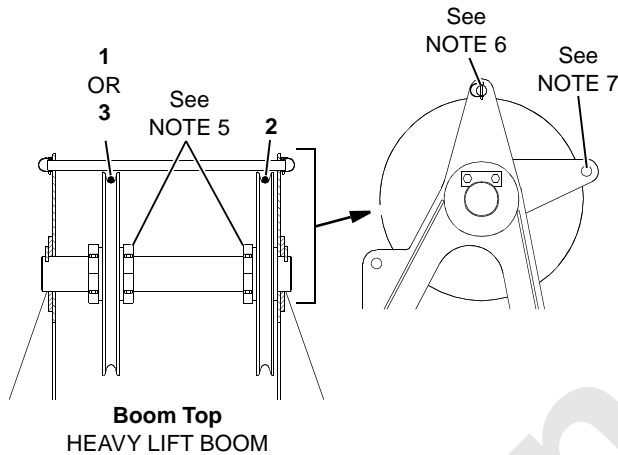
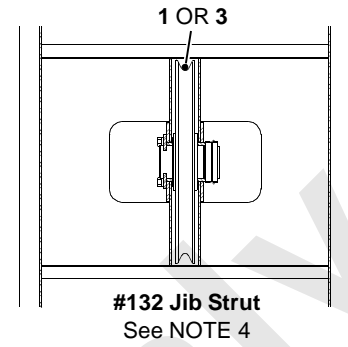
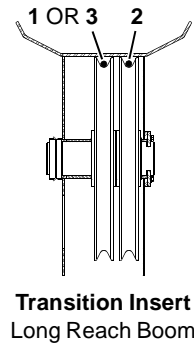
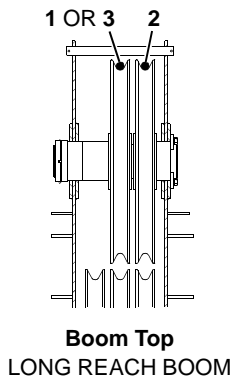


NOTE 1: Hand position clamps tight against bearing. Before torquing bolts, check that sheave turns freely. Torque bolts lubricated with S.A.E. 20 oil to 120 ft-lb (163 Nm).

NOTE 2: This location requires sheave bearing to bear up against boom top plate as shown at Dimension B.

NOTE 3: This location requires four clamps as shown at Dimension A.

NOTE 4: Also position guide sheave at this location for whipline operation over upper point. Use two clamps.



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: Guide sheave identification in this section applies only to the 2250 with #44 or 44A Heavy Lift or Long Reach Boom.

Guide sheave identification for other attachments (Max-Spander, MAX-ER, Luffing Jibs) is located in Operator's Manual for specific attachment.

Bold dots (•) indicate load line engagement with sheaves when viewed from boom butt.

NOTE 2: Install rope retaining pins in these holes for luffing hoist operation.

NOTE 3: Install rope retaining pins in these holes for equalizer handling.

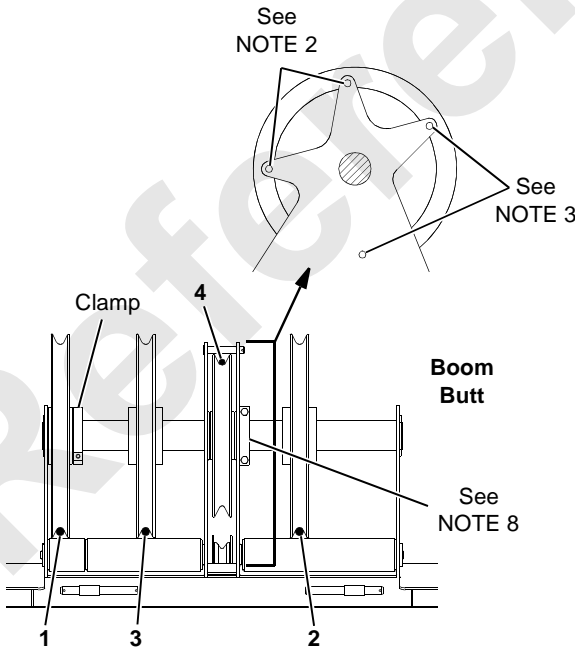
NOTE 4: For #132 jib operation, do not route load line through guide sheave on transition insert or on boom top. Route desired load line through proper guide sheave on boom butt and then directly to guide sheave on jib strut.

NOTE 5: See Figure 4-65 for guide sheave positioning.

NOTE 6: Install rope retaining pin in this hole for #44, 44A, or 49A-44 boom.

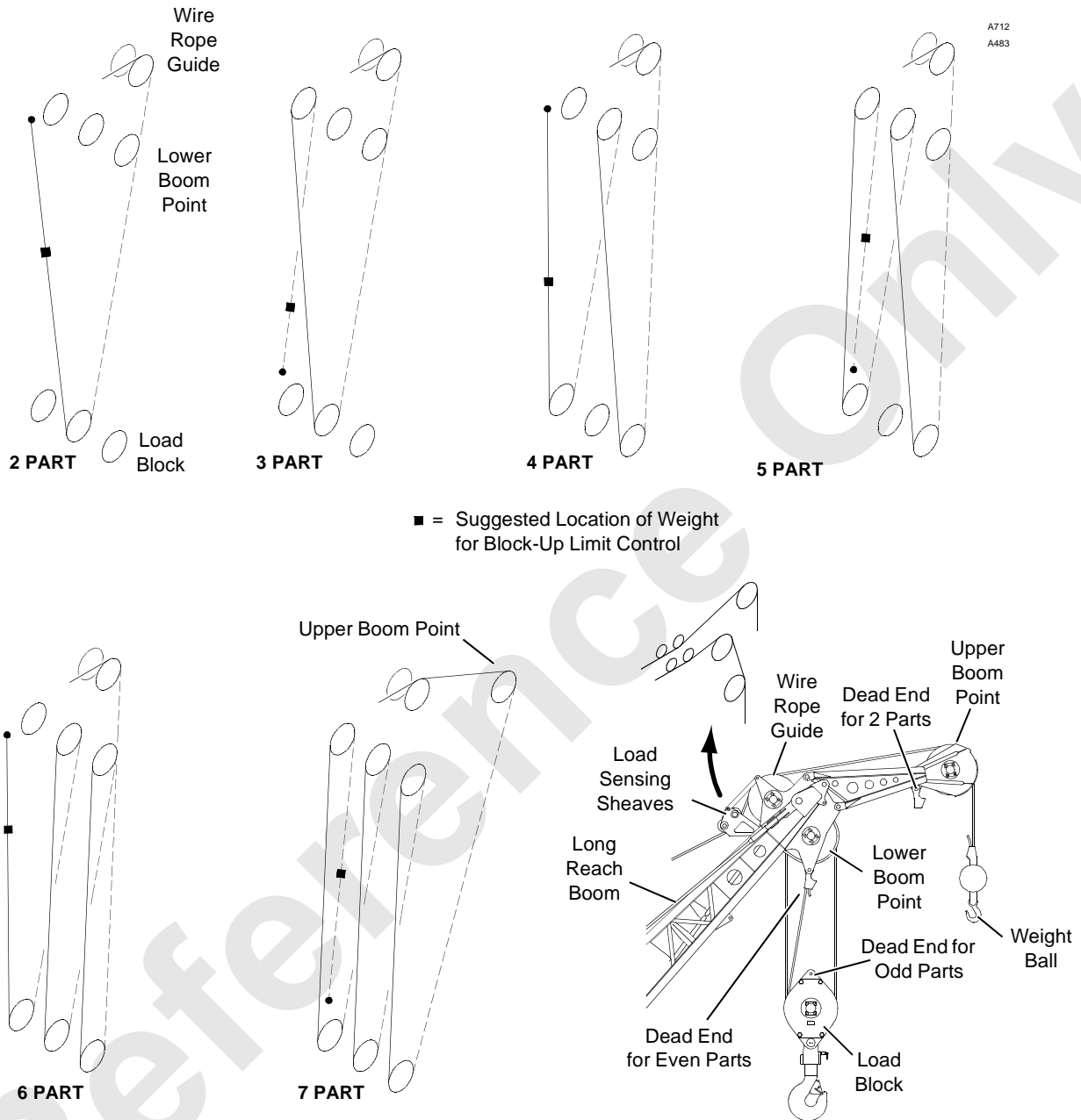
NOTE 7: Install rope retaining pin in this hole for #49A-44 boom with 133A luffing jib.

NOTE 8: Clamp must be installed when equipped with equal width split rear drums.



A791

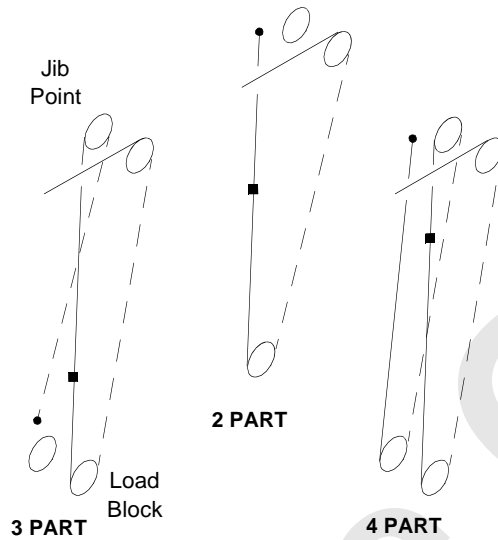
FIGURE 4-66



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A483

**STANDARD LIFTCRANE
#44 Long Reach Boom**

FIGURE 4-67

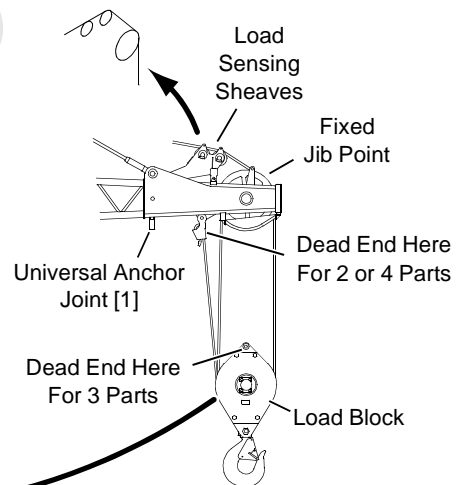


! WARNING

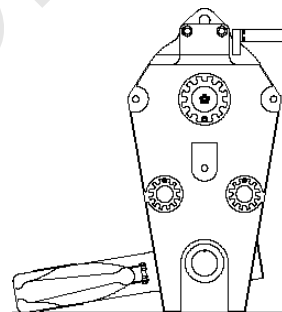
Avoid Death or Serious Injury!

If you are using a load block that can be stood up vertically for reeving, exercise care, as the potential for tipping exists. Potential causes of tipping are unstable work area, boom or jib movement, and the reeving process.

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



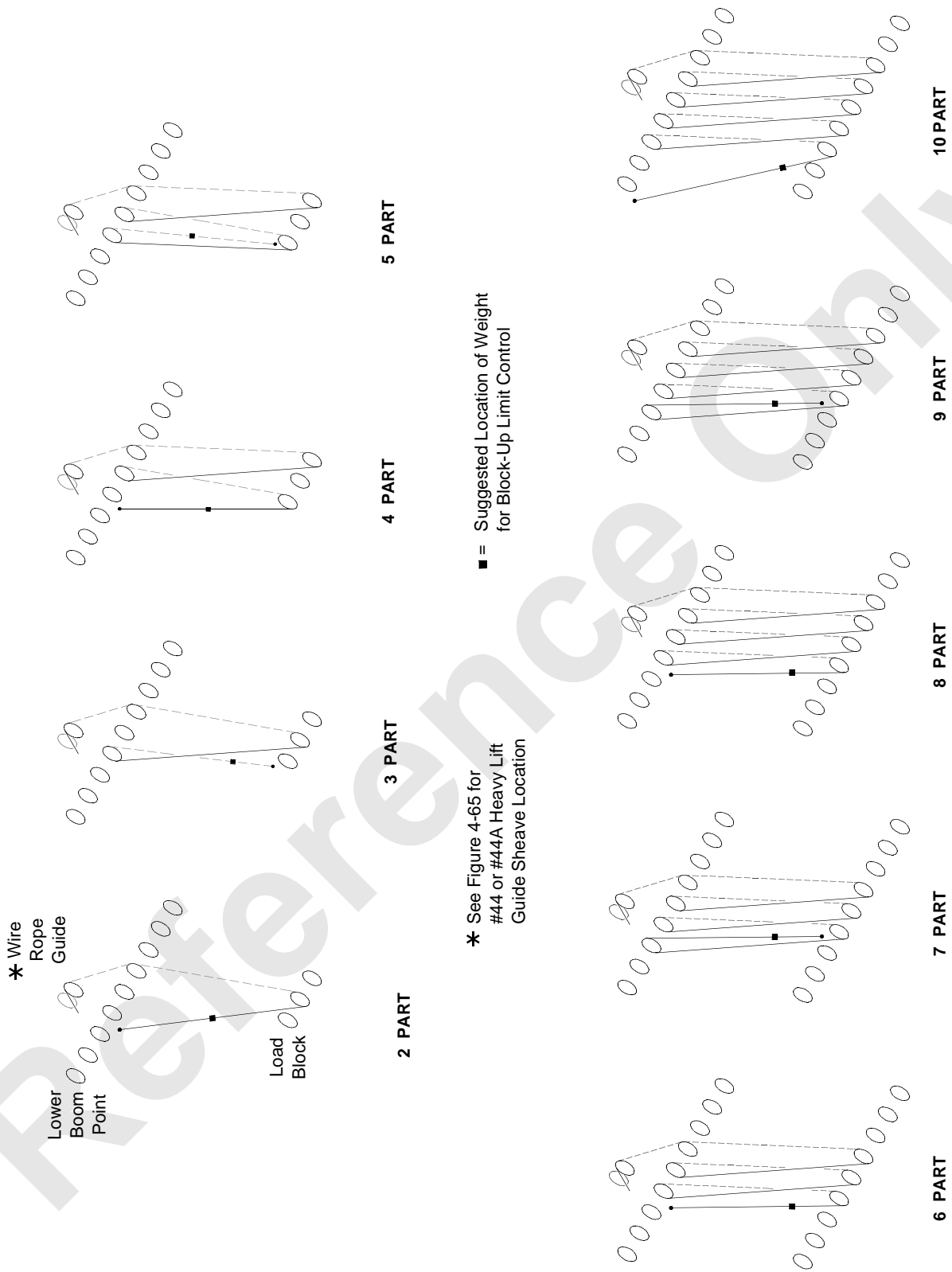
[1] Must be removed when 2 or 4 part line is dead ended at upper dead end lug or when 3 part line is used.



**STANDARD LIFTCRANE
#132 Fixed Jib**

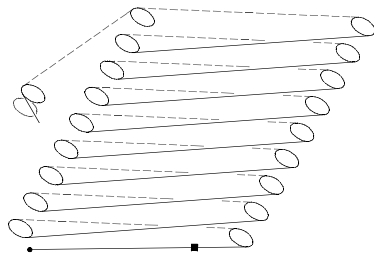
FIGURE 4-68

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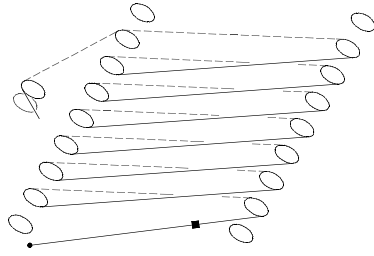


STANDARD LIFTCRANE
#44 or 44A Heavy Lift Boom

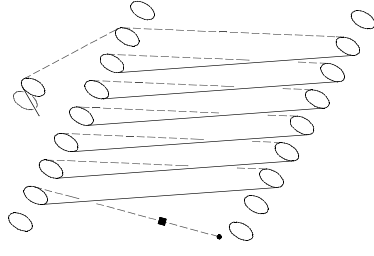
FIGURE 4-69



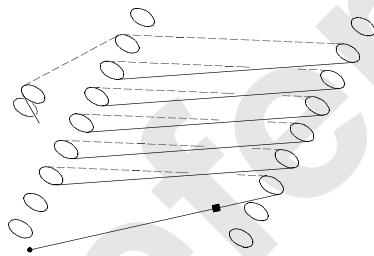
11 PART



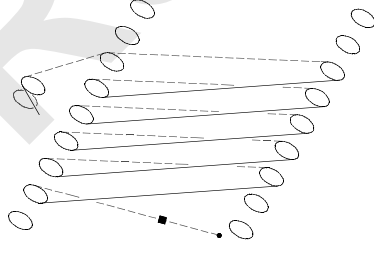
12 PART



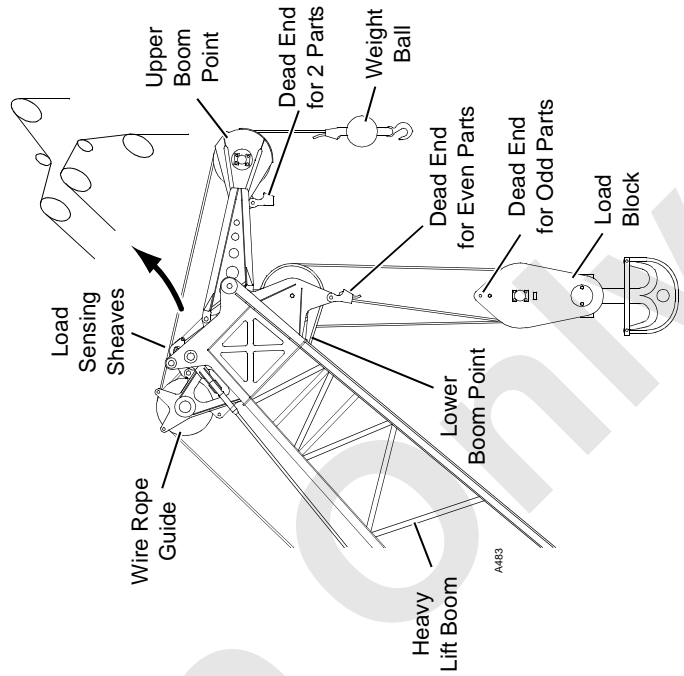
13 PART



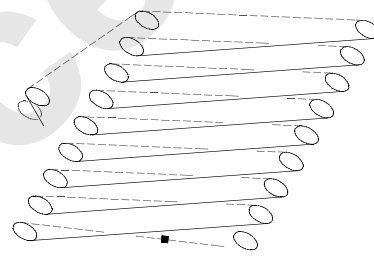
14 PART



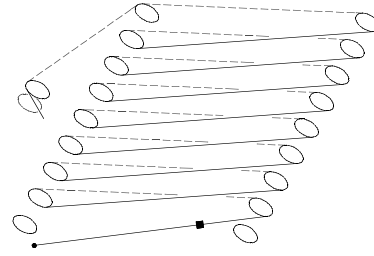
15 PART



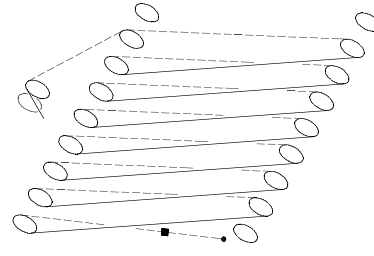
16 PART



17 PART



18 PART



19 PART

STANDARD LIFTCRANE
#44 or 44A Heavy Lift Boom

FIGURE 4-69 continued

10-Part Continuous Reeving

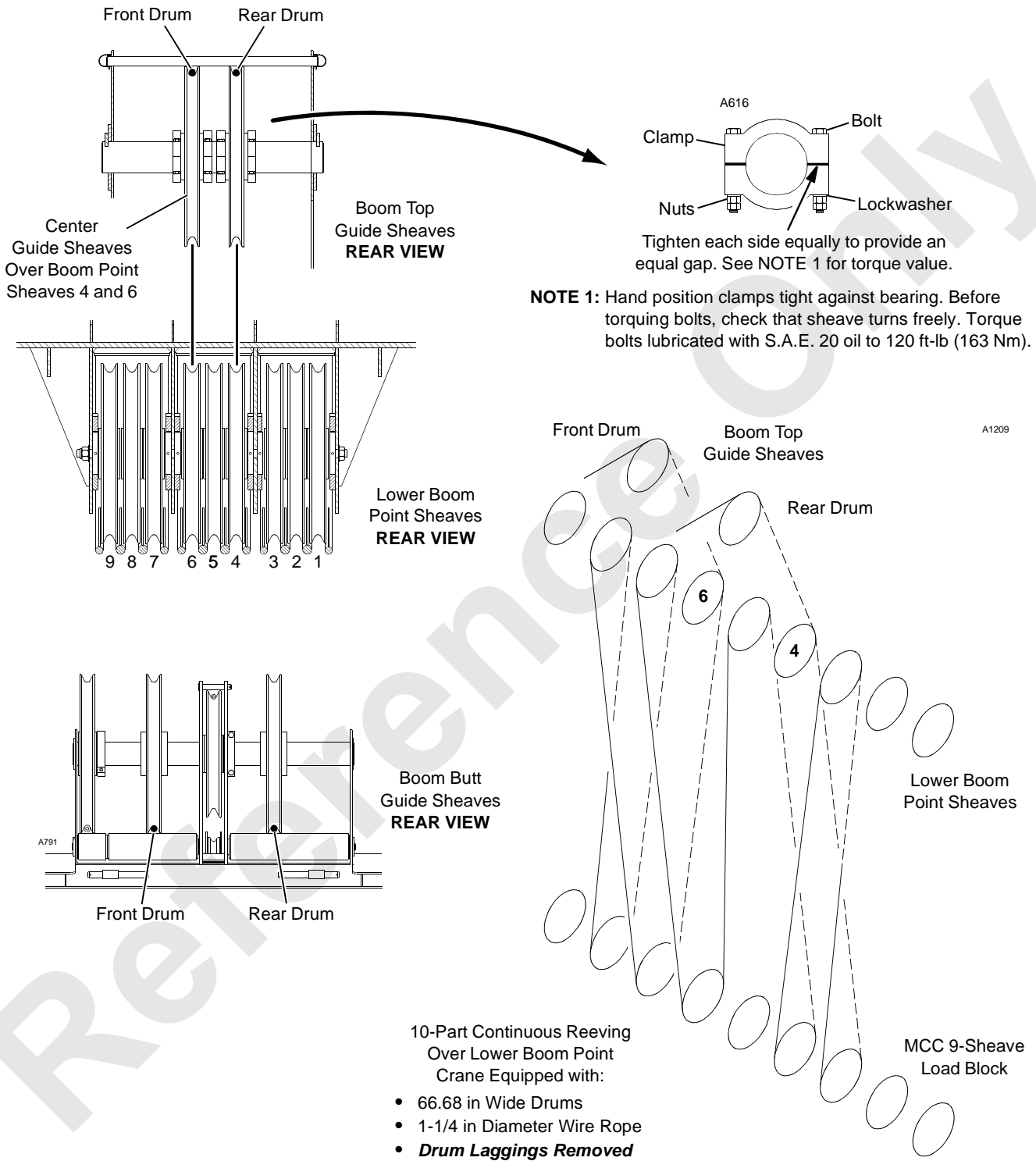
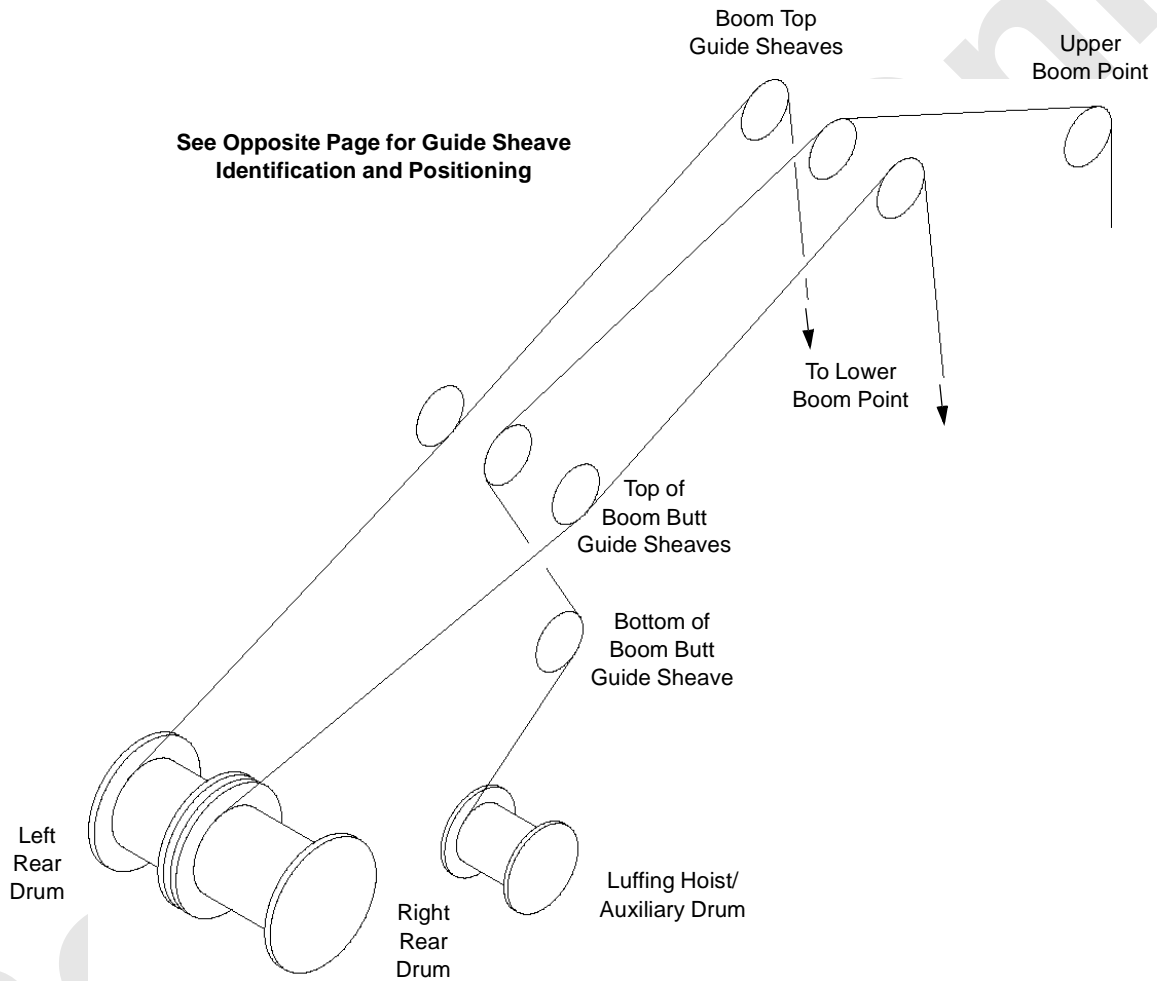


FIGURE 4-70

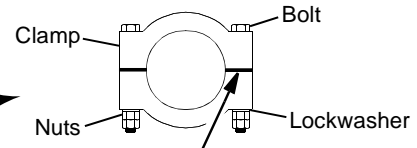
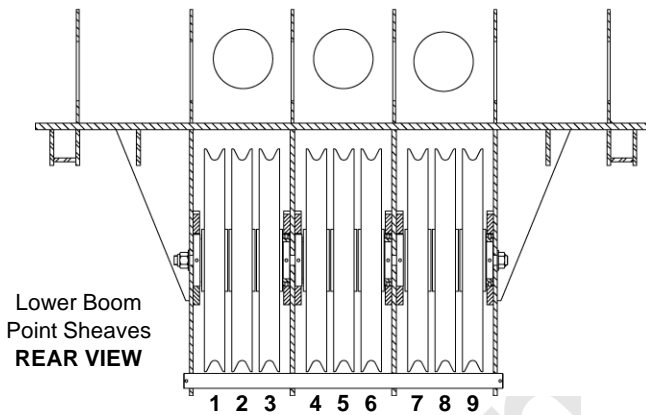
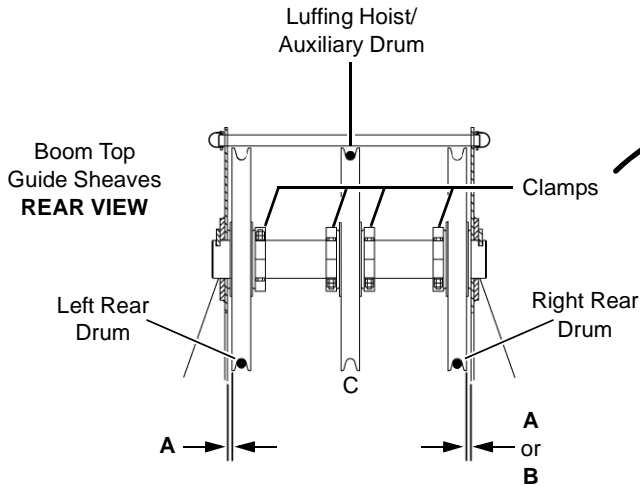
3 Lines Up Top of Boom



4

FIGURE 4-70

A1276
A616



Tighten each side equally to provide an equal gap. Hand position clamps tight against bearing. Before torquing bolts, check that sheave turns freely. Torque bolts lubricated with S.A.E. 20 oil to 120 ft-lb (163 Nm).

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	2-1/16 in (52 mm) ¹

¹ This position requires two sets of clamps.

Right Rear Drum Guide Sheave

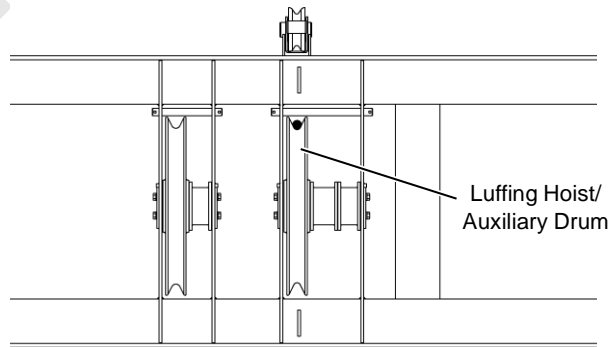
Rope Routed to Sheave:	Dimension B
9	Sheave tight against side frame.

Luffing Hoist Drum Guide Sheave

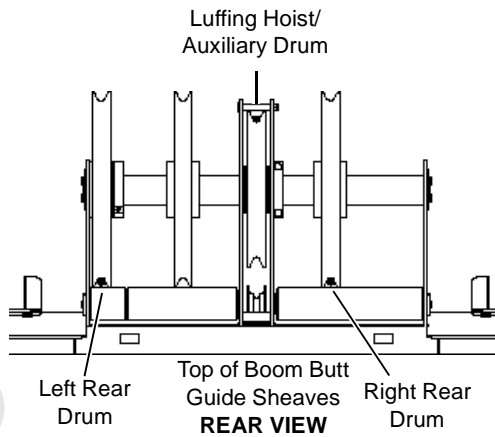
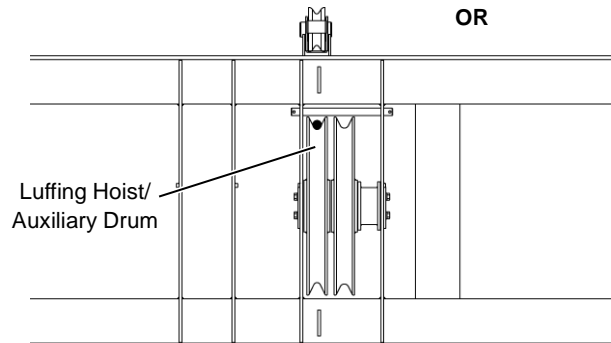
Rope Routed to Sheave:	Dimension C
Upper Boom Point	Sheave centered. ¹

¹ This position requires two sets of clamps.

**Bottom of Boom Butt Guide Sheaves
TOP VIEW**



OR



- = Wire Rope.
- AVOID DAMAGE TO WIRE ROPE:**
- Route rope as shown.
- Position boom top guide sheaves as shown.

FIGURE 4-70 continued

Container Handling Reeving — #44 Heavy Lift Boom

A712

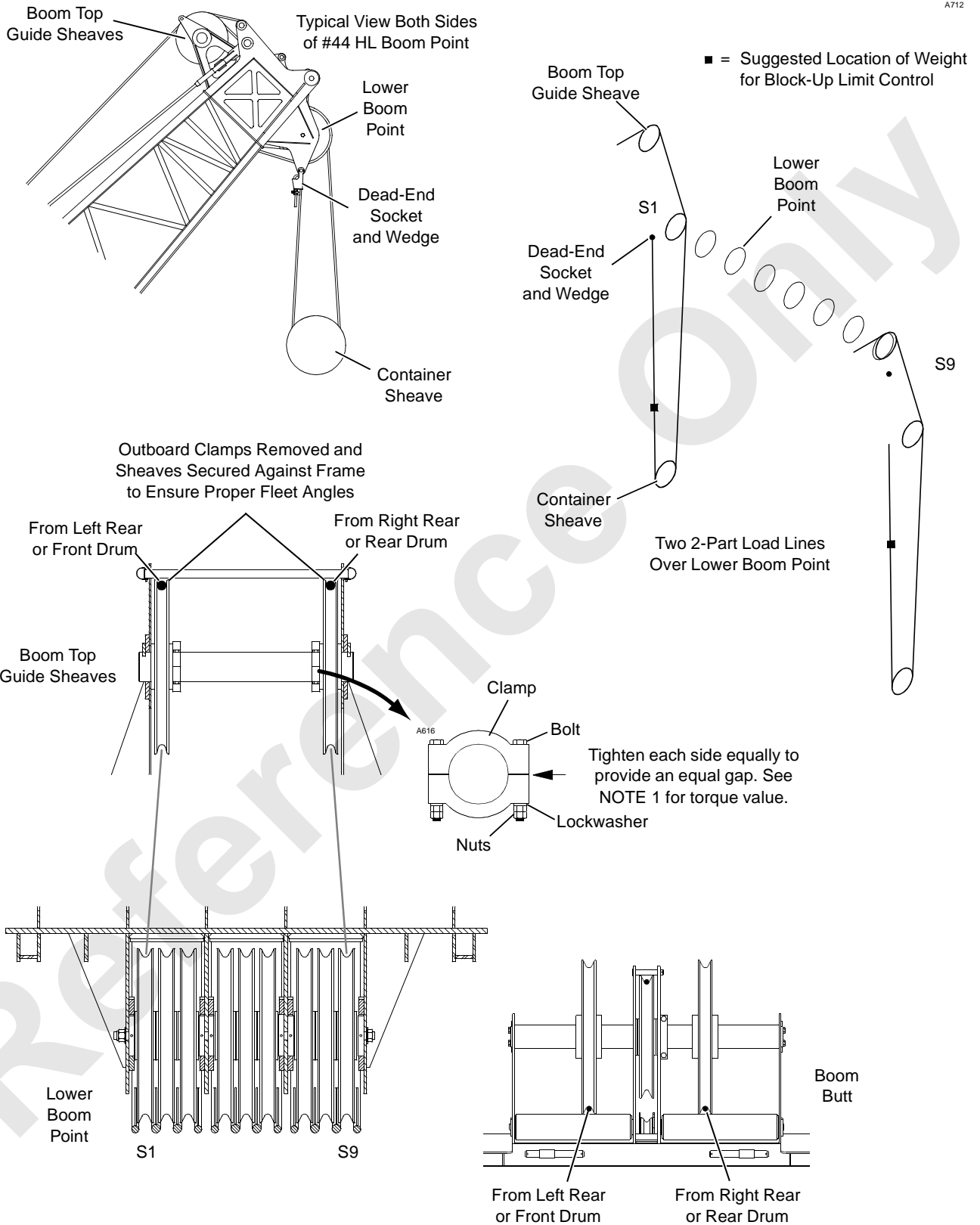
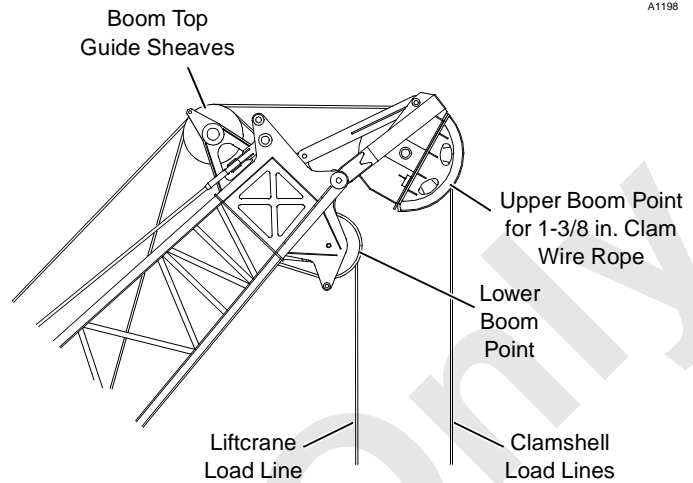
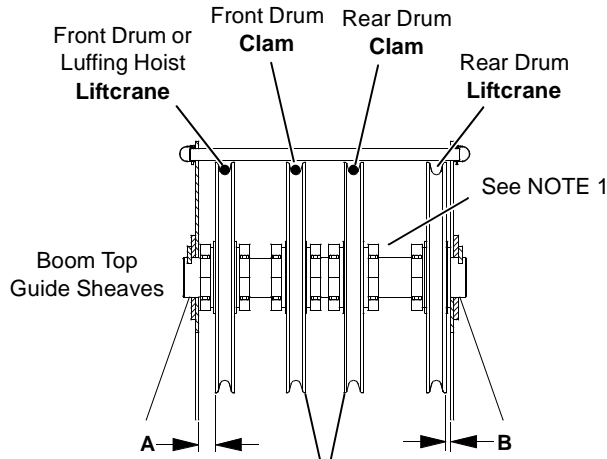


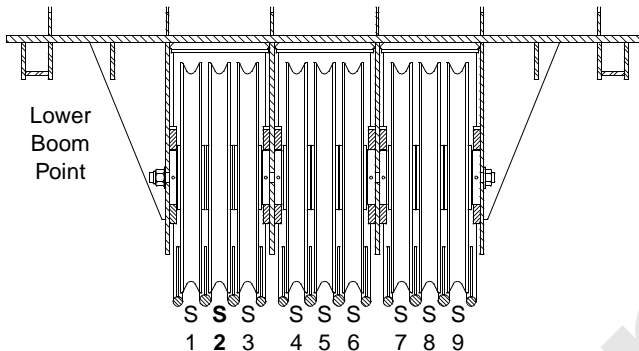
FIGURE 4-71

Clamshell Reeving — #44 Heavy Lift Boom with Clamshell Upper Boom Point

A1198



For Clamshell Operation,
Position Sheaves Inline with Upper Boom Point Sheaves



Location of Guide Sheaves with Lead Line
Going to Lower Boom Point Sheave Indicated

Front Drum Sheave		Rear Drum Sheave	
Lead Line to Sheave	Liftcrane (NOTE 2)	Lead Line to Sheave	Liftcrane (NOTE 2)
	Dimension A		Dimension B
S4	10.69 in (272 mm) NOTE 4 & NOTE 5	S9	0.62 in (16 mm) NOTE 3
S3	5.0 in (127 mm) NOTE 4	S8	2.06 in (52 mm) NOTE 2
S2	2.06 in (52 mm) NOTE 4	S7	4.75 in (121 mm) NOTE 4
S1	0.62 in (16 mm) NOTE 2	S6	10.44 in (265 mm) NOTE 4

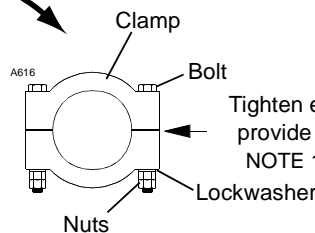
NOTE 1: Position clamps tight against bearing. Before torquing bolts, check that sheave turns freely. Torque bolts lubricated with S.A.E. 20 oil to 120 ft-lb (163 Nm).

NOTE 2: When using liftcrane sheaves, it may necessary to move or remove clamshell sheaves to properly position liftcrane sheaves.

NOTE 3: Remove outboard clamp and position sheave against boom point plate.

NOTE 4: This location requires two clamps.

NOTE 5: Position guide sheave here for liftcrane operation with single-part line over upper point. Use two clamps.



WARNING
Falling Load Hazard!

When using luffing hoist wire rope as a load line (routed under boom), do not operate with boom higher than 75°. Wire rope will rub against wire rope guide frame under boom top. Wire rope could break allowing load to fall.

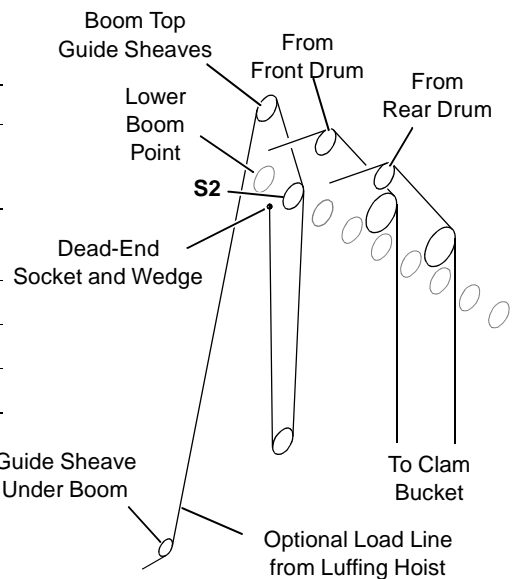


FIGURE 4-72

UNIVERSAL ANCHOR JOINT

See Figure 4-72 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:

1. Link in boom or jib point for liftcrane operation.
2. Lug (if equipped) welded inside boom or jib point directly behind boom or jib point shaft for liftcrane operation.
3. Universal anchor joint located behind 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 magnet, clamshell, grapple, and liftcrane operation requiring a 2-part load line.

NOTE: Movement of the dead-end socket on the link or lug (1 and 2 above) is in two directions only – forward and back. Movement of the dead-end socket on the universal anchor joint (3 above) is in four directions – forward, back and sideways.

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 Crane CARE Customer Service at the factory for repair procedure.

If the boom or jib point is not prepared for the universal anchor joint, the boom or jib top is neither designed for nor intended for duty-cycle work.

For liftcrane operation requiring 3-parts of 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!

Do not operate as liftcrane at high boom angle with universal anchor joint in place. Interference of wire rope with universal anchor joint can damage wire rope causing rope to break and load to fall.

For wire rope size and maximum load of universal anchor joint, see appropriate wire rope chart, capacity chart, or rigging drawing.



WARNING Falling Load Hazard!

Do not dead-end a 2-part load line to anchor link or lug in boom or jib point for magnet, clamshell, grapple, or other operations requiring rapid swing cycles. Sideways motion may break link or lug causing load to fall.

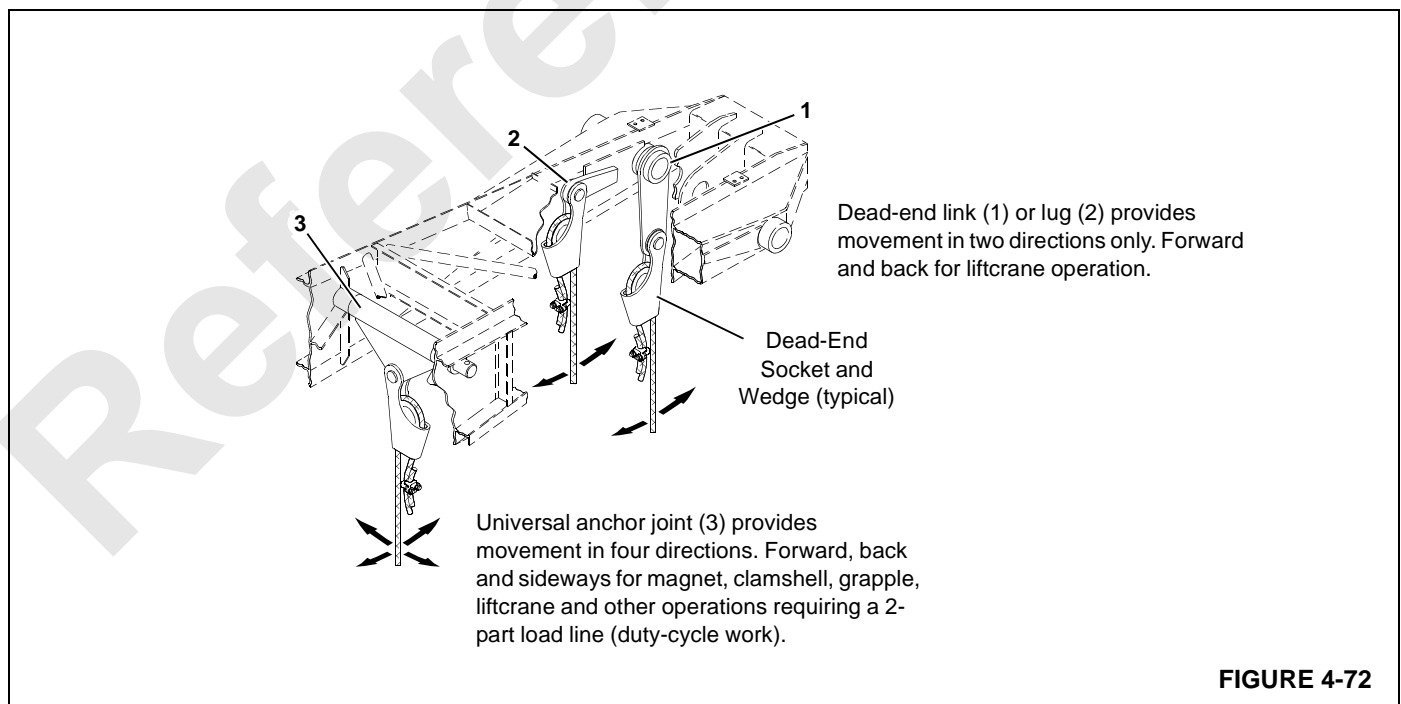


FIGURE 4-72

LOAD BLOCK TIEBACK

General

A lug is provided on the front of the rotating bed (Figure 4-73, View A) and on the luffing hoist frame (Figure 4-73, 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 tieback hole and to the hook of the freely suspended load block. This will prevent personnel from having to swing the block in, toward crane, to make the connection.

Sling Capacity

The sling must be capable of supporting the weight of the load block and 1/2 the weight of the wire rope suspended from the boom point. When sizing the sling, take into account the dynamic affects of traveling and swinging the crane. ***It is the crane users responsibility to calculate this load.***

Shackle

See Figure 4-73 for identification of tieback hole diameter and shackle size.

CAUTION

Avoid damage to boom:

- Haul in load line only until tieback sling is taut. Purpose of tieback is only to prevent load block from swinging when not in use.
- Do not tighten load line to point that load line can rub against lacings in boom section or load block can bounce into lacings.

Operator, be aware that as you boom down load lines and tieback sling will tighten even more. Pay out load line while booming down so that you don't pull load block into boom. Damage to lacings or chords could result.

- Make sure that tieback sling, load block, and load lines do not interfere with operation of luffing hoist wire rope.
-

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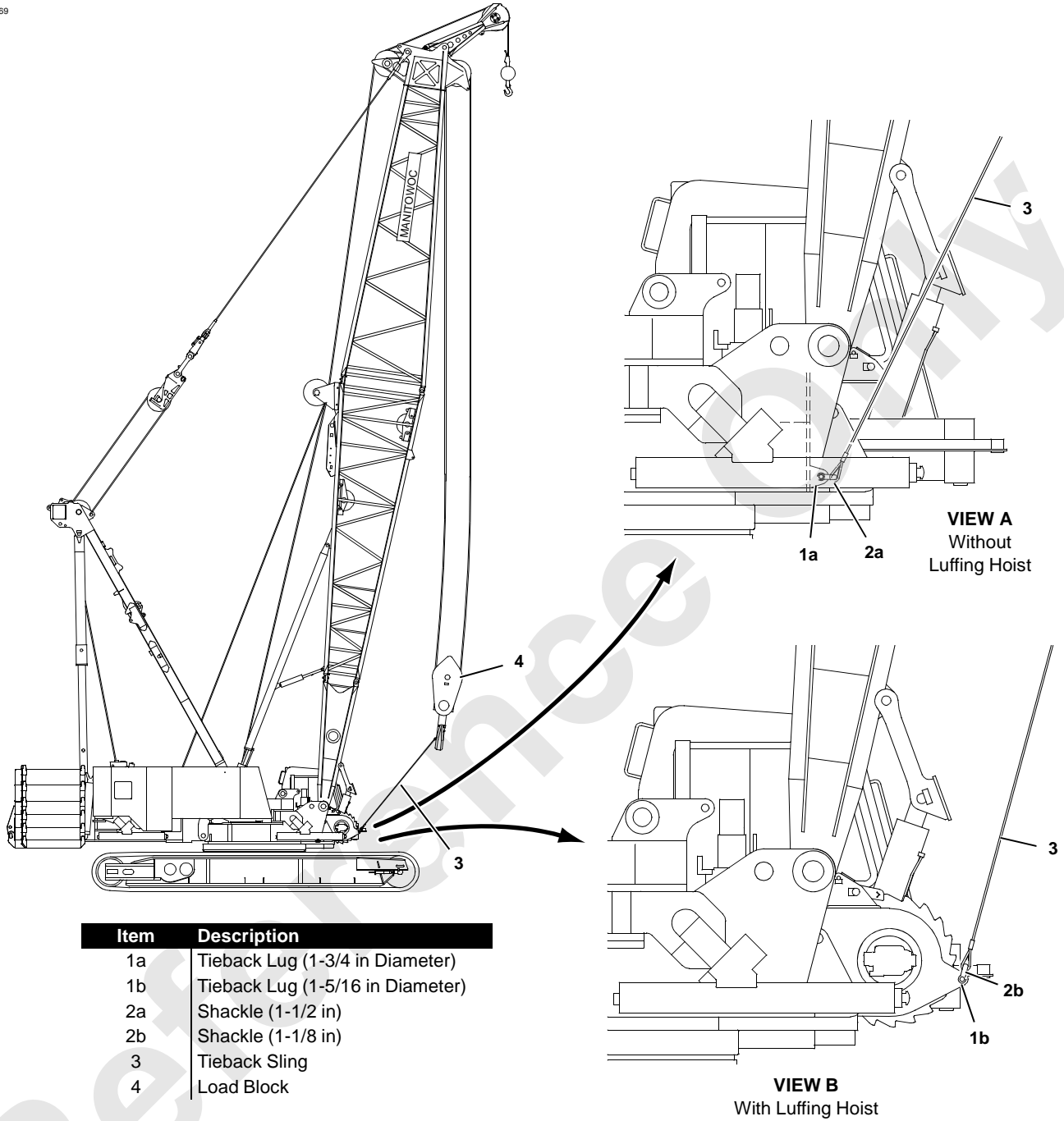


FIGURE 4-73

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LUBE AND COOLANT PRODUCT GUIDE

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INSPECTION AND MAINTENANCE CHECKLIST

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FIBERGLASS MAINTENANCE

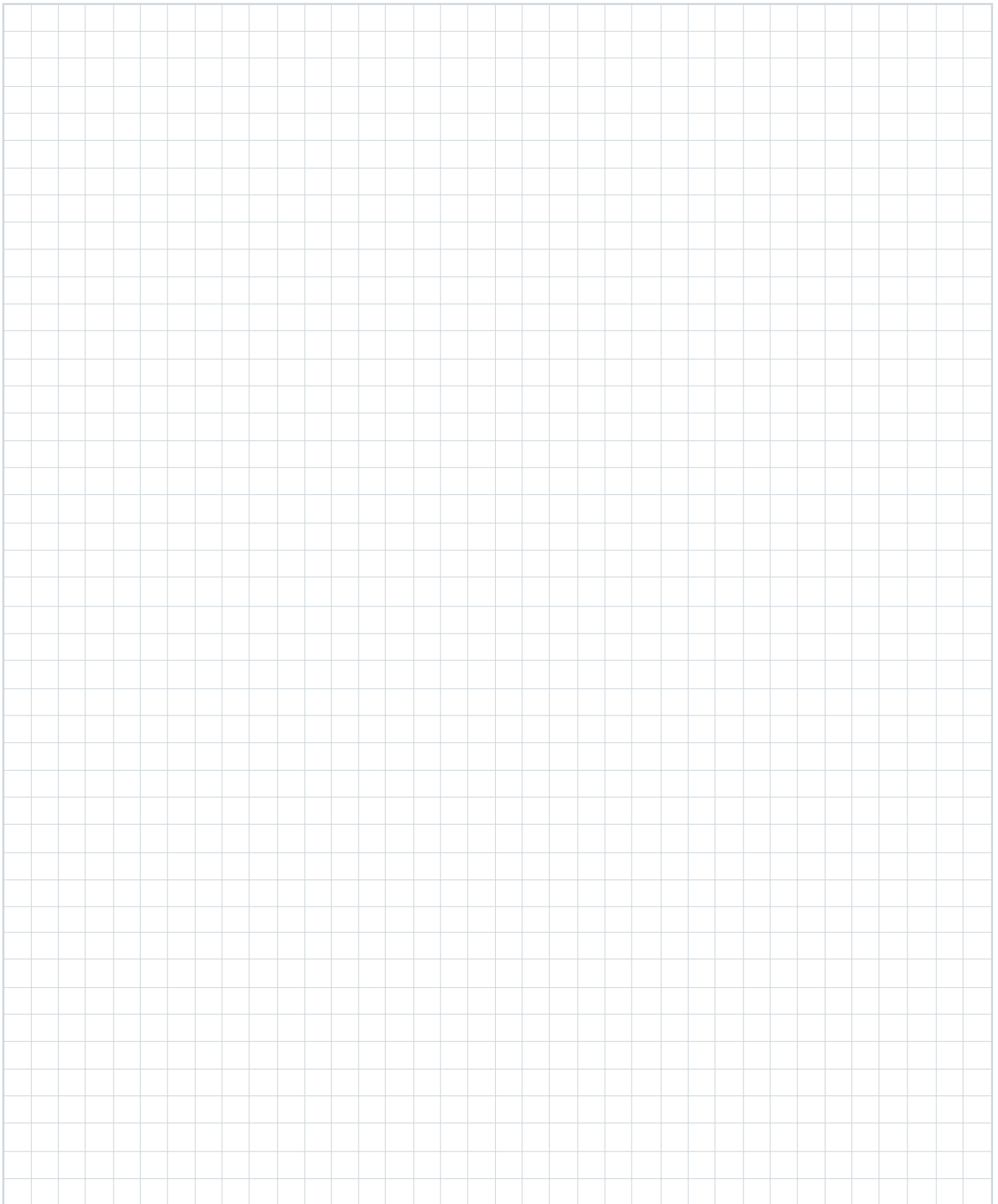
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Grove

Manitowoc

National Crane

Potain



Grove

Manitowoc

National Crane

Potain

