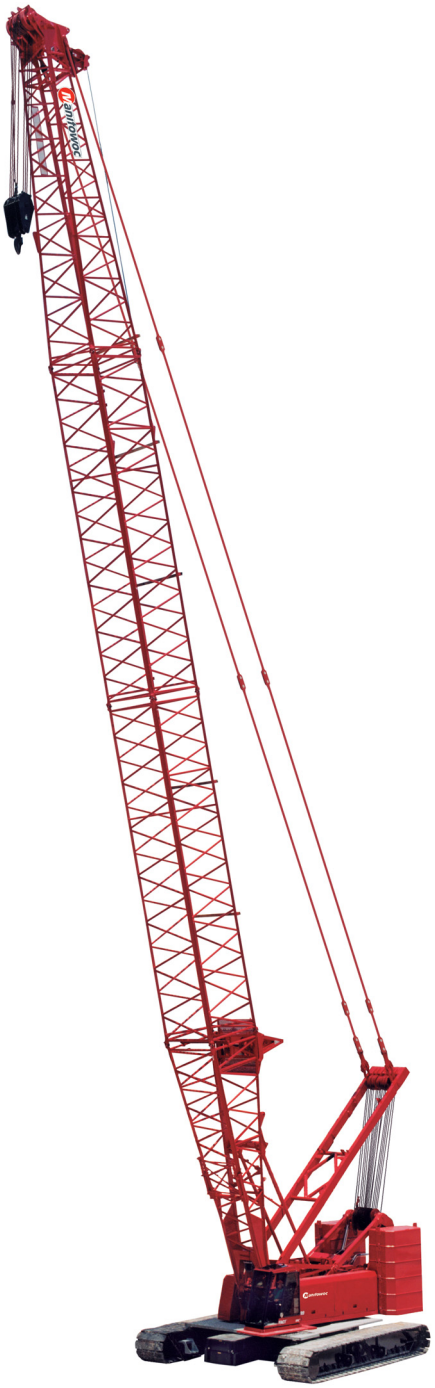
Manitowoc 999

Operator Manual
Luffing Jib Attachment



Grove Manitowoc National Crane Potain

Manitowoc

OPERATOR MANUAL

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

999

Luffing Jib Model Number

XXXXXRef

Luffing Jib Serial Number

This Manual is divided into the following sections:

NOTICE

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

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

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

⚠ WARNING

To prevent death or serious injury:

- Avoid unsafe operation and maintenance.

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

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

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THE ORIGINAL LANGUAGE OF THIS PUBLICATION IS ENGLISH

See end of this manual for Alphabetical Index

SECTION 1
INTRODUCTION

TABLE OF CONTENTS

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SECTION 1
INTRODUCTION

CRANE DATA

See end of this section for data specific to your luffing jib:

- Basic Specifications

CRANE/ATTACHMENT IDENTIFICATION

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

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

For the exact location of the identification labels on the crane and attachments, see the Nameplates and Decals Drawing at the end of Section 2.

See the end of this section for Luffing Jib weights.

CHANGE OF OWNERSHIP REGISTRATION

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

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

MANITOWOC DEALER

For questions about this manual or the 999 crane, contact your Manitowoc dealer. If you do not know the contact information for your dealer, locate the Manitowoc dealer nearest you, as follows:

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

CRANE ORIENTATION

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

- The boom is on the front of the upperworks.
- The carbody and crawler controls are on the front of the carbody.

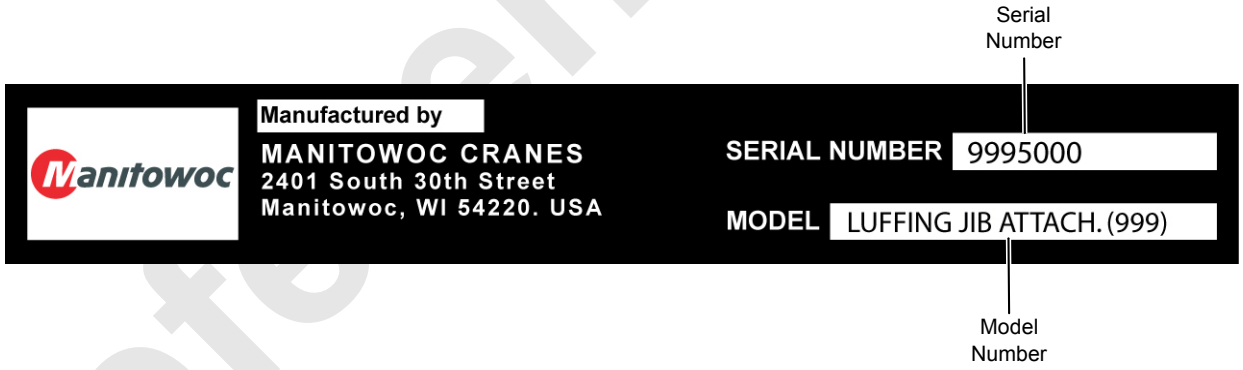
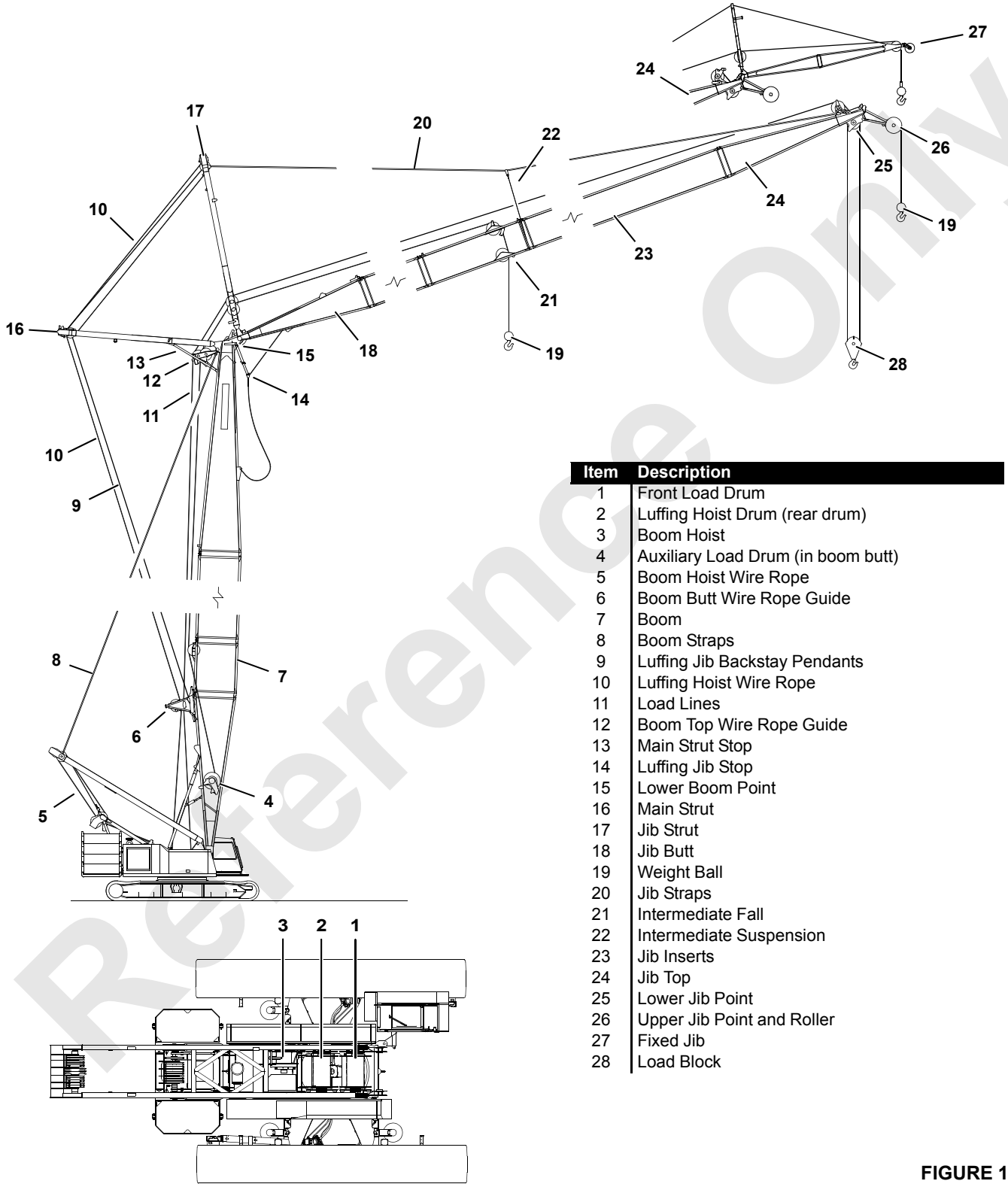


FIGURE 1-1

IDENTIFICATION OF LUFFING JIB COMPONENTS

See Figure 1-2 for identification of the luffing jib components. See Section 1 of the Crane Operator Manual for identification of crane components.



Item	Description
1	Front Load Drum
2	Luffing Hoist Drum (rear drum)
3	Boom Hoist
4	Auxiliary Load Drum (in boom butt)
5	Boom Hoist Wire Rope
6	Boom Butt Wire Rope Guide
7	Boom
8	Boom Straps
9	Luffing Jib Backstay Pendants
10	Luffing Hoist Wire Rope
11	Load Lines
12	Boom Top Wire Rope Guide
13	Main Strut Stop
14	Luffing Jib Stop
15	Lower Boom Point
16	Main Strut
17	Jib Strut
18	Jib Butt
19	Weight Ball
20	Jib Straps
21	Intermediate Fall
22	Intermediate Suspension
23	Jib Inserts
24	Jib Top
25	Lower Jib Point
26	Upper Jib Point and Roller
27	Fixed Jib
28	Load Block

FIGURE 1-2

CRANE AND LUFFING JIB WEIGHTS

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

	Weight Pounds	Weight Kilograms
LIFTCRANE - BOOM NO. 82:		
Upperworks and lowerworks complete, 48 in (1 219 mm) crawler treads, counterweight, gantry, backhitch, mast, fully rigged 70 ft (21,3 m) Boom No. 82 [including single sheave upper boom point, 8 sheave lower point, 3 sheave wire rope guide, lower wire rope guide, 250 Ton (227t) block, and 15 Ton (14t) hook and weight ball], boom stops and maximum length hoist and whip lines		
999 Series 1	349,420	158 494
999 Series 2	428,445	194 339
999 Series 3	499,465	226 553
UPPERWORKS MACHINERY MODULE WITH CARBODY:		
Carbody, upperworks with two full power drums, operator's cab, gantry, backhitch, mast, boom hoist wire rope, carbody jacking arrangement (optional), and maximum length hoist and whip lines - - - - - -	87,500	39 689
CRAWLERS:		
28 ft, 2 in (8 585 mm) crawler assembly with platforms, steps and 48 in (1 219 mm) treads (each) - -	43,260	19 622
COUNTERWEIGHT - UPPER:		
Box - Side (6 on 999 Series 1; 8 on Series 2; 10 on Series 3) with pins (each)	17,500	7 937
Box - Center - - - - - -	23,500	10 659
Tray - Lower counterweight - - - - - -	21,050	9 548
Total upperworks counterweight 999 Series 1	149,600	67 857
999 Series 2	184,600	83 733
999 Series 3	219,600	99 608
COUNTERWEIGHT - UPPER — LOW-PROFILE:		
Box - Side (12 required) with pins (each)	14,485	6 570
Box - Center - - - - - -	23,500	10 659
Tray - Lower counterweight - - - - - -	21,050	9 548
Total upperworks counterweight - 999 Series 3 only	219,600	99 608
COUNTERWEIGHT - LOWER:		
Carbody Counterweight (2 on Series 2, 4 on Series 3) (each)		
Upper Box	18,000	8 164
Lower Box	22,000	9 979
GANTRY:		
10 ft, 2-3/4 in (3 118 mm) Gantry (with nylon sheaves)	4,430	2 009
Backhitch cylinders and pins (each) - -	1,030	467
Counterweight handling links and pins (each)	155	70
MAST FOR BOOM NO. 82:		
30 ft (9 144 mm) mast (with nylon sheaves)	5,100	2 313
Pendant link on mast (each) - - - - - -	155	70

	Weight	
	Pounds	Kilograms
2 ft, 2 in (0,7 m) link (each) with pin	115	52
8-1/2 in (216 mm) link (each) with pin	45	20
9 ft, 1-1/4 in (2,8 m) strap (each)	120	54
BOOM NO. 82:		
30 ft (9,1 m) butt	6,615	3 000
40 ft (12,2 m) top (with 8 sheave lower point and 3 sheave wire rope guide)	11,230	5 093
10 ft (3,0 m) insert with wire rope guide	2,270	1 029
10 ft (3,0 m) insert	1,820	825
20 ft (6,1 m) insert (with jib backstay lugs)	2,530	1 147
40 ft (12,2 m) insert	4,400	1 995
40 ft (12,2 m) insert (with jib backstay lugs)	4,430	2 009
37 ft, 7-1/4 in (11,5 m) basic strap with link (each)	445	201
10 ft (3,0 m) strap with link (each)	160	72
20 ft (6,1 m) strap with link (each)	275	124
40 ft (12,2 m) strap with link (each)	480	217
Upper boom point (single sheave)	920	417
Wire rope guide (top)	1,845	836
Wire rope anchor	285	129
Wire rope roller assembly (auxiliary drum)	335	151
Wire rope guide (butt)	2,490	1 129
Boom stop assembly (each side)	765	346
JIB NO. 134:		
15 ft (4,6 m) butt	580	263
15 ft (4,6 m) top (with jib point)	990	449
10 ft (3,0 m) insert	350	158
20 ft (6,1 m) insert	580	263
30 ft, 9 in (9,4 m) basic pendant (each)	115	52
9 ft, 6 in (2,9 m) pendant (each)	65	29
19 ft (5,8 m) pendant (each)	85	38
12 ft, 6 in (3,8 m) strut with sheave	665	301
Backstay link (each) attached to strut	25	11
Backstay tie link	10	4
Backstay link (each)	65	29
Backstay spreader	50	22
44 ft, 7 in (13,6 m) backstay pendant (each)	150	68
4 ft, 8 in (1,4 m) backstay pendant (each)	50	22
Backstay link (each) attached to boom insert	20	9
Jib stop assembly	175	79
Wire rope anchor	70	31
Winch	35	15
Load sensor	110	49
Jib adaptor (required for No. 82LR boom)	400	181
LUFFING JIB NO. 149:		
25 ft (7,6 m) butt	3,275	1 485
25 ft (7,6 m) top (with main and upper jib point, wire rope guide, hand winch, and strap links)	5,875	2 664
10 ft (3,0 m) insert	1,060	480
20 ft (6,1 m) insert	1,710	775
20 ft (6,1 m) intermediate fall insert	2,665	1 208
40 ft (12,2 m) insert	2,995	1 358

	Weight	
	Pounds	Kilograms
Intermediate fall assembly including wire rope guide	645	292
21 ft, 9-1/2 in (6,6 m) basic strap (each)	185	83
10 ft (3,0 m) strap with link (each)	110	49
20 ft (6,1 m) strap with link (each)	185	83
40 ft (12,2 m) strap with link (each)	335	151
Intermediate suspension arrangement required without intermediate fall (complete)	90	40
Intermediate suspension arrangement required with intermediate fall (complete)	55	24
30 ft, 6 in (9,3 m) jib strut with guide sheaves, luffing sheaves, and links	4,450	2 018
26 ft, 6 in (8,1 m) main strut with luffing sheaves and links	3,785	1 716
LUFFING JIB NO. 149:		
Backstay spreader link with pins	90	40
7 ft, 1 in (2,2 m) backstay spreader strap (each) with pin	80	36
Backstay spreader beam	180	81
9 ft, 5 in (2,9 m) backstay strap (each)	95	43
Adjustable link (each) with pin	85	38
20 ft (6,0 m) basic backstay strap (each)	160	72
10 ft (3,0 m) strap with link (each)	110	49
20 ft (6,1 m) strap with link (each)	185	83
40 ft (12,2 m) strap with link (each)	335	151
15-1/2 in (0,4 m) backstay link (each) attached to boom (with pin)	50	22
Rope guide on boom top	1,245	564
Jib stop assembly	730	331
Main strut stop assembly	325	147
Wire rope guide on jib top	405	183
Luffing jib hinge pin (each)	25	11
MACHINE OPTIONS:		
Carbody jacking (each)	720	326
BOOM NO. 82 OPTIONS:		
Upper boom point assembly	920	417
Auxiliary drum assembly in boom butt	3,670	1 664
Wire rope guide (10 ft (3,0 m) insert - required with auxiliary drum)	450	204
Boom assembly ladder storage	30	13
Wire rope guide assembly (boom top)	625	283
Wire rope guide support assembly	505	229
Boom butt support assembly	265	120
LOAD BLOCK AND HOOK AND WEIGHT BALL OPTIONS:		
15 ton (14t) hook and weight ball	1,310	594
30 ton (27t) load block with 500 lb (227 kg) of weight plates	2,000	907
45 ton (41t) load block	2,600	1 179
60 ton (54t) load block	2,825	1 281
100 ton (91t) load block	3,900	1 769
155 ton (141t) load block	4,660	2 113
200 ton (181t) load block	5,600	2 540
230 ton (209t) load block (Boom No. 22EL)	5,660	2 567
250 ton (227t) load block (Boom No. 82)	6,050	2 744

WIRE ROPE:

Boom Hoist

	Weight Pounds	Kilograms
1060 ft (323 m) of 7/8 in (22 mm) wire rope - 1.50 lb per ft (2,23 kg/m)	1,590	721
Luffing Jib Hoist - No. 149 Luffing Jib		
900 ft (274 m) of 1 in (25,4 mm) wire rope - 2.00 lb per ft (2,98 kg/m)	1,800	816
Load Lines - Rotation resistant wire rope		
26 mm - 2.13 lb per ft (3,17 kg/ m)		
1625 ft (495 m) No. 82, 82LR, or 22EL Boom	3,460	1 569
1600 ft (488 m) No. 22E Boom	3,410	1 546
1250 ft (381 m) No. 135 Luffing Jib	2,665	1 208
1450 ft (442 m) No. 149 Luffing Jib	3,090	1 401
26 mm - 2.39 lb per ft (3,56 kg/ m)		
1625 ft (495 m) No. 82, 82LR or 22EL Boom	3,885	1 762
1600 ft (488 m) No. 22E Boom	3,825	1 734
1250 ft (381 m) No. 135 Luffing Jib	2,990	1 356
1450 ft (442 m) No. 149 Luffing Jib	3,465	1 571
Alternate Load Lines - Conventional wire rope		
26 mm - 1.94 lb per ft (2,89 kg/m)		
1625 ft (495 m) No. 82, 82LR or 22EL Boom	3,155	1 431
1600 ft (488 m) No. 22E Boom	3,105	1 408
1250 ft (381 m) No. 135 Luffing Jib	2,425	1 099
1450 ft (442 m) No. 149 Luffing Jib	2,815	1 276
Whip Lines		
26 mm - 2.13 lb per ft (3,17 kg/m)		
1010 ft (308 m) No. 82 or No. 22EL Boom	2,150	975
950 ft (290 m) No. 22E Boom	2,025	918
1130 ft (344 m) No. 82LR Boom	2,410	1 093
890 ft (271 m) No. 138 Fixed Jib on No. 135 Luffing Jib	1,895	859
1400 ft (427 m) No. 149 Luffing Jib	2,980	1 351
26 mm - 2.39 lb per ft (3,56 kg/m)		
1010 ft (308 m) No. 82 or No. 22EL Boom	2,415	1 095
950 ft (290 m) No. 22E Boom	2,270	1 029
1130 ft (344 m) No. 82LR Boom	2,700	1 224
890 ft (271 m) No. 138 Fixed Jib on No. 135 Luffing Jib	2,125	963
1400 ft (427 m) No. 149 Luffing Jib	3,345	1 517
Alternate Whip Lines - Conventional wire rope		
26 mm - 1.94 lb per ft (2,89 kg/m)		
1010 ft (308 m) No. 82 or No. 22EL Boom	1,960	889
950 ft (290 m) No. 22E Boom	1,845	836
1130 ft (344 m) No. 82LR Boom	2,190	993
890 ft (271 m) No. 138 Fixed Jib on No. 135 Luffing Jib	1,725	782
1400 ft (427 m) No. 149 Luffing Jib	2,715	1 231
Auxiliary Lines		
26 mm - 2.13 lb per ft (3,17 kg/m)		
1010 ft (308 m) No. 82 or 22EL Boom	2,150	975
1130 ft (344 m) No. 82LR Boom	2,410	1 093
1600 ft (488 m) No. 82E Boom	3,410	1 546
1500 ft (457 m) No. 135 Luffing Jib	3,195	1 449
2025 ft (617 m) No. 82 or No. 22EL Boom with No. 135 or 149 Luffing Jib attached	4,315	1 957
890 ft (271 m) No. 138 Fixed Jib on No. 135 Luffing Jib	1,895	859
1050 ft (320 m) No. 149 Luffing Jib Intermediate Fall	2,235	1 013

	Weight Pounds	Weight Kilograms
WIRE ROPE:		
26 mm - 2.28 lb per ft (3,39 kg/m)		
1010 ft (308 m) No. 82 or 22EL Boom	2,305	1 045
1130 ft (344 m) No. 82LR Boom	2,575	1 168
1600 ft (488 m) No. 82E Boom	3,650	1 655
1500 ft (457 m) No. 135 Luffing Jib	3,420	1 551
2025 ft (617 m) No. 82 or No. 22EL Boom with No. 135 or 149 Luffing Jib attached	4,615	2 093
890 ft (271 m) No. 138 Fixed Jib on No. 135 Luffing Jib	2,030	920
1050 ft (320 m) No. 149 Luffing Jib Intermediate Fall	2,395	1 086
1 in. - 2.03 lb per ft (3,02 kg/m)		
1010 ft (308 m) No. 82 or 22EL Boom	2,050	929
1130 ft (344 m) No. 82LR Boom	2,295	1 040
1600 ft (488 m) No. 82E Boom	3,250	1 474
1500 ft (457 m) No. 135 Luffing Jib	3,045	1 381
2025 ft (617 m) No. 82 or No. 22EL Boom with No. 135 or 149 Luffing Jib attached	4,110	1 864
890 ft (271 m) No. 138 Fixed Jib on No. 135 Luffing Jib	1,805	818
1050 ft (320 m) No. 149 Luffing Jib Intermediate Fall	2,130	966
Alternate Auxiliary Lines - Conventional wire rope		
26 mm - 1.94 lb per ft (2,89 kg/m)		
1010 ft (308 m) No. 82 or 22EL Boom	1,960	889
1130 ft (344 m) No. 82LR Boom	2,190	993
1600 ft (488 m) No. 82E Boom	3,105	1 408
1500 ft (457 m) No. 135 Luffing Jib	2,910	1 319
2025 ft (617 m) No. 82 or No. 22EL Boom with No. 135 or 149 Luffing Jib attached	3,930	1 782
890 ft (271 m) No. 138 Fixed Jib on No. 135 Luffing Jib	1,725	782
1050 ft (320 m) No. 149 Luffing Jib Intermediate Fall	2,035	923
1 in. - 1.85 lb per ft (2,75 kg/m)		
1010 ft (308 m) No. 82 or 22EL Boom	1,870	848
1130 ft (344 m) No. 82LR Boom	2,090	948
1600 ft (488 m) No. 82E Boom	2,960	1 342
1500 ft (457 m) No. 135 Luffing Jib	2,775	1 258
2025 ft (617 m) No. 82 or No. 22EL Boom with No. 135 or 149 Luffing Jib attached	3,745	1 698
890 ft (271 m) No. 138 Fixed Jib on No. 135 Luffing Jib	1,645	746
1050 ft (320 m) No. 149 Luffing Jib Intermediate Fall	1,945	882

ENGLISH AND METRIC CONVERSIONS

Direct Conversion

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

12 ft x 0.3048 = 3,6576 m

Inverse Conversion

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

3,6576 m ÷ 0.3048 = 12

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

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

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SECTION 2
SAFETY INFORMATION

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SECTION 2
SAFETY INFORMATION

WARNING

California Proposition 65

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

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

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

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 the Manitowoc Crane Care Lattice Team.

NAMEPLATES AND DECALS

See drawing at the end of this section.

SAFETY MESSAGES

General

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

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

Safety Alert Symbol

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

Signal Words

DANGER

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

WARNING

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

CAUTION

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

CAUTION

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

NOTE: Highlights operation or maintenance procedures.

Symbol Identification

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

Table 2-1 Common Safety Symbols

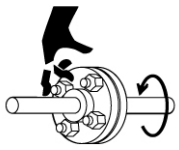
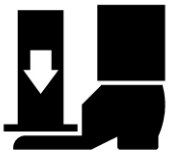
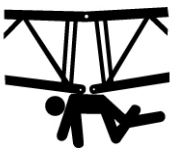
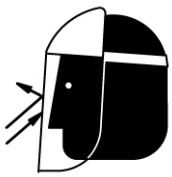
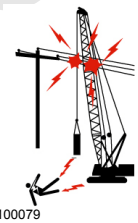
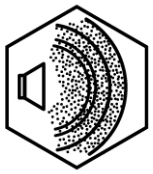
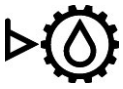
Cut or Crush Hazards					Cut Hazard
 M100090	 M100091	 M100066	 M100065	 M100069	 M100067
Crush Hazards					Fire Extinguisher
 M100070	 M100071	 M100072	 M100073	 M100074	 M100082
Fall Hazards			Falling Boom (Crush) Hazards		Explosion Hazard
 M100083	 M100084	 M100085	 M100068	 M100075	 M100080
Falling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

SAFETY AND INFORMATION SIGNS

Maintaining Signs

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

Ordering Signs

Order replacement safety and information signs from your Manitowoc dealer.

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

Item	Description
1	Steps
2	Platforms (front and rear)
3	Platforms (side)
4	Catwalk (operator's cab)
5	Ladder (behind door)
6	Enclosure Doors
7	Platform (between drums)
8	Tool Storage Compartment (front corner of right enclosure)
	Non-Skid Surfaces
	Platforms and Steps

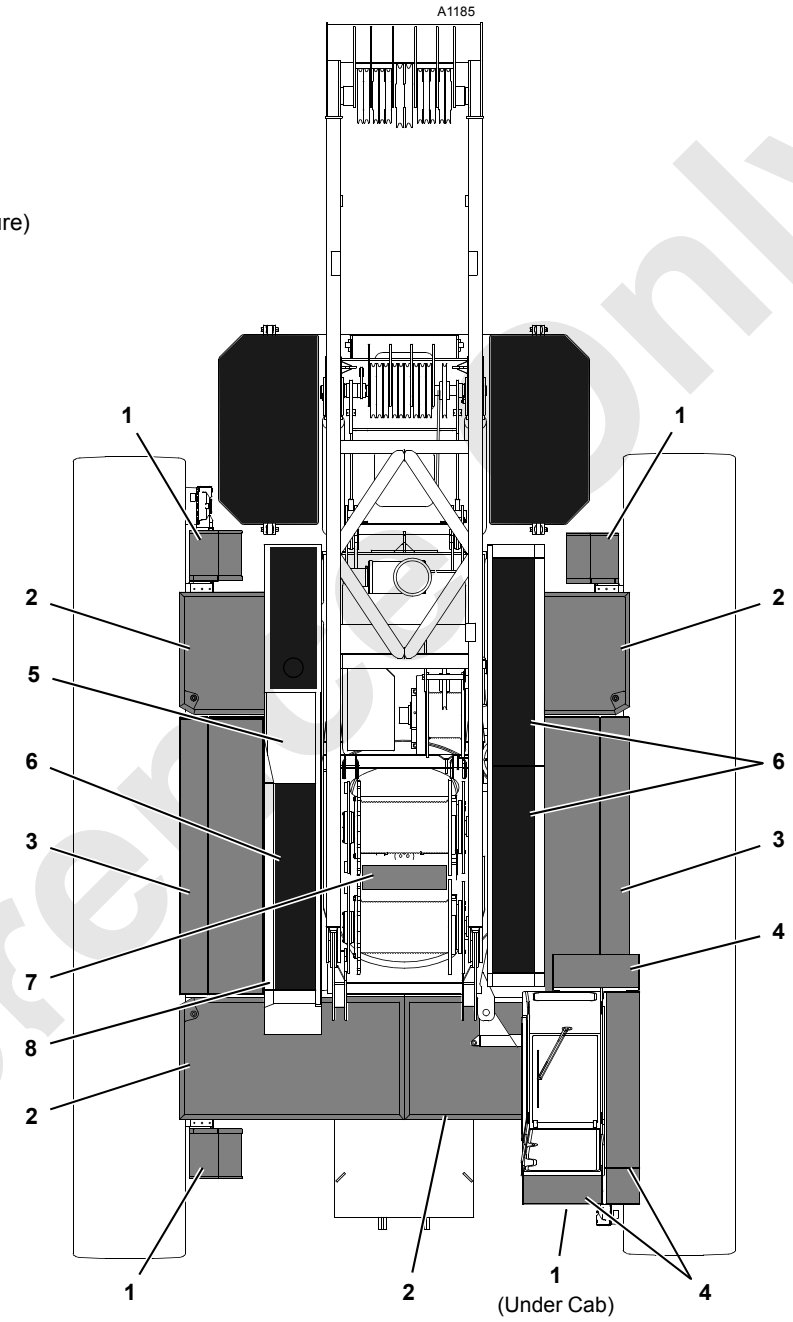


FIGURE 2-1

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.
- 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.
- If equipped, 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, platforms, and catwalks at the locations shown in Figure 2-1.

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

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

- Access points must be kept clear to prevent personal injury and unsafe operation of 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 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.***

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

OPERATOR MANUAL/CAPACITY CHART STORAGE

General

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

- Operator Manual (Serial Numbered)
  Contains safety information, crane specifications, assembly/erection procedures, operating instructions, lubrication and maintenance checks.
- Parts Manual (Serial Numbered)
  Contains illustrations and part numbers of replaceable parts.
- Capacity Chart Manual (Serial Numbered)
  Contains lifting capacities and related information (wire rope specifications, drum and lagging information, etc.)
- Maintenance Checks and Lube Guide
  Contains lists of maintenance checks and lube services and their prescribed intervals.
- Rated Capacity Indicator/Limiter Operation
  Contains Load capacity operation and calibration procedures.
- Service Manual (Serial Numbered)
  Contains theory of operation, maintenance procedures, crane and wire rope inspection procedures, troubleshooting information, and shop procedures.

The manuals which must be retained in the operator's cab (Operator Manual, Capacity Charts, Maintenance Checks and Lube Guide, and RCL Operation) are supplied in an OPERATOR INFORMATION binder. A separate binder is provided for the crane and each applicable attachment.

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

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

If the serial numbers of your manuals and capacity charts do not match the serial numbers of the crane or attachment, contact your Manitowoc Dealer for the proper manual or capacity charts.

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

Storing Manuals

Store a copy of the Operator Manual for the crane and each applicable attachment in the holder provided in the Operator's cab (Figure 2-2).

Attach the chain from the manual in use to the link behind the operator's seat.

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

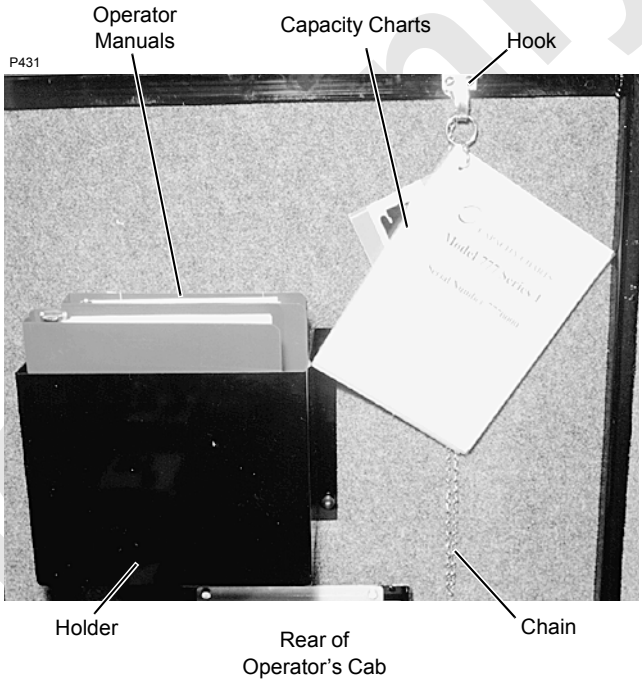


FIGURE 2-2

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 in safe operation. Manitowoc cannot foresee all hazards that will arise in the field. Therefore, ***safety remains responsibility of crane operators and owner.***

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

Read Operator Manual

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

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

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

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

Operator Qualifications

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

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

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

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

Operator training and qualification is crane owner's responsibility.

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

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

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

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

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

Operator Conduct

1. Operator shall not engage in any practice which diverts his/her attention while operating crane.
2. Operator shall not operate crane when physically or mentally unfit.
3. Operator shall be responsible for all operations under his/her direct control. When safety of an operation is in doubt, operator shall stop the crane's functions in a controlled manner. Lift operations must resume only after safety concerns have been addressed or the continuation of crane operations is directed by the lift supervisor.
4. 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, crane must not be operated until unsafe conditions have been corrected.
5. If there is a warning sign at start controls, operator shall not start engine until warning sign has been removed by 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 position and all brakes and locking devices are applied or engaged.
   c. All personnel are clear of crane. Deploy a swing radius barrier.
7. Operator shall test all controls, limits, and communication systems at start of each shift. Any defects found must be corrected before operation is begun.

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 must not be loaded beyond applicable static or dynamic ratings given on 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.

8. 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 lift. ***Operator shall obey a stop signal at all times, no matter who gives it***.

10. Operator shall verify that the capacity chart being used is the correct one for how the crane is equipped (boom length, load line reeving, counterweight, etc.).

11. Operator shall verify that:

a. All attachments are properly assembled and attached to the crane according to the rigging drawings called for on the capacity chart.

b. The counterweight — to include applicable auxiliary counterweight — is in place and of proper weight. ***Maximum required counterweight must not be exceeded***.

WARNING

Moving Load/Tipping Crane Hazard!

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

12. Operator shall perform the following operations before leaving 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 boom onto blocking at ground level or onto a boom rest if possible.

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

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

e. Move all controls to off.

f. Apply all drum brakes and pawls.

g. Disengage master clutch, if equipped.

h. Stop engine.

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

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

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

b. Apply all brakes and locking devices.

c. Move all controls to off.

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

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

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

Never operate the crane during an electrical thunderstorm.

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

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

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

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

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

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

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

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

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

Handling Load

Size of Load

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

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

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

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

The operator's judgment shall be used to further reduce total 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 must take priority over RCI/RCL readings.

Attaching Load

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

a. Inspect each hook and latch before using.

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

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

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

2. Only use slings and other rigging that are in safe operating condition and have a rating equal to or greater than the load to be lifted.

3. Do not wrap the load line around the load.

4. Use suitable protection between slings and any sharp edges on the load. When synthetic slings are used, the synthetic sling manufacturer's instructions, limitations, specifications, and recommendations must be followed.

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

Lifting/Moving Load

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

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

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

For ground bearing data go to:
www.manitowoccranes.com

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 must be blocked or cribbed before personnel are allowed to work under or between them.

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

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

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

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

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

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

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

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

m. Do not lower the load or the boom to a point where less than three full wraps of wire rope 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 must be in accordance with the designated person's decision.

b. Maintain specified tire pressures (truck cranes).

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

Multiple Load Line Operation

WARNING

Avoid Over Load and Side Load Damage to Crane

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

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

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

1. The qualified lift planner and 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 must be thoroughly inspected by a qualified person prior to setup.

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

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

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

Operator is still responsible for knowing load and radius whether or not 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 and the load being lifted.
- The load must remain centered on the boom and jib point shafts unless special lift approval is granted by Manitowoc.
- The load lines should be located over the load's center of gravity as it is supported on a trailer, a barge, or the ground.

8. The crane operator shall be familiar with the operational characteristic of the crane as it relates to multiple drum

operation (simultaneous operation, same or opposite direction, or individual operation).

9. When using tandem drums, the maximum operating layers may be limited depending on whether the crane was initially designed for tandem drum operation or not.
10. Load shift when lifting with two hooks may be more unpredictable than typical one hook lifting.

Holding Load

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

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

SIGNALS

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

SAFETY DEVICES

WARNING

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

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

Manitowoc provides the following safety devices on its cranes:

1. Horn activated by a switch on the control console in the operator's cab

   If the horn is not working properly, it must be tagged-out or removed, if possible.
2. Crane level indicator: either electronic (viewable in crane's electronic display) or mechanical (viewable from operator's cab seat). If the crane level indicator is not working properly, it must be tagged-out or removed, if possible.
3. Cranes operating on a barge require: a trim indicator, a swing brake, and a wind direction indicator if the wind is a factor (supplied by crane owner or user).
4. Boom stops, both physical and automatic

   If a boom stop is damaged or not working properly, it must be tagged-out or removed if possible.

5. Jib stops, both physical and automatic (for fixed jib and luffing jib)

   If a jib stop is damaged or not working properly, it must be tagged-out or removed, if possible.

6. Pedal locks for all foot-operated brakes (if applicable)

   If a pedal lock is damaged or not working properly, it must be tagged-out or removed if possible.

7. An integral holding device or check valve on each jacking cylinder

OPERATIONAL AIDS

WARNING

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

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

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

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

Category 1 Operational Aids

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

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

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

   Temporary alternative measures if inoperative or malfunctioning:

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

   a. Measure radius using a tape measure.

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

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

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

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

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

   Temporary alternative measures if inoperative or malfunctioning:

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

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

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

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

1. **Rated Capacity Indicator/Limiter**

   Temporary alternative measures if inoperative or malfunctioning:

   The qualified person directing the lift shall establish procedures for determining load weights and shall make

sure that the weight of the load does not exceed the crane's rating at the radius where the load is handled.

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

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

   Temporary alternative measures if inoperative or malfunctioning:

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

   The safest way to avoid electrocution is to stay away from electrical power lines and electrical power sources.
5. The operator is responsible for alerting all personnel to the dangers associated with electrical power lines and equipment. The crane is not insulated. Do not allow unnecessary personnel in the vicinity of the crane while operating. Permit no one to lean against or touch the crane. Permit no one, including riggers and load handlers, to hold the load, load lines, taglines, or rigging gear.
6. Even if the 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 must be deenergized OR,
   - Tests must be made to determine if an electrical charge will be induced into the crane or load.
   - The crane must be provided an electrical ground.
   - If taglines are used, they must be non-conductive.
   - Every precaution must be taken to dissipate induced voltages. Consult with a qualified RF (radio frequency) Consultant. Also refer to local, state, and federal codes and regulations.

Electrocution Hazard Devices

1. The use of insulated links, insulated boom cages/guards, proximity warning devices, or mechanical limit stops does not ensure that electrical contact will not occur. Even if codes or regulations require the use of such devices, failure to follow the rules in this section may result in serious injury or death.
2. Be aware that such devices have limitations and you should follow the rules and precautions outlined in this section at all times even if the crane is equipped with these devices.
3. Insulating links installed into the load line afford limited protection from electrocution hazards. Links are limited in their lifting abilities, insulating properties, and other properties that affect their performance. Moisture, dust, dirt, oils, and other contaminants can cause a link to conduct electricity. Due to their capacity ratings, some links are not effective for large cranes and/or high voltages/currents.
4. The only protection that may be afforded by an insulated link is below the link (electrically downstream), provided the link has been kept clean, free of contamination, has not been scratched or damaged, and is periodically tested (just before use) for its dielectric integrity.

5. Boom cages and boom guards afford limited protection from electrocution hazards. They are designed to cover only the boom nose and a small portion of the boom. Performance of boom cages and boom guards is limited by their physical size, insulating characteristics, and operating environment (dust, dirt, moisture, etc.). The insulating characteristics of these devices can be compromised if not kept clean, free of contamination, and undamaged.
6. Proximity sensing and warning devices are available in different types. Some use boom point (localized) sensors and others use full boom length sensors. No warning may be given for components, cables, loads, and other attachments located outside of the sensing area. Reliance is placed upon the operator in selecting and properly setting the sensitivity of these devices.
7. Never rely solely on a device to protect you and your fellow workers from danger.

   Some variables you shall know and understand are:

   - Proximity devices are advertised to detect the existence of electricity and not its distance, quantity, or magnitude.
   - Some proximity devices may detect only alternating current (AC) and not direct current (DC).
   - Some proximity devices detect radio frequency (RF) energy and others do not.
   - Most proximity devices simply provide a signal (audible, visual, or both) for the operator and this signal must not be ignored.
   - Sometimes the sensing portion of the proximity devices becomes confused by complex or differing arrays of power lines and power sources.
8. DO NOT depend on grounding. Grounding of a crane affords little or no protection from electrical hazards. The effectiveness of grounding is limited by the size of the (wire) conductor used, the condition of the ground, the magnitude of the voltage and current present, and numerous other factors.

Electrical Contact

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

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

   Only as a last resort should an operator attempt to leave the crane upon contacting a power source. If it is absolutely necessary to leave the cab, JUMP COMPLETELY CLEAR OF CRANE. DO NOT STEP OFF. Hop away with both feet together. DO NOT walk or run.
5. Following any contact with an energized electrical source, your Manitowoc Dealer must be immediately advised of the incident and consulted on necessary inspections and repairs.

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

REFUELING

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

FIRE EXTINGUISHERS

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

ACCIDENTS

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

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

Phone: 920-684-6621

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

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

SAFE MAINTENANCE

WARNING

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

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

Maintenance Instructions

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

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

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

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

Safe Maintenance Practices

1. Perform the following steps (as applicable) before starting a maintenance procedure:
   a. Park the crane where it will not interfere with other equipment or operations.
   b. Lower all loads to the ground or otherwise secure them against movement.
   c. Lower the boom onto blocking at ground level, if possible, or otherwise secure the boom against dropping.
   d. Move all controls to off and secure all functions against movement by applying or engaging all brakes, pawls, or other locking devices.
   e. Stop the engine and render the starting means inoperative.
   f. Place a warning sign at the start controls alerting other personnel that the crane is being serviced and the engine must not be started. ***Do not remove sign until it is safe to return 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 inflater, and an extension hose which permits standing well away from the tire.
22. Only use cleaning solvents which are non-volatile and non-flammable.
23. Do not attempt to lift heavy components by hand. Use a hoist, jacks, or blocking to lift components.
24. Use care while welding or burning on the crane. Cover all hoses and components with non-flammable shields or blankets to prevent a fire or other damage.
25. To prevent damage to crane parts (bearings, cylinders, swivels, slewing ring, computers, etc.), perform the following steps ***before welding on 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.

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BOOM DISASSEMBLY SAFETY

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

DANGER!

Collapsing Boom Hazard!

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

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

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

- Workers are not familiar with equipment or are not properly trained.
- Disassembly area is not suitable.
- Safe procedures are overlooked because not enough time is allocated for 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 shall be trained and experienced in the operation and disassembly of construction cranes. Everyone shall read and understand these instructions, the information in the Boom Assembly Drawing, and the instructions in Section 4 before beginning disassembly. Anyone who has a question should ask for an explanation. ***One worker who does not fully understand or fails to follow correct procedures can endanger other workers.***

Location

Select a suitable location for boom disassembly. It must be firm, level, and 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.

Pin Removal

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

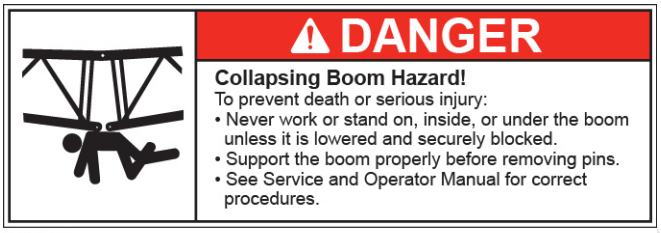

FIGURE 2-3

Disassembly Precaution — #82 Boom

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

DANGER

Collapsing Boom Hazard!

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

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

DANGER

Falling Boom Hazard!

Crane can tip or boom can collapse if excess boom is cantilevered. Never cantilever more boom than allowed in rigging drawings or capacity charts.

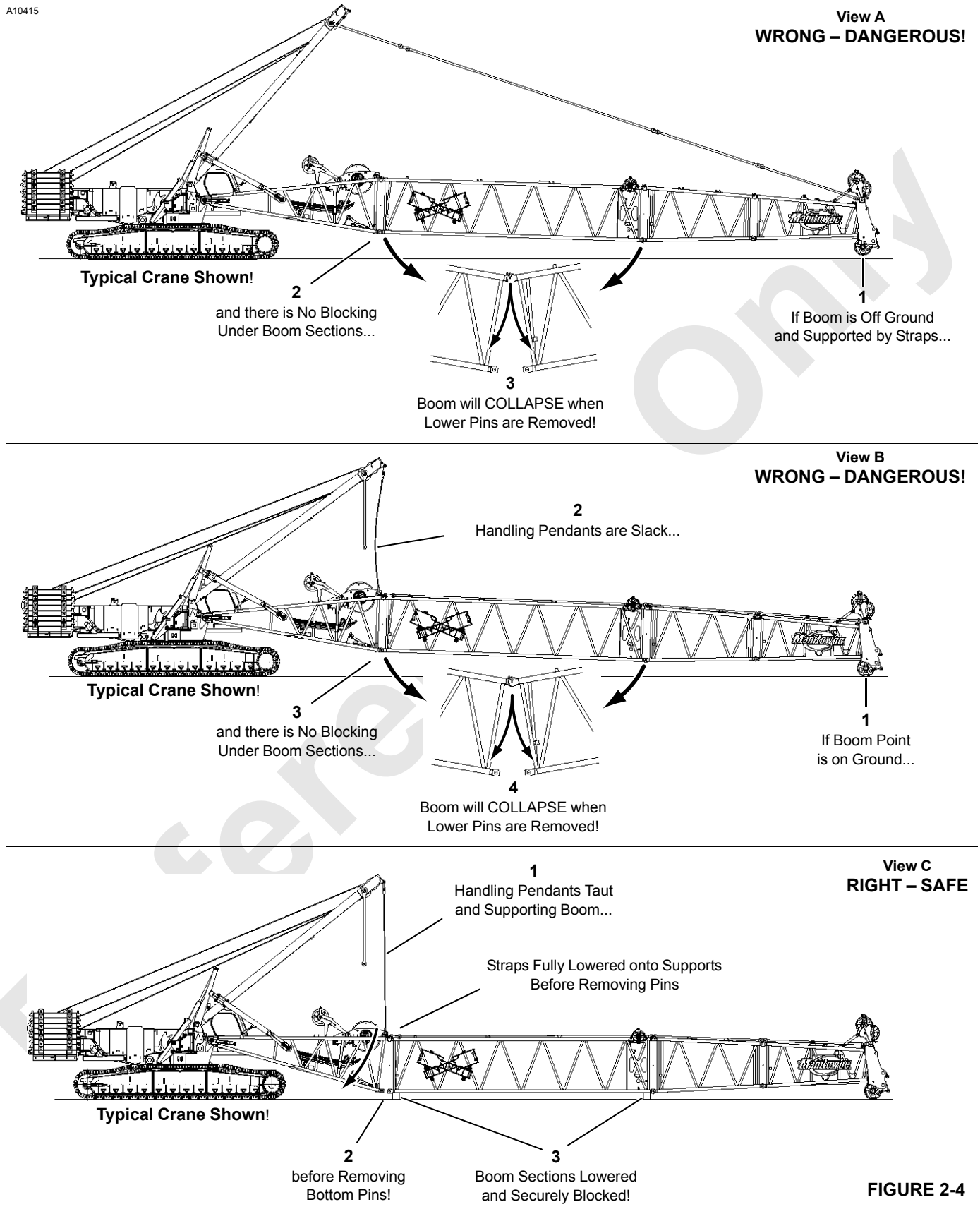

FIGURE 2-4

Disassembly Precaution — #22E/22EL Boom

See Figure 2-5 in the following procedure.

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

DANGER

Collapsing Boom Hazard!

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

- Never remove any pin until the boom is lowered and securely blocked.
- Never work or stand under or inside boom.
- Do not stand or walk on top of boom.
- Remove pins from outside of boom.

Lower boom onto blocking on the ground. Block boom sections on both sides of each connection.

If boom to be disassembled is not cantilevered, pay out boom hoist line so that line is slack. As long as all boom sections are securely blocked, top and bottom connecting pins can be safely removed. Boom can collapse, however, if a section is not blocked and pins are removed.

DANGER

Tipping Hazard!

Crane can tip if excess boom is cantilevered. Never cantilever more boom than allowed on rigging drawings and capacity charts.

If a cantilevered boom is disassembled, boom sections ahead of boom hoist connection must be blocked before removing pins. Boom will collapse if upper pins are removed and boom sections are not blocked. Boom will also collapse if lower pins behind boom hoist connection are removed and sections are not blocked.

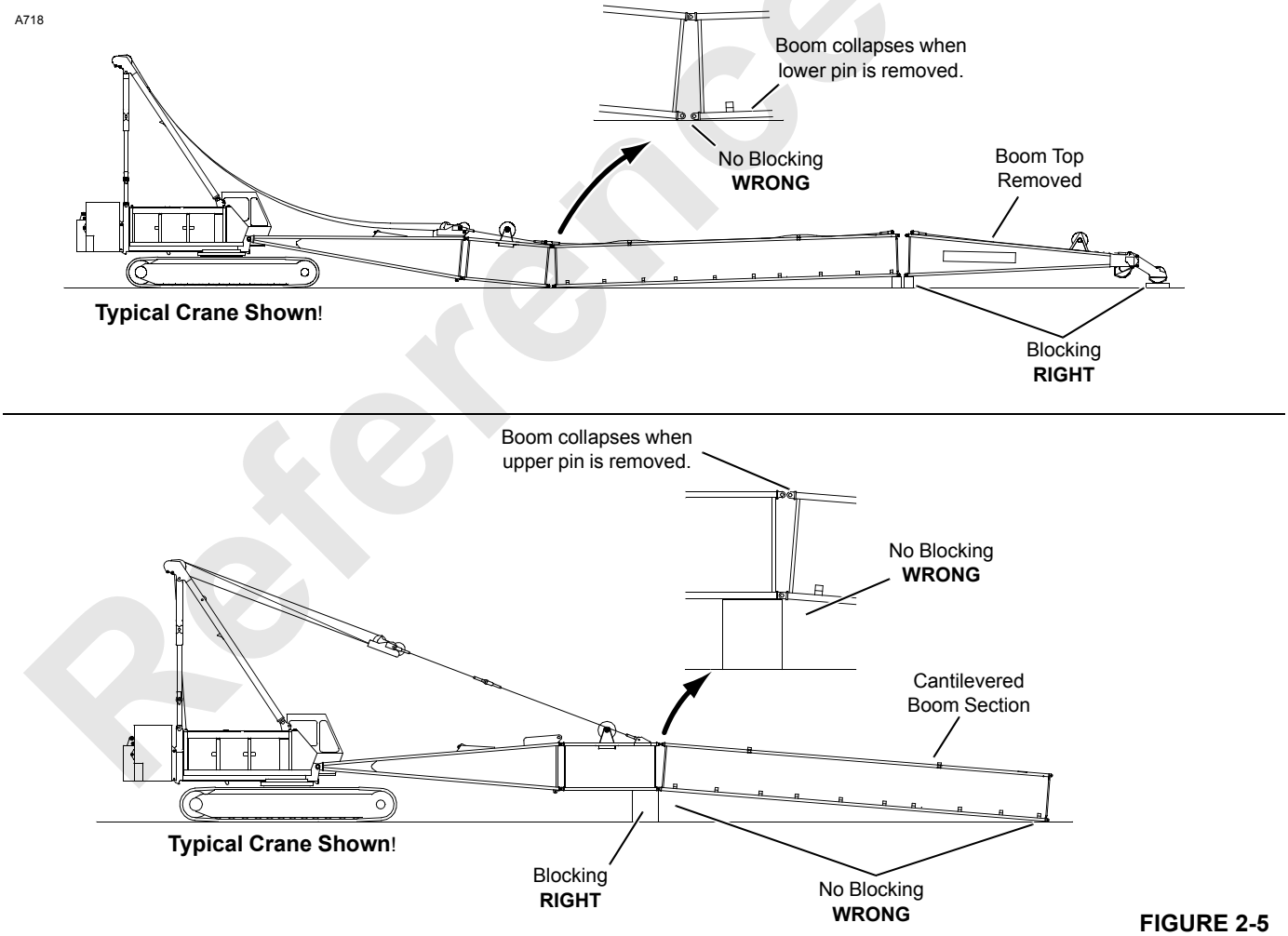

FIGURE 2-5

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PERSONNEL HANDLING POLICY

In 1998, the American Society of Mechanical Engineers issued a new American National Standard entitled, Personnel Lifting Systems, ASME B30.23-1998. This standard provides, ***"lifting and lowering of personnel using ASME B30 Standard hoisting equipment shall be undertaken only in circumstances when it is not possible to accomplish the task by less hazardous means. Unless all of the applicable requirements of this volume are met, the lifting or lowering of personnel using ASME B30 Standard equipment is prohibited."***

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

This new standard is consistent with the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) regulations for Construction that state, in 29CFR1926.1431(a): ***The use of a crane or derrick to hoist employees on a personnel platform is prohibited, except when the erection, use, and dismantling of conventional means of reaching the work site, such as a personnel hoist, ladder, 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 shall remain in the crane cab at all times when personnel are off the ground.
- The crane operator and occupants have been instructed in the recognized hazards of personnel platform lifts.
- The crane is in proper working order.
- Load and boom hoist drum brakes, swing brakes, and locking devices such as pawls and dogs must be engaged when the occupied personnel platform is in a stationary position.
- The crane must be equipped with a boom angle indicator that is visible to the crane operator.
- The crane must be equipped with boom hoist limiting device.
- If the luffing jib is used for hoisting personnel, the crane must be equipped with a luffing jib angle indicator that is visible to the crane operator.
- If the luffing jib is used for hoisting personnel, the crane must be equipped with a luffing hoist limiting device.
- The crane is equipped with a positive acting device which prevents contact between the load block or overhaul ball and the boom tip (anti-two-block device).

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

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

  Cranes with outriggers or stabilizers must have them all extended and locked. All outriggers or stabilizers must be extended equally in accordance with the Capacity Charts and operating procedures.
- Handling personnel from a platform suspended by wire rope from a luffing jib is acceptable, but only when it is not possible to accomplish the task using a less hazardous means. The crane user and operator shall take into account hazards that may be present when using a luffing jib.
- Direct attachment of a personnel platform to a luffing jib is prohibited.
- The platform meets the requirements as prescribed by applicable standards and regulations.
- Applicable personal protection equipment is provided (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 PROHIBITTED, except for work covered in OSHA 29CFR1926 subpart V.

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

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

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

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

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

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

Phone: 920-684-6621

PEDESTAL/BARGE MOUNTED CRANES

WARNING

Overload Hazard!

A pedestal mounted crane will not tip to indicate to 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, and hook rollers or other structural components may break, causing crane to separate from pedestal.

WARNING

Crane owner/user shall 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 2-6)

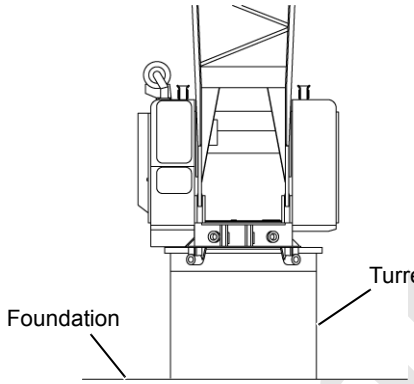
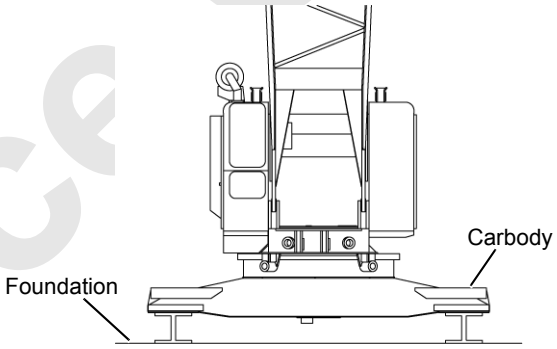


FIGURE 2-6

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



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

FIGURE 2-7

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 2-8)

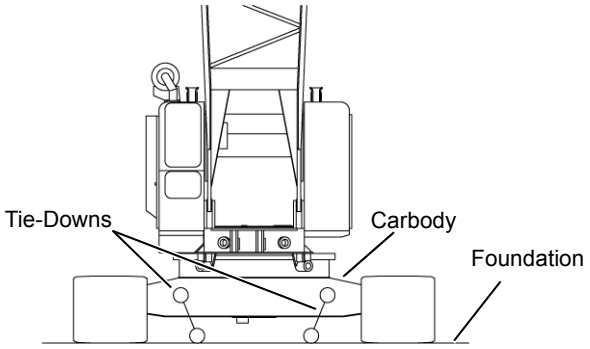
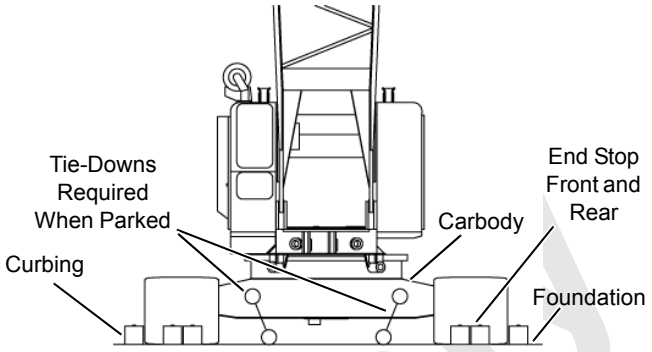


FIGURE 2-8

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

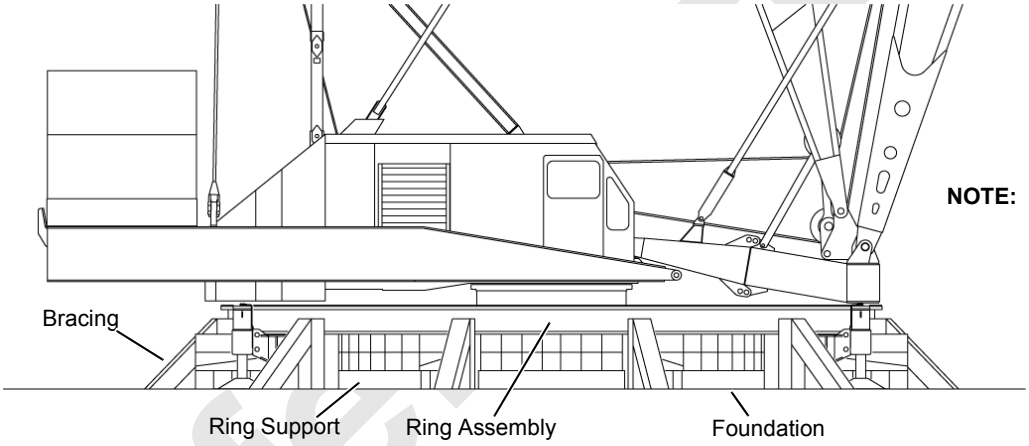


NOTE: Manitowoc does not permit traveling with load.

FIGURE 2-9

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

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



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

FIGURE 2-10

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

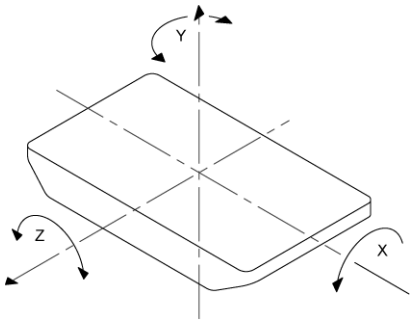


FIGURE 2-11

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 2-11 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 must be inspected to detect cracks and other damage. Nondestructive test equipment, such as magnetic particle or ultrasonic procedures, is recommended for this inspection.

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

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.

Operation On Barge

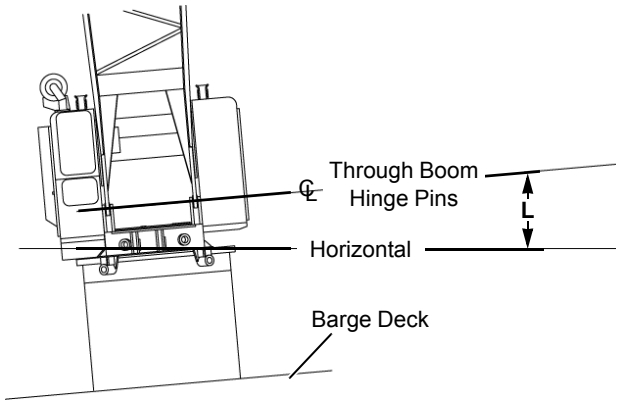
General

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.

Definitions

1. Machine List, as defined by Manitowoc, is the crane's out-of-level condition — from side-to-side — as measured by the angle between horizontal and a line drawn through the centerline of the crane's boom hinge pins (Figure 2-12). This out-of-level condition creates side load and affects the crane's lifting capacity.
2. Barge List (also referred to as heel or trim) causes swing out of the load and may produce side load. When Manitowoc provides a Capacity Chart showing capacities for a 2 degree machine list for example, we are referring to the maximum allowable lifting capacity for the crane when experiencing an out-of-level condition (side-to-side) of 2 degrees as measured by angle between horizontal and a line drawn through centerline of the crane's boom hinge pins.

   Unless otherwise specified in the Capacity Chart, barge list (heel or trim) must not exceed the machine list degrees given in the Capacity Chart.
3. Barge List and Machine List are not the same. As the crane rotates on a barge, barge list (as defined above) will change. The worst machine list condition generally occurs when the crane swings over the corner of the barge, producing maximum side load.



L = Degrees of Machine List (Maximum allowable is specified in Capacity Chart)

FIGURE 2-12

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 must be lowered onto a cradle (or other support) and the crane's boom, rotating bed, and lowerworks must be secured against movement. If the crane is equipped with a mast, the mast must be securely tied down with guylines. Failing to take these steps can result in shock load or side load damage to the boom and mast.

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SECTION 3
OPERATION

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Published 05-15-17, Control # 043-09

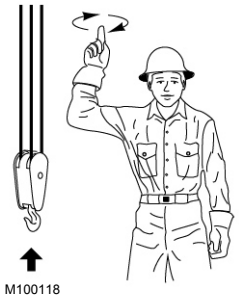
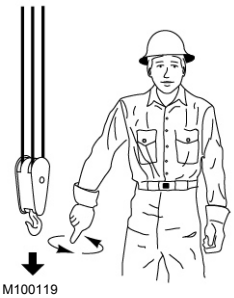
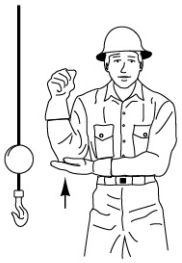
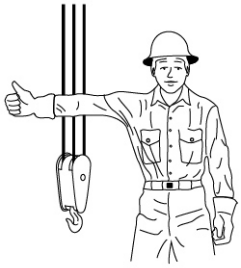
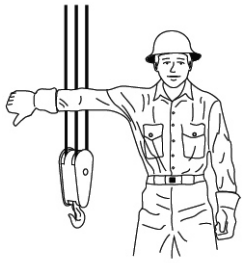
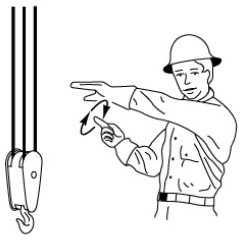
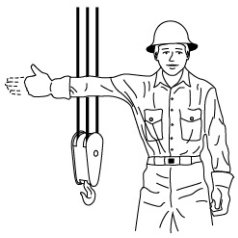
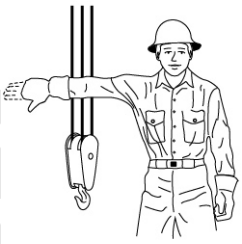
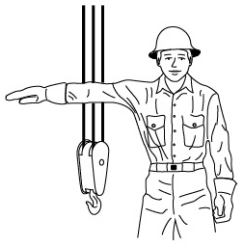
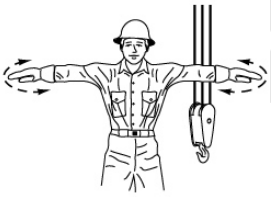
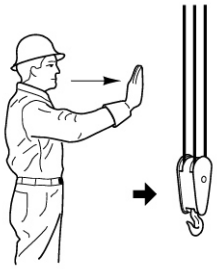
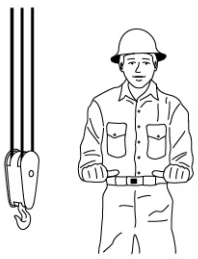
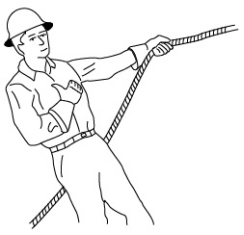
SECTION 3
OPERATING CONTROLS AND PROCEDURES

THIS SECTION STARTS ON THE NEXT PAGE

STANDARD HAND SIGNALS FOR CONTROLLING CRANE OPERATIONS

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

Table 3-1Standard Hand Signals for Controlling Crane Operations

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

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

Numbers Correspond to the Luffing Jib Operating Controls

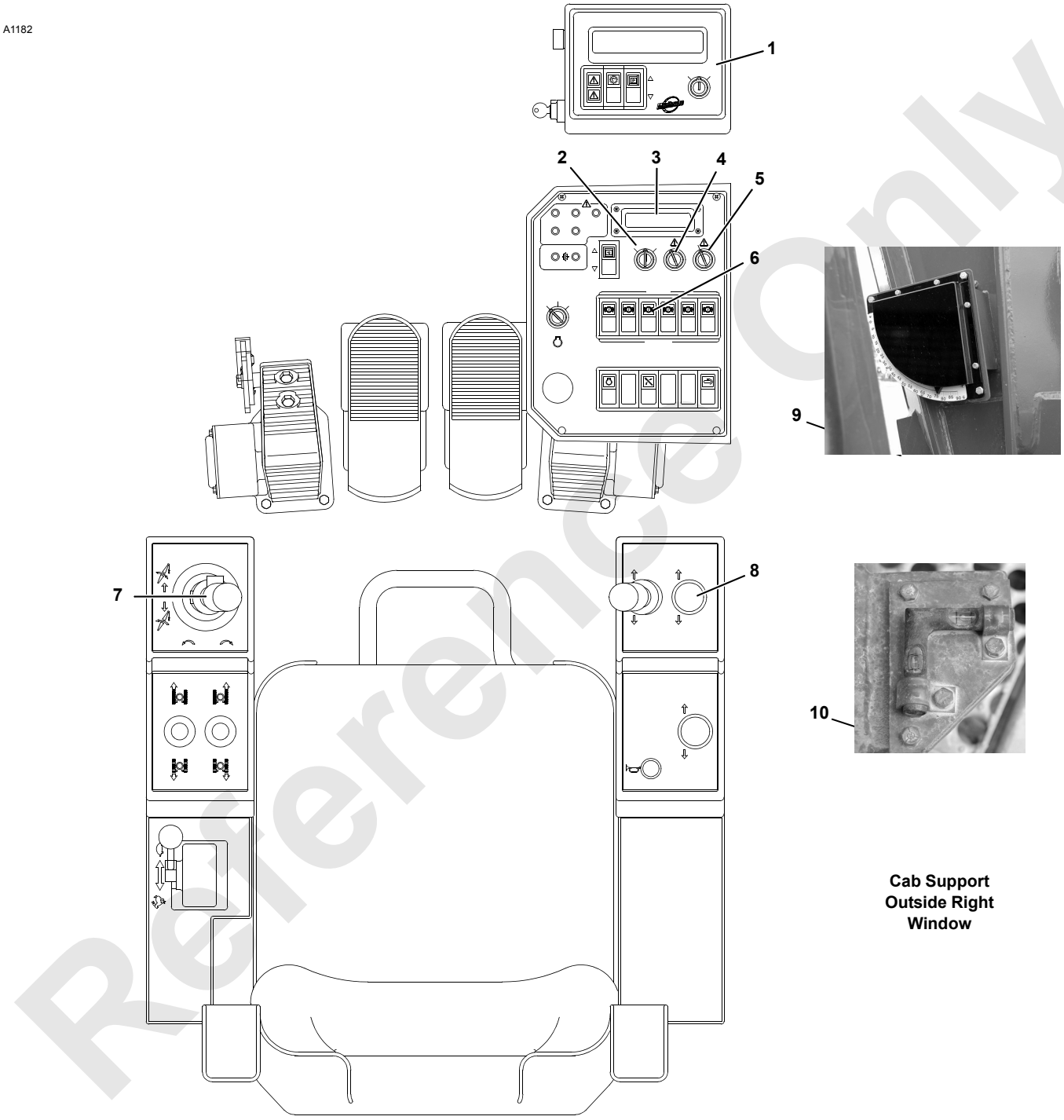


FIGURE 3-1

LUFFING JIB OPERATING CONTROLS

See for Location of Controls.

The instructions in this section supplement the operating control instructions in the Crane Operator Manual. This section has two purposes:

- To familiarize qualified operators with the location of the controls used for luffing jib operation.
- To alert operators to important safety information.

WARNING

Prevent death or serious injury to personnel!

Luffing jib attachment must be installed and operated by experienced personnel trained in erection and operation of construction cranes. These personnel shall read, understand, and comply with instructions in this manual, in Crane Operator Manual, and in Luffing Jib Rigging drawings and Capacity Charts.

1 – Rated Capacity Indicator/Limiter (RCL)

Displays load lifting information and alerts the operator to overload conditions.

See separate RCL Manual for operating instructions.

2 – Crane Mode Selector

See the Crane Operator Manual for detailed instructions on selecting and confirming the crane mode.

Use this control to select and confirm the LUFFING JIB mode.

Once selected and confirmed, the mode appears on the digital display as shown in .

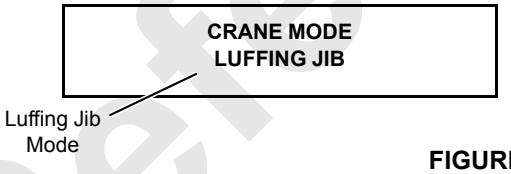


FIGURE 3-2

Also use this control on crane S/N 9991326 and newer to select and confirm the LUFFING JIB SETUP mode.

Once selected and confirmed, the mode appears on the digital display as shown in .

Use the LUFFING JIB SETUP mode during luffing jib assembly and disassembly to bypass the limits identified in Table 3-3.

See the Crane Operator Manual for detailed instructions on selecting and confirming the crane mode.

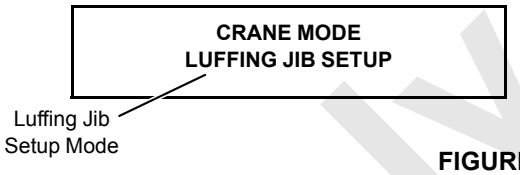


FIGURE 3-3

3 – Digital Display

Displays boom angle, luffing jib angle, and boom to luffing jib angle. See for identification of each angle:

- BOOM ANGLE — angle between centerline of boom and horizontal. Monitor this angle when raising boom to operating position.
- LUFFING JIB ANGLE — angle between centerline of jib and horizontal. Monitor this angle when raising and lowering jib during operation.
- BOOM TO LUFFING JIB ANGLE — angle between centerline of boom and centerline of jib. Monitor this angle when raising boom and jib from ground and lowering boom and jib to ground.

The digital display also displays system faults and operating limits for the luffing hoist and all other crane functions. See Digital Display Readings in the Crane Operator Manual for a complete list of operating conditions, system faults, and operating limits.

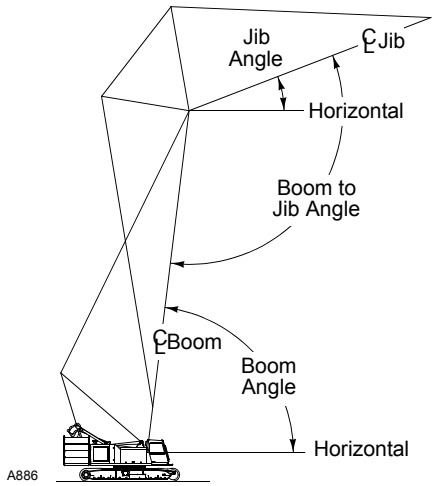


FIGURE 3-4

4 – Limit Bypass Switch

This switch bypasses the limits identified in and .

Insert key. Turn CLOCKWISE to BYPASS 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.

Remove key to prevent unauthorized operation.

NOTE: To bypass the limits listed in for luffing jib setup on crane S/N 9991326 and newer, proceed as follows:

- Select and confirm luffing jib setup mode.
- Rotate limit bypass switch (4) 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.

5 – Luffing Jib Limit Bypass Switch

If equipped, this switch bypasses the limits identified in .

This switch is provided to allow the jib MAX Up 2 limit to be bypassed when the boom and luffing jib are lowered to the ground.

Insert Key. Turn CLOCKWISE to BYPASS (deactivate) 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.

Remove key to prevent unauthorized operation.

Table 3-2 Bypassable Limit Identification (S/N 9991001 through 9991325)

Limit	Non-European Limit Bypass Switch (4) (momentary rocker or key Switch)	European	
		Limit Bypass Switch (4) (momentary key switch)	Luffing Jib Limit Bypass Switch [1] (5) (maintained key switch)
Boom Up Limit	Yes or No [2]	Yes or No [2]	No
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 [3]	No	Yes [3]
Luffing Jib Maximum Down 2	Yes	No	Yes

[1] Use only for rigging.

[2] 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 3-9 in this section.

[3] Only when boom is below 50°.

Table 3-3 Bypassable Limit Identification (S/N 9991326 and newer)

This Table Applies to Cranes Without Luffing Jib Limit Bypass Switch (5)					
Limit	Limit Bypass Switch (4) (momentary key switch)		Limit Bypass Switch (4) (momentary key switch) Luffing Jib Setup Mode On [1]		External Override Switch [2]
	Non-CE	**CE** [3]	**Non-CE**	**CE** [3]	**CE** [3]
Boom Up	No	No	No	No	No
Block Up (each drum)	Yes	Yes [6]	Yes	Yes	No
Minimum Bail (each drum)	Yes	No	No	No	No
Luffing Jib Maximum Up 1	Yes	No	Yes	Yes	No
Luffing Jib Maximum Up 2	Yes	No	Yes [4]	Yes [4]	No
Luffing Jib Maximum Down 1	Yes	No	Yes	Yes	No
Luffing Jib Maximum Down 2	Yes [5]	No	Yes [5]	No	No
Mast Too Far Forward	No	No	No	No	No
Gantry Down	Yes	Yes	No	No	No
Boom Limiter	Yes	Yes	No	No	No
Swing Limiter	No	No	No	No	No
Rated Capacity Indicator/Limiter	Yes	Yes [6]	Yes	Yes [6]	Yes [7]

[1] Use only for rigging. The luffing jib setup mode must be turned on.

[2] Cranes meeting 2010 European requirements are equipped an RCI/RCL External Override Switch located outside the operator's cab (see Rated Capacity Indicator/Limiter Operation Manual).

[3] CE = Cranes that comply with 2010 European requirements (see NOTE below).

[4] Only when boom is below 50°.

[5] When this limit is contacted, operation will stop and you will not be able to continue lowering luffing jib. See Luffing Jib Max Down 2 on page 3-8 for detailed instructions.

[6] Only if boom or luffing jib is below allowable angle given in Capacity Chart (while raising or lowering boom and luffing jib from or to ground level).

[7] When the external bypass is in override, the speed of the crane functions are limited to 15% of their maximum speed for movements that increase load.

6 – Rear Drum Park Switch

Parks the rear drum (luffing hoist) when not in use.

See the Crane Operator Manual for detailed instructions on operating the drum park switch.

7 – Boom Hoist Control
8 – Luffing Hoist Control

When the LUFFING MODE is selected and confirmed:

- The luffing hoist limits are activated.
- The rear drum operates as the luffing hoist and must be rigged accordingly. See Section 4 for raising and lowering instructions when equipped with a luffing jib attachment.

  See the Crane Operator Manual for drum identification and for detailed instructions on drum operation.

For luffing jib operation, ***free fall must be disabled for rear drum***.

9 – 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 digital display.

10 – Level

Indicates crane levelness from front to rear and from side to side.

Automatic Jib Stops (not shown)

Luffing Jib Up Limits—

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 luffing jib can be lowered after the limit is contacted.

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

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.

- **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 with the jib up limit bypass switch only when the attachment is lowered to the ground (boom below 50°).

  For crane S/N 9991326 and newer:

  - For non-CE cranes, this limit can be bypassed only when the attachment is lowered to the ground (boom below 50°) and the handle is returned to neutral while holding the bypass switch in the bypass position.
  - For CE cranes, 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 following screen will appear on the digital display.

  LUFFING JIB MAX UP 2
  CONFIRM TO RESET

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

Luffing Jib Down Limits—

WARNING

Falling Boom/Jib Hazard!

Do not lower luffing jib below down limit. Structural damage will result, possibly causing boom and luffing jib to collapse.

For crane S/N 9991001-9991325, this limit automatically stops the luffing jib when the boom to luffing jib angle is:

- 40° – Past Production #149 Luffing Jib

  This limit cannot be bypassed. The luffing jib can be raised after the limit is contacted.

For crane S/N 9991326 and newer, this limit automatically stops the luffing jib when the boom to luffing jib angle is:

- **LUFFING JIB MAX DOWN 1 Limit** is a programmed limit which automatically stops the luffing hoist when the boom to luffing jib angle is 58°.

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

- **LUFFING JIB MAX DOWN 2 Limit** is a limit switch which automatically stops the luffing hoist when the boom to luffing jib angle is 55°.

  For non-CE cranes, the luffing jib can be raised after the luffing jib maximum down 2 limit is contacted.

  For CE cranes, the luffing jib cannot be raised after luffing jib maximum down 2 limit is contacted until the limit switch is reset. When the limit is contacted, the following screen will appear on the digital display.

  LUFFING JIB MAX DN 2
  CONFIRM TO RESET

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

Automatic Boom Stop (not shown)

When the automatic boom stop is reached, the boom hoist stops automatically (brake spring applies) and is inoperable. The operating limit alert (yellow light and buzzer) comes on and the digital display indicates which limit has been reached.

The boom stop must be set at the following angle for operation with a luffing jib:

- 88° — when the boom up limit ***can be bypassed***
- 89° — when the boom up limit ***cannot be bypassed***

The boom can be lowered after the limit is contacted.

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 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 the boom stop rod in to trip the boom up limit switch open.
3. Rotate limit bypass key (D3) 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.
5. The test is complete: release the limit bypass key and the boom stop rod to the normal operating positions.

OPERATING PRECAUTIONS

WARNING

Observe the following precautions to prevent tipping, structural failure of attachment, and death or serious injury to personnel.

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

   Make sure proper counterweight is installed.
2. Read and comply with instructions in this manual and in Crane Operator Manual.
3. Read and comply with Maximum Allowable Travel Specifications in Luffing Jib Capacity Chart Manual.
4. Make sure luffing jib attachment is installed properly. Read and comply with instructions in Section 4.
5. Make sure all operating limits — block-up, boom and jib stops, boom and jib angle indicators, and Rated Capacity Indicator/Limiter (RCL) — are installed and operating properly. See Section 6 for adjustment procedures. See separate Rated Capacity Indicator/ Limiter Manual for operation and calibration of the RCL.

   The LUFFING JIB mode must be selected and confirmed to turn on luffing hoist limits.
6. Raise and lower attachment as instructed in Section 4.
7. Perform all operations with crane on a firm, level, uniformly supporting surface. Crane must be level to within 1 ft (0,3 m) in 100 ft (30,1 m).
8. Operate all crane functions slowly and smoothly. Avoid sudden starts and stops which could side load or shock load attachment.
9. Do not operate, to include raising boom and luffing jib from ground level, if wind exceeds allowable limits given in Capacity Charts provided with crane and luffing jib. Contact your local weather station for wind velocity.
10. Disable free fall for rear drum by moving valve handle to DISABLE (down) position as shown in .

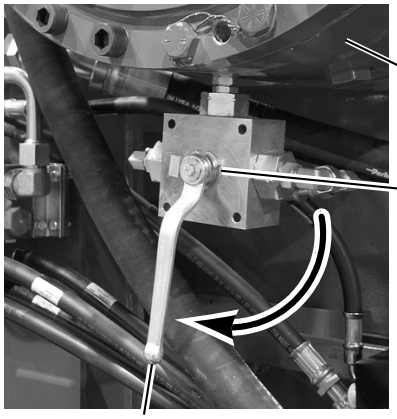


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FIGURE 3-5

WIND CONDITIONS

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

WARNING

Tipping Crane Hazard!

Judgment and experience of qualified operators, job planners, and supervisors must be used to compensate for 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 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.

SECTION 4
SET-UP AND INSTALLATION

TABLE OF CONTENTS

SECTION 4
SETUP AND INSTALLATION

LUFFING JIB ATTACHMENT

This section contains installation and removal instructions for the luffing jib attachment.

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

WARNING

Avoid Death or Serious injury!

Read and understand instructions in this section before attempting to install or remove attachment.

Moving Parts/Pinch Points!

Avoid death or crushing injury during crane assembly and disassembly:

- Assembly personnel — take every precaution to prevent injury when working near moving parts.
- Maintain communication between operator and assemblers to avoid accidents.
- Keep unauthorized personnel well clear of crane.

Falling Load Hazard!

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

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

The attachment must be installed, operated, and removed by experienced personnel trained in the operation and erection of construction cranes. These personnel shall read, understand, and comply with the instructions in this section, in the Luffing Jib Rigging Drawing, and in the Liftcrane Luffing Jib Capacity Charts provided with the attachment.

Contact your Manitowoc dealer for a detailed explanation of any procedure not fully understood.

The installation/removal area must be firm, level, and free of ground and overhead obstructions. The area selected must be large enough to accommodate the crane, selected boom and jib length, and movement of an assist crane.

ACCESSING PARTS

Some parts of the crane, boom, and jib cannot be reached from the ground. Take necessary precautions to prevent falling off the crane, boom, or jib during installation and removal.

Owner/user shall provide approved ladders or personnel hoists so workers can safely access those areas of crane, boom, and jib that cannot be reached from ground. Adhere to local, state, and federal regulations for handling personnel.

Optional boom ladders (stored in boom butt) are available from Manitowoc. If your crane has ladders, see Section 3 in the Operator Manual provided with the crane.

ASSIST CRANE REQUIREMENTS

Either the Model 999 or an assist crane can be used to install and remove the jib. If the Model 999 is used, it must be in the setup configuration (same as when installing counterweights and crawler or assembling boom) — see Crane Assembly in Crane Operator Manual for detailed instructions and capacity limitations.

The jib butt, jib strut, and main strut are shipped from Manitowoc as an assembled unit. The assembly weighs approximately 14,000 lb (6 350 kg) and is the heaviest load to be lifted. ***Size the assist crane accordingly.***

Instructions in this section assume an assist crane will be used.

CRANE WEIGHTS

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

OPERATING CONTROLS

Become thoroughly familiar with the location and function of all operating controls provided for the crane and attachment. Read and understand the instructions in Section 3.

COUNTERWEIGHT REQUIREMENT

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

WARNING

Tipping Hazard!

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

BLOCKED CRAWLERS

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

DANGER

Tipping Hazard!

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

RIGGING DRAWINGS

See the end of this section for applicable luffing jib and fixed jib rigging drawings.

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

Two tables are provided on the luffing jib rigging drawing: one table lists the boom sections and backstay pendants required for various boom lengths. The other table lists the boom sections required for various jib lengths. Make sure the proper table is referred to. Read and comply with insert and pendant notes on the rigging drawing.

The boom and jib straps are stored on the boom and jib sections for shipping. There is no means provided for storing the backstay pendants on the boom sections. It is the owner's responsibility to coil and safely store the pendants for shipping.

LUFFING JIB RAISING PROCEDURE

See the end of this section for applicable luffing jib raising (and lowering) procedures.

IDENTIFYING BOOM/JIB COMPONENTS

Boom and jib sections are marked for proper identification as shown in Views A and B, Figure 4-1.

Boom and jib pendants are marked for proper identification as shown in View C, Figure 4-1.

Boom straps and links are marked for proper identification as shown in View D, Figure 4-1.

NOTE: The markings shown in Figure 4-1 can vary depending on when your crane was produced and the original equipment manufacturer.

HANDLING COMPONENTS

Handle boom and jib components with care to avoid damaging lacings and chords. Lift against chords only, never against lacings.

Nylon slings should be used to handle components. If wire rope or chain slings are used, protective covering (such as sections of rubber tire) must be used between the slings and the component.

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.

PIN AND CONNECTING HOLE CLEANLINESS

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

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

SHIPPING CRANE COMPONENTS

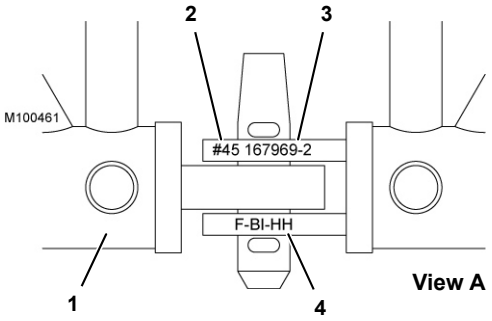
It is the owner/user's responsibility to ensure the following:

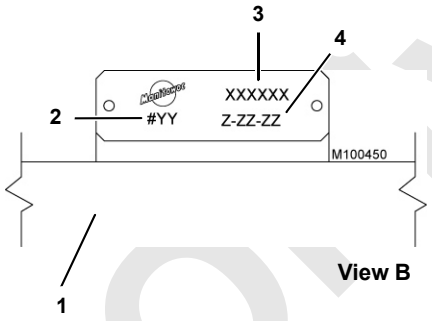
- That all trailer loads comply with local, state, and federal transportation requirements
- ***That all crane components are properly blocked and secured so they cannot shift or fall off trailers***
- To avoid damage to components:

Use nylon tie-downs to secure components as shown in Figure 4-2, View A.

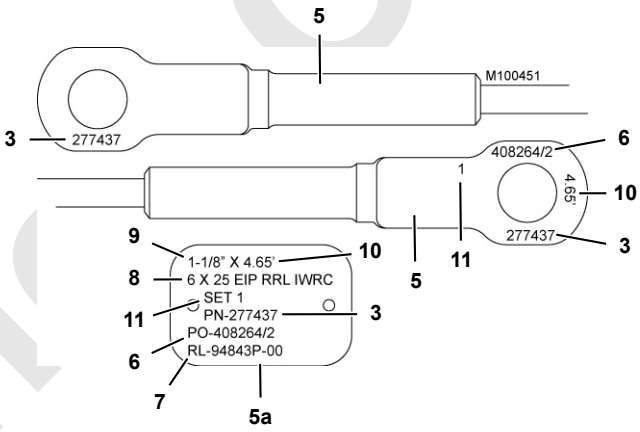
If chain tie-downs are used, install protective covering (such as sections of rubber tire) between the chain and component being secured as shown in Figure 4-2, View B.

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.





Item	Description
1	Boom or Jib Chord
2	Boom or Jib Number
3	Manitowoc Part Number
4	Manitowoc Manufacturing Code
5	Pendant
5a	Aluminum Tag (if equipped)
6	Manitowoc Purchase Order Number
7	Manufacturer's Number
8	Wire Rope Type
9	Diameter
10	Length
11	Set Number
12	Strap or Link



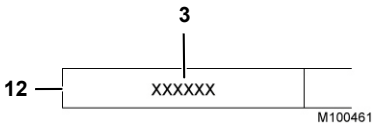


FIGURE 4-1

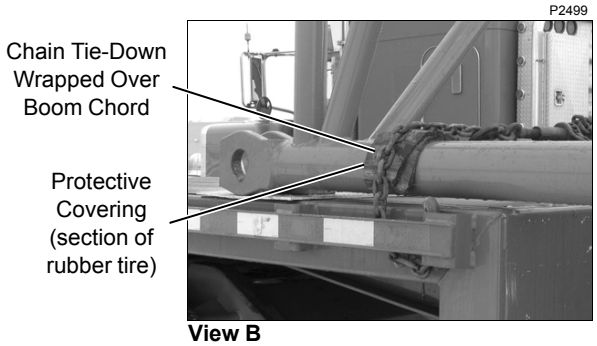


FIGURE 4-2

Item	Description
1	Guide Roller
2	Shaft with Cotter Pins
3	Storage Pin with Snap Pins
4	Pin with Cotter Pins
5	Lifting Slings
6	Lifting Lug (4 places)
7	Pin
8	Keeper Plate with Screws and Lock Washers
9	Shims
10	Jib Stop Pendant 24 ft, 1 in (7,3 m)
11	Pin with Cotter Pin
12	Jib Stop Pendant 9 ft, 6-1/2 in (2,9 m)

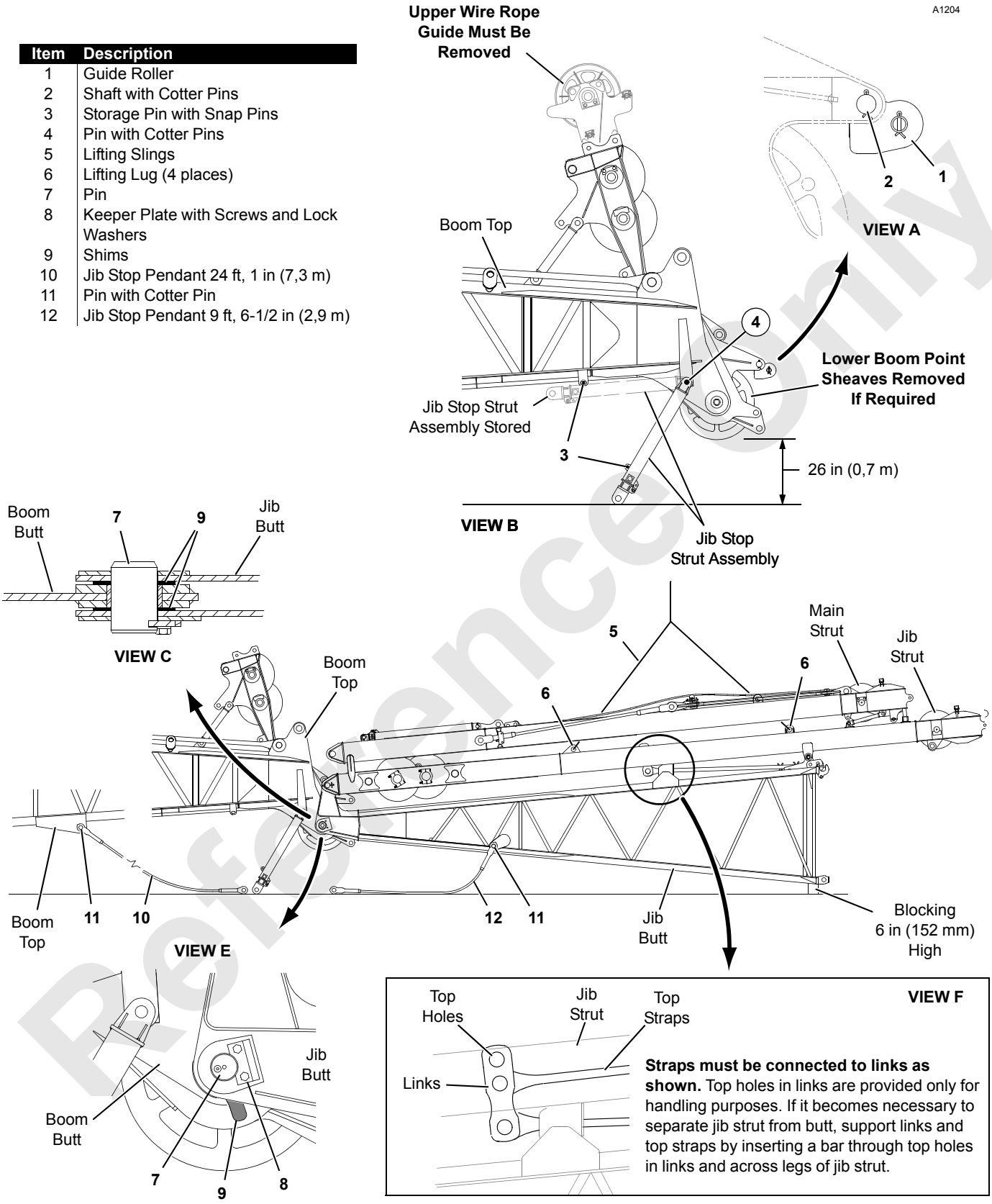


FIGURE 4-3

LUFFING JIB RIGGING GUIDE - #149 JIB

Installing Jib

Lower Boom

1. Travel front crawler rollers onto blocking. ***All boom and jib combinations must be raised over front or rear of blocked crawlers.***
2. Swing upper slightly to either side and lower load block and weight ball onto ground.
3. Swing boom in-line with crawlers and lower boom onto blocking placed under connectors between boom top and insert next to boom top. Size height of blocking so distance between boom point sheaves and ground is approximately 26 in (0,7 m) (Figure 4-3, View B).

Prepare Crane for Jib

1. Disconnect load lines from weight ball and/or load block. ***Rear drum is required for luffing hoist. Front drum is required for raising main strut and for load line to luffing jib.***
2. Remove fixed jib, if equipped.
3. Change boom length as necessary to meet job requirements.

   Make sure boom top and all boom sections have been properly modified for use with luffing jib. Contact the Manitowoc Crane Care Lattice Team for details.
4. Check that all boom inserts and boom straps are assembled in the proper sequence according to rigging drawing.
5. To reduce boom weight, remove upper wire rope guide assembly from boom top (Figure 4-3, View B).
6. If necessary to reduce boom weight, remove sheave clusters from lower boom point and replace them with spacers (if applicable). See Luffing Jib Raising Procedure for boom length limitations with sheave clusters installed. See Lower Boom Point Installation instructions in Crane Operator Manual for procedure.

WARNING

Tipping Crane Hazard!

Do not attempt to raise more boom than specified when lower boom point sheave clusters are installed. Rear of crane will tip forward.

7. Install auxiliary drum, if required (see Auxiliary Drum Installation instructions in Crane Operator Manual).
8. Add or remove crane counterweight to comply with applicable Capacity Chart.
9. Determine luffing hoist wire rope requirements. If desired, remove the load line from the rear drum and install the desired luffing hoist wire rope specified on Luffing Jib Rigging Drawing.
10. Install guide roller (1, Figure 4-3, View A) on boom top.

Install Jib Stop Strut Assembly

See Figure 4-3, View B for the following procedures.

1. If jib stop strut assembly is already assembled to boom top, proceed as follows:
   a. Support strut assembly so it cannot fall.
   b. Remove storage pins (3).
   c. Lower strut assembly to ground.
   d. Store pins (3) in lugs on upper strut.
2. If jib stop strut assembly is not assembled to boom top, proceed as follows:
   a. Using a forklift, lift strut assembly into position under boom top. ***Storage pins (3) in lugs on upper strut must face boom butt.***
   b. Align connecting holes and pin strut assembly to boom top.
   c. Lower strut assembly to ground.

Install Jib Butt Assembly

See Figure 4-3 for the following procedure.

1. Attach lifting slings (5) from assist crane to four lifting lugs (6, View D) on jib strut (pass slings through opening in main strut).
2. Remove pins (7, View E), keeper plates (8), and shims (9) from holes in jib butt.
3. Lift jib butt assembly (butt and both struts) into position at end of boom top and align connecting holes in jib butt with holes in boom top.
4. Install pins (7, View E) and keeper plates (8).

   As pins are installed, install shims (9, View C) on outboard side of both boom top lugs ***so jib butt is centered on boom top.***

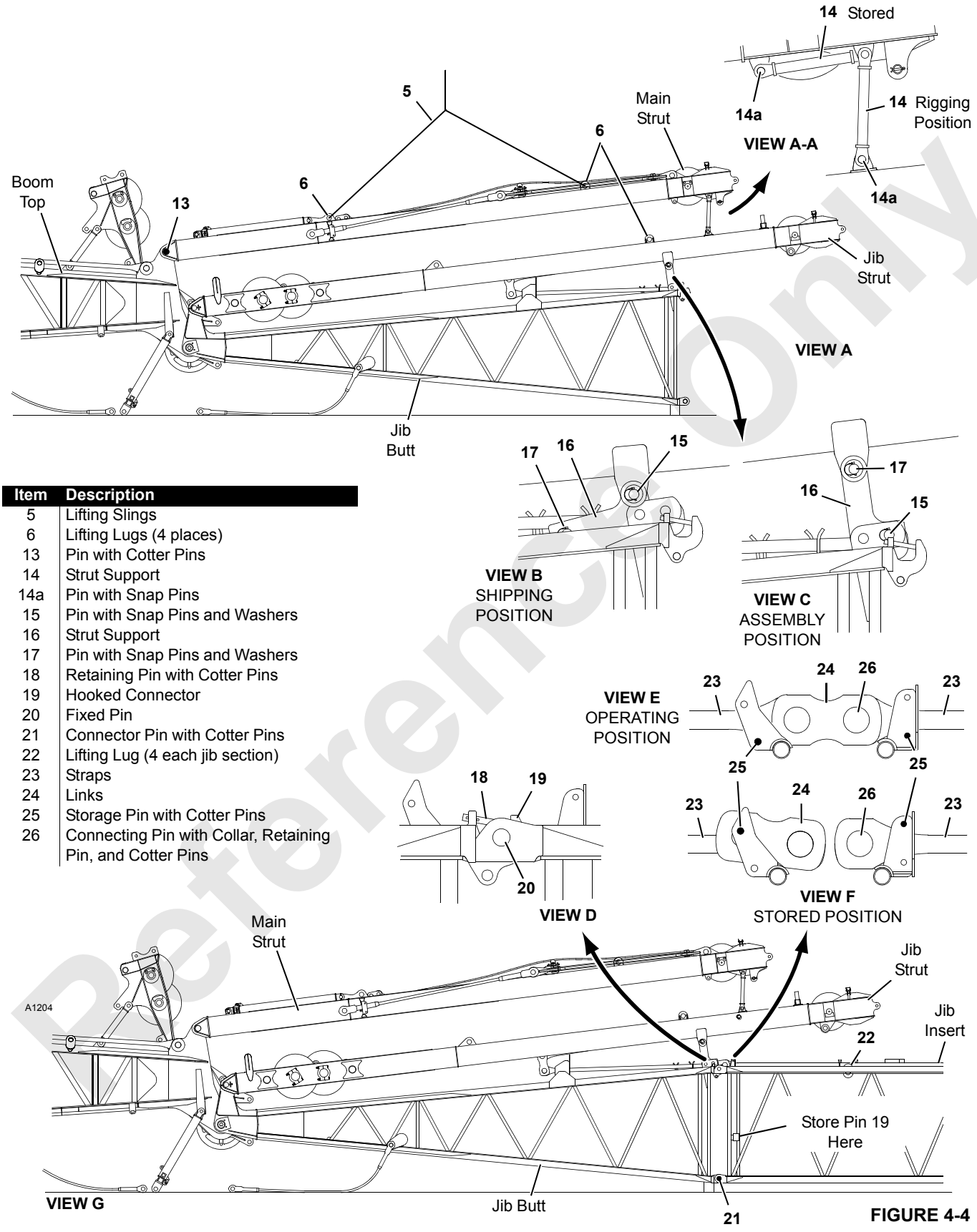
   The shims have handles to make assembly easier.
5. Lower boom butt onto blocking approximately 6 in. (152 mm) high.

Install Jib Stop Pendants

See Figure 4-3, View D for the following procedure.

1. Pin jib stop pendants (10) to lugs on underside of boom top.
2. Pin jib stop pendants (12) to lugs on underside of jib butt.

NOTE: Jib stop pendants will be connected to jib stop lower strut when jib is raised later in this guide.



Item	Description
5	Lifting Slings
6	Lifting Lugs (4 places)
13	Pin with Cotter Pins
14	Strut Support
14a	Pin with Snap Pins
15	Pin with Snap Pins and Washers
16	Strut Support
17	Pin with Snap Pins and Washers
18	Retaining Pin with Cotter Pins
19	Hooked Connector
20	Fixed Pin
21	Connector Pin with Cotter Pins
22	Lifting Lug (4 each jib section)
23	Straps
24	Links
25	Storage Pin with Cotter Pins
26	Connecting Pin with Collar, Retaining Pin, and Cotter Pins

FIGURE 4-4

Connect Main Strut to Boom Top

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

1. Remove pins (13) from connecting holes in end of main strut.
2. Attach slings (5) from assist crane to four lifting lugs (6) on main strut.
3. Slowly lift main strut until it is supported by assist crane.
4. Unpin strut supports (14, View A-A) from rigging position and pin in storage position.
5. Align connecting holes in end of strut with holes in boom top and install pins (13).
6. Unpin strut supports (14, View A-A) from storage position and pin in rigging position.
7. Remove slings (5).

Raise Jib Strut to Assembly Position

See Figure 4-4 for the following procedure.

1. Attach slings from assist crane to top two lifting lugs (6, View A) on jib strut.
2. Lift jib strut just enough to loosen pins (15, View B) and remove pins.
3. Lift jib strut clear of strut supports (16, View B).
4. Rotate strut support (16) to assembly position and install pins (15, View C).
5. Remove pins (17, View B) from strut supports.
6. Align connecting holes in strut with connecting holes in strut supports (16) and install pins (17, View C).

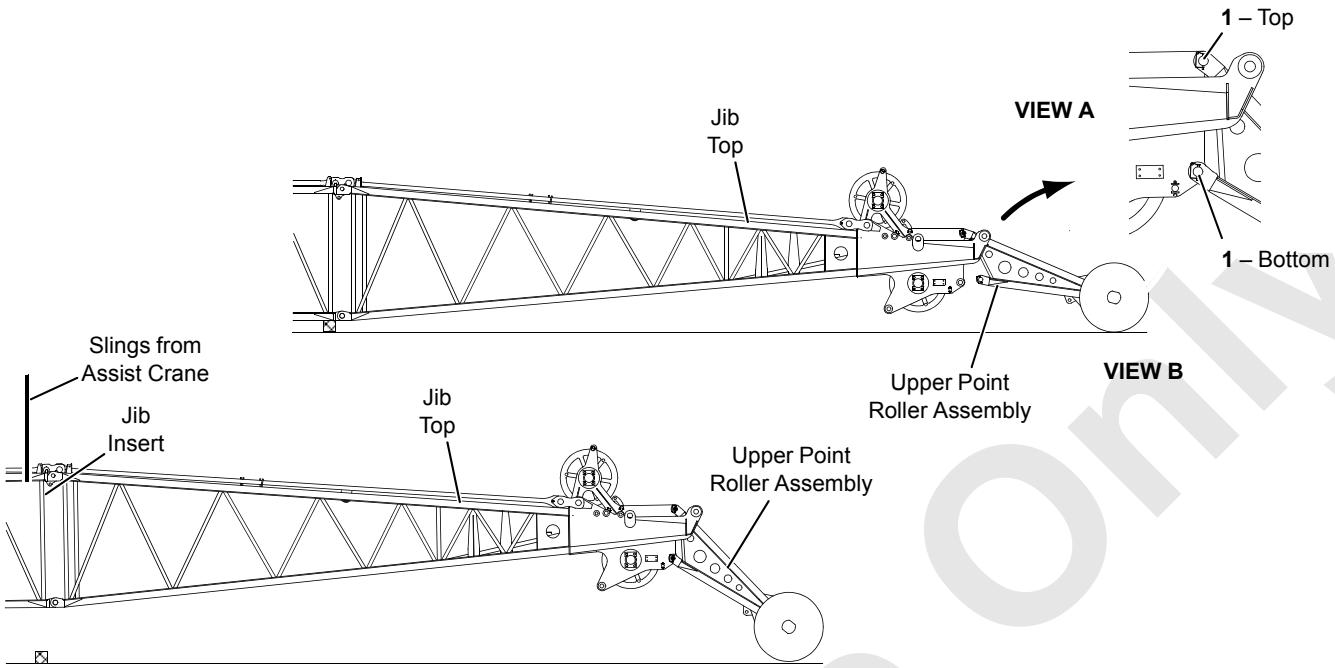
Install Jib Inserts

- Determine jib length required for lift to be made.
- Pin inserts to butt *in proper sequence* — see Luffing Jib Rigging Drawing.

See Figure 4-4 View D for the following procedure.

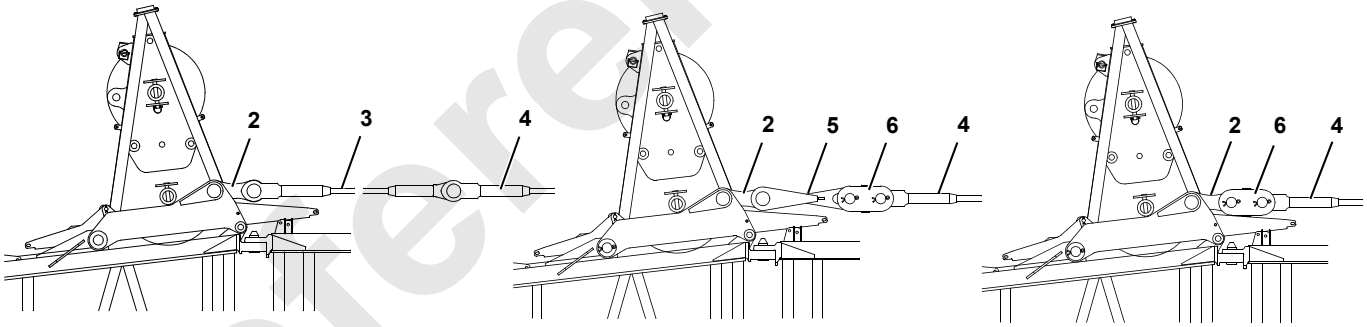
1. Remove retaining pins (18) from hooked connectors (19).
2. Lift insert into position at end of butt and engage fixed pins (20) in insert with hooked connectors (19) in butt.

   Each jib section has four lifting lugs (22, View G).
3. Install retaining pins (18).
4. Lower insert until bottom connecting holes line up and install connecting pins (21, View G).
5. Connecting pins are stored in pockets on vertical lacings of adjacent insert (View G).
6. Install blocking under top end of insert.
7. Repeat steps 1 – 5 for remaining inserts.



VIEW C

Item	Description	Item	Description
1	Connecting Pin with Snap Pins	5	Link with Pin — 24 in (607 mm)
2	Link with Pins — 11 in (279 mm)	6	Link with Pins — 8-1/2 in (216 mm)
3	Pendant with Pin — 5 ft, 1/2 in (1,5 m)	7	Basic Backstay Pendant — 20 ft, 1-1/2 in (6,1 m)
4	Backstay Pendant with Pin (matches length of adjacent insert)		



VIEW D1
80 ft (24,4 m) Boom

VIEW D2
90 – 120 ft (27,4 – 36,6 m) Boom

VIEW D3
130 – 200 ft (39,6 – 61,0 m) Boom

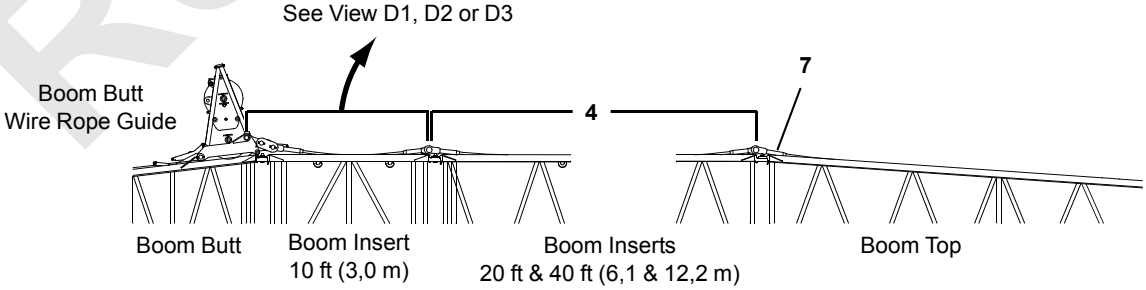


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FIGURE 4-5

Install Jib Top

See Figure 4-5 for the following procedure.

The following procedure assumes that the upper point roller assembly was removed from the jib top for shipping.

1. Install jib top in same manner inserts were installed.
2. Lift upper point roller assembly into position at end of jib top and align top connecting holes (View B).
3. Install top connecting pins (1, View A).
4. Attach slings from assist around to top chords at end of jib insert next to jib top (View C). ***Assist crane and slings must be able to lift one-half weight of complete jib***.
5. Raise jib to align bottom connecting holes between jib top and upper point roller assembly.
6. Install bottom connecting pins (1, View A).

Connect Jib Straps

See Figure 4-4 for the following procedure.

Jib straps (23) and links (24) are shipped in the stored position on the jib sections as shown in View F. Connect straps, as follows:

1. Remove storage pins (25) from top holes in strap brackets (View F).
2. Store pins (25) in bottom holes in strap brackets (View E).
3. Remove pins (26) from straps on adjacent section.
4. Rotate links (24) forward and pin to adjacent straps with pins (26, View E) — ***pin heads toward outside of jib***.

Install Jib Backstay Pendants

See Figure 4-5 for the following procedure.

WARNING

Falling Boom Hazard!

Starting at boom butt wire rope guide, jib backstay pendants must be installed in same sequence as inserts (shortest inserts and pendants nearest butt).

Pendants are furnished in matched sets of two and must be installed in matched sets — pendant on one side of boom insert must match pendant on opposite side of boom insert.

Failing to observe this precaution will cause main strut to twist excessively when boom is raised. Structural damage to jib or boom could occur.

1. Depending on boom length, pin pendants (3) or links (5 and/or 6) to links (2) on boom butt wire rope guide (View D1, D2, or D3).
2. Pin adjacent backstay pendants (4) to pendants (3, View D1) or to links (6, View D2 or D3).
3. While working toward boom top, pin remaining backstay pendants (4) together ***in the proper sequence*** and lay pendants along top of boom inserts.
4. Pin basic backstay pendants (7) to last backstay pendant (4) and lay pendants along top of boom top.

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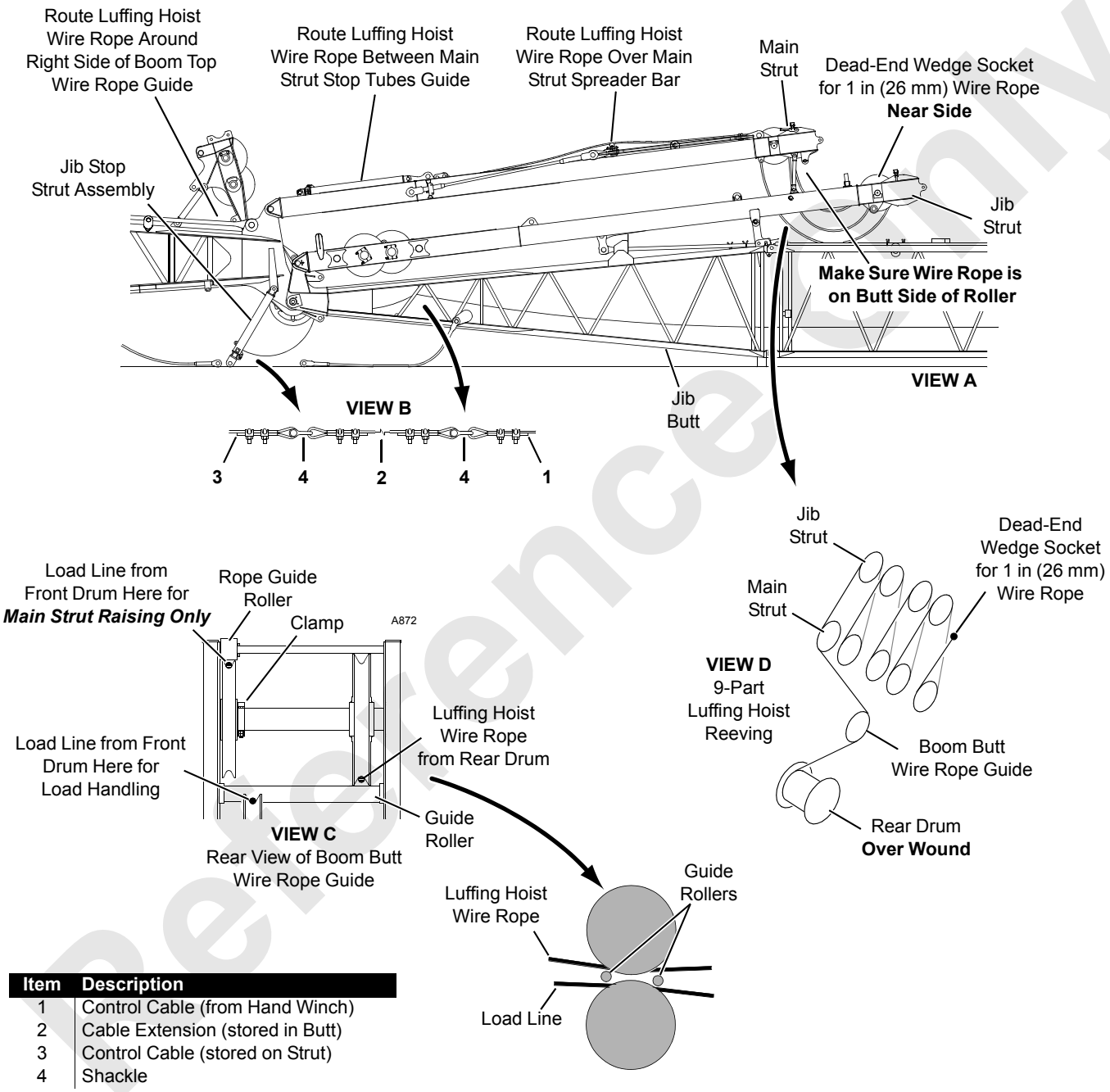


Item	Description
1	Control Cable (from Hand Winch)
2	Cable Extension (stored in Butt)
3	Control Cable (stored on Strut)
4	Shackle

FIGURE 4-6

Install Jib Stop Control Cable

See Figure 4-6, View B for the following procedure.

1. Pay out control cable (1) from winch on left side of jib point.
2. Connect end of control cable (1) to cable extension (2) stored in jib butt with shackle (4).
3. Connect other end of cable extension (2) to control cable (3) on jib stop strut assembly with shackle (4).
4. Make sure cable extension (3) is routed through sheave on left side of strut assembly.

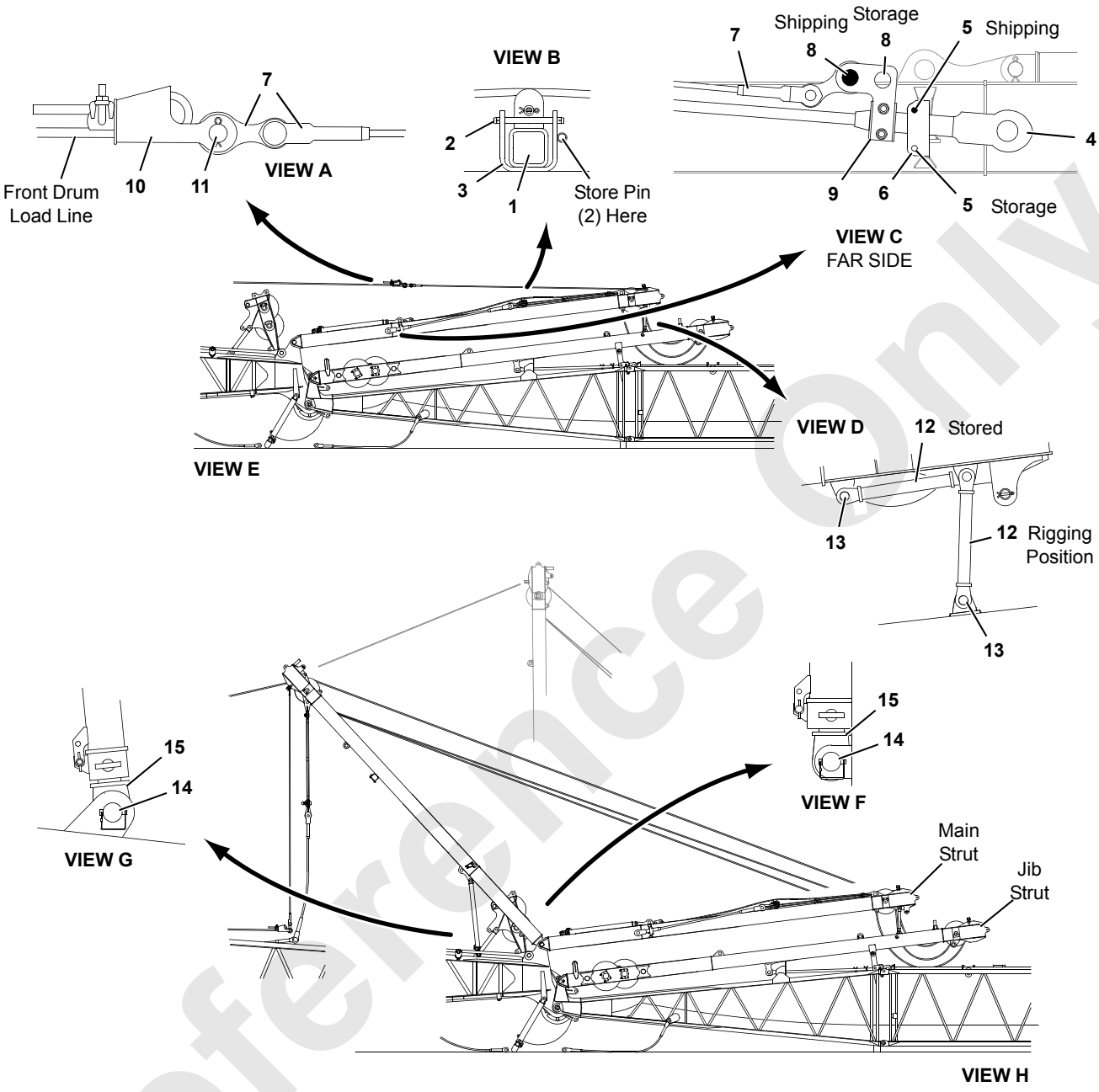
Install Luffing Hoist Wire Rope

See Figure 4-6 for the following procedure.

1. If not already done, remove load line from rear drum and install luffing hoist wire rope specified on Luffing Jib Rigging Drawing.
2. Pay out luffing hoist wire rope and route under top sheave in boom butt wire rope guide (View C).

   Make sure guide rollers (7, Figure 4-5, View D) are installed.
3. Continue to pay out luffing hoist wire rope and route along top of boom to strut sheaves (View A).
   - Lay wire rope along right side of boom top wire rope guide. ***Do not route through any guide sheave in boom top wire rope guide.***
   - Route wire rope between main strut stop tubes and over top of main strut spreader bar.
4. Reeve wire rope through strut sheaves (see View D).
5. Anchor free end of wire rope to right side of main strut with wedge socket provided.

   A terminator wedge socket is used. See OEM instructions at the end of this section.



Item	Description	Item	Description
1	Spreader Bar	9	Bracket
2	Retaining Pin with Cotter Pins	10	Wedge Socket — 1 in (26 mm)
3	Bracket	11	Connecting Pin with Cotter Pin
4	Main Strut Pendant — 9 ft, 8 in (2,9 m)	12	Strut Support
5	Retaining Pin with Snap Pins	13	Pin with Snap Pins
6	Bracket	14	Pin with Snap Pins
7	Strut Raising Pendant and Link	15	Lower Stop Tube
8	Retaining Pin with Cotter Pins		

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FIGURE 4-7

Raise Main Strut/Connect Backstay Pendants

See Figure 4-7 for the following procedure.

WARNING

Moving Part Hazard!

Do not stand on boom top or jib butt while main strut is being raised or lowered.

Wait until main strut is stopped and supported by load line or luffing hoist wire rope before climbing onto boom top or jib butt when connecting and disconnecting strut stop tubes.

1. Unpin main strut spreader bar (1, View B) from brackets (3) on main strut.

   Store pins (2) in pockets in side of brackets (3).

2. Unpin main strut pendants (4, View C) from storage lugs (6).

   Store pins (5) in bottom holes in storage lugs (6).

3. Unpin strut handling pendant and link (7, View C) from storage lugs (9) on left side main strut pendant (4).

   Store pins (8) in rear holes in storage lugs (9).

4. Route load line from front drum over left upper sheave in boom butt wire rope guide (Figure 4-6, View C).

5. Lay load line down center of boom and along left side of boom top wire rope guide.

   Do not route load line through any guide sheave in boom top wire rope guide.

6. Connect wedge socket (10, View A) to load line from front drum (this is same wedge socket used to anchor load line to jib point).

7. Pin wedge socket (10, View A) to strut handling pendant and link (7).

8. Slowly haul in load line just enough to support main strut.

   Make sure load line does not catch on any other components as it tightens.

9. Unpin strut supports (12, View D) from jib strut and pin supports to main strut for storage.

10. Slowly haul in load line while paying out luffing hoist wire rope to raise main strut.

CAUTION

Jib Strut Damage!

Do not allow luffing hoist wire rope to go into tension until main strut is near vertical. Jib strut could be damaged.

11. Tighten luffing hoist wire rope as main strut nears vertical so strut moves smoothly past vertical.

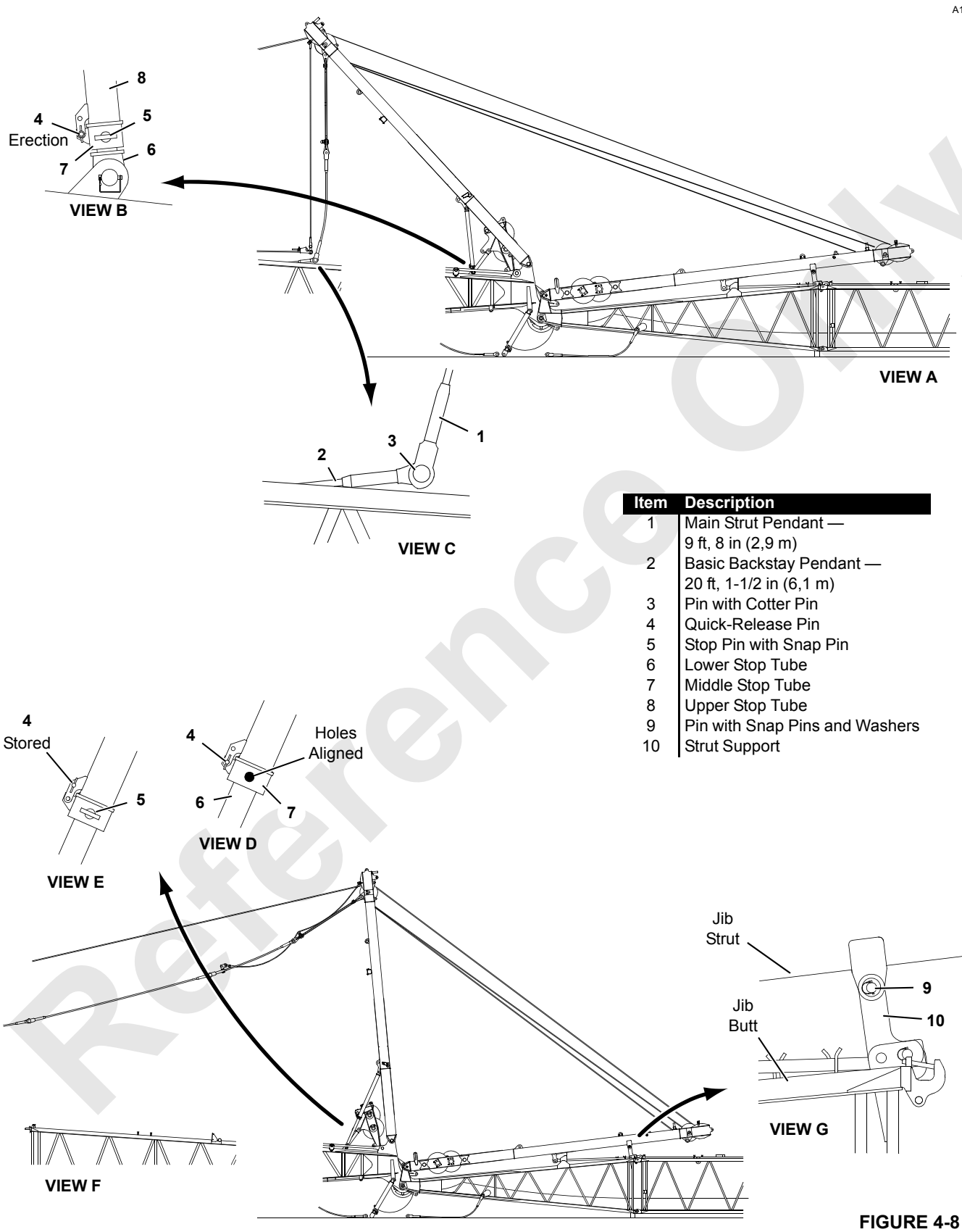
12. Stop raising main strut when it starts to go past vertical and remove pins (14, View F) connecting lower stop tubes (15) to main strut.

13. Continue to haul in load line and pay out luffing hoist wire rope to lower main strut to rear (Figure 4-7, View H).

    Keep load line slacker than luffing hoist wire rope so jib strut is not over tensioned.

14. Stop lowering main strut when holes in lower stop tubes (15, View G) line up with holes in lugs on boom top.

15. Pin lower stop tubes (15, View G) to lugs on boom top.



Item	Description
1	Main Strut Pendant — 9 ft, 8 in (2,9 m)
2	Basic Backstay Pendant — 20 ft, 1-1/2 in (6,1 m)
3	Pin with Cotter Pin
4	Quick-Release Pin
5	Stop Pin with Snap Pin
6	Lower Stop Tube
7	Middle Stop Tube
8	Upper Stop Tube
9	Pin with Snap Pins and Washers
10	Strut Support

FIGURE 4-8

Raise Main Strut/Connect Backstay Pendants (continued)

Unless otherwise specified, see Figure 4-8 for the remaining steps.

16. Unpin wedge socket from strut handling pendant and link (Figure 4-7, View A) and pin strut handling pendant and link to left side main strut pendant (Figure 4-7, View C).
17. Remove wedge socket from front drum load line.
18. Pin main strut pendants (1) to basic backstay pendants on boom top (2, View C).
19. Leave quick-release pins (4, View B) in erecting holes and remove stop pins (5) from middle stop tubes (7).
20. Slowly haul in luffing hoist wire rope to raise main strut to operating position.
21. Continue to haul in luffing hoist wire rope until holes in middle stop tubes (7, View D) line up with upper holes in lower stop tubes (6).
22. Install stop pins (5, View E).
23. Remove quick-release pins (4, View E) from erecting holes and install them in storage holes.

Disconnect Jib Strut from Jib Butt

See Figure 4-8, View G for the following procedure.

1. Luff up or down as required to loosen pins (9) in strut supports (10).
2. Remove pins (9).
3. Store pins in strut supports.
4. Luff up until ***jib straps on insert next to jib butt are clear of strap brackets*** (jib strut at approximately 60°).

CAUTION

Jib Strut Damage!

Do not allow jib strut to come into contact with boom top when luffing up. Jib strut damage could occur.

Install Load Lines

If required, remove lower boom point sheaves. See Luffing Jib Raising Procedure for sheave removal requirements.

Depending on your lifting requirements, the luffing jib can be operated with load lines from the following locations:

- Lower Boom Point
- Intermediate Fall
- Lower Luffing Jib Point
- Upper Luffing Jib Point
- Fixed Jib Point

1. See Capacity Charts for lifting limitations and required deducts when handling loads from selected locations.
2. See Wire Rope Specifications to determine parts of line required for your job and size load block accordingly.
3. Route load line from desired drum through proper guide sheaves on boom (see Load Line Reeving in this section).

   Be sure to route load line from front drum over top of lower guide sheave on boom butt (see Figure 4-6).
4. If jib will be raised using In-Line Method, install load block or weight ball from jib points before boom and jib are raised.
5. If jib will be raised using Jack-Knife Method, proceed as follows:

   a. Reeve load line through guide sheaves in jib point.

   b. Pull load line approximately 20 ft (6,1 m) past end of jib and lay line on ground.

   c. Securely tie off load line to jib. Install load block or weight ball after boom and jib have been jack-knifed into position just prior to raising jib point rollers off ground.

WARNING

Run-Away Wire Rope!

For long boom and short jib combinations, wire rope on boom side of attachment can overhaul unsecured wire rope on jib side. This could cause personnel injuries and damage to equipment. Securely tie off load lines to jib before raising attachment.

Connect Electric Cords/Adjust Electronic Devices

1. Connect electric cords from following components to respective junction boxes on boom and jib points. See Boom Wiring Drawing at the end of this section:
   - Jib Stop Limit Switches
   - Block-Up Limit Switches
   - Load Sensor Sheaves
   - Install shorting plugs on all unused connectors on junction boxes.
2. Adjust electronic devices. See appropriate instructions in Section 6:
   - Jib Stops Limit Switches
   - Block-Up Limit Switches
   - Boom Stop Limit Switch (set to proper angle after boom and jib are raised)

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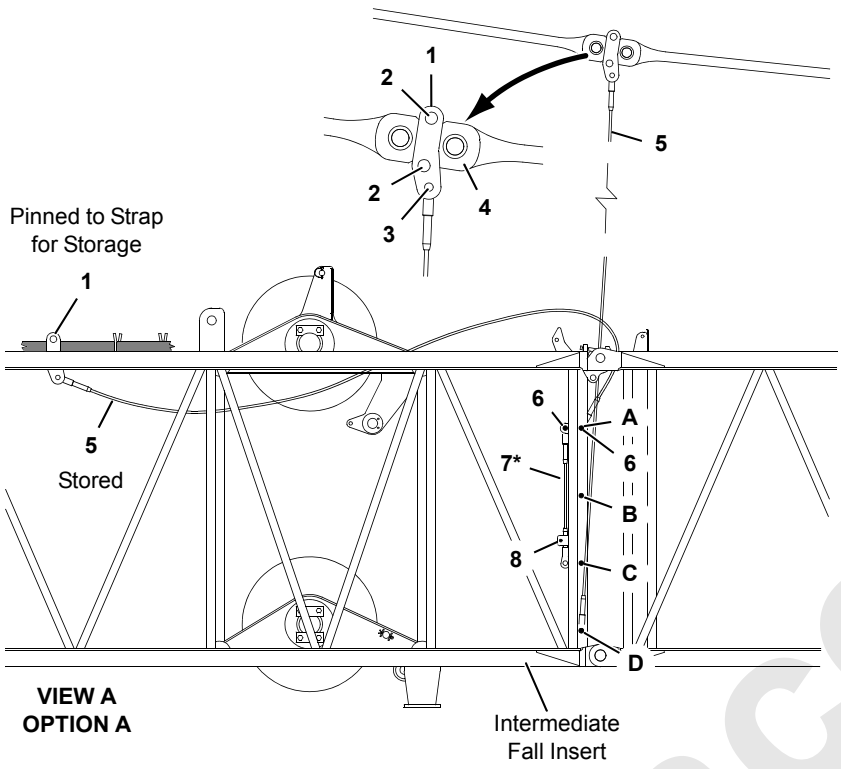
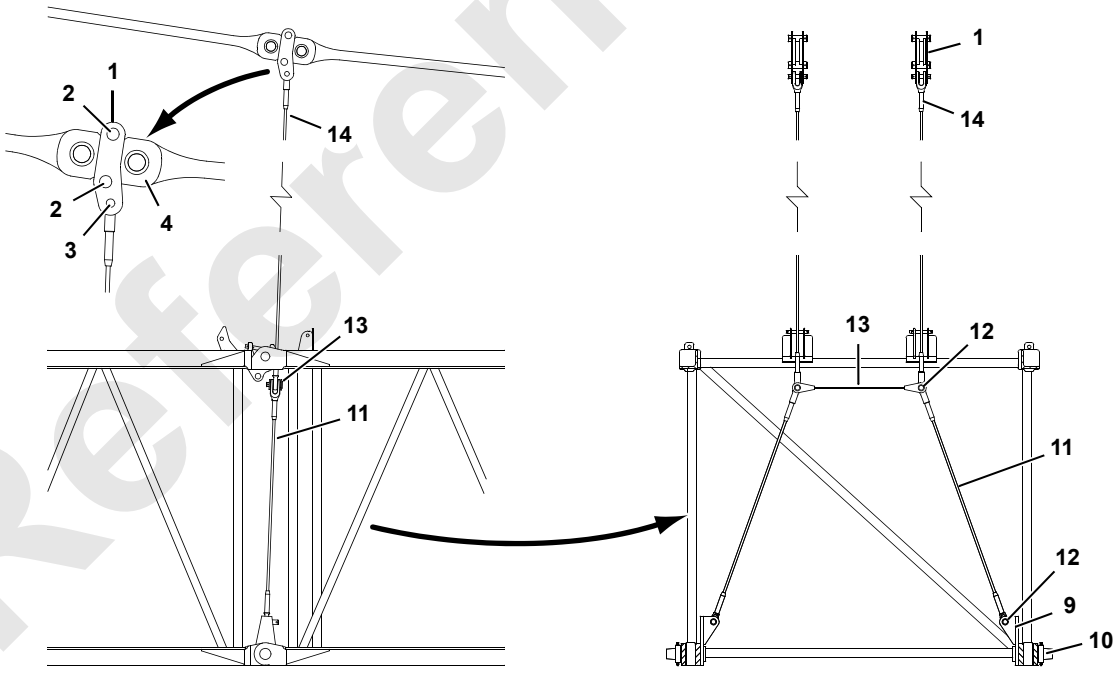


VIEW A
OPTION A

Item	Description
1	Links
2	Pin with Snap Pins
3	Pin with Snap Pins
4	Jib Links
5	Pendant – 13 ft, 8 in (4,2 m) *
6	Pin with Cotter Pin
7	Pendant – 2 ft, 6 in (0,8 m) *
8	Pin with Snap Pins
9	Link
10	Connector Pin with Collar, Retaining Pin, and Cotter Pins
11	Pendant – 4 ft, 7-1/4 in (1,4 m)
12	Pin with Cotter Pin
13	Link
14	Pendant – 9 ft, 2 in (2,8 m)

Hole	Jib Length
A	110, 130, 190 ft (33,5, 39,6, 57,9 m)
B	120, 140, 170, 200 ft (36,6, 42,7, 51,8, 61,0 m)
C	150, 180, 210, 220 ft (45,7, 54,9 64,0 67,1 m)
D	160, 230, 240 ft (48,8, 70,1, 73,2 m)
*	110 and 120 ft (33,5, 36,6 m) Jibs Require both Pendants (5 and 7)



VIEW B – OPTION B
230 and 240 ft (70,1- 73,2 m) Jibs
without Intermediate Fall Insert

FIGURE 4-9

Installing Intermediate Suspension

General

Intermediate suspension is required for the following jib lengths:

- Option A for specified jib lengths when intermediate fall insert is installed.
- Option B for 230 and 240 ft (70,1 and 73,2 m) jib lengths when intermediate fall insert is not installed. See Jib Rigging Drawing to determine location of intermediate suspension.

Option A

For this option, all of the intermediate suspension parts are stored on the intermediate fall insert.

See Figure 4-9, View A for the following procedure.

1. Unpin links (1) from stored position on jib straps.
2. Pin links (1) around jib links (4) at end of intermediate fall insert.
3. Unpin pendants (5) from end of intermediate fall insert.
4. If required, remove pendants (7) from end of intermediate fall insert and pin pendants (7) to pendants (5).

   Store pins (8) in brackets on end of intermediate fall insert.
5. Pin pendants (5) or (7) to proper holes in end of intermediate fall insert.

Option B

See Figure 4-9, View B for the following procedure.

1. Remove standard insert connector pin between required jib inserts.
2. Connect links (9) to inserts with pins (10).
3. Attach lower pendants (11) to links (9) with pins (12).
4. Connect lower pendants (11), link (13), and upper pendants (14) with pins (12).
5. Pin links (1) around jib links (4) between straps.
6. Pin pendants (14) to links (4).

Pre-Raising Checks

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

- ☐ Boom properly assembled and connected to crane according to instructions in Crane Operator Manual.
- ☐ Crawlers blocked (required for all boom and jib lengths). See Crawler Blocking Diagram in Luffing Jib Capacity Chart Manual.
- ☐ All installation steps given in this section performed.
- ☐ Boom and jib inserts installed in the proper sequence according to Rigging Drawing.
- ☐ Boom and jib insert straps installed in the proper sequence according to Rigging Drawing.
- ☐ Backstay pendants installed in the proper sequence according to Rigging Drawing.
- ☐ All connecting pins installed and properly secured.
- ☐ Main strut raised and mast strut stop tubes pinned in operating position.
- ☐ Jib strut unpinned from storage position.
- ☐ Boom and luffing hoist wire rope anchored properly to drums, spooled tightly onto drums, and engaged with proper sheaves (see Rigging Drawings and Wire Rope Installation instructions in this section). Make sure rope guard pins, bars, or rollers are installed to retain wire rope in sheaves.
- ☐ Lower boom point sheaves removed (if required for boom and jib length in use). See Luffing Jib Raising Procedure for sheave removal requirements.
- ☐ Load lines anchored properly to drums, spooled tightly onto drums, and engaged with proper sheaves (see Load Block Reeving and Wire Rope Installation instructions in this section). Make sure rope guard pins, bars, or rollers are installed to retain wire rope in sheaves.

  If load line will be installed after boom and jib are jack-knifed into position, make sure load line going to jib point is securely attached to end of jib point so load line cannot fall off jib and boom.
- ☐ All blocking, tools, and other items removed from boom and jib.
- ☐ All blocking, tools, and other items removed from jib point roller path area.
- ☐ All safety devices installed, electric cords connected, and limits adjusted (see instructions in Section 6):
  - Rated Capacity Indicator/Limiter (see separate manual)
  - Automatic boom stop (must be reset for luffing jib operation after boom and jib are raised)
  - Automatic jib stops
  - Jib and boom block-up limits
- ☐ Luffing Jib Raising Procedure Chart reviewed, and following operations determined:
  - Raising method — in-line or jack-knife
  - Required boom to jib angle for jack-knife raising method
- ☐ Raising procedure in this section read and thoroughly understood.
- ☐ Wind within allowable limits for raising boom and jib (see Section 3).
- ☐ All lube points greased (see Section 5).
- ☐ LUFFING JIB mode selected and confirmed.

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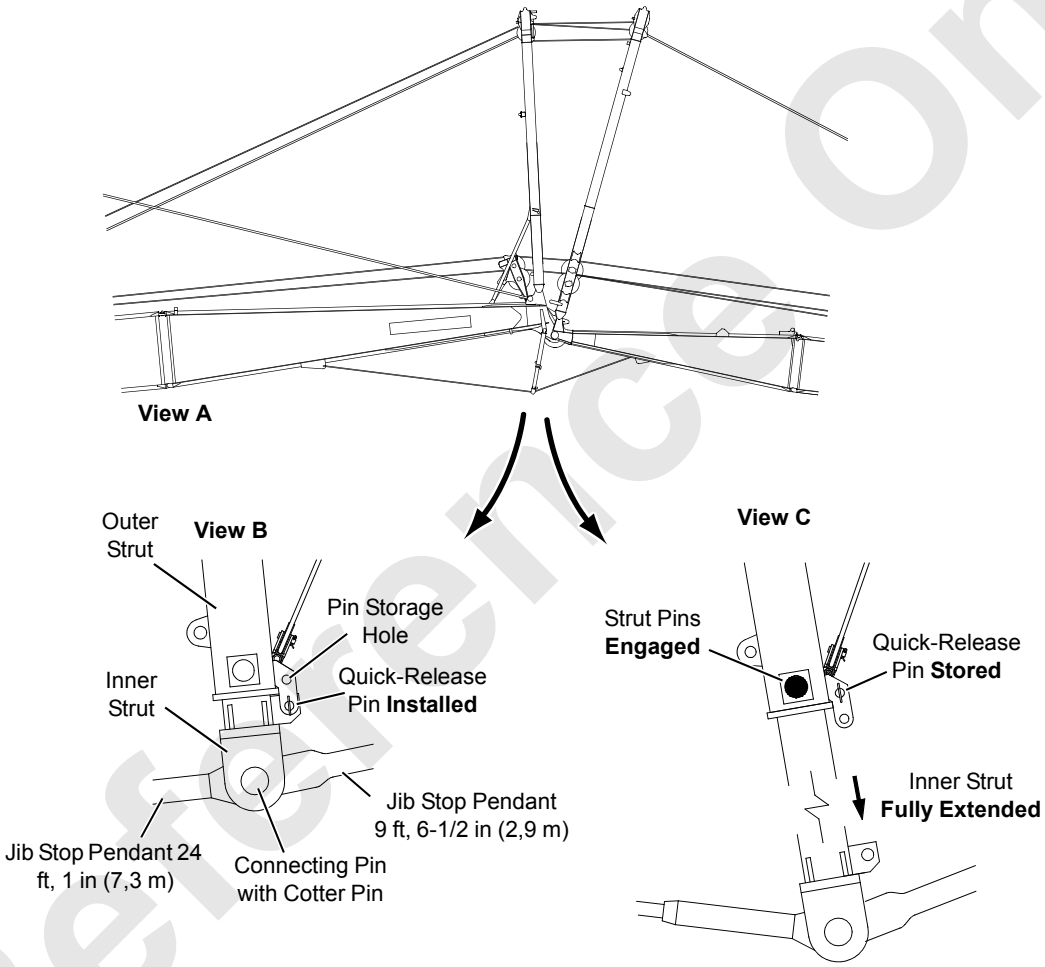

FIGURE 4-10

Raising Boom and Jib

General

WARNING

Falling Boom And Jib Hazard!

Select and confirm LUFFING JIB mode. Operating in any other mode with luffing jib attached is prohibited.

Luffing jib limits are disabled when LUFFING JIB mode is off. Boom and jib could be pulled over backwards.

DANGER

Moving Part Hazard!

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

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

As defined in the Raising Procedure Chart, one of two methods can be used to raise the boom and jib depending on the boom and jib combination: IN-LINE METHOD or JACK-KNIFE METHOD.

The luffing jib can also be raised and lowered using Assemble-In-Air Raising Procedure. (see Assemble-In-Air Raising Procedure topic in this section).

See the Luffing Jib Raising Procedure to determine which method can be used.

Preliminary Raising Procedure

See Figure 4-10 for the following procedure.

1. Using hand winch on left side of jib top, slacken jib stop control cable until it rests on bottom lacings in jib.

   Jib stop inner strut will not extend properly and pins will not engage if control cable is tight.

2. Slowly boom up until ends of jib stop inner strut are 2 – 4 ft (0,6 – 1,2 m) off ground.
3. Pin jib stop pendants to jib stop inner strut (View B).
4. ***Stand to side of jib stop strut*** and remove quick-release pin from both sides of inner strut (View B).

   Inner strut will extend slightly when this step is performed.

5. Store quick-release pins in storage holes on outer strut (View C).
6. Monitor boom to jib angle on digital display while performing step 7.
7. Slowly boom up until jib stop inner strut is fully extended (View C). Boom to jib angle will be approximately 168°.

   Jib stop strut pins should engage automatically when inner strut is fully extended (View C). ***Do not raise boom any higher until both pins are engaged.***

   NOTE: Outer ends of jib stop strut pins are painted white (or other contrasting color) to make pins more visible from ground.

8. Check that jib stop control cable is slack: pay out cable until it rests on bottom lacings in boom. ***Jib stop control cable must be slack at all times during luffing jib operation. Otherwise, pins may disengage or cable may break.***

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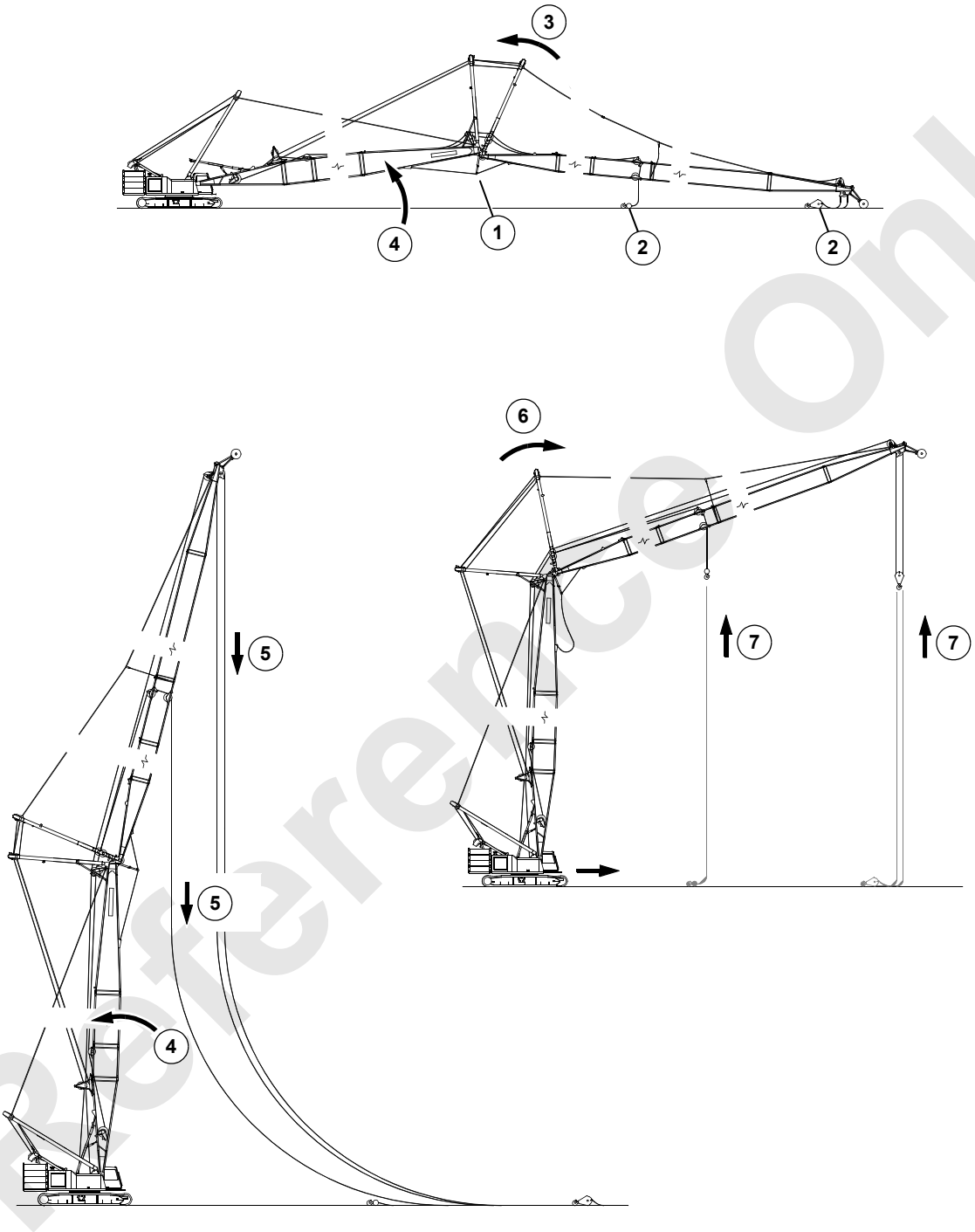

CIRCLED NUMBERS CORRESPOND TO IN-LINE RAISING PROCEDURE STEPS

FIGURE 4-11

In-Line Raising Procedure

See Figure 4-11 for the following procedure. Circled numbers in Figure 4-11 correspond to numbered steps in the following procedure.

WARNING

Tipping Crane Hazard!

For in-line procedure, do not raise boom and jib combinations longer than specified on Raising Procedure Chart. Crane will tip.

NOTE: It is normal for the BLOCK UP fault to come on during the raising procedure. The fault will go off once the boom and luffing jib are raised and the load lines/block-up limit chains are hanging freely.

1. Perform Preliminary Raising Procedure.
2. Install load block and/or weight ball at desired points if not already done (see Load Block Reeving in this section).

WARNING

Falling Load Hazard!

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

3. Slowly luff up until backstay pendants and jib straps start to go into tension and stop. It will be necessary to use limit bypass switch if MAX UP 1 limit is on.

CAUTION

Jib Stop Damage!

Do not raise jib off ground with luffing hoist during step 3. Jib stop straps will be over tensioned, possibly resulting in damage.

4. Slowly raise boom and jib (boom up) to desired boom angle. See Capacity Chart for allowable boom angles.
5. Pay out load lines as boom and jib are raised.
6. Luff down to position jib at required operating radius for load to be handled. It will be necessary to use limit bypass switch if BLOCK UP limit is on.
7. Travel forward as required to position load blocks or weight balls below boom or jib points and raise load blocks or weight balls to desired position.

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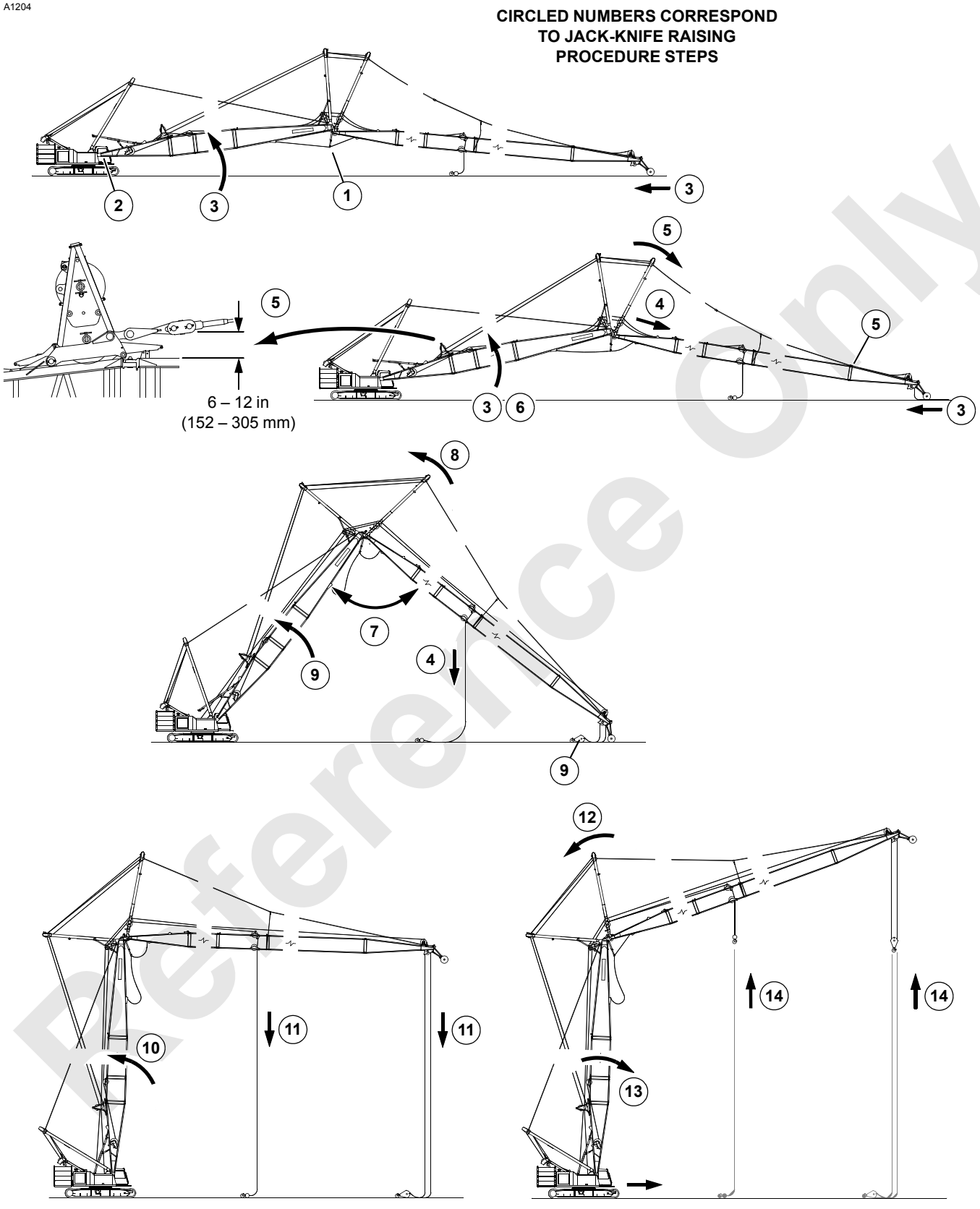


FIGURE 4-12

Jack-Knife Raising Procedure

See Figure 4-12 for the following procedure. Circled numbers in Figure 4-12 correspond to numbered steps in the following procedure.

WARNING

Tipping Hazard!

Determine BOOM TO JIB ANGLE that boom and jib must be jack-knifed to before jib can be raised (see Luffing Jib Raising Procedure). Crane will tip or structural damage will result if specified angle is not adhered to.

Monitor angle on digital display as boom and jib are raised.

CAUTION

Structural Damage!

Avoid possible structural damage to boom and jib from side loading as boom and jib are raised:

Disengage swing lock and release swing brake until boom and jib have been raised to required boom to jib angle.

NOTE: It is normal for the following limits to come on during the raising procedure:

BLOCK UP — this fault will go off once the boom and luffing jib are raised and the load lines/block-up limit chains are hanging freely.

MAX UP 1 and MAX UP 2 — these faults will go off once the boom to jib angle is less than 168°.

1. Perform Preliminary Raising Procedure.
2. Disengage swing lock and release swing brake.
3. Slowly boom up.

   Jib point rollers will roll along ground as boom and jib are jack-knifed into position.
4. Pay out load lines as boom and jib are raised.
5. Backstay pendants and jib straps will tighten as boom and jib rise:
   - OPERATOR — watch backstay pendants along left side of boom. While booming up, pay out luffing hoist wire rope (luff down) at a rate of speed that allows backstay pendant connectors nearest you to float up and down 6 – 12 in (152 – 305 mm) above boom chord.
   - SIGNAL PERSON — watch jib straps along left side of jib. Straps should remain slack and lay on jib top as boom and jib rise. If straps rise out of brackets on jib top, signal operator to luff down faster.

   It will be necessary to use limit bypass switch to luff down if BLOCK UP limit is on.

WARNING

Tipping Hazard!

Do not allow backstay pendants and jib straps to become too tight during raising steps. Crane will tip or structural damage will result.

Do not allow backstay pendants and jib straps to become too slack during raising steps. Jib strut could fall onto jib butt.

6. Slowly continue with Jack-Knife Raising Procedure steps 3 – 5.
7. Stop raising boom when boom and jib have been positioned at required boom to jib angle or jib is vertical, whichever occurs first. ***Monitor this angle on digital display***.

DANGER

Falling Jib Hazard!

Do not position boom and jib any boom to jib angle less than minimum stop (40°). Structural damage to jib butt will occur, possibly causing jib to collapse.

8. Slowly luff up until jib straps start to go into tension and stop.
9. Boom up to raise jib point rollers clear of ground, apply swing brake, and install load blocks or weight balls at jib points (see Load Block Reeving in this section).

WARNING

Falling Load Hazard!

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

WARNING

Falling Load Hazard!

Load lines going up boom can overhaul load lines going down jib. Do not untie load lines from jib until load blocks or weight balls have been installed. Load lines can fall off boom if this precaution is not followed.

10. Slowly raise boom and jib (boom up) to 85° boom angle.
11. Pay out load line as boom and jib are raised.
12. Luff up to position jib at required operating radius for load to be handled.
13. Boom down to position jib at desired operating angle. See Capacity Chart for allowable boom angles.
14. Travel forward as required to position load blocks or weight balls below boom or jib points and raise load blocks or weight balls to desired position.

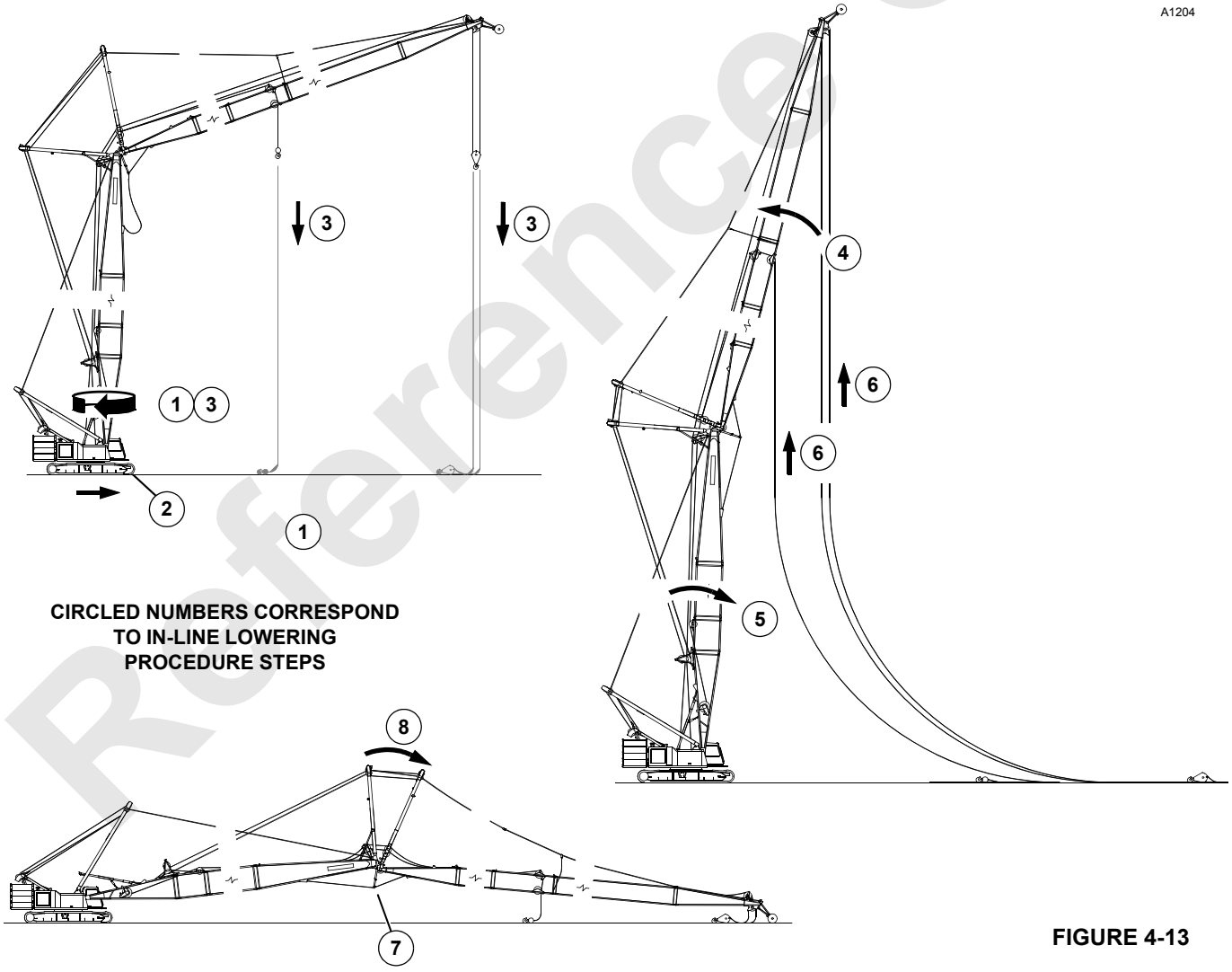


FIGURE 4-13

Lowering Boom and Jib

WARNING

Falling Boom And Jib Hazard!

Select and confirm LUFFING JIB mode. Operating in any other mode with luffing jib attached is prohibited.

Luffing jib limits are disabled when LUFFING JIB mode is off. Boom and jib could be pulled over backwards.

DANGER

Moving Part Hazard!

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

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

As defined in the raising procedure chart, one of two methods can be used to lower the boom and jib depending on the boom and jib combination: IN-LINE METHOD or JACK-KNIFE METHOD.

See the Luffing Jib Raising Procedure to determine which method can be used.

In-Line Lowering Procedure

See Figure 4-13 for the following procedure. Circled numbers in Figure 4-13 correspond to numbered steps in following procedure.

NOTE: It is normal for the following for BLOCK UP, MAX UP 1, and MAX UP 2 limits to come on during the lowering procedure.

1. Swing upperworks in-line with lowerworks so boom is centered over either end of crawlers.
2. Travel crawler rollers onto blocking (end under boom).

DANGER

Tipping Crane Hazard!

Lower all boom and jib combinations over blocked crawlers, otherwise crane will tip.

3. Swing boom and jib slightly to either side of center and lower load blocks and/or weight balls onto ground. Then swing boom and jib in-line with crawlers.

WARNING

Tipping Crane Hazard!

Lower all load blocks and/or weight balls onto ground before lowering boom and jib. Crane could tip if this step is not performed.

DANGER

Tipping Crane Hazard!

For in-line method, do not lower boom and jib combinations longer than specified in Raising Procedure Chart. Crane will tip.

4. Raise jib to 168° boom to jib angle. ***Monitor this angle on digital display.***
5. Slowly boom down to lower boom and jib until jib point rollers contact ground. It will be necessary to use limit bypass switch if BLOCK UP limit is on.
6. Haul in load lines as boom and jib are lowered, but do not lift load blocks or weight balls off ground.

CAUTION

Jib Stop Damage!

Do not lower boom any farther until in-line lowering step 7 is performed. Once jib point rollers contact ground, damage to jib stop struts or pendants will result if struts are over tensioned

7. Retract and store jib stop struts. Perform Final Lowering Procedure.
8. Struts can now be lowered. See Lowering Struts later in this section for procedure.

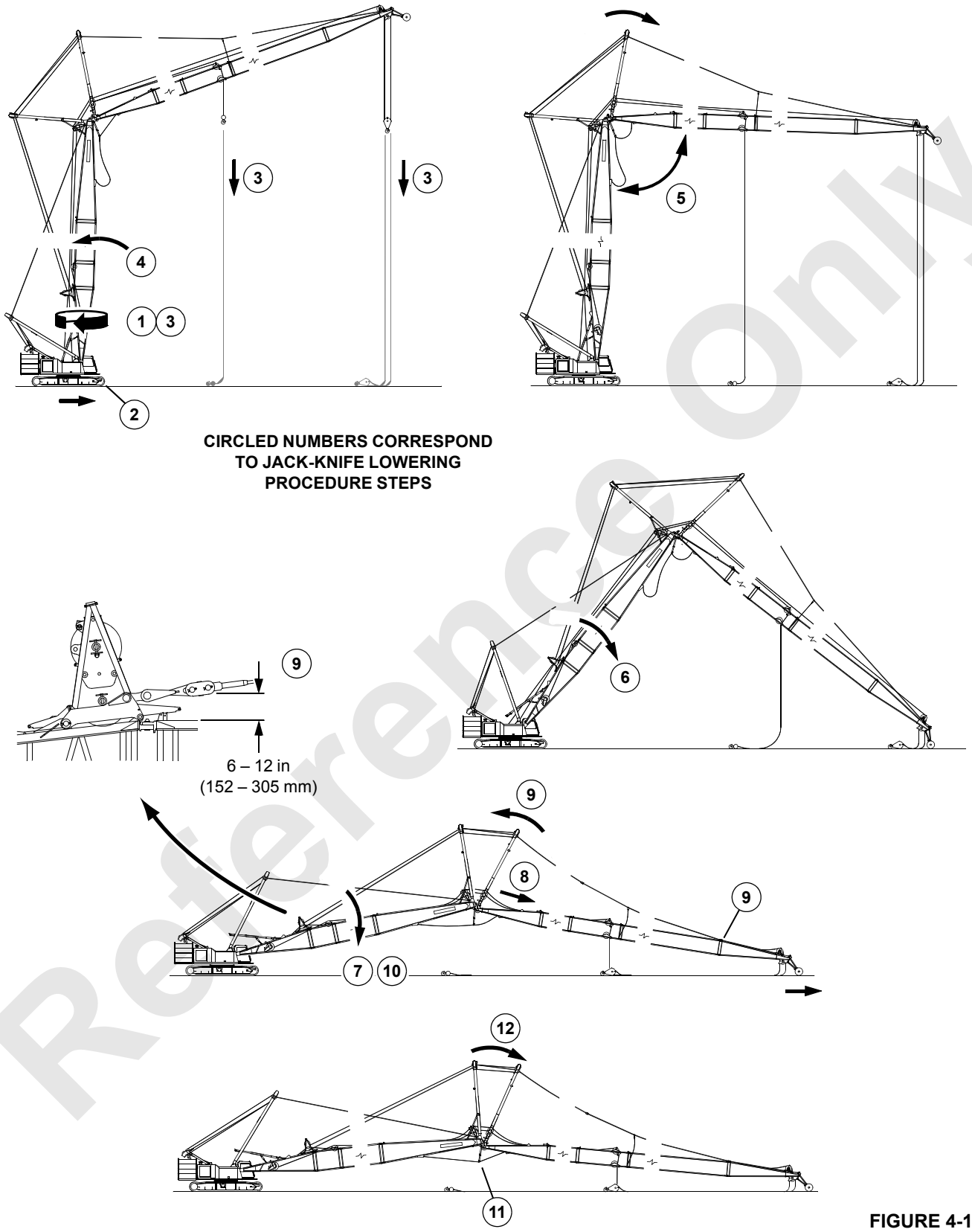


FIGURE 4-14

Jack-Knife Lowering Procedure

See Figure 4-14 for the following procedure. Circled numbers in Figure 4-14 correspond to numbered steps in the following procedure.

NOTE: It is normal for the BLOCK UP, MAX UP 1, and MAX UP 2 limits to come on during the lowering procedure.

1. Swing upperworks in-line with lowerworks so boom is centered over either end of crawlers.
2. Travel crawler rollers onto blocking (end under boom).

DANGER

Tipping Crane Hazard!

Lower all boom and jib combinations over blocked crawlers, otherwise crane will tip.

3. Swing boom and jib slightly to either side of center and lower load blocks and/or weight balls onto ground. Then swing boom and jib in-line with crawlers and apply swing brake.

WARNING

Tipping Crane Hazard!

Lower all load blocks and/or weight balls onto ground before lowering boom and jib. Crane could tip if this step is not performed.

4. Raise boom to 85° boom angle.
5. Slowly luff down to position jib at required boom to jib angle (see Raising Procedure Chart for angle). ***Monitor angle on digital display.***

   It will be necessary to use limit bypass switch to luff down if BLOCK UP limit is on.

DANGER

Tipping Crane Hazard!

For jack-knife method, do not lower boom and jib to ground until boom has been positioned at minimum angle of 80° and jib has been positioned at specified boom to luffing jib angle. Crane will tip.

Falling Jib Hazard!

Do not lower jib to any boom to jib angle less than minimum stop (40° past or 55° current). Structural damage to jib butt will occur, possibly causing jib to collapse.

CAUTION

Side Loading Hazard!

Avoid possible structural damage to boom and jib from side loading as boom and jib are lowered:

Disengage swing lock and release swing brake when jib point rollers contact ground.

6. Slowly boom down until jib point rollers contact ground. Depending on boom and jib combination, jib may be hanging vertical when rollers contact ground. If this happens, raise jib (luff up) until jib is a few degrees forward of vertical.

   It will be necessary to use limit bypass switch to boom down if BLOCK UP limit is on.
7. Release swing brake (disengage swing lock) and continue to lower boom slowly.

   Jib point rollers will roll along ground as boom and jib unfold.
8. Pay out load lines as boom and jib lower.
9. Backstay pendants and jib straps will slacken as boom and jib lower:
   - OPERATOR — watch backstay pendants along left side of boom. While booming down, haul in luffing hoist wire rope (luff up) at a rate that allows backstay pendant connectors nearest you to float up and down 6 – 12 in (152 – 305 mm) above boom chord.
   - SIGNAL PERSON — watch jib straps along left side of jib. Jib top straps should lay on jib top as boom and jib lower. If more straps start to lower into strap brackets on jib inserts, signal operator to luff up faster.

   It will be necessary to use limit bypass switch to luff down if BLOCK UP limit is on.

WARNING

Tipping Hazard!

Do not allow backstay pendants and jib straps to become too tight during lowering steps. Crane will tip or structural damage will result.

Do not allow backstay pendants and jib straps to become too slack during raising steps. Jib strut could fall onto jib butt.

10. Continue with Jack-Knife Lowering Procedure steps 7 – 9 until jib stop pendants start to go into tension (approximately 168° boom to jib angle). ***Monitor this angle on digital display.***

CAUTION

Jib Stop Damage!

Once jib stop pendants start to go into tension, do not lower boom any farther until jack-knife lowering step 11 is performed. Damage to jib stop struts or pendants will result if struts are over tensioned.

11. Retract and store jib stop struts. Perform Final Lowering Procedure.
12. Struts can now be lowered. See Lowering Struts in this section for procedure.

Final Lowering Procedure

Perform the following steps once the boom and jib have been lowered to either of the following positions:

IN-LINE PROCEDURE — jib point rollers just contact ground.

JACK-KNIFE PROCEDURE — jib stop pendants just start to go into tension (approximately 168° boom to jib angle).

1. Disengage jib stop strut pins with hand winch on left side of jib top.

NOTE: Outer end of jib stop strut pins are painted white (or other contrasting color) to make pins more visible from ground.

2. Slowly lower boom to retract jib stop inner strut.

   It will be necessary to use limit bypass switch to boom down if BLOCK UP or MAX UP limits are on.

3. Stop lowering boom when jib stop inner strut is fully retracted (Figure 4-10, View B).
4. Remove both quick-release pins from storage holes and install pins to connect jib stop inner strut to outer strut in retracted position (Figure 4-10, View B).
5. Unpin both jib stop pendants from jib stop inner strut (Figure 4-10, View B).
6. Rotate jib stop struts to rear and pin struts in stored position under boom top (Figure 4-3, View B).
7. Lower boom onto blocking placed under connectors between boom top and insert next to boom top. Size height of blocking so distance between boom point sheaves and ground is approximately 26 in (0,7 mm) (Figure 4-3, View B).
8. Lower struts if required.

Lowering Struts

WARNING

Moving Part Hazard!

Do not stand on boom top or jib butt while main strut is being raised or lowered.

Wait until main strut is stopped and supported by load line or luffing hoist wire rope before climbing onto boom top or jib butt when connecting and disconnecting strut stop tubes.

1. Luff down to lower jib strut until storage holes in strut line up with holes in strut supports (10, Figure 4-8, View G).
2. Pin jib strut to strut support as shown in (Figure 4-8, View G).
3. Remove quick-release pins (4, Figure 4-8, View E) from storage holes in main strut stop tubes and install both quick-release pins in erecting holes (View D). It may be necessary to luff up or down slightly to align holes.

WARNING

Falling Load Hazard!

Do not perform step 4 until main strut is supported by luffing hoist wire rope.

Strut stop tubes will retract and main strut will fall suddenly with violent force.

4. Remove both stop pins (5, Figure 4-8, View E). It may be necessary to luff up or down slightly to loosen pins.
5. Pay out luffing hoist wire rope to lower main strut until holes in middle stop tubes (7, Figure 4-8, View B) line up with bottom holes in lower stop tubes (6).
6. Install stop pins (5, Figure 4-8, View B) to connect middle stop tubes to lower stop tubes.
7. Unpin main strut pendants (1, Figure 4-8, View C) from basic backstay pendants (2) on boom top.
8. Remove load block or weight ball from front drum load line (if attached).
9. Route front drum load line over top of left-upper guide sheave in wire rope guide on boom butt (Figure 4-6, View C).
10. Attach wedge socket (10, Figure 4-7, View A) to front drum load line.
11. Unpin strut handling pendant and link (7, Figure 4-7, View C) from bracket on left side main strut pendant.

12. Pin wedge socket (10, Figure 4-7, View A) to strut handling pendant and link (7).
13. Haul in front drum load line so load line and strut handling pendant are just slightly slack.

    Keep load line slacker than luffing hoist wire rope so jib strut is not over tensioned.
14. Unpin lower stop tubes from lugs on boom top (Figure 4-7, View G). It may be necessary to luff up or down to loosen pins.
15. Slowly pay out load line while hauling in luffing hoist wire rope to raise main strut to vertical.
16. Stop raising main strut as it nears vertical and pin strut stop tubes to main strut as shown in Figure 4-7, View F.

CAUTION

Jib Strut Damage!

Do not allow luffing hoist wire rope to go into tension until main strut is near vertical. Jib strut could be damaged.

17. Tighten load line as main strut nears vertical and continue to haul in luffing hoist wire rope so strut moves smoothly past vertical.
18. Continue to lower main strut to approximately 3 ft (1 m) above jib strut.
19. Unpin strut supports (12, Figure 4-7, View D) from storage position on main strut and allow to hang vertically. Slowly pay out load line to lower strut supports to lugs on jib strut.
20. Pin strut supports to lugs on jib strut (Figure 4-7, View D).
21. Unpin strut handling pendant and link from wedge socket and pin to left side main strut pendant for storage (Figure 4-7, View C).
22. Remove socket and wedge from front drum load line and store. Spool wire rope onto front drum for storage.
23. Pin main strut pendants to main strut for storage (Figure 4-7, View C).
24. Unreeve and spool luffing hoist wire rope onto rear drum for storage.
25. Store main strut:
    a. Attach slings (5, Figure 4-4, View A) from assist crane to four lifting lugs (6) on main strut.
    b. Slowly lift main strut until it is supported by assist crane.
    c. Unpin strut supports (14, Figure 4-4, View A-A) from rigging position and pin in storage position.
    d. Remove pins (13) from connecting holes in end of main strut.
    e. Unpin strut supports (14, View A-A) from storage position and pin in rigging position.
    f. Slowly lower main strut onto jib strut for shipping (Figure 4-3, View B).
    g. Remove slings (5).
    h. Store pins (13) in main strut holes.

Removing Jib

WARNING

Collapsing Boom/Jib Hazard!

Improper disassembly of boom and jib sections can cause boom or jib to collapse onto personnel removing connecting pins.

Death or serious injury can result if precautions listed below are not taken:

- Lower boom/jib so boom and jib points are supported on blocking or ground.
- Slacken rigging — do not attempt to remove connecting pins while boom or jib is supported by rigging.
- Block below both ends of each boom or jib section before removing connecting pins.
- Stand on outside of boom or jib sections when removing connecting pins. Never work under or inside boom or jib sections. Use care not to damage lacings and chords as pins are knocked out.

Reverse Installing Jib steps in this section to disassemble and remove jib.

Jib butt and both struts can be shipped as an assembled unit. ***When handling this assembly, use lifting slings attached to four lifting lugs on main strut (6, Figure 4-3, View D).***

NOTE: Automatic boom stop must be reset to 83° for operation without the luffing jib (see Automatic Boom Stop Adjustment in Section 6).

ASSEMBLE-IN-AIR RAISING PROCEDURE

This section contains raising and lowering instructions for #82 boom, #149 luffing jib, and #134 fixed jib combinations that require use of the Assemble-In-Air Raising Procedure (see Jib Luffing Assembly, Assemble-In-Air Drawing A01426).

Extreme care must be used when raising and lowering boom and jib combinations that require use of the Assemble-In-Air Raising Procedure. The luffing jib attachment must be raised and lowered by experienced personnel trained in the operation and erection of construction cranes.

Personnel shall read, understand, and comply with the instructions in this section.

Contact the Manitowoc Crane Care Lattice Team for explanation of any procedure not fully understood.

The area in which the crane is assembled and the attachment raised and lowered must be firm, level to within 1 ft in 100 ft (0,3 m in 30 m), and free of ground and overhead obstructions. The area selected must be large enough to accommodate the crane with selected boom-luffing jib length and movement of the assist crane.

DANGER

Read Instructions!

To prevent tipping or structural failure of boom and luffing jib:

- Read Luffing Jib Capacity Charts and instructions before attempting to raise or lower luffing jib attachment.
- Rig and operate crane as instructed in Luffing Jib Capacity Charts, and Jib Luffing Assembly, Assemble-In-Air Drawing.

Death or serious injury to personnel can result if instructions are not followed.

Danger Tag

A Danger Tag must be attached in the 999 operator's cab in clear view of the operator as a reminder that boom-luffing jib combination in use requires assist crane for raising and lowering.

DANGER

Falling Attachment Hazard!

To raise and lower luffing jib attachment in use, an assist crane must be used to partially assemble and disassemble luffing jib in air.

Read and comply with Jib Luffing Assembly and Jib Luffing Assembly, Assemble-In-Air Drawing before attempting to raise or lower this attachment.

Structural damage to crane will occur and boom and luffing jib will collapse if instructions are not followed.

Signal Person

Two operators are required to raise and lower the luffing jib with the Assemble-In-Air Raising Procedure — one to operate the 999 crane and one to operate the assist crane. A qualified signal person shall be provided to coordinate the raising and lowering procedure and to provide necessary signals (visual and audible) to both crane operators.

Counterweight Requirement

For operation with boom-luffing jib combinations requiring the Assemble-In-Air Raising Procedure, the 999 must be equipped with Series 3 counterweight as specified in Luffing Jib Capacity Chart and Jib Luffing Assembly, Assemble-In-Air Drawing.

WARNING

Tipping Hazard!

Do not operate crane until Series 3 counterweight is installed. Crane will tip if not equipped with proper counterweight.

Outrigger

To prevent tipping or structural damage, all boom-luffing jib combinations requiring the Assemble-In-Air Raising Procedure must be ***raised or lowered over side of crane with outrigger assembly installed and jack pads extended firmly against foundation***.

WARNING

Tipping Hazard/Structural Damage!

Do not raise or lower boom and luffing jib from or to ground until outrigger assembly is installed and fully set. Crane could tip or fail structurally.

Boom-Luffing Jib Rigging

The boom, luffing jib, and fixed jib components must be assembled according to the instructions in this section and in Luffing Jib Rigging Drawings.

Lifting Slings

Lifting slings are required to raise the jib with the assist crane. Each lifting sling must have a minimum capacity of 16,000 pounds (7 257 kg).

CAUTION

Structural Damage!

Keep load line from assist crane vertical during raising and lowering procedures. Use extreme care not to side load boom and luffing jib.

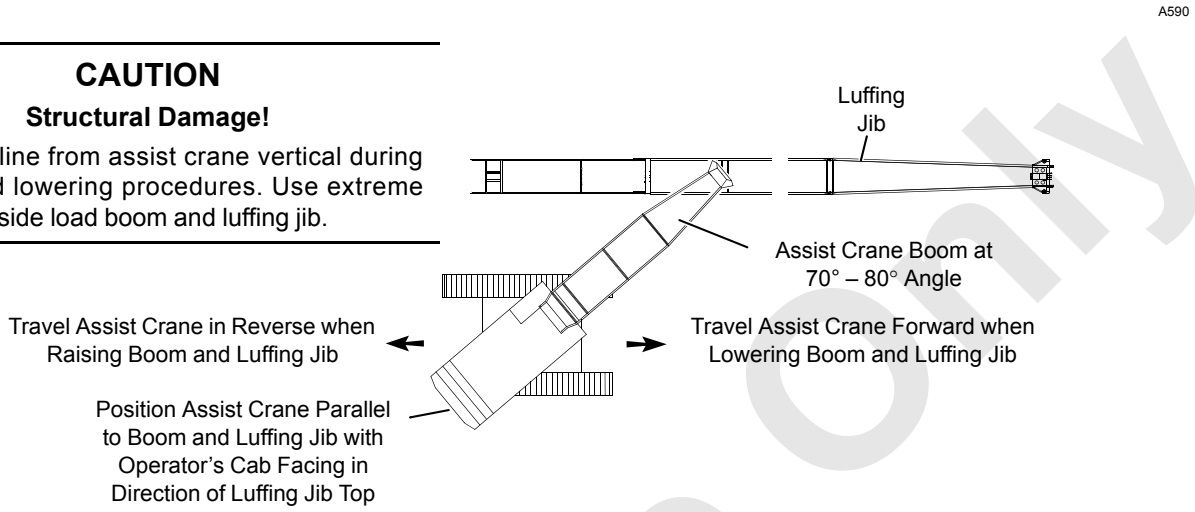


FIGURE 4-15

Assist Crane

The assist crane must meet the capacity and boom length requirements specified in Jib Luffing Assembly, Assemble-In-Air Drawing.

Position the assist crane along either side of the boom and luffing jib, as shown in Figure 4-15:

WARNING

Tipping Crane Hazard!

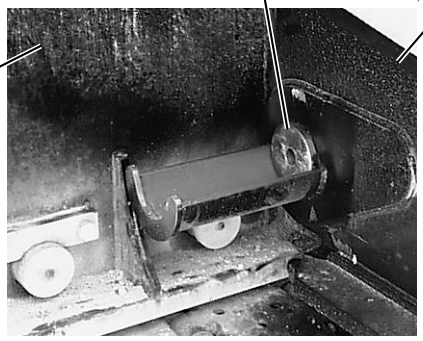
Assist crane must meet requirements specified in Jib Luffing Assembly, Assemble-In-Air Drawing. Using too small an assist crane or positioning and operating assist crane improperly will result in tipping. Boom and luffing jib could collapse.

1. Position assist crane boom at 70 – 80° boom angle.
2. Position assist crane on a firm, level, uniformly supporting surface with its crawlers parallel to boom and luffing jib.
3. Position assist crane upperworks facing in direction of 999 boom top.
4. Operate assist crane so that load line remains vertical at all times. ***Assist crane must not put any side load on boom and luffing jib.***

Item	Description
1	Outrigger Assembly
2	Outrigger Side Beam
3	Crawler Side Frame
4	Pin with Collar and Retaining Pin
5	Collar Storage Lug
6	Jack Pad
7	Screw Jack

P1644

View A



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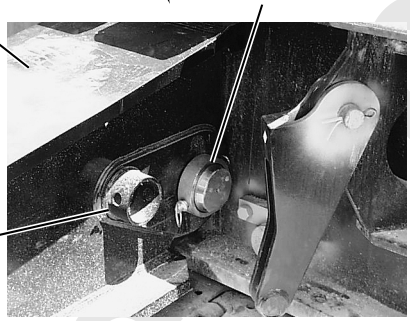
View C
(outboard side)



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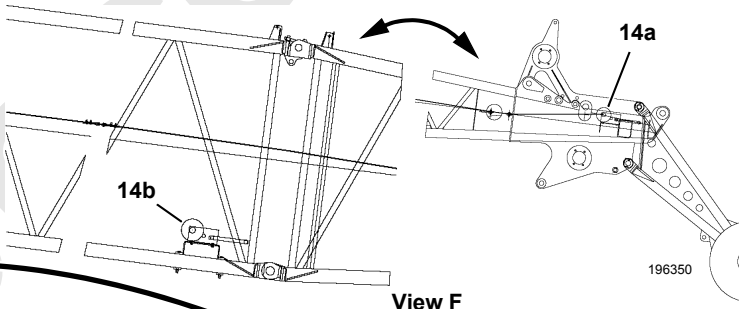
View B
(inboard side)

View D

P1647



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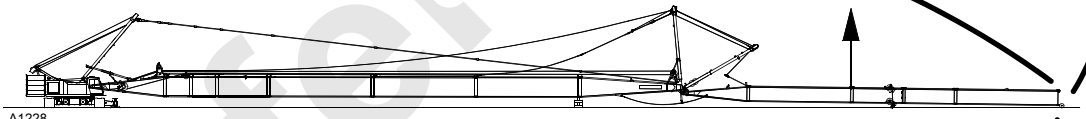
View F


A1228

Item	Description
8	Jib Insert
9	Strap Links
10	Round Steel Bar
11	Connector
12	Load Line
13	Roller
14	Pin with Cotter Pin
15a	Normal Winch Location
15b	Winch Location with Assemble-In-Air Raising Procedure

P1648

View E

FIGURE 4-16

Prepare Crane and Boom

See Figure 4-16 for the following procedure.

1. Position crane in assembly area.
2. Install outrigger assembly (View A).
   a. Pin outrigger side beams to lugs on crawler side frame (View C).
   b. Remove pin and collar from storage lug on outrigger beam (View B).
   c. Place collar over outrigger pin and secure with collar pin (View B).
   d. Using screw jacks, turn down outrigger pads until they are firmly seated against foundation (View A).
3. Swing crane so front of upperworks is 90° to crawlers and over outrigger assembly.
4. Assemble boom to desired length per instructions in Boom Rigging Guide. Block boom approximately 4 ft (1,2 m) high.
5. Remove lower boom point. ***This is mandatory!***

Assemble Partial Luffing Jib

See Figure 4-16 for the following procedure.

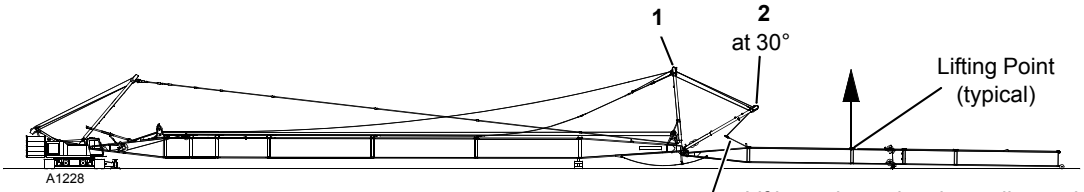
1. Assemble desired length of partial luffing jib (butt and inserts without top) by performing following ***Installing Jib*** steps:
   a. Install Jib Stop Strut Assembly.
   b. Install Jib Butt Assembly.
   c. Install Jib Stop Pendants.
   d. Connect Main Strut to Boom Top.
   e. Raise Jib Strut to Assembly Position.
   f. Install Jib Inserts.
   g. Connect Jib Straps (between jib strut and each jib insert).
2. Slide round bar through connector holes in last jib insert and through holes in strap links (Figure 4-16, View D).

   Bar must be installed to prevent straps from accidentally sliding off inserts as boom and luffing jib are raised.
3. Pin rollers to bottom connectors at end of last jib insert (View E).

   To prevent excessive side load on boom, luffing jib, and swing drive, release 999 swing brake and disengage swing lock while rollers are touching ground.
4. Continue to assemble desired length of partial luffing jib (butt and inserts without top) by performing following ***Installing Jib*** steps:
   a. Install Jib Backstay Pendants.
   b. Install Luffing Hoist Wire Rope.
   c. Raise Main Strut/Connect Backstay Pendants — ***perform all steps so main strut is pinned in operating position***.
5. Tie load line off securely to end of last jib insert (View E) with chain. Load line should have some slack but be tight enough to keep it from falling off top of inserts.

   This step is required to prevent load line on boom side of attachment from overhauling load line on jib side of attachment.
6. For Assemble-In-Air Raising Procedure the winch must be installed on the end of last jib insert so that it may be reached from the ground during disassembly (View F).
7. If fixed jib is used with luffing jib, attach backstay pendants for fixed jib backstay to luffing jib insert.

   Place pendants on top of insert.



View C

CONNECTING LOCATION FOR LIFTING SLINGS FROM ASSIST CRANE

ft (m) (measured from right end of last jib insert)

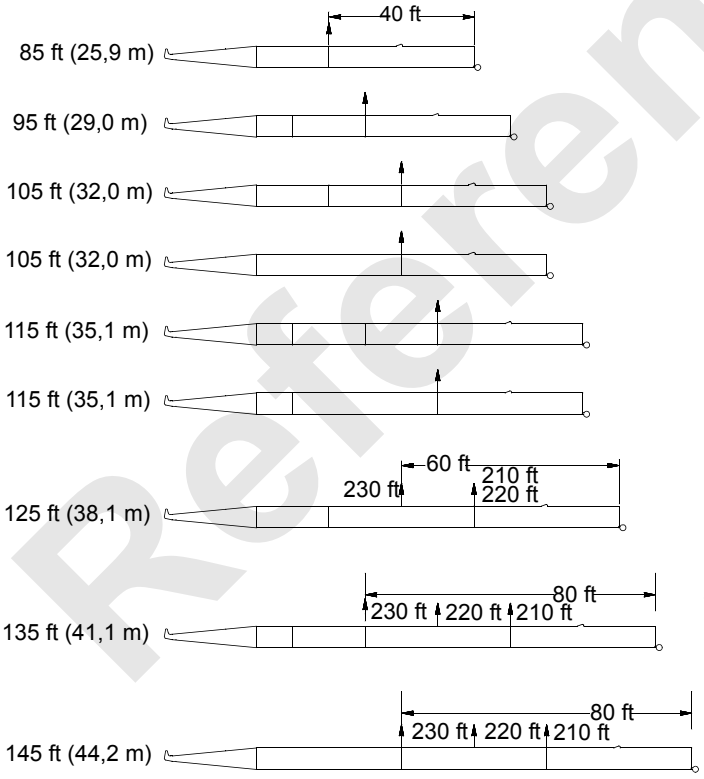
	85 (25,9)	95 (28,9)	105 (31)	115 (35)	125 (38,1)	135 (41,1)	145 (44,2)
200 (60,1) *	—	—	—	N/A	N/A	N/A	N/A
210 (64)	N/A	N/A	40 (12,2)	40 (12,2)	40 (12,2)	40 (12,2)	40 (12,2)
220 (67)	40 (12,2)	40 (12,2)	40 (12,2)	40 (12,2)	40 (12,2)	60 (18,2)	60 (18,2)
230 (70,1)					60 (18,2)	80 (24,4)	80 (24,4)

Item	Description
1	Main Strut
2	Jib Strut
3	jib Straps

* 200 ft (60,1 m) boom with 140 - 170 ft (42,6 - 51,8 m) luffing jib with intermediate fall can be raised/lowered over end of blocked crawlers (outriggers assembly is not required).

View D

#149 Luffing Jib Without Intermediate Fall Insert



#149 Luffing With Intermediate Fall Insert

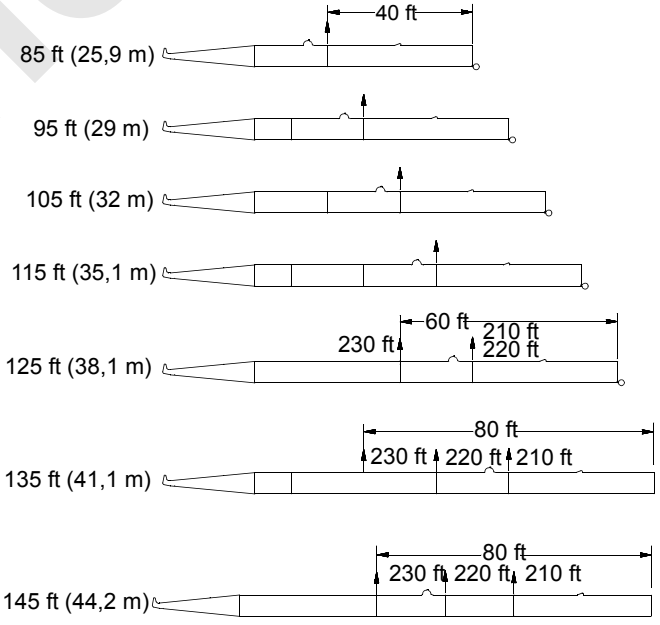


FIGURE 4-17

Raising Procedure

Before beginning the raising procedure, make the checks listed under Pre-Raising Checks topic in this section and correct any defects.

Two raising procedures are provided:

- Procedure A – Raise Boom and Luffing Jib
- Procedure B – Raise Boom, Luffing Jib, and Fixed Jib

WARNING

Moving Part Hazard!

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

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

CAUTION

Structural Damage Hazard!

Prevent side load damage to boom and jib. Disengage swing lock and release swing brake when jib point rollers are on ground.

Raise Jib

See Figure 4-17 for the following procedure.

1. Disconnect jib strut from strut supports.
2. LUFF UP to raise jib strut until jib straps just lift off rear brackets (approximately 30°) (View C).
3. Attach lifting slings from assist crane to jib insert as shown in Figure 4-18. See View D for location.

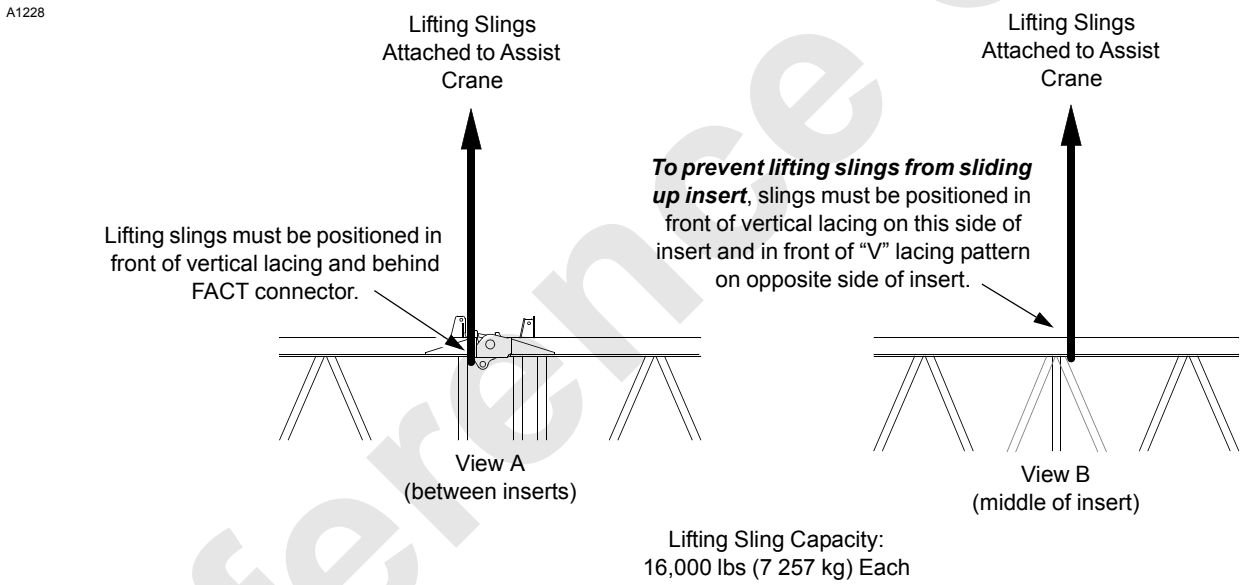
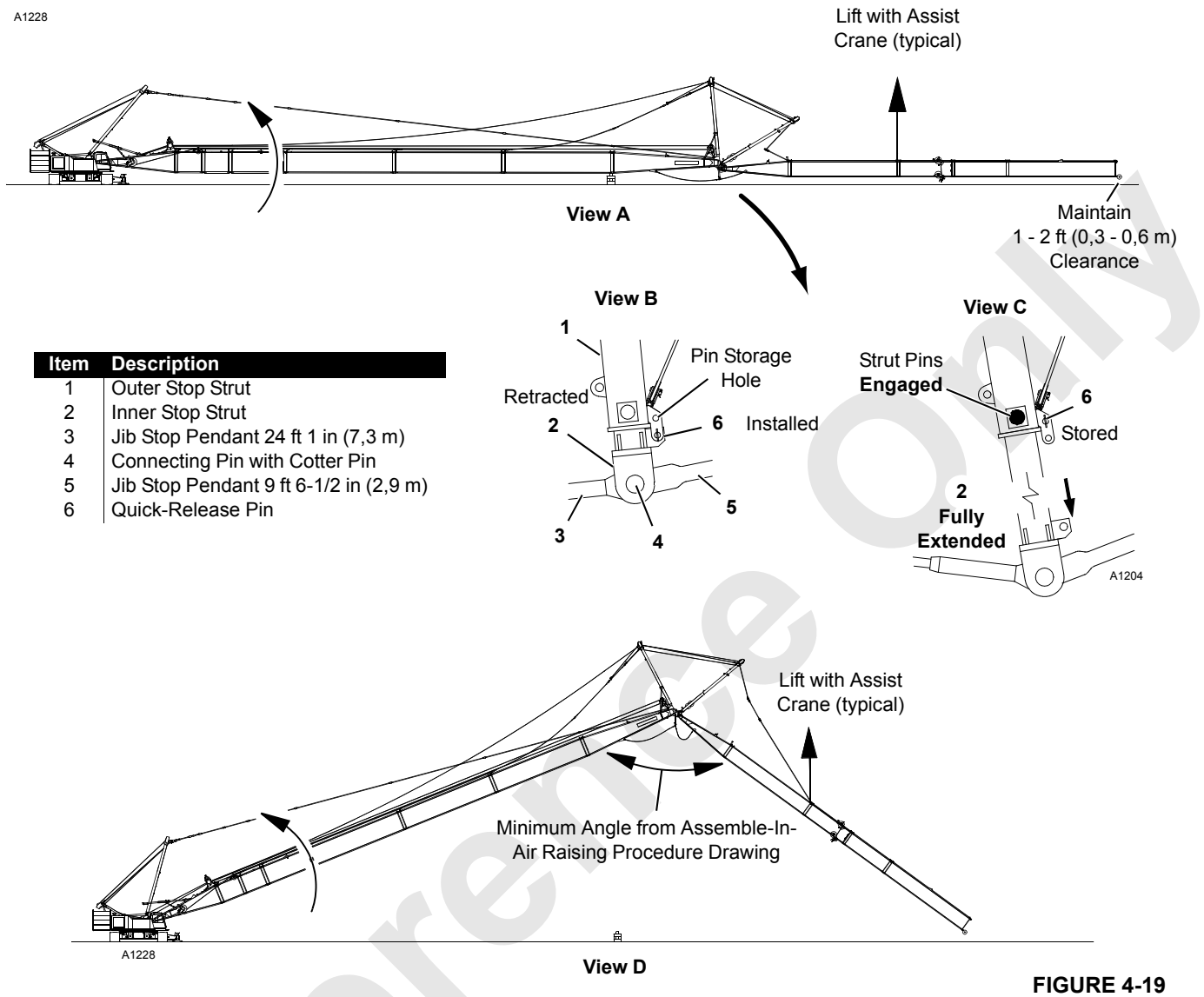


FIGURE 4-18

4. Apply 999 swing brake and engage swing lock. ***Swinging 999 is not permitted while jib rollers are off ground.***

Using assist crane, lift partial jib 1 - 2 ft (0,3 - 0,6 m) off ground (Figure 4-19). ***Assist crane must not exert side load on jib.***



Item	Description
1	Outer Stop Strut
2	Inner Stop Strut
3	Jib Stop Pendant 24 ft 1 in (7,3 m)
4	Connecting Pin with Cotter Pin
5	Jib Stop Pendant 9 ft 6-1/2 in (2,9 m)
6	Quick-Release Pin

FIGURE 4-19

Raise Boom

See Figure 4-19 for the following procedure.

CAUTION

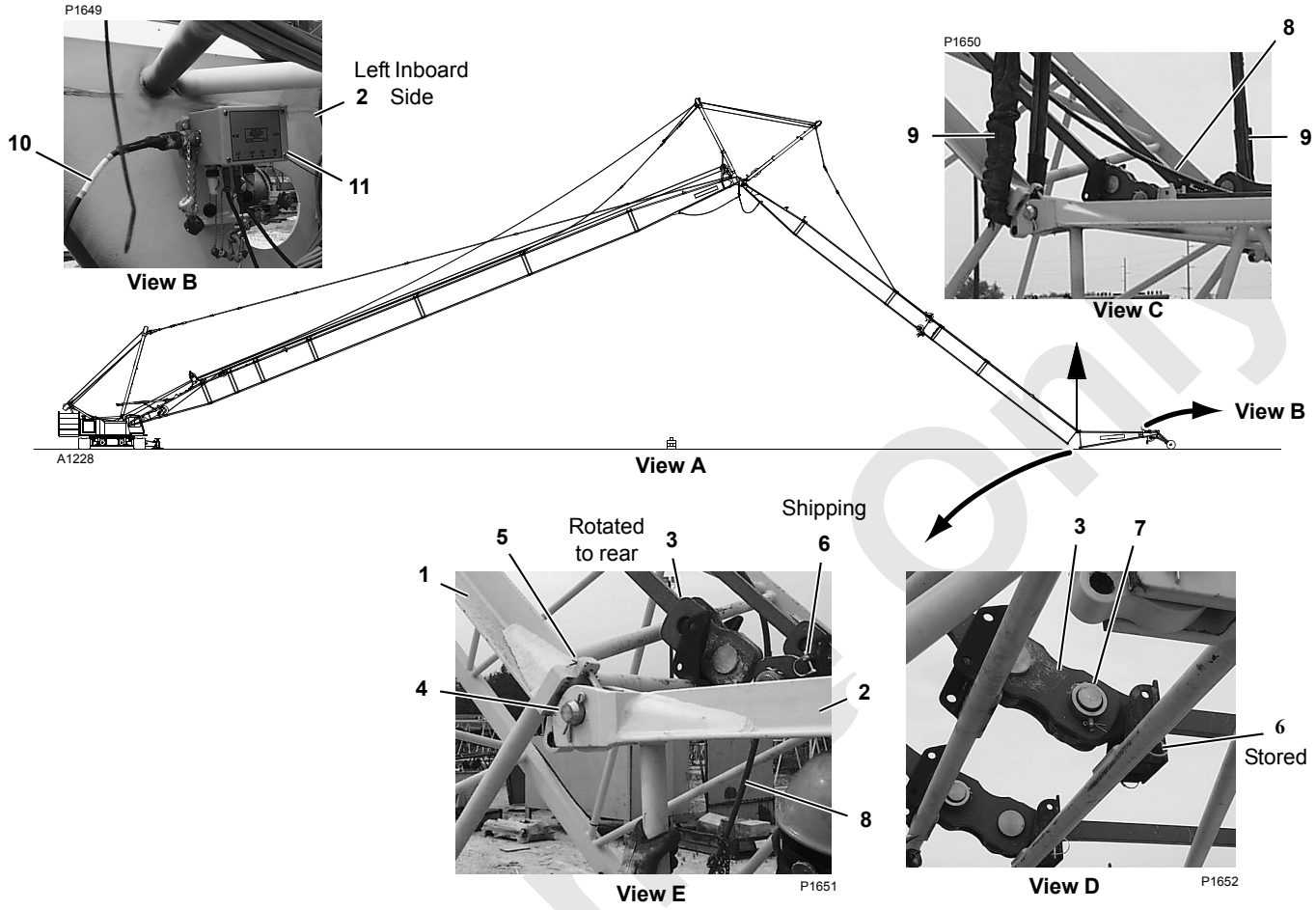
Structural Damage Hazard!

To prevent structural damage to crane or attachment while raising boom:

- Jib rollers must not touch ground. Maintain at least 1 - 2 ft (0,3 - 0,6 m) clearance while raising boom.
- Travel assist crane in reverse and hoist as needed to maintain required clearance between jib rollers and ground. Do not side load jib.

1. With the exception of the hand winch step, perform the Preliminary Raising Procedure to connect the jib stop pendants and to fully extend jib stop
2. Slowly raise boom until inner strut is fully extended and strut pins are fully engaged as shown in View B (approximately 168° boom to luffing jib angle).
3. Slowly BOOM UP to minimum BOOM ANGLE given in Jib Luffing Assembly, Assemble-In-Air Drawing (View D). ***Monitor boom angle on digital display.***

   LUFF UP as needed to keep luffing jib strut off luffing jib.
4. With boom at minimum boom angle, lower jib with assist crane until jib rollers touch ground and lifting slings are slack.
5. Disengage swing lock and release swing brake.
6. Disconnect lifting slings from assist crane at jib insert.



Item	Description
1	Jib Insert
2	Jib Top
3	Strap Link
4	Fixed Upper Pin with Cotter Pin
5	Retained Pin with Cotter Pin
6	Strap Storage Pin with Snap Pins
7	Connecting Pin with Cotter, Retaining Pin and Cotter Pin
8	Load Lines
9	Lifting Sling
10	Electric Cable
11	Junction Box
12	Removable Bottom Pin with Cotter Pins

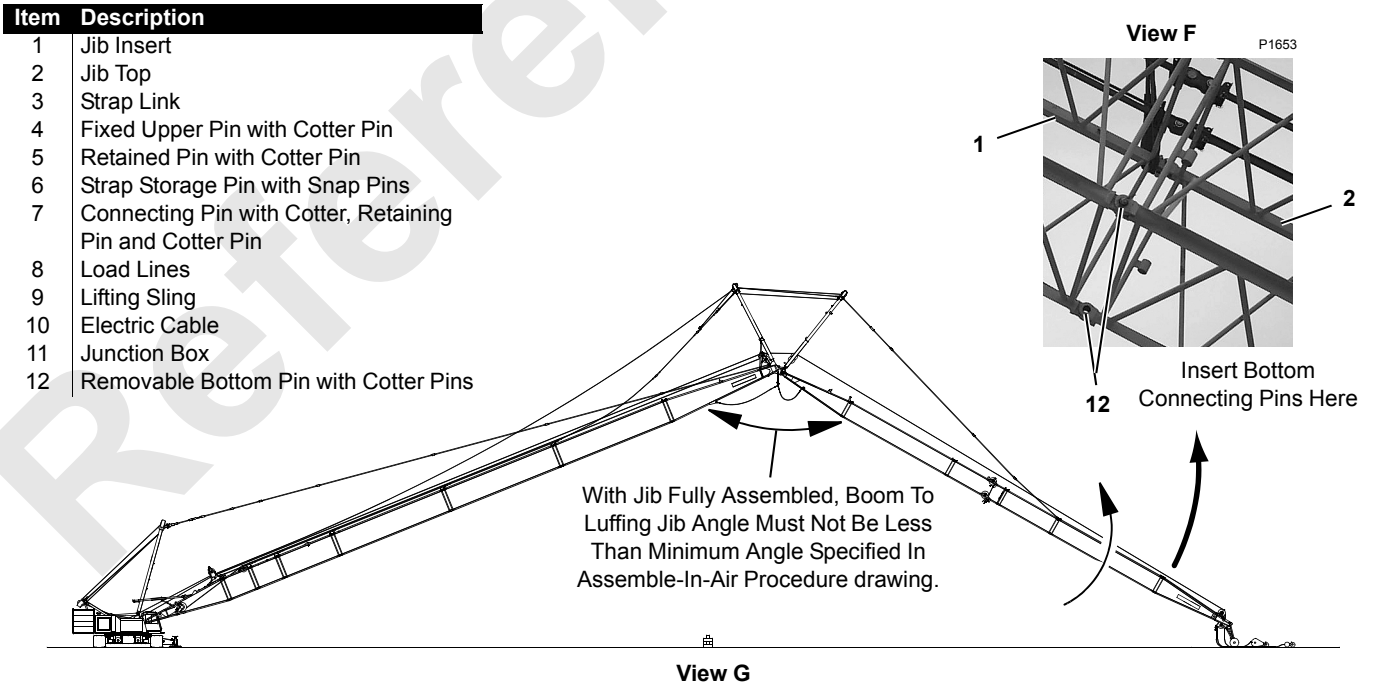


FIGURE 4-20

Attach Jib Top

See Figure 4-20 for the following procedure.

1. Remove round bar from strap links (Figure 4-16, View D).

WARNING

Moving Part Hazard!

Do not stand in front of straps while removing bar. Straps could hit you if they accidentally slide off the insert.

2. Rotate links to rear (View E). ***Links must not contact lacings when jib top is installed.***
3. Using four-point hook-up, lift jib top into place with assist crane.
4. Engage fixed upper pins in jib top with hooked connectors on insert (View E).
5. Install retaining pins (View E).
6. Unhook assist crane from jib top.
7. Connect jib strap links to straps on jib top (View D).
   a. Remove storage pins from top holes in strap brackets (View E).
   b. Store pins in bottom holes in strap brackets (View D).
   c. Rotate links forward and pin to adjacent straps (View D).
   d. If necessary, LUFF UP slightly or use a pry bar to align holes in links and straps.
8. Disconnect load line from jib insert (Figure 4-16, View E).
9. Slide load line over jib top (View C) and securely anchor to jib point.

   This step is required to prevent load line on boom side of attachment from overhauling load line on jib side of attachment.
10. Install intermediate suspension if required. See Install Intermediate Suspension topic in this section.
11. Attach lifting slings from assist crane between vertical lacings and connectors at end of insert next to jib top (Figure 4-18, View A and Figure 4-20, View C).
12. Raise luffing jib with assist crane until rollers on jib insert are off ground.
13. Remove rollers (Figure 4-16, View E) and store.
14. Attach electric boom cable to junction box on jib top (View B).
15. Attach jib stop cable from winch in jib top to cable in jib butt.
16. Raise luffing jib with assist crane until jib top is approximately 1ft (0,3 m) off ground.
17. Install lower removable pins between jib insert and top (View F).
18. LUFF UP to center strap links between brackets.
19. Lower jib with assist crane until jib top rollers touch ground (View G) and lifting slings are slack.
20. Disconnect lifting slings from insert.
21. Disengage swing lock and release swing brake.
22. The 999 can now raise the boom and luffing jib to the working position.

CAUTION

Structural Damage Hazard!

To prevent structural damage to crane or attachment:

- BOOM TO LUFFING JIB ANGLE must be as specified in Jib Luffing Assembly, Assemble-In-Air Drawing or jib must hang vertical (whichever occurs first) before boom and jib can be raised. Structural damage can cause attachment to collapse.
- Monitor angle on digital display as boom and jib are raised.
- Do not allow boom to luffing jib angle to become less than 55°

Raise Boom and Luffing Jib

Read and fully understand Jack-Knife Raising Procedure in this section before proceeding.

1. Perform Jack-Knife Raising Procedure steps to raise boom and luffing jib to BOOM TO LUFFING JIB ANGLE specified in Jib Luffing Assembly, Assemble-In-Air Drawing or jib is hanging vertical whichever occurs first.
2. Perform the remaining raising steps, to include installing load blocks or weight balls and connecting electronic devices.
3. Install wind speed indicator assembly if removed for shipping. Use star washers to attach mounting bracket to jib top to provide a good ground (see Wind Speed Assembly drawing at the end of this section).

   Connect electrical cable at base of wind speed mounting bracket.

CAUTION

Tipping Hazard!

Make sure luffing jib is within radius specified in appropriate Luffing Jib Capacity Chart BEFORE retracting outrigger pads or swinging over either end of crawlers.

Raise Boom, Luffing Jib, and Fixed Jib

Read and fully understand Jack-Knife Raising Procedure in this section before proceeding.

1. Perform Jack-Knife Raising Procedure steps to raise boom and luffing jib to BOOM TO LUFFING JIB ANGLE specified in Jib Luffing Assembly, Assemble-In-Air Drawing.

CAUTION

Structural Damage!

Luffing jib to fixed jib angle must never be less than 95°.

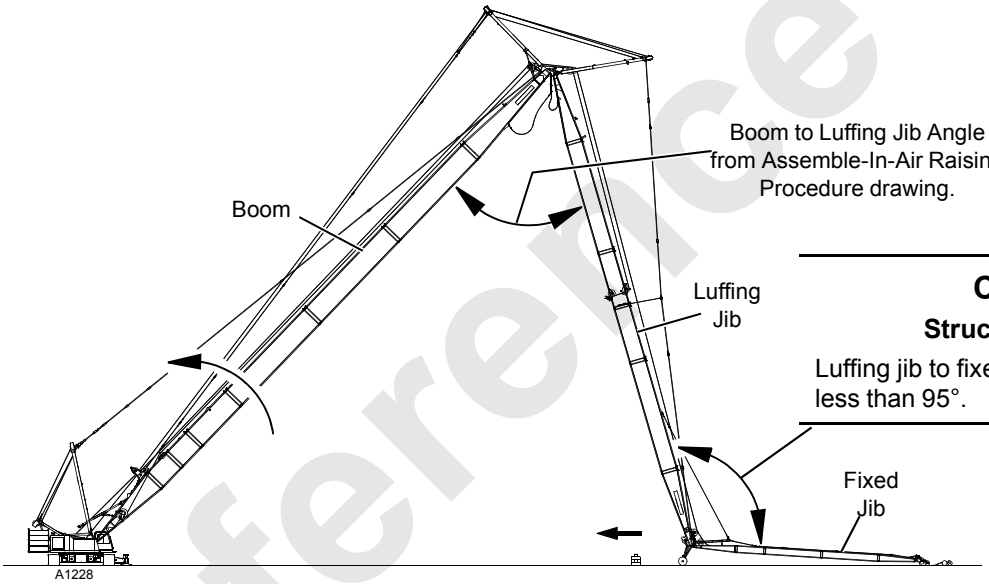
2. Also perform Raising Boom and Jib steps in this section to assemble and attach fixed jib to luffing jib.
3. Perform the remaining raising steps to include pinning fixed jib stop in operating position, installing load block or weight ball, and connecting electronic devices.
4. Install wind speed indicator assembly if removed for shipping. Use star washers to attach mounting bracket to jib top to provide a good ground (see Wind Speed Assembly drawing at the end of this section).

   Connect electrical cable at base of wind speed mounting bracket.

CAUTION

Tipping Hazard!

Make sure fixed jib is within radius specified in appropriate Fixed Jib Capacity Chart BEFORE retracting outrigger pads or swinging over either end of crawlers.



CAUTION

Structural Damage!

Luffing jib to fixed jib angle must never be less than 95°.

FIGURE 4-21

Lowering Procedure

Two lowering procedures are provided:

- Procedure A – Lower Boom and Luffing Jib
- Procedure B – Lower Boom and Luffing Jib with Fixed Jib

WARNING

Moving Part Hazard!

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

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

Falling Load Hazard!

Lower load blocks or weight balls to ground before lowering jib past required operating radius.

Structural damage can occur or attachment can collapse.

CAUTION

Tipping Hazard!

To prevent tipping:

Do not lower boom and luffing jib to ground until outrigger assembly is installed and jack pads are extended firmly against foundation. Boom and jib must be lowered over outrigger.

Structural Damage Hazard!

To prevent structural damage to crane or attachment:

- BOOM TO JIB ANGLE must be as specified in Jib Luffing Assembly, Assemble-In-Air Drawing or jib must hang vertical (whichever occurs first) before boom and jib can be lowered. Structural damage can cause attachment to collapse.
- Monitor angle on digital display as boom and jib are lowered.
- Do not lower boom and luffing jib beyond BOOM ANGLE given in Jib Luffing Assembly, Assemble-In-Air Drawing until slings from assist crane are attached to luffing jib. Structural damage can cause attachment to collapse.

Monitor angle on digital display as boom and jib are lowered.

Structural Damage Hazard!

Prevent side load damage to boom and jib. Disengage swing lock and release swing brake when jib point rollers are on ground.

Remove Jib Top

Lower Boom and Luffing Jib

Read and fully understand Jack-Knife Lowering Procedure in this section before proceeding.

1. Perform Jack-Knife Lowering Procedure steps to lower boom and luffing jib until jib point rollers contact ground.

   Make sure boom and jib are over extended outrigger, that BOOM ANGLE is 85°, and that boom to luffing jib angle is at value given in Jib Luffing Assembly, Assemble-In-Air Drawing.

2. Continue with lowering steps until *BOOM ANGLE is* ***at or slightly above value given in Jib Luffing Assembly, Assemble-In-Air Drawing.***
3. Go to Remove Jib Top procedure.

Lower Boom, Luffing Jib, and Fixed Jib

Read and fully understand Jack-Knife Lowering Procedure in this section before proceeding.

1. Perform Jack-Knife Lowering Procedure steps in this section to lower boom and luffing jib until fixed jib point rollers contact ground.

   Make sure boom and jib are over extended outrigger, that BOOM ANGLE is 85°, and that BOOM TO LUFFING JIB ANGLE is at value given Jib Luffing Assembly, Assemble-In-Air Drawing.

2. Unpin fixed jib stop. See Lowering Boom and Jib instructions in this section.

CAUTION

Structural Damage!

Luffing jib to fixed jib angle must never be less than 95°.

3. Continue with lowering steps in this section until luffing jib point rollers contact ground.
4. Remove fixed jib.
5. Continue with lowering steps in this section until *BOOM ANGLE is* ***at or slightly above value given in Jib Luffing Assembly, Assemble-In-Air Drawing.***
6. Go to Remove Jib Top procedure.

See Figure 4-20 for the following procedure.

CAUTION

Structural Damage Hazard!

Prevent side load damage to boom and luffing jib:

- Do not induce any side load with assist crane.
- Disengage swing lock and release swing brake when rollers are on ground.

1. Check that jib straps and links are in brackets and that intermediate suspension pendants are clear of jib straps.

   If not, luff up and down (raise and lower jib strut).
2. Attach lifting slings from assist crane between vertical lacings and connectors at end of insert next to jib top (Figure 4-18, View A and Figure 4-20, View C).
3. Raise luffing jib with assist crane until jib point rollers are approximately 1 ft (0,3 m) off ground.
4. Remove bottom pins between jib insert and top (View F).
5. Lower jib top to ground (View A). LUFF UP as required to keep jib straps from sliding down jib.
6. Pin rollers to bottom connectors at end of last jib insert (View E).

   To prevent excessive side load on boom and jib, release 999 swing brake and disengage swing lock while rollers are touching ground.
7. Lower jib until rollers are on ground and lifting slings are slack.
8. Disconnect lifting slings from jib insert (View C).
9. Remove retaining pins from insert connectors (View E).
10. Remove pins from between links and straps on boom top (View D) and rotate links back onto jib insert.
11. Store pins and collars in boom top straps.
12. Remove strap storage pins from stored position (View D) and install in shipping position to secure boom top straps (View E).
13. Unplug electric cable from boom top junction box (View B) and store. Fasten dust cover to junction box.
14. If necessary, remove fixed jib backstay pendants from jib top.
15. Disconnect jib stop cable from winch on boom top at cable in jib butt.
16. Remove wind speed indicator from jib top to prevent damage during shipping (see Wind Speed Assembly drawing at the end of this section).
    a. Disconnect electrical cable to wind speed indicator at base of mounting bracket.
    b. Remove nuts, star washers, and bolts from base of wind speed mounting bracket.
    c. Store wind speed assembly in a safe place on crane.
17. Remove load line from jib top and tie it off securely to end of last jib insert (Figure 4-16, View E) with chain. Load line should have some slack but be tight enough to keep it from falling off top of inserts.

    This step is required to prevent load line on boom side of attachment from overhauling load line on jib side of attachment.
18. Attach lifting slings from assist crane to jib top (four point hook-up).
19. Remove jib top and set to side.
20. Slide round bar through connector holes in last jib insert and through holes in strap links (Figure 4-16, View D).

    Bar must be installed to prevent straps from accidentally sliding off inserts as boom and luffing jib are lowered.

Lower Boom

See Figure 4-19 for the following procedure.

CAUTION

Structural Damage Hazard!

To prevent structural damage while lowering boom:

- Do not allow jib rollers to touch ground. Maintain a 1 - 2 ft (0,3 - 0,6 m) clearance while lowering boom.
- Travel assist crane forward and hoist as needed to maintain required clearance between jib rollers and ground. Do not side load jib.

1. Attach lifting slings from assist crane at location shown in Figure 4-17, View D.
2. Using assist crane, raise partial jib so rollers are 1 - 2 ft (0,3 - 0,6 m) above ground. ***Rollers must not touch ground while completing steps 3 through 9.***
3. Slowly BOOM DOWN until luffing jib stop pendants start going into tension (168° boom to luffing jib angle).

   Raise jib as needed with assist crane to keep rollers off ground.
4. Disengage luffing jib stop strut pins (View C).
5. Slowly lower boom to retract inner strut stop and pin in retracted position (View B).
6. Unpin luffing jib stop pendants (View B).

7. Pin strut stop to underside of boom for storage.
8. Lower boom onto blocking 4 ft (1,2 m) high.
9. Lower partial jib with assist crane until rollers touch ground.
10. Perform Lowering Struts and Removing Jib steps in as described in this section.

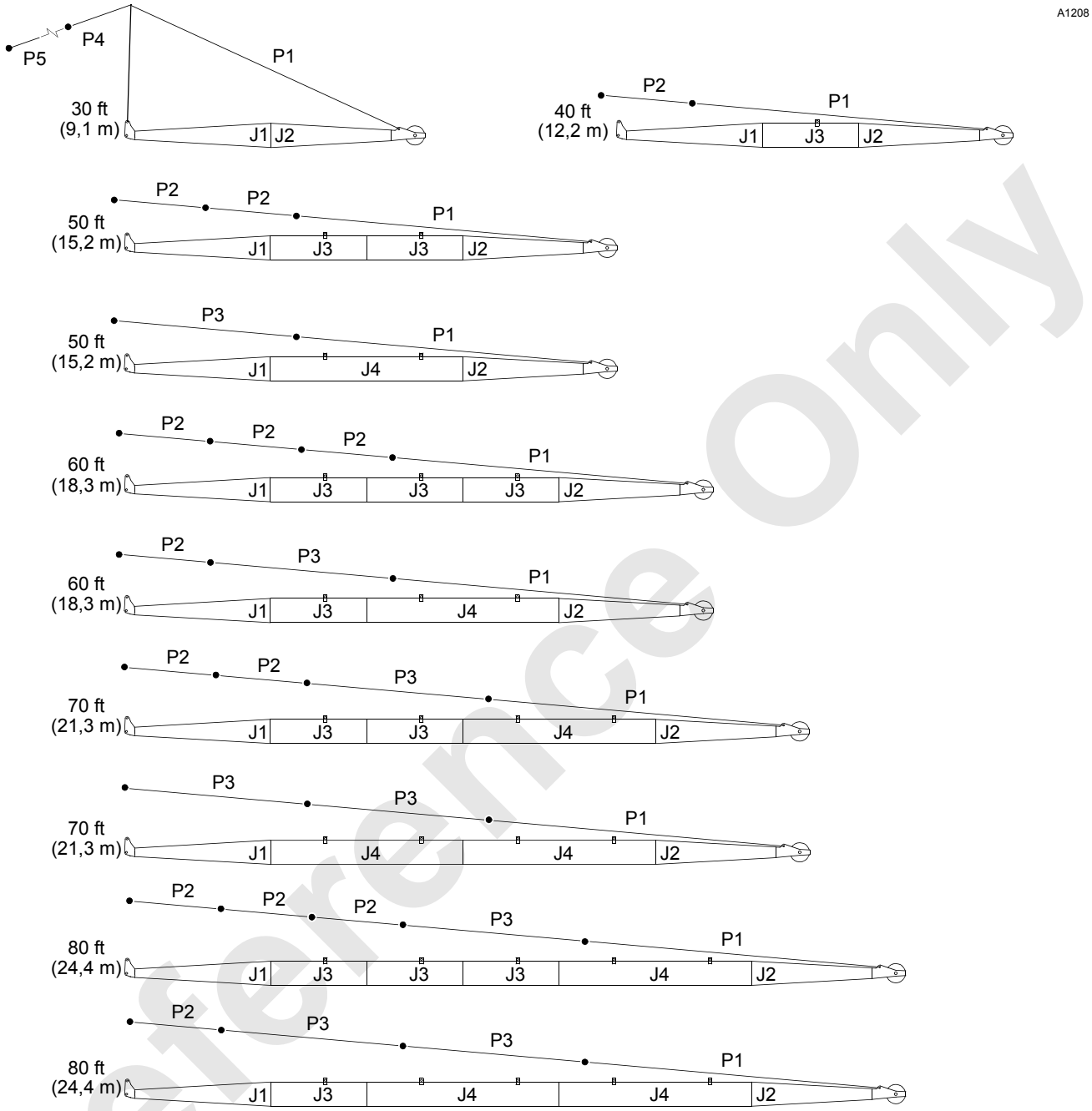
FIXED JIB RIGGING GUIDE — #134 FIXED ON #149 LUFF

This section contains installation and removal instructions for the #134 fixed jib on the #149 luffing jib.

The jib consists of a 15 ft (4,6 m) butt and a 15 ft (4,6 m) top, providing a basic length of 30 ft (9,1 m). Inserts are available to assemble additional jib lengths of 40 – 80 ft (12,2 – 24,4 m) as shown in Figure 4-22.

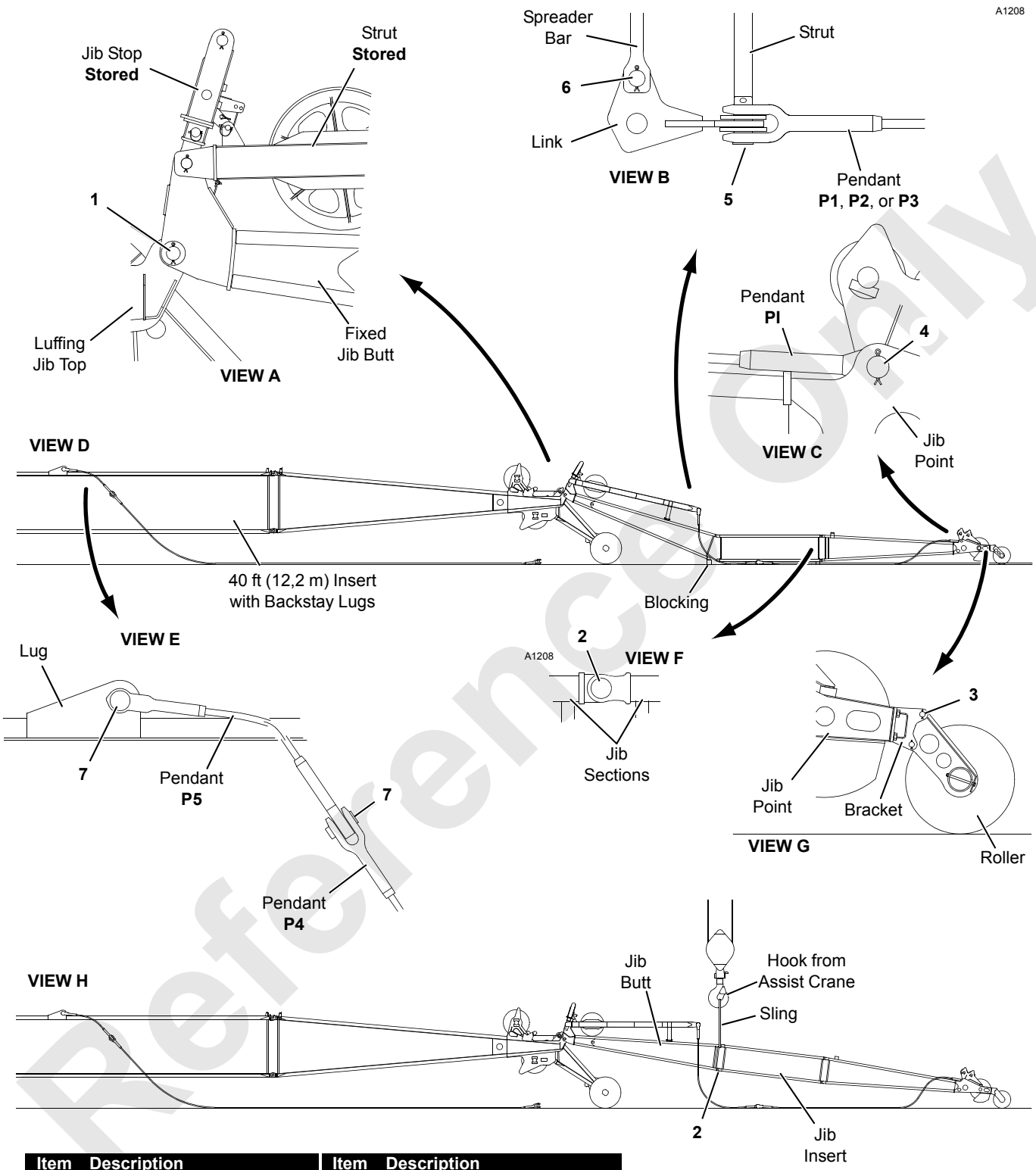
The #134 jib sections, jib pendants, and some of the backstay pendants used on the #149 luffing jib are identical to the #134 jib components used on the 777, 888, and 999 liftcrane booms. ***Be sure to check part numbers of each jib component before using components from another model/application.***

See applicable Jib Lifting Capacities Chart to determine boom and luffing jib length limitations with fixed jib attached.



Section	Type	Length	Pendant	Type	Length
J1	Jib Butt	15 ft (4,6 m)	P1	Basic Jib	30 ft, 9 in (9,4 m)
J2	Jib Top	15 ft (4,6 m)	P2	Jib	9 ft, 6 in (2,9 m)
J3	Jib Insert	10 ft (3,1 m)	P3	Jib	19 ft (5,8 m)
J4	Jib Insert	20 ft (6,1 m)	P4	Backstay	44 ft, 7 in (13,6 m)
			P5	Backstay	5 ft, 6 in (1,7 m)

FIGURE 4-22



Item	Description	Item	Description
1	Pin with Cotter Pins	5	Pendant Pin with Cotter Pin
2	Pin with Cotter Pin	6	Pin with Cotter Pin
3	Pin with Cotter Pins	7	Pendant Pin with Cotter Pin
4	Pin with Cotter Pins	See Figure 4-22 for Pendants P1 – P5	

FIGURE 4-23

Preparing Boom and Luffing Jib

The luffing jib must be prepared as follows for fixed jib installation and use:

1. 40 ft (12,2 m) insert with jib backstay lugs installed next to luffing jib top as shown in Figure 4-23, View D.
2. Lower boom point sheaves removed, if required per Luffing Jib Raising Procedure Chart in Luffing Jib Operator's/Parts Manual.

Installing Jib

See Figure 4-22 for proper assembly sequence of jib sections and pendants.

Install Jib Butt

See Figure 4-23 for the following procedure.

NOTE: The jib strut and jib stop are shipped in the stored position on the jib butt as shown in View A.

1. Lift jib butt into position at end of luffing jib top.
2. Align holes in jib butt with holes in luffing jib top and install connecting pins (1, View A).
3. Lower jib butt onto blocking 6 in (127 – 152 mm) high.

Install Jib Inserts

See Figure 4-23 for the following procedure.

1. Pin desired length of jib inserts to butt. Pin heads must be toward outside of jib (View F).

   Pin only the top connectors on the insert next to the jib butt.
2. Block inserts as assembly progresses.

Install Jib Top

See Figure 4-23 for the following procedure.

1. If not already done, pin roller to bracket on end of jib top (View G).
2. Pin jib top to last insert or butt, depending on jib length. Pin heads must be toward outside of jib (View F).

Install Jib Pendants

See Figure 4-23 for the following procedure.

The jib pendants are furnished in matched sets of two and must be installed in matched sets — pendant on one side of jib section must match pendant on other side of jib section.

1. Pin basic pendants (P1) to jib top (View C) and lay pendants on ground along side jib.
2. If required, pin required insert pendants (P2 or P3) to basic pendants (P1).
3. Pin links and other end of basic or insert pendants (depending on length) to jib strut (View B).
4. Pin spreader bar between links (View B).

Install Backstay Pendants

The backstay pendants are furnished in matched sets of two and must be installed in matched sets — pendant on one side of luffing jib section must match pendant on other side of luffing jib section.

NOTE: If the boom and luffing jib will be jack-knifed into position before the fixed jib is installed, perform step 1 before raising the boom and luffing jib.

1. Pin backstay pendants (P4 and P5) to lugs on luffing jib insert and to each other (Figure 4-23, View E).
2. Lay backstay pendants on ground along side of luffing jib.

NOTE: The jib strut will be raised and the backstay pendants pinned to the strut after the boom and luffing jib are raised.

Connect Jib Sections to Jib Butt

See Figure 4-23, View H for the following procedure.

1. Attach nylon lifting slings to chords at top end of jib butt.
2. Hook assist crane to slings. ***Crane must have capacity to lift 1/2 the weight of assembled fixed jib.***
3. Lift jib butt until bottom connecting holes between jib butt and adjacent insert line up.
4. Install bottom connecting pins.
5. Remove slings.

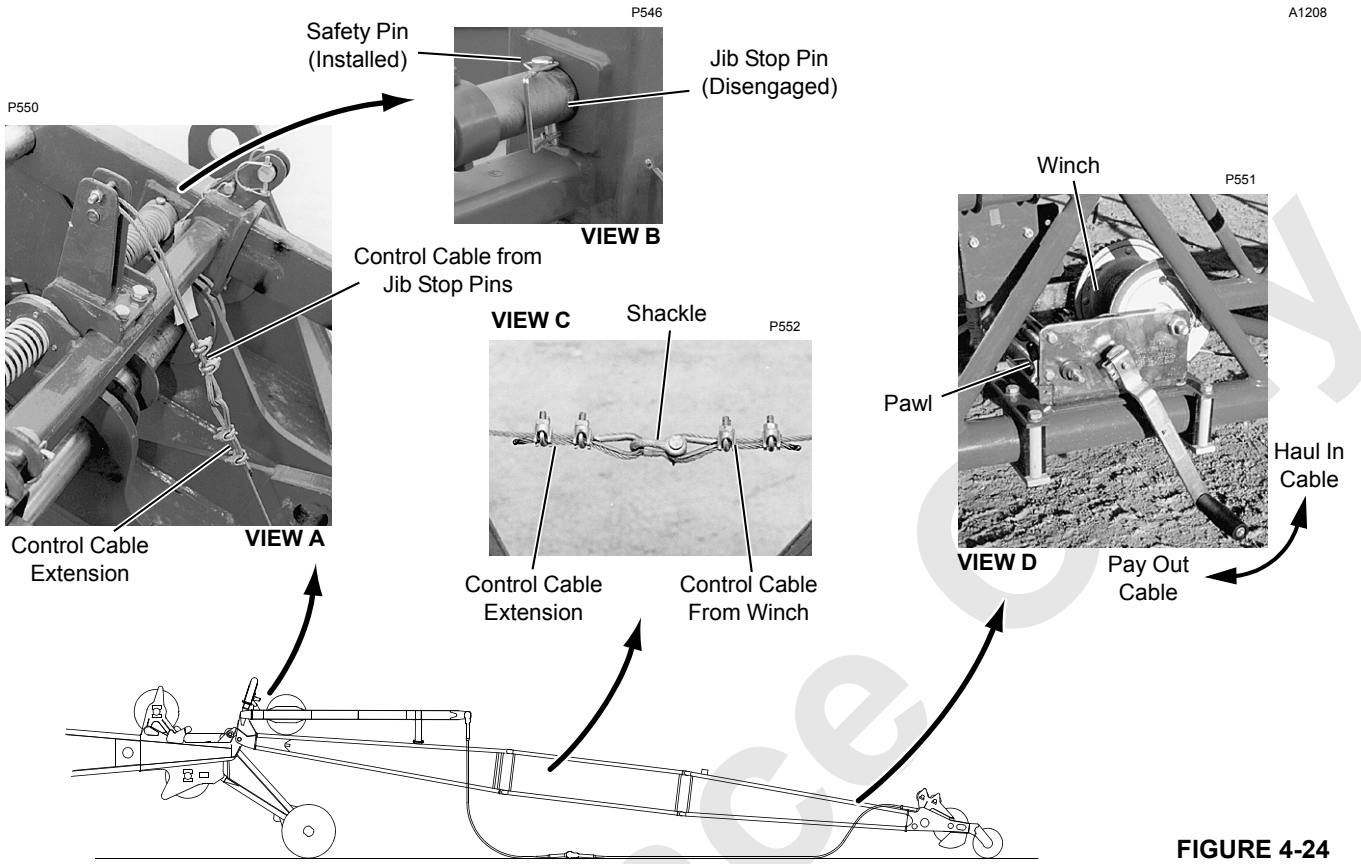


FIGURE 4-24

Connect Jib Stop Control Cable

See Figure 4-24 for the following procedure.

1. Jib stop cable extension (stored in jib butt) should already be connected to control cable on jib stop (View A).
2. Using hand winch on jib top (View D), pay out control cable.
3. Connect control cable from winch to cable extension in jib butt with shackle provided (View C).
4. Haul in control cable with hand winch until both jib stop pins are fully disengaged (View B) and install both safety pins.
5. Pay out control cable until it is resting on bottom of jib sections.

WARNING

Crushing Injury!

Jib stop pins are spring engaged. Do not remove safety pins (Figure 4-24, View B) until jib stop assembly is pinned in working position and control cables are tensioned.

Installing Load Line

Either the load line from the front drum on the crane or from the auxiliary drum in the boom butt can be used for the fixed jib.

The auxiliary drum is approximately 20% faster than the front drum. However, if the load line from the auxiliary drum is used, a 2-part line is required for maximum jib capacity. If a 1-part line is used, the capacity is limited to 20,000 lb (9 072 kg).

The crane user shall decide which drum to use based on required spooling capacity, line pull, and line speed.

NOTE: If the boom and luffing jib will be jack-knifed into position before the fixed jib is installed, then

perform steps 1 and 2 before raising the boom and luffing jib and securely fasten the load line to the jib point.

1. See Load Block Reeving in this section for proper routing of desired load line to jib point.
2. Pull approximately 50 ft (5,24 m) of load line past end of jib point and securely fasten load line to end of jib. Weight ball or load block will be installed just prior to lifting jib from ground.

WARNING

Falling Wire Rope Hazard!

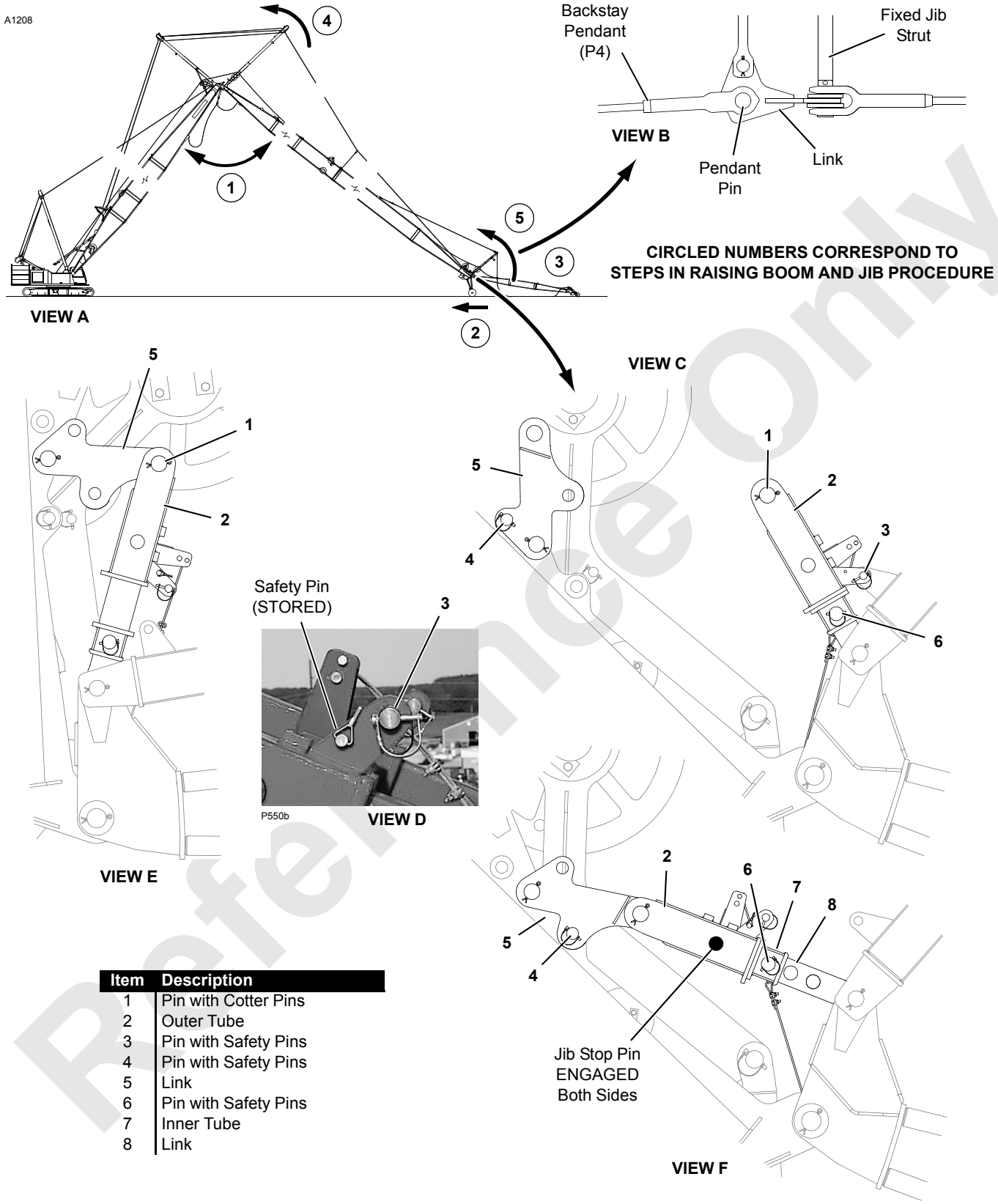
For long boom and short luffing jib combinations, load line on boom side of attachment can overhaul load line on luffing jib side of attachment. Load line could fall off boom as attachment is raised. Securely fasten load line to jib point before raising attachment.

Installing Electronic Devices

1. Install block-up limit and load indicator components and connect electric cords to required junction boxes on jib points (see Boom Wiring Drawing at end of this section).
2. Connect all unused electric cords to proper shorting plugs on junction boxes. ***Boom and luffing jib will not lower and drums will not hoist if electric cords are not shorted out.***
3. Adjust block-up limit switch at fixed jib point according to instructions in Section 6.

Pre-Raising Checks

- ☐ Boom and luffing jib properly assembled according to instructions in this manual and in Crane Operator Manual.
- ☐ Crawlers blocked (required for all boom and jib lengths). See Crawler Blocking Diagram in Luffing Jib Capacity Chart Manual.
- ☐ All installation steps given in this section performed.
- ☐ All connecting pins installed and properly secured.
- ☐ Load line to fixed jib anchored properly on drum, spooled tightly onto drum, and routed through proper sheaves. ***Make sure rope guard pins, bars, or rollers are installed to retain wire rope in sheaves.***
- ☐ If load line will be installed after boom and luffing jib are jack-knifed into position, ***make sure load line going to jib point is securely anchored to end of jib point so load line cannot fall off jib and boom.***
- ☐ All blocking, tools, and other items removed from jib and jib point roller path area.
- ☐ Pendants not hooked alongside jib. ***Guide pendant connectors clear of jib chords as jib is raised.***
- ☐ All safety devices installed, electric cords connected, and limits adjusted.
- ☐ Luffing Jib Raising Procedure Chart reviewed to determine required boom to luffing jib angle for raising fixed jib.
- ☐ Wind within allowable limits for raising boom and jib (see Section 3).
- ☐ All lube points greased (see Section 5).
- ☐ LUFFING JIB mode selected and confirmed.



Item	Description
1	Pin with Cotter Pins
2	Outer Tube
3	Pin with Safety Pins
4	Pin with Safety Pins
5	Link
6	Pin with Safety Pins
7	Inner Tube
8	Link

FIGURE 4-25

Raising Boom and Jib

NOTE: Circled numbers in Figure 4-25 and Figure 4-26 correspond to numbered steps in the following procedure.

1. Raise boom and luffing jib to jack-knife angle called for in Luffing Jib Raising Procedure.

WARNING

Tipping Hazard!

Crane can tip if boom and luffing jib are not at specified angle when boom is raised with fixed jib attached.

2. If fixed jib point is already installed, fixed jib rollers will roll along ground as boom and luffing jib are raised.
3. If fixed jib point is not installed, install after boom and luffing jib have been positioned at specified angle.
4. Once boom and luffing jib have been raised to specified angle, slowly haul in luffing hoist wire rope until luffing jib pendants start to go into tension and stop. ***Do not attempt to lift luffing jib at this time or crane will tip***.
5. Connect fixed jib backstay pendants (View B):
   a. Using an assist crane, raise fixed jib strut and pin backstay pendants (P4) to links.
   b. Lower strut until it is supported by backstay pendants and disconnect assist crane.
6. Connect jib stop assembly as follows:
   a. Remove connecting pins (1, View C) from outer tube (2).
   b. Support outer tube (2) with slings from assist crane and remove pins (3, View C) connecting outer tube to jib strut.
   c. Remove pins (4, View C).
   d. Lower outer tube (2) with assist crane and rotate links (5, View E) by hand until connecting holes line up.
   e. Install pins (1, View E).
   f. Store pins (3) in lugs on outer tube (Figure 4-25, View D).

NOTE: Depending on your boom and jib length, step 6g may not be possible. If this is the case, perform step 6g after the fixed jib roller is raised just clear of the ground.

   g. If possible, lower outer tube (2) until hole in link (5, View F) lines up with hole in luffing jib top and install pins (4).
   h. Remove pins (6, View F) from inner links (7).
   i. Slide inner links into outer link (2) until holes in inner links line up with third hole in links (8). Install pins (6, View F).
   j. Using hand winch on jib top, haul in jib stop control cable enough to tension jib stop pins so that safety pins (Figure 4-24, View B) can be removed.
   k. Remove safety pins from jib stop pins (Figure 4-24, View B) and store pins in lugs on outer tube (Figure 4-25, View D).
   l. Pay out control cable until cable is loose. Cable should be resting on bottom lacings in jib sections. ***Pins will not engage if cable is not slack.***

NOTE: The jib stop pins will engage automatically when the jib is raised.

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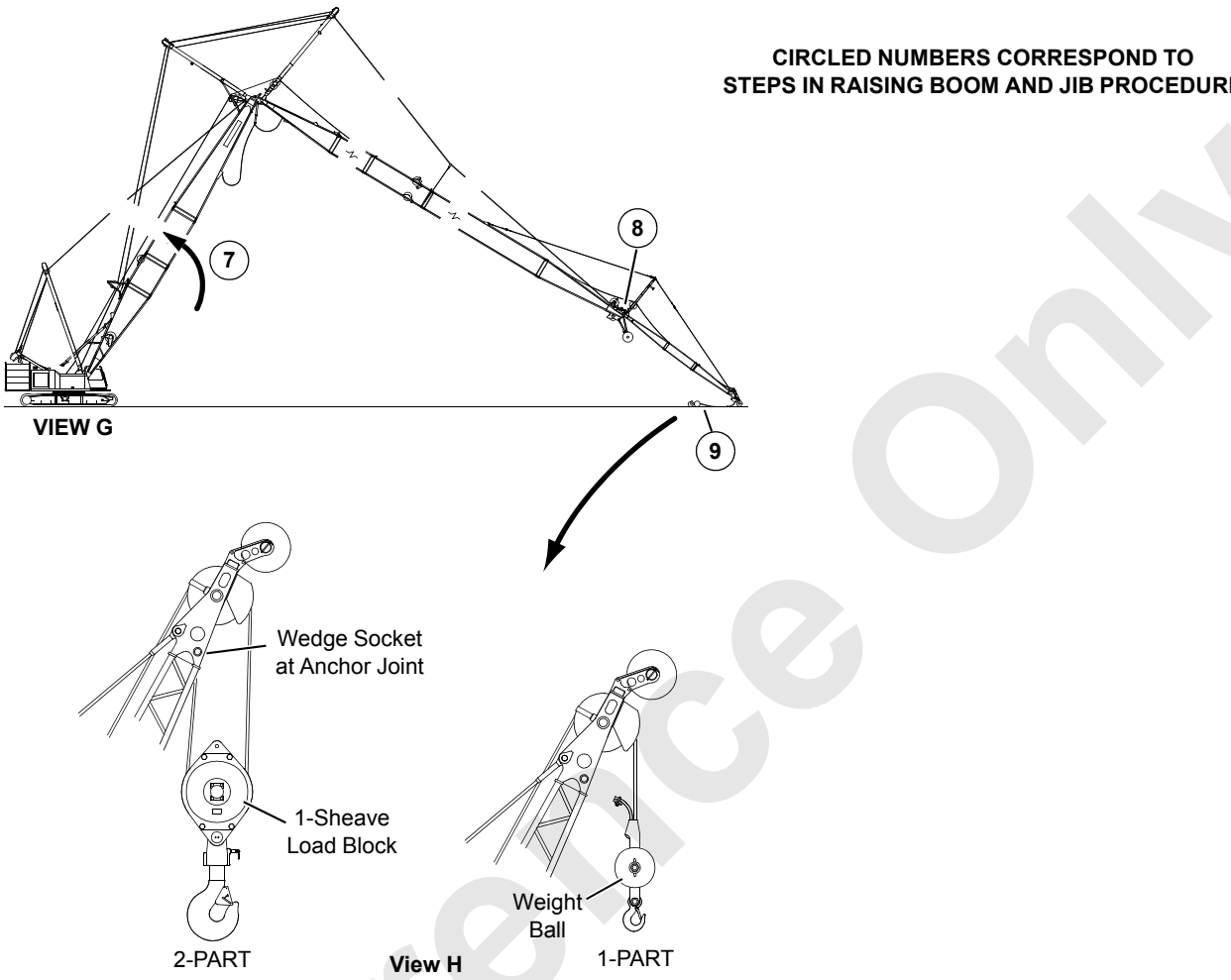

FIGURE 4-26

Raising Boom and Jib (continued)

7. Slowly raise boom — ***do not raise luffing jib*** — until fixed jib is hanging from backstay pendants with roller just lightly touching ground.

   Take care not to allow jib pendants to get caught on side of fixed jib. Guide jib pendants clear of jib sections as fixed jib rises.

8. Make sure jib stop pins are engaged. A personnel hoist is required for this step:

   a. Visually inspect that both jib stop pins are fully engaged (Figure 4-25, View F).

   b. If not already done, install pins (4, Figure 4-25, View F) to anchor links (5) to luffing jib top.

9. Install weight ball or load block as shown in Figure 4-26, View H.

10. Raise boom to desired operating angle (see capacity chart).

11. Pay out load line as boom and jib are raised.

12. Position luffing jib at required operating radius.

13. Travel as required to position weight ball or load block below jib point.

14. Lift weight ball or load block to desired position.

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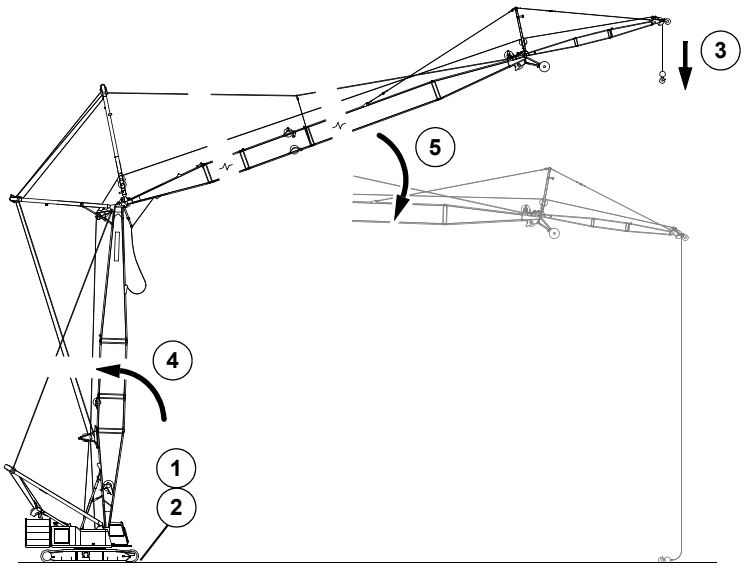
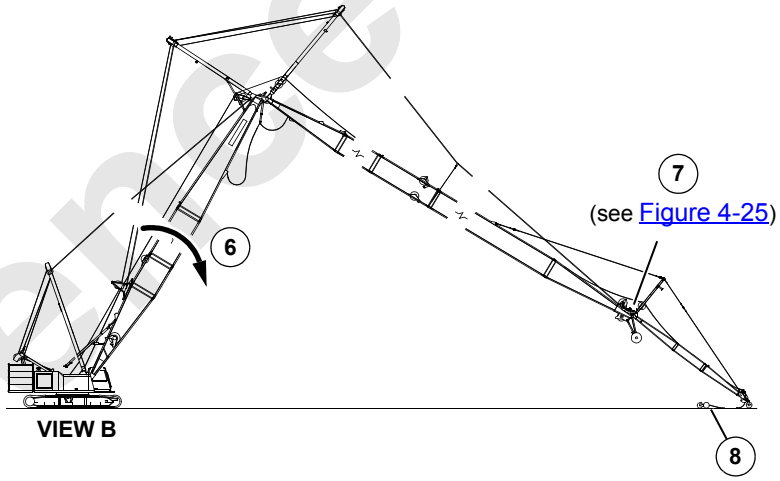


VIEW A

CIRCLED NUMBERS CORRESPOND TO
STEPS IN RAISING BOOM AND JIB PROCEDURE



VIEW B

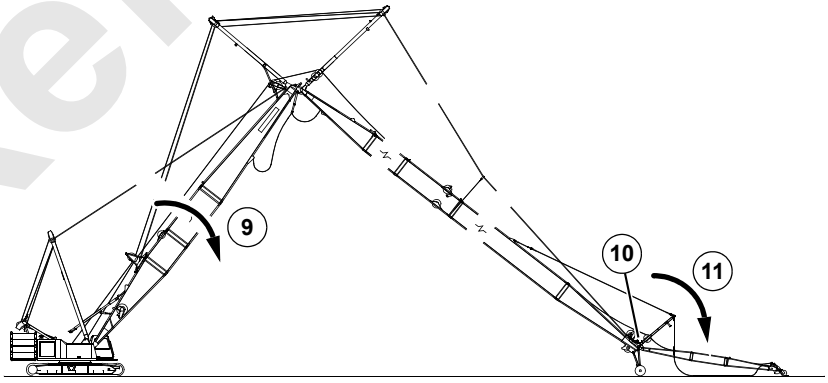


FIGURE 4-27

Lowering Boom and Jib

NOTE: Circled numbers in Figure 4-27 correspond to numbered steps in the following procedure.

Monitor angles on digital display in operator's cab while lowering boom and jibs.

WARNING

Moving Part Hazard!

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

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

1. Swing upperworks in-line with lowerworks so boom is over desired end of crawlers.
2. Travel crawler rollers onto blocking (end under boom).

WARNING

Tipping Crane Hazard!

Lower all boom and jib combinations over blocked crawlers. Otherwise crane will tip.

3. Swing boom and jib slightly to either side of center and lower weight ball or load block onto ground. Then swing boom and jib in-line with crawlers.

WARNING

Tipping Crane Hazard!

Lower all weight balls or load blocks onto ground before lowering boom and jib. Crane could tip if this step is not performed.

4. Raise boom to a minimum angle of 80°.
5. Position jib at required boom to luffing jib angle (see Luffing Jib Raising Procedure Chart for angle).

WARNING

Tipping Crane Hazard!

Do not lower boom and jibs to ground until boom has been positioned at minimum angle of 80° and luffing jib has been positioned at specified boom to luffing jib angle. Crane will tip.

6. Slowly lower boom until fixed jib roller just lightly contacts ground.
7. Unpin fixed jib stop. A personnel hoist will be required for the following steps:
   a. Haul in jib stop control cable with hand winch on jib top until both jib stop pins are fully disengaged and install both safety pins (Figure 4-24, View B).
   b. Pay out control cable until it is resting on bottom of jib sections.
   c. Remove pins (4, Figure 4-25, View F).

CAUTION

Tipping Crane Hazard!

Do not lower boom any further until jib stop pins are fully disengaged and pins (4, Figure 4-25, View F) are removed. Damage to jib stop, jib strut, or luffing jib top will occur.

8. If desired, load block or weight ball can be removed from fixed jib point at this time. Prior to removal, securely fasten load line to end of jib point before removing load block or weight ball.

WARNING

Falling Wire Rope Hazard!

For long boom and short luffing jib combinations, load line on boom side of attachment can overhaul load line on luffing jib side of attachment. Load line could fall off boom if load line is not secured to jib point.

9. Continue to lower boom slowly — ***do not lower luffing jib*** — until luffing jib rollers contact ground.

   Fixed jib roller will roll along ground as boom is lowered.

10. Store jib stop, as follows (see Figure 4-25):
    a. Support outer tube (2) with slings from assist crane.
    b. Support links (5) by hand and remove pins (1).
    c. Rotate links (5) to stored position and install pins (4, Figure 4-25, View C).
    d. Support inner tubes (7, Figure 4-25, View F) and remove pins (6).
    e. Slide inner tubes down to first hole in links (8) and install pins (6, Figure 4-25, View C).
    f. Rotate jib stop to stored position on jib strut (Figure 4-25, View C) and install pins (3).

11. Disconnect fixed jib backstay pendants:

a. Using an assist crane, support fixed jib strut so it cannot fall.

b. Unpin backstay pendants (P4, Figure 4-25, View B) from links and lay pendants on ground.

c. Lower strut onto fixed jib butt and disconnect assist crane.

12. Remove fixed jib at this time or after boom and luffing jib have been lowered to ground level.

Removing Fixed Jib

Removing the fixed jib is opposite of installing the jib.

The jib butt, jib strut, and jib stops can be shipped as an assembled unit.

WARNING

Collapsing Jib Hazard!

Improper disassembly of jib sections can cause jib to collapse onto personnel removing connecting pins.

Death or serious injury can result if precautions listed below are not taken:

- Lower boom so luffing jib and fixed jib points are supported on ground.
- Slacken rigging — do not attempt to remove connecting pins while jib is supported by rigging.
- Block below both ends of jib sections before removing connecting pins.
- Stand on outside of jib sections when removing connecting pins. Never work under or inside jib sections. Use care not to damage lacings and chords as pins are knocked out.

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LOAD BLOCK REEVING

Load Blocks and Weight Ball

The following load blocks and weight ball are available from Manitowoc:

100 Ton (91 Metric Ton) Capacity Load Block (MCC #237099)

- Three sheaves (2 to 6-parts of line)
- Single hook
- 3,900 lb (1 769 kg)

45 Ton (41 Metric Ton) Capacity Load Block (MCC #236504)

- One sheave (1 to 3-parts of line)
- Single hook
- 2,600 lb (1 179 kg)

15 Ton (14 Metric Ton) Capacity Weight Ball (MCC #218214)

- 1,310 lb (594 kg)

WARNING

Crush Hazard!

Use only a load block or weight ball with a capacity equal to or greater than load to be handled.

Load block or weight ball can fail if overloaded, allowing load to fall.

Guide Sheaves

See Figure 4-28 for identification of the guide sheaves and other components.

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.***

Wire Rope Specifications

See Wire Rope Specifications Chart in Capacity Chart Manual for parts of line required to handle desired load.

Wire Rope Installation

See Wire Rope Installation in this section for the following instructions:

- Anchoring wire rope to drum
- Installing wire rope on drum
- Anchoring wire rope to wedge socket

Reeving

See Figure 4-29 for multiple part reeving over the lower luffing jib point.

Legends for Figure 4-28

Item	Description
F	Front Drum 29,500 lb (13 381 kg) Capacity per Line
A	Auxiliary Drum 20,000 lb (9 072 kg) Capacity per Line
L	Left Guide Sheave at Boom Point or at Luffing Jib Point
C	Center Guide Sheave at Boom Point or at Luffing Jib Point

Route wire rope over TOP of all sheaves

Item		Item	
Front Drum Only		Front and Auxiliary Drum	
FL1	Lower Boom Point [1]	FL1	Lower Boom Point [1]
FL3	Lower Luffing Jib Point [2]	FL3	Lower Luffing Jib Point [2]
FC1	Lower Boom Point [1]	FL5	Fixed Jib Point
FC2	Intermediate Fall	AC2	Intermediate Fall
FC4	Upper Luffing Jib Point	AC3	Lower Luffing Jib Point [3]
FC5	Fixed Jib Point	AC4	Upper Luffing Jib Point
		AC5	Fixed Jib Point

[1] See Load Block Reeving in Crane Operator Manual.

[2] See Figure 4-29 in this section.

[3] Only when load line from front drum is routed to lower boom point or fixed jib.

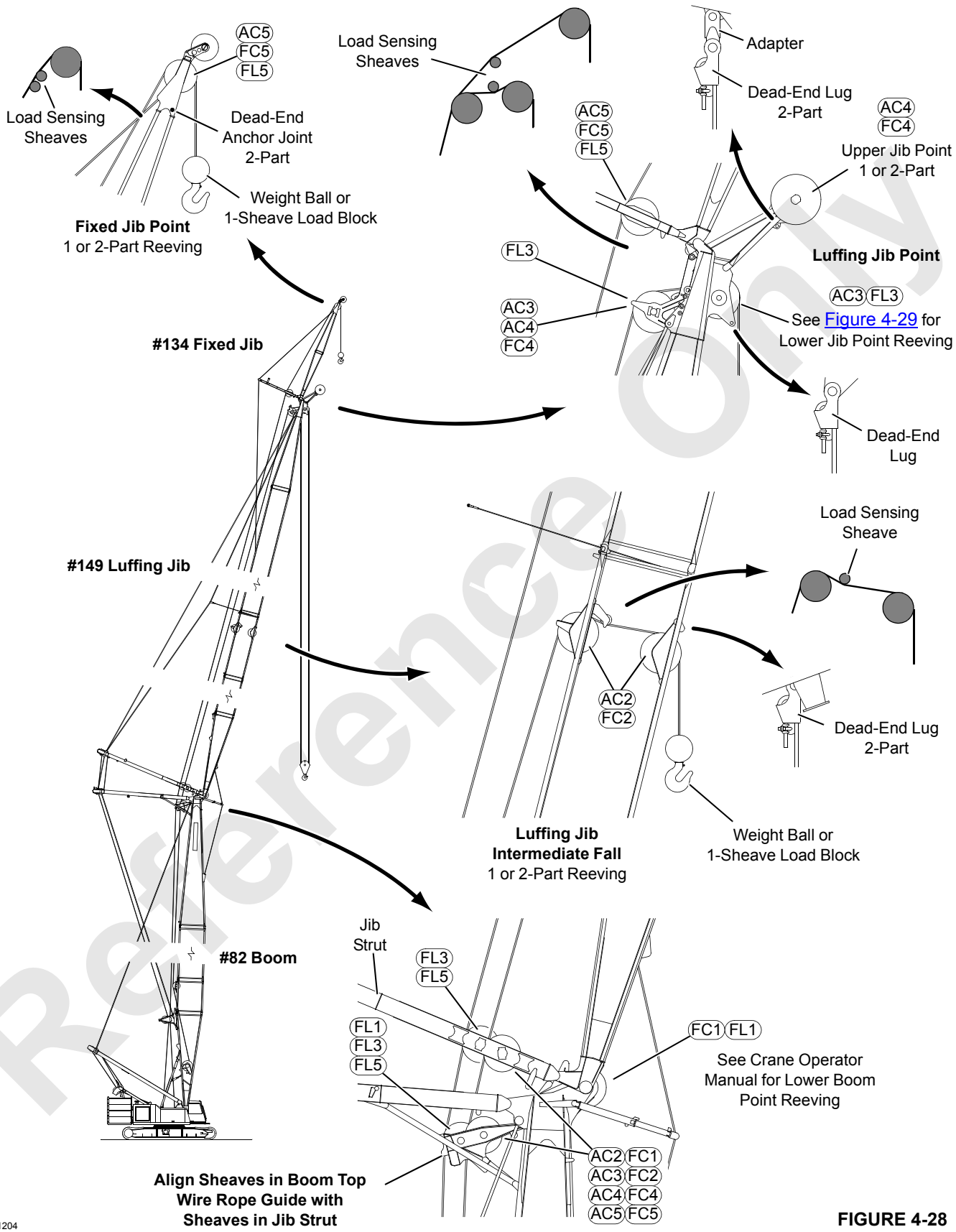

FIGURE 4-28

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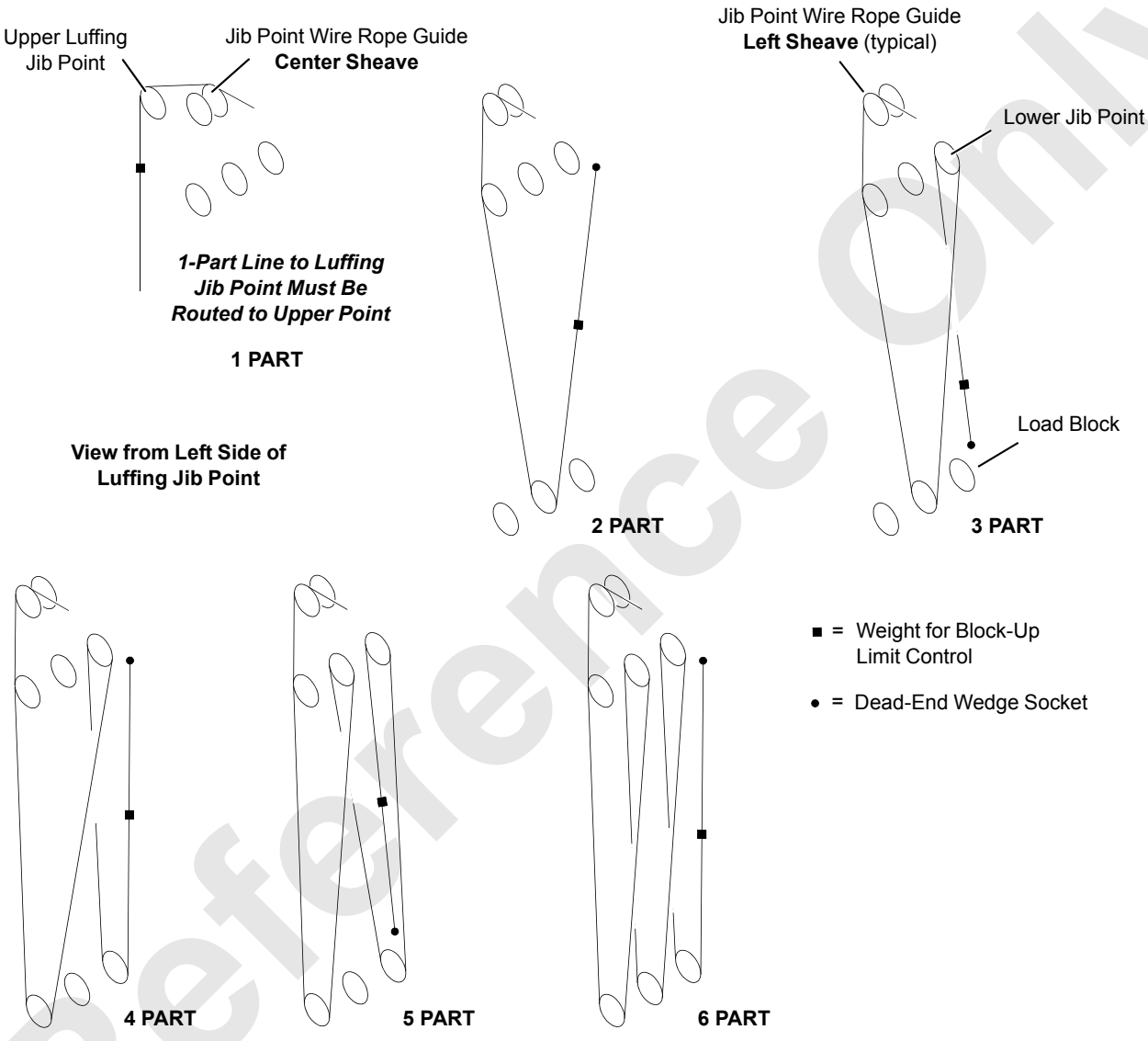


FIGURE 4-29

RIGGING WINCH OPERATION

This crane is equipped with an optional hydraulically operated rigging winch (Drum 6 on front of rotating bed) which can be used to reeve the load line from a load drum through the load block.

- Refer to the Rigging Winch Assembly drawing at the end of this section for wire rope routing.
- Refer to Wire Rope Installation in this section for instructions on anchoring the wire rope to the load drums and to the dead-end sockets.

Operation

Selecting Rigging Mode

TO TURN RIGGING WINCH MODE ON —

1. Turn the crane mode selector clockwise and hold until **RIG WINCH ON** appears in the display as shown in Figure 1.
2. Turn the crane mode selector counterclockwise and release to confirm the rigging winch mode.

   The boom hoist handle on the left console will now operate the rigging winch.

TO TURN RIGGING WINCH MODE OFF —

1. Turn crane mode selector clockwise and hold until desired operating mode appears in the display (example: STANDARD or LUFFING JIB).
2. Turn the crane mode selector counterclockwise and release to confirm to the desired operating mode.

NOTE The rigging mode will automatically turn OFF when power to the control system is turned off.

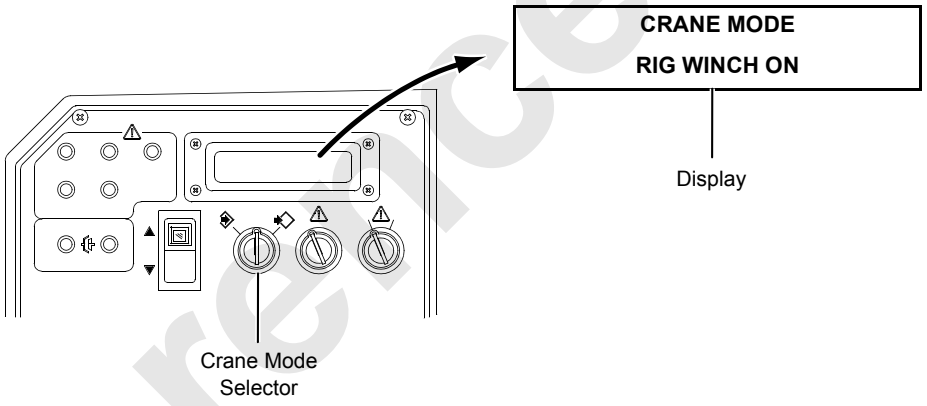
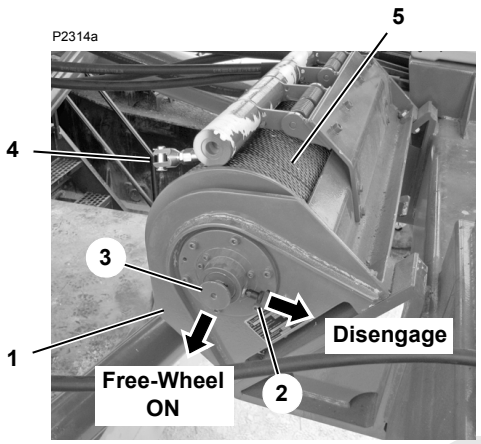


FIGURE 4-30

Operating Rigging Winch

1. Pin the guide sheaves on the bottom of the boom (and luffing jib if used) in the reeving position. See Rigging Winch Assembly drawing at the end of this section.
2. Select and confirm **RIG WINCH ON** mode.
3. Pay out rigging rope either by pushing the boom hoist handle forward or by turning on the winch free-wheel feature, as follows:
   a. Pull locking pin (2, Figure 4-31) out and hold.
   b. Pull knob (3) out.
   c. Release locking pin (2).
   d. The rigging rope can now be pulled of the winch drum manually.



Item	Description
1	Rigging Winch (Drum 6)
2	Locking Pin
3	Knob
4	Rope End Connector
5	Rigging Rope: 5/16 in (8 mm) Diameter

FIGURE 4-31

4. Route the rigging rope through the guide sheaves on the bottom of the boom butt and the boom top (and luffing jib if equipped). See Rigging Winch Assembly drawing at the end of this section.
5. Route the rigging rope through the load block and boom point sheaves, through the guide sheaves on the boom, and the connect the rigging rope to the pad eye on the end of the load line from the desired load drum (front, rear, or auxiliary). See Rigging Winch Assembly drawing at the end of this section.
6. If on, turn off the winch free-wheel feature:
   a. Pull locking pin (2, Figure 4-31) out and hold.
   b. Push knob (3) in.
   c. Release locking pin (2).
7. Remove slack from the rigging rope (pull boom hoist handle back) prior to paying out the load line.

NOTE If engine speed is set too low when attempting to haul in the rigging rope, the rope may go slack. If this happens, slowly increase engine speed until the rope tightens.

8. Move the boom hoist control handle to off and push the corresponding load drum control handle forward to pay out rope from the load drum. The rigging winch will haul in rope automatically.

CAUTION!

Avoid Rigging Winch or Wire Rope Damage!

Rigging winch will not automatically pay out rope if selected drum control handle is pulled back to hoist position.

Structural damage to winch or rigging line will occur!

If it is necessary to haul in rope on drum when load line is connected to rigging rope, proceed as follows:

- Pay out rigging rope with boom hoist control handle while hauling in load line with drum control handle.
- Keep rigging rope slacker than load line.

WARNING

Flying Object Hazard!

Do not attempt to disconnect rigging rope from load line until rope is slack.

Rope could fly apart with explosive force and strike personnel.

9. Once load line is reeved through load block and boom point:
   a. Move load drum control handle to off.
   b. Push boom hoist handle forward to slacken rope.
   c. Disconnect rigging rope from load line.
   d. Pull boom hoist control handle back to haul in rigging rope for storage on rigging winch.
   e. Connect load line to dead-end socket. See instructions in Section 4 of Operator Manual.
10. Pin the guide sheaves on the bottom of the boom (and luffing jib if used) in the stowed position. See Rigging Winch Assembly drawing at the end of this section.
11. Select and confirm desired operating mode.

WIRE ROPE INSTALLATION

NOTE: Wire rope installation instructions from various OEM's are provided at the end of this section. If a conflict exists between the following instructions and the OEM instructions, the OEM instructions apply.

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 4-32.

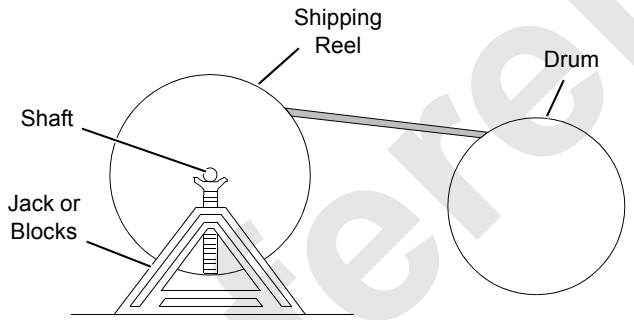


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FIGURE 4-32

2. Provide a brake at shipping reel (see Figure 4-33) so wire rope can be wound tightly onto drum.

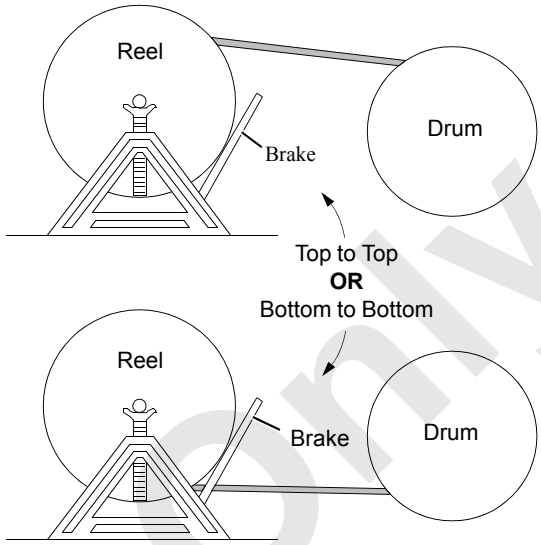

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FIGURE 4-33

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 4-33.
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 under loading of others. Bird caging and breakage of the wire rope can occur.

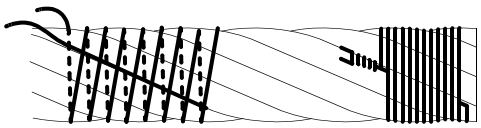
Before cutting wire rope, apply seizings on both sides of the point where the cut will be made. Then cut the wire rope with a torch, rope cutter, or abrasive cut-off wheel.

See Figure 4-34 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

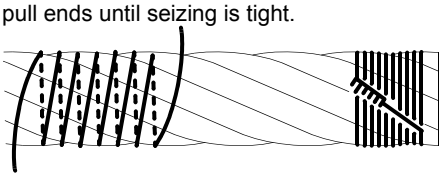
Wire Rope Type	Seizings Required
Preformed	1
Non-preformed	3

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



View A Rope Diameter 1 in (26 mm) and Larger

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



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

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FIGURE 4-34

Anchoring Wire Rope to Drum

See Figure 4-35 for the following procedure.

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

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

WARNING!

Falling Load Hazard!

Wire rope can be pulled out of drum if the 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.

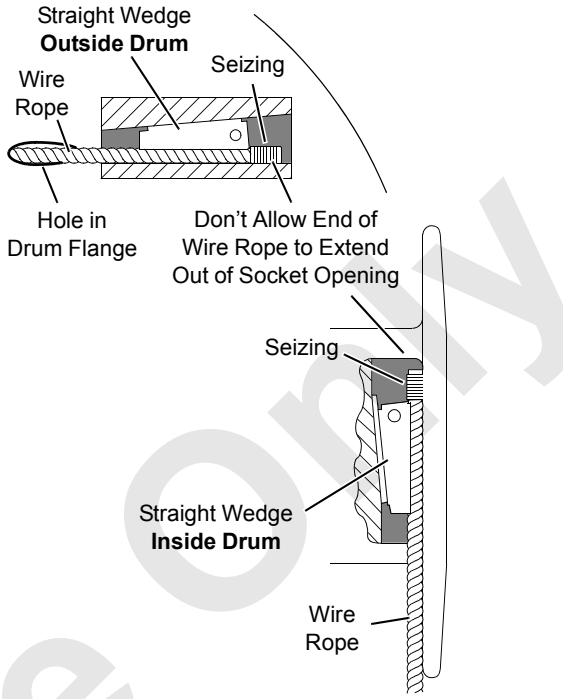


FIGURE 4-35

Winding Wire Rope onto Drum

See Drum and Lagging Chart in Capacity Chart Manual for correct size of drum laggings, 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 4-36).
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.

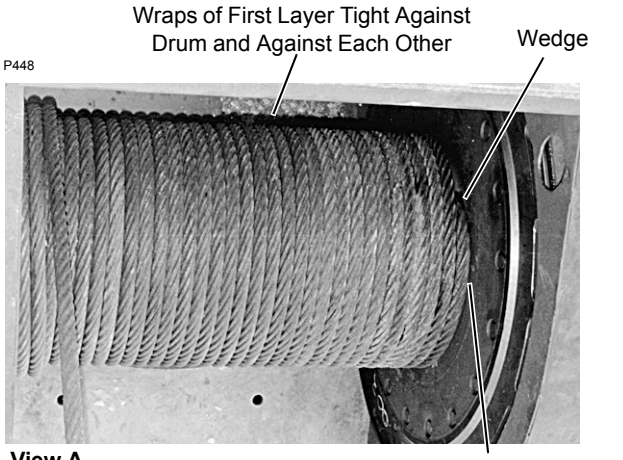


FIGURE 4-36

CAUTION!

Wire Rope Damage!

Voids or spaced wraps in first layer (Figure 4-36, 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 Wedge Socket

WARNING

Falling Load Hazard!

- Inspect all parts prior to use. Do not use parts that are cracked or otherwise defective.
- Remove minor nicks, burrs, or rough edges from socket, wedge, or pin by lightly grinding. Do not reduce original dimensions by more than 10%.
- Do not reinstall shipping material (bolt, plastic strap or wire) in 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 4-37 for the 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!

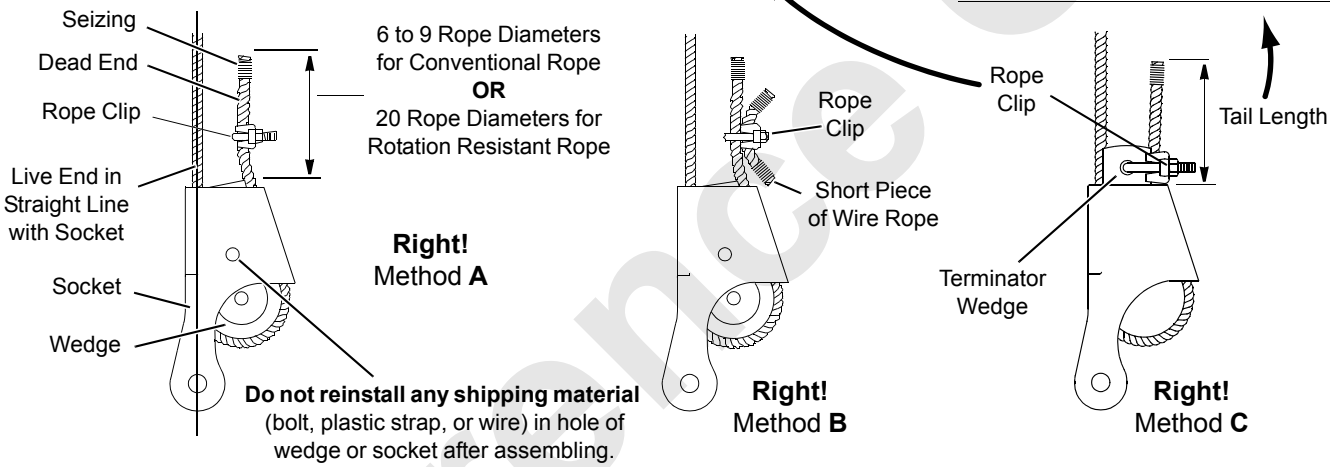
Wire rope can break if the following precaution is not observed:

- 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.

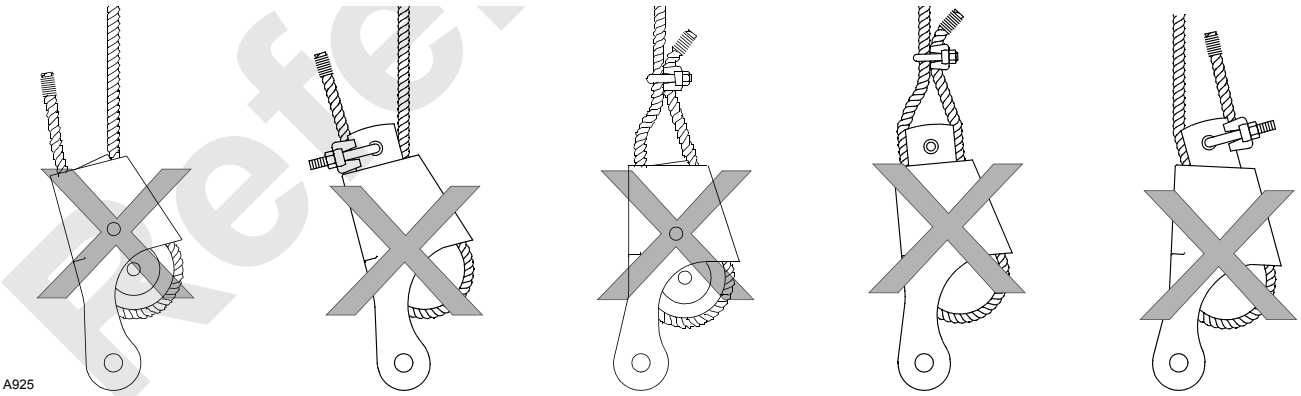
Wire Rope/Clip Size inch (mm)	0.875 (22,23)	1.0 (25,4)	1.125 (28,58)	1.25 (31,75)
Torque * ft/lbs (kN/m)	225 (0,30)	225 (0,30)	225 (0,30)	360 (0,49)

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

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



ALL ARE DANGEROUS AND PROHIBITED!



WRONG Rope Backward

WRONG Rope Backward

WRONG Dead End Clipped to Live End

WRONG Dead End Clipped to Live End

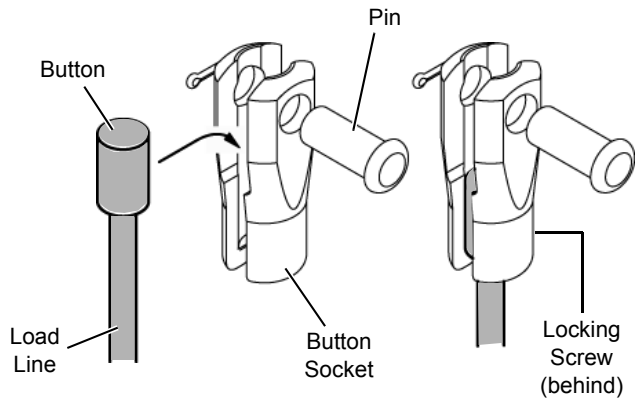
WRONG Wedge Backward

FIGURE 4-37

Anchoring Wire Rope to Button Socket

See Figure 4-38 for the 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.



Button Socket Assembly

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FIGURE 4-38

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.

PAD EYE USAGE FOR WIRE ROPE REEVING

See Figure 4-39 for the following procedure.

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

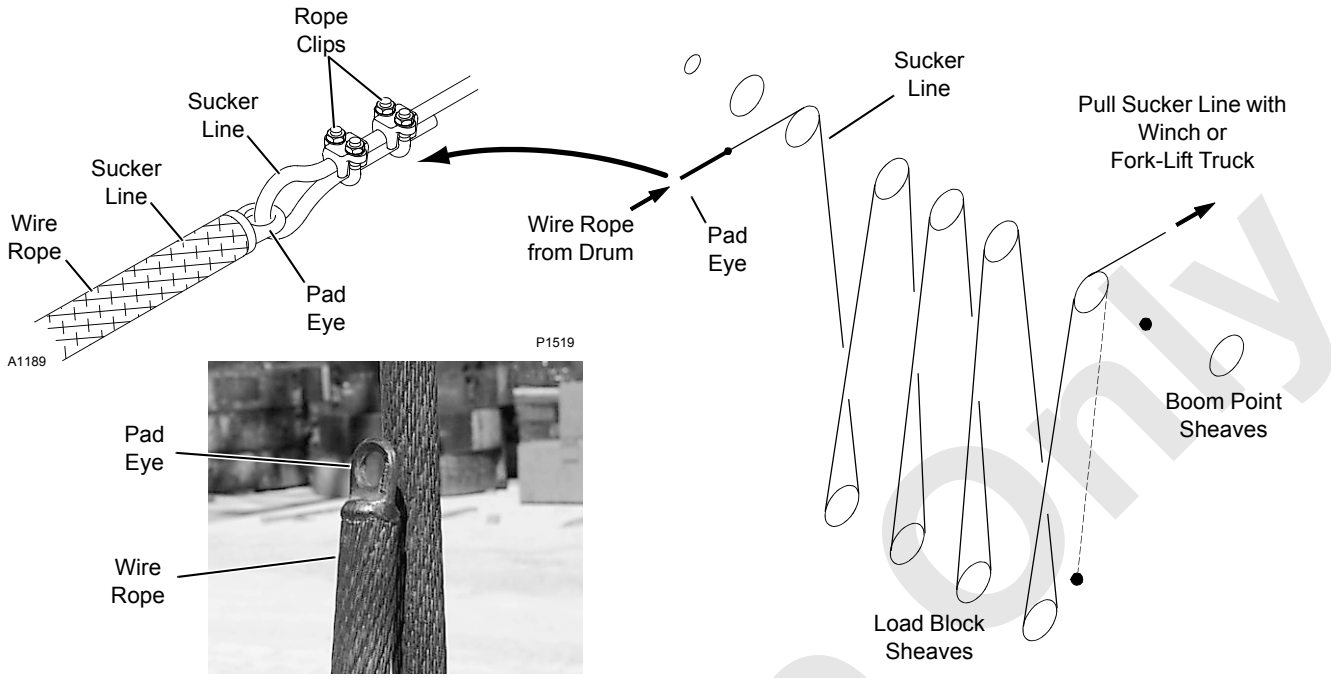
1. For No. 1.5 pad eye, do not exceed 1,000 lb (4,45 kN) single line pull.
2. Make sure sucker line and rope clips are rated for at least 1,000 lb (4,45 kN) line pull.
3. Inspect pad eye prior to each use. ***Replace it if:***
   - Any original dimensions have changed (Figure 4-39)
   - Cracks or breaks exist in metal or weld

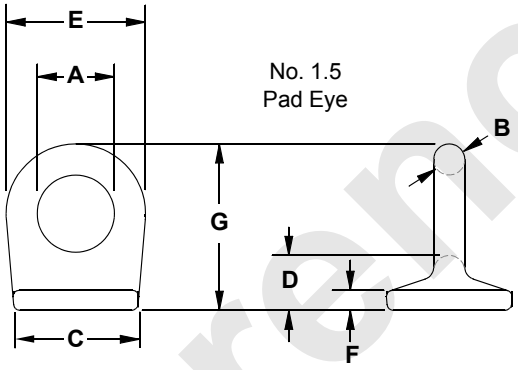
WARNING

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.





Item	Inch	mm
A	0.63	16,00
B	0.25	6,35
C	1.00	25,40
D	0.44	11,18
E	1.13	28,70
F	0.16	4,06
G	1.31	33,27

FIGURE 4-39

SECTION 5
LUBRICATION

TABLE OF CONTENTS

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SECTION 5
LUBRICATION

LUBRICATION

See F2080 at the end of this section.

LUBE AND COOLANT PRODUCT GUIDE

See the publication at the end of this section.

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SECTION 6
MAINTENANCE CHECKLIST

TABLE OF CONTENTS

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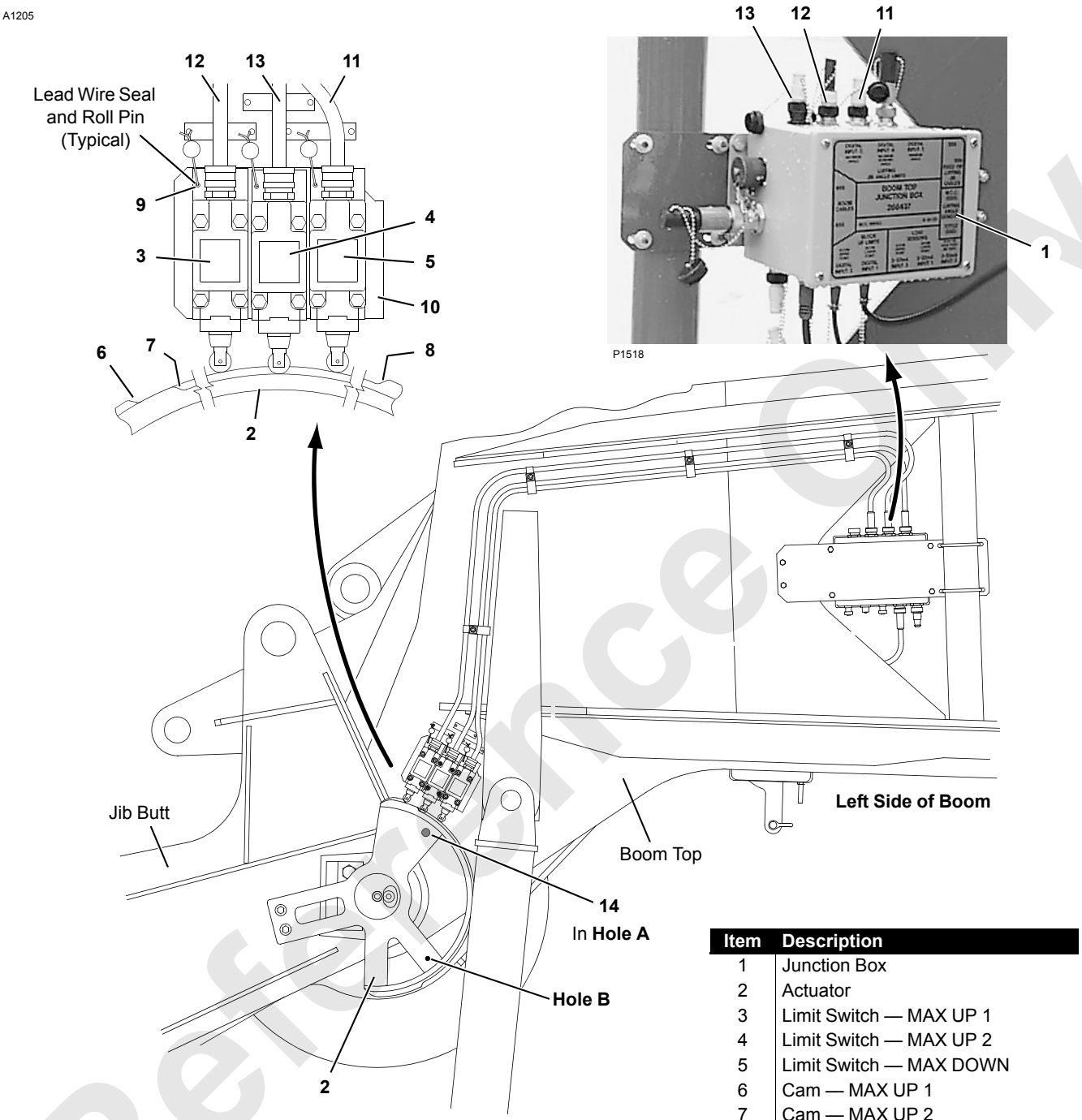
SECTION 6
MAINTENANCE

MAINTENANCE AND ADJUSTMENT

This section contains maintenance and adjustment instructions for the limit devices used with the luffing jib attachment.

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

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



Item	Description
1	Junction Box
2	Actuator
3	Limit Switch — MAX UP 1
4	Limit Switch — MAX UP 2
5	Limit Switch — MAX DOWN
6	Cam — MAX UP 1
7	Cam — MAX UP 2
8	Cam — MAX DOWN
9	Spacer (each limit switch)
10	Mounting Bracket
11	MAX DOWN Electric Cord
12	MAX UP 1 Electric Cord
13	MAX UP 2 Electric Cord
14	Alignment Pin

LIMIT SWITCH WIRING			
Cord	**Terminal**	**Wire**	**System Operation**
P1-1 WHT	S1-22	8B	12 Volts DC
P1-2 BLK	S1-21	89W1	MAX UP 1
P2-1 GRN	S2-21	89W2	MAX UP 2
P2-2 BLK	Not Used		
P2-3 WHT	S2-22	8B	12 Volts DC
P3-1 WHT	S3-22	8B	12 Volts DC
P3-2 BLK	S3-21	89S1	MAX DOWN

FIGURE 6-1

JIB STOP ADJUSTMENT

NOTE: Past production design is identified with the jib stop actuator bracket (2, Figure 6-1).

General

The luffing jib attachment is equipped with three limit switches (Figure 6-1) which automatically stop the luffing hoist and apply its brake when the luffing jib is raised or lowered to the following angles:

NOTE: The luffing jib angles can vary plus or minus 1°.

- LUFFING JIB MAX UP 1 — 168° boom to luffing jib angle.

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

- LUFFING JIB MAX UP 2 — 170° boom to luffing jib angle. This limit can be bypassed only when the attachment is lowered to the ground with the boom below 50°.

- LUFFING JIB MAX DOWN — 55° boom to luffing jib angle. ***Do not bypass this limit. Structural damage will occur.***

The operating limit alert yellow light and buzzer (in operator's cab) comes on when the jib reaches any of the limits. The operating limit alert also comes on any time the luffing jib is lowered below horizontal.

WARNING

Falling Attachment Hazard!

Do not operate crane unless luffing jib stops are properly adjusted and operational.

Operating luffing jib above MAX UP 2 limit or below MAX DOWN limit is neither intended nor approved. Jib can be pulled over backwards or collapse.

NOTE: For operation with luffing jib, the boom stop must be set at the proper angle. See Automatic Boom Stop Adjustment in this section.

Maintenance

At least once weekly, check that luffing jib stops stop jib at specified angles.lif not, replace any defective parts and/or adjust jib stops.

Adjustment

The jib stop limit switches must be installed, adjusted, and sealed at initial assembly of the attachment. Limit switch adjustments must be checked and readjusted if required each time the attachment is reassembled and when parts are replaced. Seals must be removed to allow readjustment.

Preliminary Adjustment

All adjustments must be made with the boom and luffing jib resting on blocking at ground level.

1. Lower attachment to ground.
2. Remove screws connecting actuator (2, Figure 6-1) to jib butt.

Max Up 1 Limit Adjustment

See Figure 6-1 for the following procedure.

1. Rotate actuator (2) clockwise until Hole A in actuator lines up with hole in boom top.
2. Insert alignment pin (14) through Hole A in actuator and into hole in boom top. Make sure shoulder of pin rests squarely against actuator to ensure proper alignment for adjustment.
3. Slide limit switch (3) against cam (6) until limit switch just "clicks" open and hold.
4. Securely tighten screws in limit switch.
5. Remove alignment pin (14).
6. Check MAX UP 1 limit setting as follows:
   a. Rotate actuator (2) counterclockwise and then clockwise so MAX UP 1 limit switch roller contacts cam (6).
   b. Limit switch must click open when Hole A in actuator lines up with hole in boom top (step 2).
   c. With LUFFING JIB mode selected, pull luffing jib handle back. Luffing hoist must not turn and LUFFING JIB MAX UP 1 operating limit should come on.
   d. Readjust limit switch if necessary to ensure proper operation.
7. After boom and jib are raised, check operation of MAX UP 1 limit. See instructions under Operational Checks.

Max Up 2 Limit Adjustment

See Figure 6-1 for the following procedure.

1. Loosen screws in limit switch (4).
2. Rotate actuator (2) so roller on limit switch (4) is between cams (7 and 8).
3. Slide limit switch (4) toward cam (7) until roller just touches cam and hold. Switch must not click open.
4. Securely tighten screws in limit switch.

5. After boom and jib are raised, check operation of MAX UP 2 limit following instructions under Operational Checks.

Max Down Limit Adjustment

See Figure 6-1 for the following procedure.

1. Rotate actuator (2) counterclockwise until Hole B in actuator lines up with hole in boom top.
2. Insert alignment pin (14) through Hole B in actuator and into hole in boom top. Make sure shoulder of pin rests squarely against actuator to ensure proper alignment for adjustment.
3. Slide limit switch (5) against cam (8) until limit switch just “clicks” open and hold.
4. Securely tighten screws in limit switch.
5. Remove alignment pin (14).
6. Check MAX DOWN limit setting as follows:
   a. Rotate actuator (2) clockwise away from limit switch and then counterclockwise so MAX DOWN limit switch roller contacts cam (8).
   b. Limit switch must click open when Hole B in actuator lines up with hole in boom top (step 2).
   c. With LUFFING JIB mode selected, push luffing jib handle forward. Luffing hoist must not turn and LUFFING JIB MAX DOWN operating limit should come on.
   d. Readjust limit switch if necessary to ensure proper operation.

Final Adjustment Steps

See Figure 6-1 for the following procedure.

1. Securely fasten actuator (2) to jib butt with screws and lock washers provided.
2. Once limit switches are properly adjusted, drill and seal limit switch spacers (9) to mounting bracket (10) with dowel pins and lead wire seals.
3. Make sure boom and luffing jib angle indicators are properly adjusted prior to raising boom and luffing jib. See instructions in Luffing Jib Operator/Parts Manual.

Operational Checks

Make the following operational checks after the boom and jib are raised.

1. Raise boom and luffing jib until boom is at 80°.
2. Monitor BOOM TO LUFFING JIB ANGLE on digital display while performing remaining steps.
3. SLOWLY raise luffing jib.
4. Luffing hoist must stop and be inoperable when boom to luffing jib angle is 168°.
5. Operating limit alert should come on indicating LUFFING JIB MAX UP 1 limit has been reached.

   Stop raising luffing jib immediately if limit switch fails to stop luffing hoist. Lower boom and jib to ground and readjust MAX UP 1 limit switch.
6. Turn limit bypass key clockwise to bypass MAX UP 1 limit.
7. SLOWLY raise luffing jib past MAX UP LIMIT 1.
8. Luffing hoist must stop and be inoperable when boom to luffing jib angle is 170°.
9. Operating limit alert should come on indicating LUFFING JIB MAX UP 2 limit has been reached.

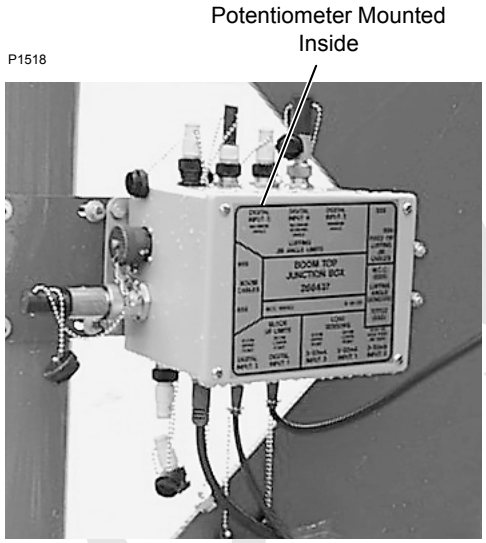
   Stop raising luffing jib immediately if limit switch fails to stop luffing hoist. Lower boom and jib to ground and readjust MAX UP 2 limit switch.
10. SLOWLY lower luffing jib.
11. Luffing hoist must stop and be inoperable when boom to luffing jib angle is 55°.

    Stop lowering luffing jib immediately if limit switch fails to stop luffing hoist. Lower boom and jib to ground and readjust MAX DOWN limit switch.

BOOM AND LUFFING JIB ANGLE INDICATOR CALIBRATION

The angle indicator potentiometers are located inside the node controllers mounted on the boom top and on the luffing jib top (Figure 6-2).

The boom and luffing jib angles are calibrated automatically by the crane's programmable controller as part of the load indicator calibration procedure (see separate Rated Capacity Indicator/Limiter Operation Manual for instructions).



Typical Node Controller Installation on Boom or Luffing Jib Top

FIGURE 6-2

AUTOMATIC BOOM STOP ADJUSTMENT

Maximum Boom Angle

Boom stop limit switch assembly (5, Figure 6-3) automatically stops the boom and applies the boom hoist brake when the boom is raised to **Angle A**.

Operation

See Figure 6-4 for the following description.

NOTE: Reference to LED is past production only.

When the boom is below the maximum angle, limit switch (5) is closed and its LED (light-emitting diode) is ON (View B). The boom hoist can be operated.

When the boom is raised to the maximum angle, boom butt (1) pushes adjusting rod (2a, 2b, or 2c) in and actuator rod (11, View A) opens limit switch (5). The LED then goes OFF. Boom hoist operation stops automatically because the open limit switch turns off power to the boom hoist electric circuit. The boom hoist pump shifts to neutral and the brake applies to stop boom movement.

WARNING

Falling Attachment Hazard!

If boom fails to stop for any reason, stop engine immediately. Troubleshoot system to determine problem.

Do not resume operation until problem has been corrected.

Maintenance

At least once weekly, check that the automatic boom stop stops the boom at the specified maximum angle. If not, replace any worn or damaged parts and/or adjust the boom stop.

Once the automatic boom stop is properly adjusted, it should not require periodic adjustment. Adjustment is required, however, when:

- The luffing jib is installed or removed.
- Parts are replaced.

WARNING

Falling Attachment Hazard!

Do not operate crane unless automatic boom stop is properly adjusted and operational. Do not adjust maximum operating angle higher than specified. Boom could be pulled over backwards or collapse, causing death or serious injury.

Bypass Limit Test

Perform the following test to determine if the boom up limit on your crane can be bypassed or not.

WARNING

Crush Hazard!

Maintain constant communication between operator and assistant during following steps.

Stay clear of moving parts.

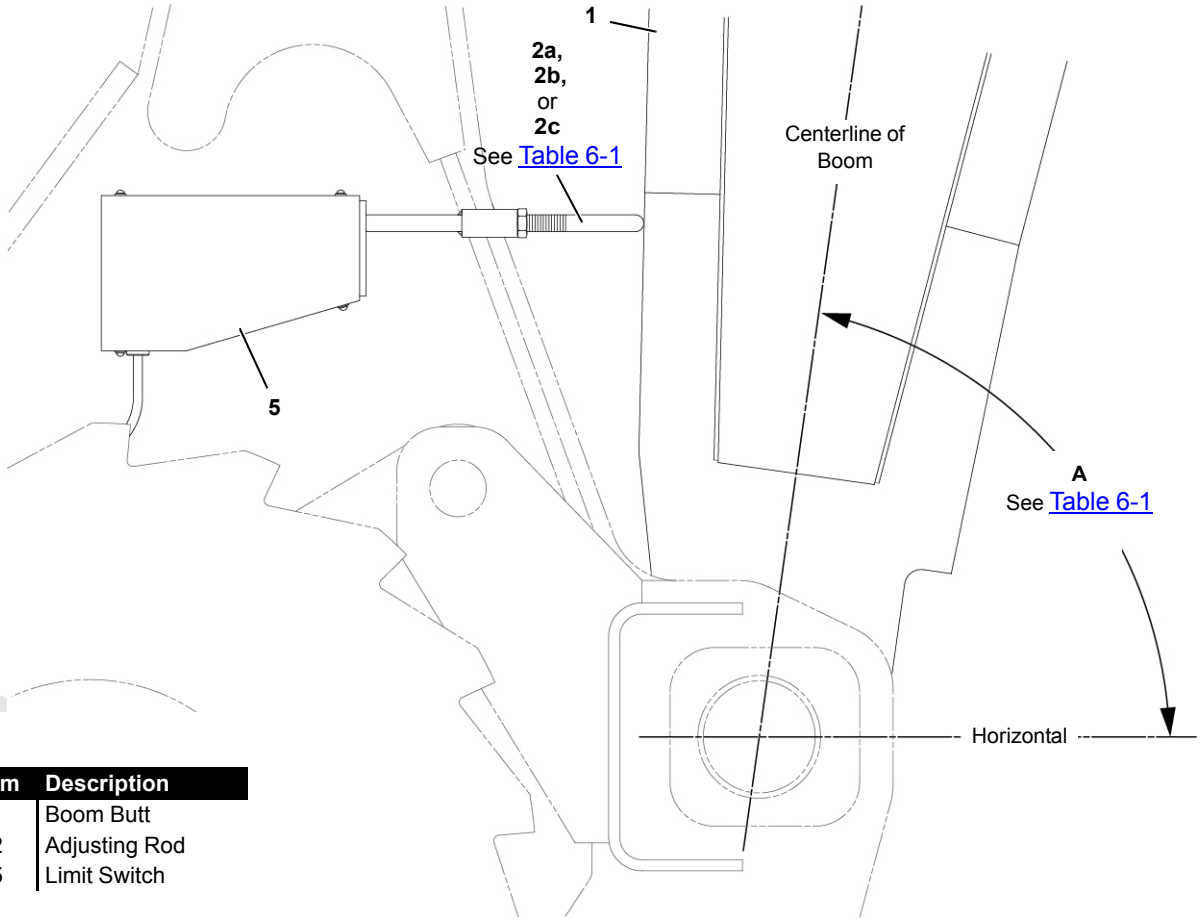
1. Lower the boom onto blocking at ground level.
2. Have an assistant push the adjusting rod (Figure 6-4) in to trip the boom stop limit switch open.
3. Rotate the limit bypass key (in crane cab) to the bypass position and hold.
4. Try to boom up — do not raise the boom any higher than necessary to perform 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 adjusting rod to the normal operating positions.

Table 6-1

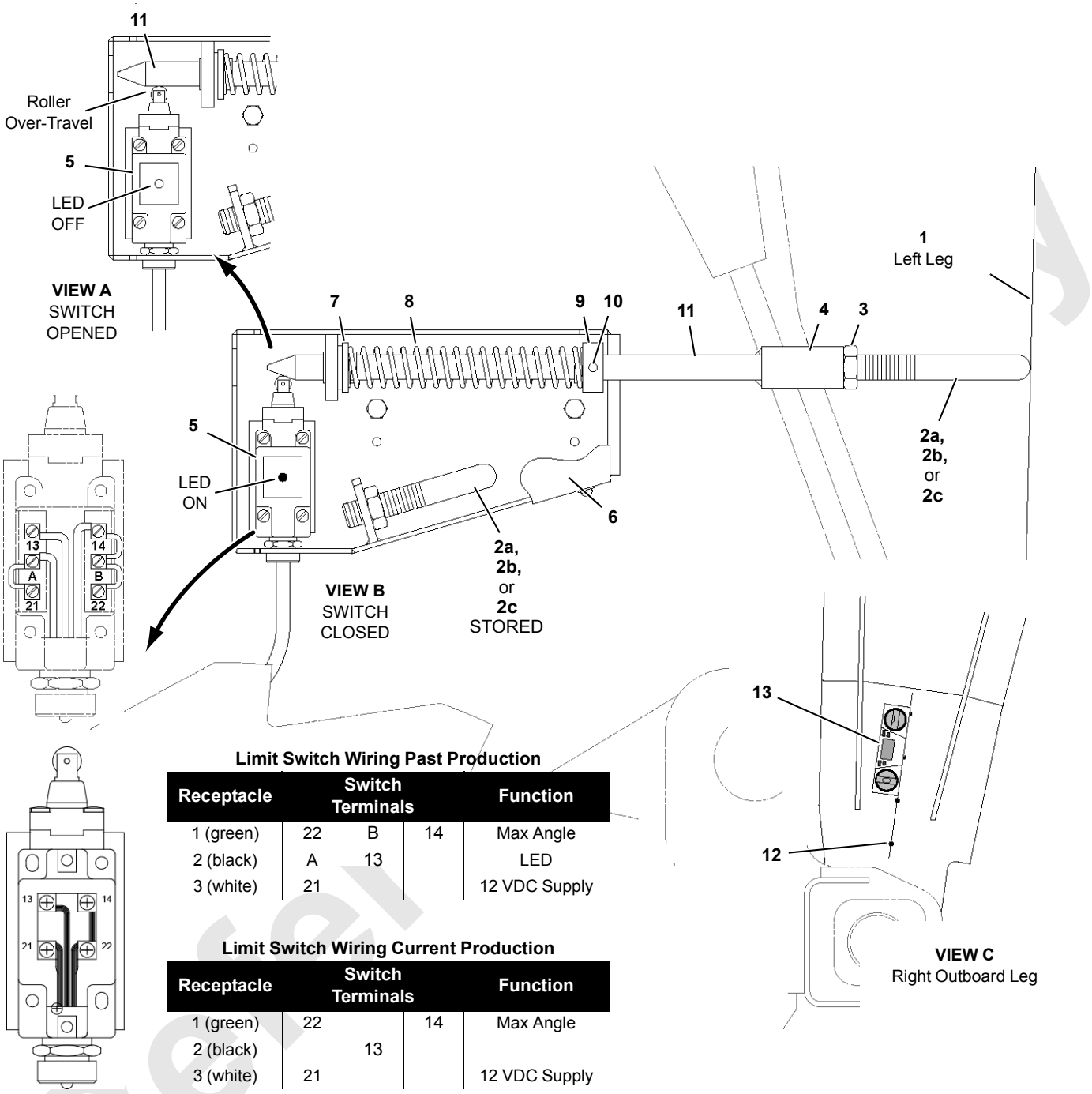
Angle A	Adjusting Rod — Length
81° — #82 Long Reach Boom	2a — 7 in (178 mm)
82° — #22E Open Throat Top	2a — 7 in (178 mm)
83° — #82 or 22EL Heavy Lift Boom	2a — 7 in (178 mm)
83° — #22E Open Throat Top Offset 4-1/2°	2a — 7 in (178 mm)
88° — #82 or 22EL Heavy Lift Boom with #149 Luffing Jib when the boom up limit ***can be bypassed.*** *	2b — 4-3/4 in (121 mm)
89° — #82 or 22EL Heavy Lift Boom with #135 or 149 Luffing Jib when the boom up limit ***cannot be bypassed.*** *	2c — 4-3/8 in (111 mm)

* To determine if the boom up limit on you crane can be bypassed or not, perform Bypass Limit Test on page 6-6.



Item	Description
1	Boom Butt
2	Adjusting Rod
5	Limit Switch

FIGURE 6-3



Limit Switch Wiring Past Production

Receptacle	Switch Terminals			Function
1 (green)	22	B	14	Max Angle
2 (black)	A	13		LED
3 (white)	21			12 VDC Supply

Limit Switch Wiring Current Production

Receptacle	Switch Terminals			Function
1 (green)	22		14	Max Angle
2 (black)		13		
3 (white)	21			12 VDC Supply

Item	Description	Item	Description
1	Boom Butt	7	Spring Washer
2a	Adjusting Rod (see Figure 6-3)	8	Spring
2b	Adjusting Rod (see Figure 6-3)	9	Spring Washer
2c	Adjusting Rod (see Figure 6-3)	10	Dowel Pin 1/4 in (6,35 mm) Diameter
3	Jam Nut	11	Actuator Rod
4	Coupling	12	Punch Marks
5	Limit Switch	13	Digital Level
6	Cover		

FIGURE 6-4

Adjustment

See Figure 6-4 for the following procedure.

NOTE: Reference to LED is past production only.

1. Park the crane on a firm level surface or level the crane by blocking under the crawlers.
2. Make sure the proper adjusting rod is installed (see Figure 6-3 and Table 6-1).
3. Raise the boom to specified **Angle A** (see Figure 6-3 and Table 6-1) while monitoring the angle on the mechanical indicator or on the operating conditions screen of the front-console display.
4. Verify that the boom is at the proper Angle A:
   a. Place an accurate digital level (13) on the centerline of the boom butt as shown in View C. **Angle A** should appear on the digital level.
   b. Raise or lower the boom as necessary.
5. If the boom stops at the specified angle, further adjustment is not needed.
   - If the boom stops before reaching the specified angle, go to step 6.
   - If the boom reaches the specified angle before it stops, go to step 7.
6. If the boom stops before reaching the specified angle:
   a. Loosen jam nut (3, View B).
   b. Turn adjusting rod (2a, 2b, or 2c) all the way into coupling (4).
   c. Boom up slowly until the boom reaches the specified angle.
   d. Turn adjusting rod (2a, 2b, or 2c) out against boom butt (1) until limit switch (5) “clicks” open and the LED is OFF (View A).
   e. Tighten jam nut (3).
7. If the boom reaches the specified angle before it stops:
   a. Loosen jam nut (3, View B).
   b. Turn adjusting rod (2a, 2b, or 2c) out against boom butt (1) until limit switch (5) “clicks” open and the LED is OFF (View A).
   c. Tighten jam nut (3).
8. Check that actuator rod (11) over-travels the limit switch as shown in View A.
9. Test the adjustment as follows:
   a. Lower the boom several degrees below specified Angle A.
   b. Slowly raise the boom.
   c. ***Boom must stop at specified Angle A.*** If the boom does not stop at the specified angle:
      - Stop raising the boom (move control handle to off).
      - Lower the boom several degrees below the specified angle.
   d. Repeat adjustment steps 3 through 9.

Actuator Rod Replacement

See Figure 6-4, View B for the following procedure.

1. Remove damaged actuator rod (11).
2. Slide spring washers (7 and 9) and spring (8) over new actuator rod (12) while sliding the actuator rod into the bracket assembly.
3. Position actuator rod (11) so the tapered end just touches the roller of limit switch (5) (View B). The actuator rod must not depress limit the roller.
4. Drill a 1/4 in (6,35 mm) hole through spring washer (9) and actuator rod (11).
5. Install dowel pin (10).
6. Install proper adjusting rod (2a, 2b, or 2c) and adjust the boom stop.

BLOCK-UP LIMIT INSTALLATION AND ADJUSTMENT

A block-up limit control (also called anti-two-block device) is a two-blocking prevention device which automatically stops the load drum from hoisting and the boom from lowering when a load is hoisted a predetermined distance.

DEFINITION: Two-blocking is the unsafe condition in which the load block or the weight ball contacts the sheave assembly from which either is suspended.

Two-blocking can result in failure of sheaves and wire rope, possibly causing load to fall.

WARNING

Two-Blocking Hazard!

Block-up limit control is a protective device designed only to assist operator in preventing a two-blocking condition. Any other use is neither intended nor approved.

Block-up limit control may not prevent two-blocking when load is hoisted at maximum single line speed. Operator shall determine fastest line speed that allows block-up limit control to function properly and, thereafter, not exceed that line speed.

The block-up limit controls consist of the following components (see Figure 6-5):

- Normally closed limit switch assembly fastened at any or all of the following locations:
  - Lower boom point
  - Upper boom point
  - Luffing jib point
  - Luffing Jib Intermediate Suspension
  - Fixed jib point (on luffing jib)
  - Universal anchor joint
- Weight freely suspended by chain from each limit switch actuating lever (weight encircles load line as shown in Figure 6-8).
- Lift block fastened to load line or lift plates fastened to load block (see Figure 6-8).

Operation

See Figure 6-5 and Figure 6-9 for component identification.

NOTE: See wiring diagrams in Boom Wiring Drawing in Section 4.

Block-Up Limit Control Deactivated

During normal operation, the weight overcomes the spring force and rotates the actuating lever away from the limit switch lever. This action allows the limit switch to close the load drum ***up*** and boom/luffing jib ***down*** electric circuits. Therefore, the load can be hoisted and the boom/luffing jib can be lowered.

Block-Up Limit Control Activated

When the weight is lifted by the lift block or the lift plates, spring force rotates the actuating lever against the limit switch lever. This action causes the corresponding limit switch to open the load drum ***up*** and boom/luffing jib ***down*** electric circuits.

The load drum and boom hoist pumps stroke to off. At the same time, the load drum and boom/luffing jib parking brakes apply to stop the load drum from hoisting and the boom/luffing jib from lowering.

Installation

The block-up limit controls must be installed according to Boom Wiring, Limits, and Load Indicator Electrical Assembly drawing at end of this section.

See Figure 6-8 for installation of the weights.

Storing Electric Cable

The electric cables for the boom, fixed jib, and luffing jib are long enough to accommodate the maximum length of each attachment.

Store the excess cable for the boom and luffing jib on the reel mounted on either butt (Figure 6-6). The reel is equipped with a locking pin. Disengage the locking pin to allow the reel to be wound. Engage the locking pin to lock the reel in position. The power supply cable to the reel must be disconnected before the reel can be wound.

Store the excess electric cable for the fixed jib by winding it around the brackets on the fixed jib butt (Figure 6-6).

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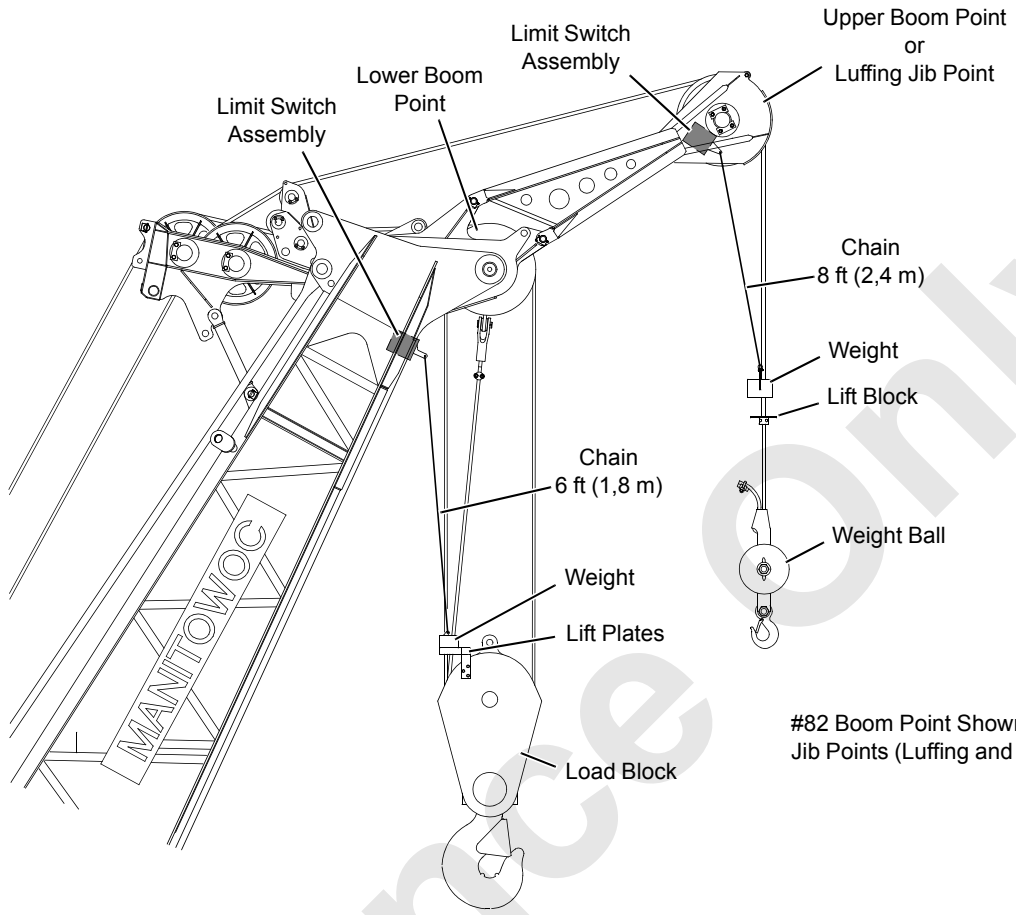

FIGURE 6-5

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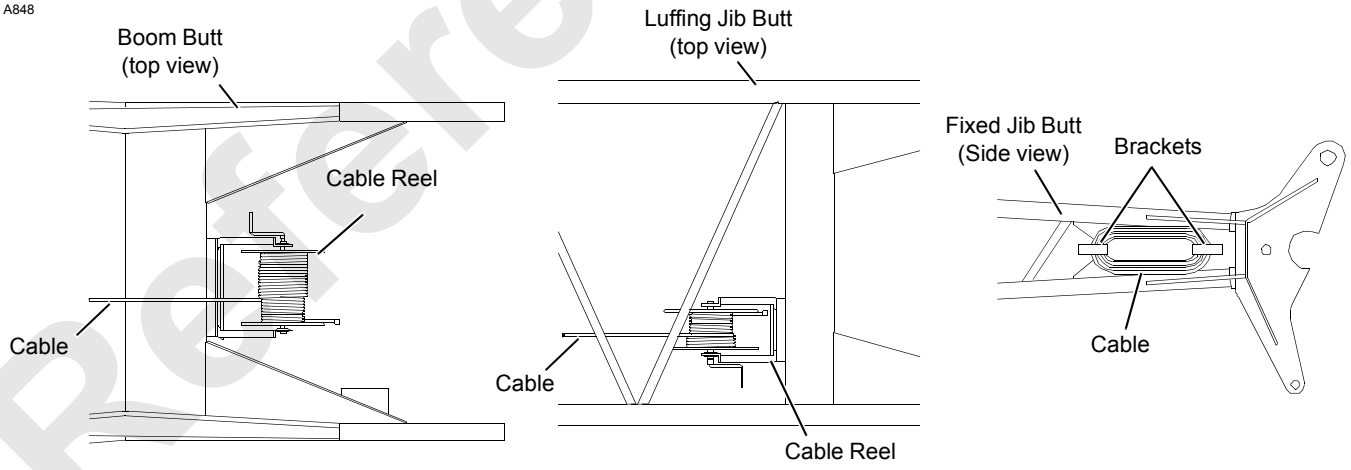

FIGURE 6-6

6

Disconnecting Block-Up Limit Controls

Shorting plug (SP1, View A, Figure 6-7) is provided on the left front corner of the rotating bed so the block-up limit controls can be disconnected for the following reasons:

- Crane setup and rigging
- Maintenance
- Operations not requiring use of a block-up limit control (clamshell and drag-line)

To disconnect the block-up limit controls, proceed as follows (see Figure 6-7):

1. Disconnect electric cable (C1, View B) from electric cable (C2).
2. Connect shorting plug (SP1, View A) to electric cable (C1).
3. Connect closure cap to electric cable (C2).
4. Reverse the steps to reconnect the block-up limit controls.

Removing Jib or Boom Point

The junction boxes on the boom and jib points are equipped with shorting plugs as shown in View C, Figure 6-7.

When an attachment is removed, the electric cable from the corresponding limit switch must be disconnected from the junction box receptacle (View C, Figure 6-7) and the proper shorting plug connected to the receptacle.

Failing to perform this step will prevent the load drum from hoisting and the boom from lowering. Also the operating limit alert will come on.

Disconnect shorting plug and reconnect electric cable to proper receptacle on junction box when corresponding attachment is reinstalled.

Always connect closure caps to shorting plugs or ends of cables when they are not in use.

NOTE: Each junction box has a decal identifying what circuit each receptacle applies to. If in doubt, see the wiring diagrams in Boom Wiring, Limits, and Load Indicator Electrical Assembly drawing at end of this section.

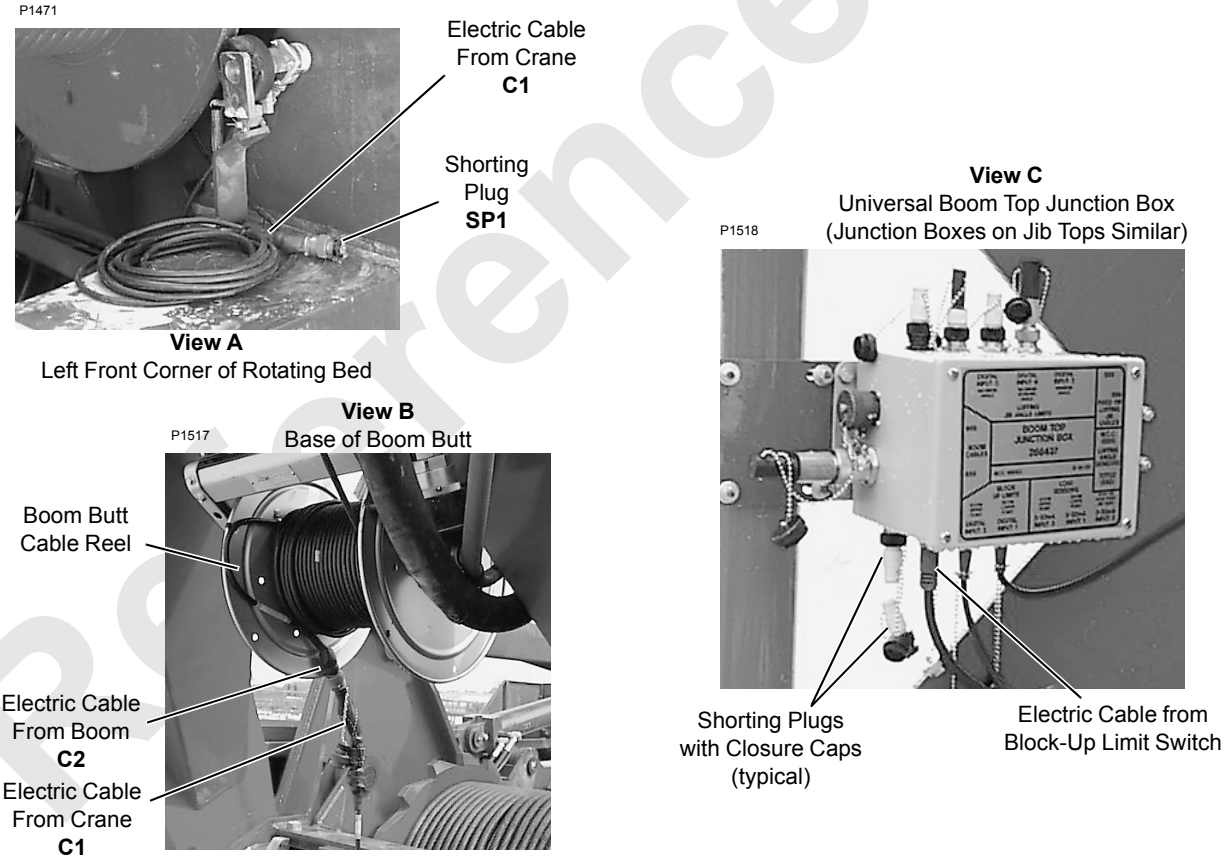

FIGURE 6-7

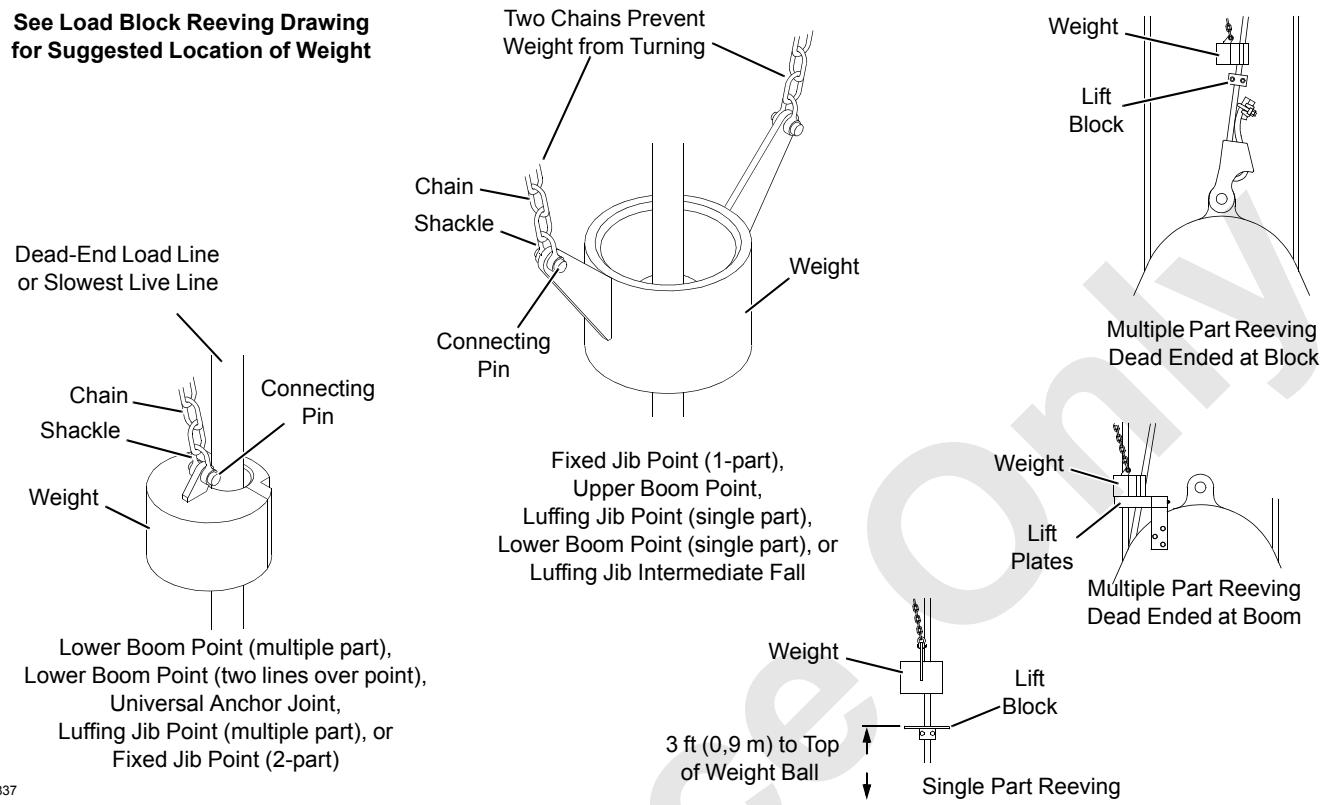

FIGURE 6-8

Maintenance

Inspect and test the block-up limit controls ***weekly*** *or* ***every 40 hours of operation***, as follows:

IMPORTANT: Do not operate crane until cause for improper operation and all hazardous conditions have been found and corrected.

1. Lower the boom onto blocking at ground level and carefully inspect the following items:
   - **a.** Inspect each limit switch lever and actuating lever for freedom of movement. Apply one-half shot of grease to the fitting on the actuating lever. Wipe away any excess grease.
   - **b.** Inspect each weight for freedom of movement on the load line.
   - **c.** Inspect each weight, chain, shackle, and connecting pin for excessive or abnormal wear. Make sure cotter pins for shackles are installed and spread.
   - **d.** Inspect the entire length of electric cables for damage.
   - **e.** Check that the electric cables are clear of all moving parts on the boom and jib and that the cables are securely fastened to the boom and jib with clips or nylon straps.
   - **f.** Check that all plugs are securely fastened.
2. Test the block-up limit controls for proper operation using either of the following methods:
   - **a.** BOOM LOWERED: Manually lift each weight — ***one at a time*** — while the engine is running. The load drum should not operate in the ***hoist*** direction and the boom/luffing hoist should not operate in the ***lower*** direction.
   - **b.** BOOM RAISED: ***Slowly*** hoist each load block and weight ball — ***one at a time*** — against the weight. When the chain goes slack, the corresponding load drum should stop hoisting and the boom/luffing hoist should not operate in the lower direction.

CAUTION

Two-Block Hazard!

Use extreme care when testing block-up limit controls when boom is raised. If block-up limit control fails to stop load, immediately stop load by moving drum control handle to off or by applying drum working brake. Otherwise, two-blocking may occur.

Adjustment

See Figure 6-9 for the following procedure.

Lower the boom onto blocking at ground level and adjust each limit switch as follows:

1. Adjust spring tension so there is enough force to lift the weight of the chain and rotate the actuating lever when the weight is lifted.
2. Loosen the setscrew in the limit switch lever so the lever is free to rotate.
3. Manually lift the weight to allow the actuating lever to rotate upward.
4. Hold lever at Dimension A.
5. Hold the roller on the limit switch lever against the actuating lever while performing step 6
6. Turn the limit switch shaft ***clockwise*** only enough to "click" limit switch open and hold. Then securely tighten the setscrew in the limit switch lever.
7. Test the limit switch for proper operation (see Maintenance); repeat the adjustment steps until the limit switch operates properly.

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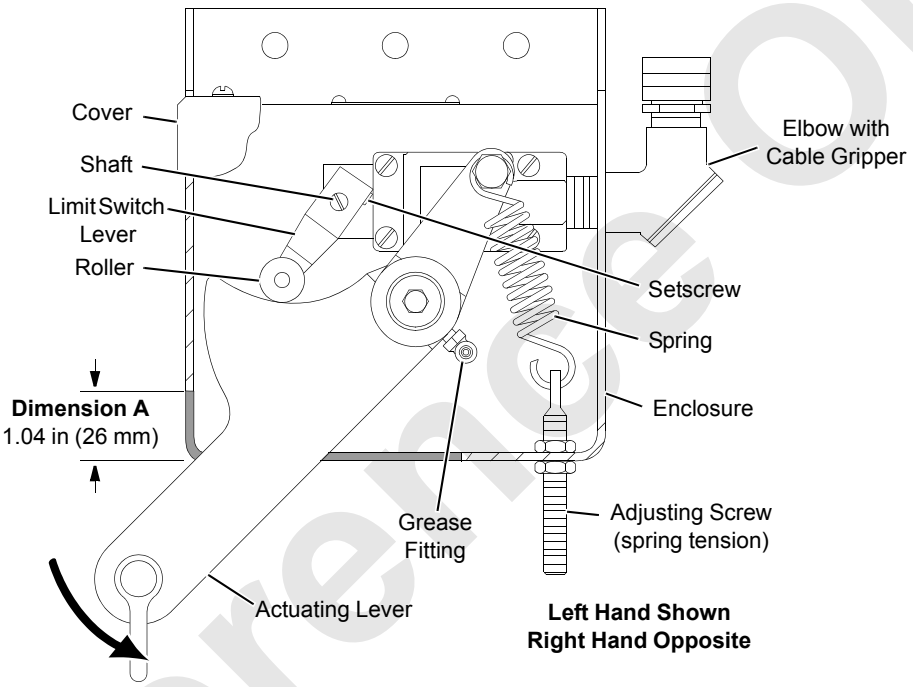

FIGURE 6-9

ALPHABETICAL INDEX